

APPENDIX A

STANDARD OPERATING PROCEDURES

A.1

STANDARD OPERATING PROCEDURE

SOIL SAMPLING AND ANALYSIS OF PER - AND POLYFLUOROALKYL SUBSTANCES

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.1
FOR SOIL SAMPLING AND ANALYSIS OF PER- AND
POLYFLUOROALKYL SUBSTANCES**

1. INTRODUCTION

1.1 Purpose and Scope

Standard operating procedures (SOPs) were prepared to guide per- and polyfluoroalkyl substance (PFAS) sampling activities. This SOP describes recommended procedures to be used by field personnel when collecting surface and subsurface soil samples. Because PFAS are potentially present in a variety of materials that may come into contact with soil samples, and because laboratory analytical method detection limits are low (low to sub microgram per kilogram concentrations for soil and low to sub nanogram per liter concentrations for liquids), conservative precautions are recommended to avoid sample cross-contamination and false positive results. The procedures in this SOP are consistent with best practices at the time of authoring.

1.2 Definitions and Acronyms

1.2.1 Definitions

PFAS-free water

Water that has been analyzed by an accredited laboratory (see Section 3.1) and determined to be below the method detection limit (i.e., non-detect) for the suite of PFAS to be analyzed for in environmental samples. Method detection limits (MDLs) used during analysis of PFAS-free water should be at or below the MDLs used for environmental samples.

1.2.2 Acronyms

ASTM	American Society for Testing and Materials
CoC	chain of custody
DoD	Department of Defense
DOT	Department of Transportation
ETFE	ethylene tetrafluoroethylene
FEP	fluorinated ethylene propylene
HDPE	high-density polyethylene
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

LDPE	low-density polyethylene
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
PFAS	per- and polyfluoroalkyl substance
PFTE	polytetrafluoroethylene
PPE	personal protective equipment
PVC	polyvinyl chloride
PVDF	polyvinylidene fluoride
QA	quality assurance
QC	quality control
SOP	standard operating procedure
USCS	Unified Soil Classification System

1.3 **Equipment and Products**

Sections 1.3.1 and 1.3.2 detail items that are safe to use versus not recommended for use on the job site to protect PFAS samples from potential cross-contamination. Science-based evidence is not currently available to support a determination of the realistic impact of these commonly used field items and materials on PFAS samples. In the absence of scientific-based sampling guidance, field staff, contractors, and analytical laboratories should try to avoid using items that may pose a risk for cross-contamination and false positive results and instead use acceptable alternatives identified in this section. If the field team needs to use products and equipment on site that are not recommended, additional quality assurance/quality control (QA/QC) samples may be collected to evaluate any potential impact on PFAS environmental samples. This information is also provided in an abbreviated format as a checklist for field staff to reference (Attachment A).

1.3.1 **Field Equipment**

Items that are **safe to use** on site when sampling for PFAS include the following:

- High-density polyethylene (HDPE)¹, silicone, acetate, and stainless steel sampling equipment and materials (e.g., sampling containers and screw caps, bowls, pans, trays, spoons, trowels, forceps);
- Low-density polyethylene (LDPE)² materials not in direct contact with the sample (e.g., Ziploc® bags);

¹ HDPE plastics are commonly identified by a recycling symbol with a number 2 inside it.

² LDPE plastics are commonly identified by a recycling symbol with a number 4 inside it.

- Survey stakes, flags, or whiskers;
- Drill rigs equipped with direct-push capabilities and push rods;
- Drill rigs equipped with hollow-stem augers, solid-stem augers, and drop hammers;
- Shovels, pick axes, pick mattocks, or other excavating tools;
- Stainless steel hand augers with extension rods;
- Stainless steel or brass split-spoon samplers;
- Plastic sleeves, liners, and caps that do not contain fluoropolymers (e.g., acetate, polyvinyl chloride, polycarbonate);
- Hook-blade utility knife to cut liners;
- Munsell soil color charts and grain size charts;
- Hand lenses;
- Stainless steel baskets or retainers for loose soils;
- Sampling forms, loose paper or field notebooks, chain of custody (CoC) record, and sample container labels;
- Masonite or aluminum clipboards;
- Ballpoint pens;
- Alconox[®], Liquinox[®] and Luminox[®] detergents (Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment used for collection of media to be submitted for analysis of 1,4-dioxane);
- Paper towels;
- Trash bags;
- HDPE sheeting;
- Hard-shell coolers;
- Shipping and handling labels;
- Regular (wet) ice;
- Bubble wrap; and
- Duct tape and packing tape; and • Large (e.g., 55-gallon) containers.

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Glass sample containers, due to PFAS adherence to glass surfaces;
- Water-resistant paper, notebooks, and labels (e.g., certain Rite in the Rain[®] products), due to use of PFAS in water-resistant inks and coatings;

- Sticky notes (e.g., certain Post-It® products), due to potential use of a paper coating product Zonyl™ or similar fluorotelomer compounds;
- Plastic clipboards, binders, and spiral hardcover notebooks;
- Pens with water-resistant ink;
- Felt pens and markers (e.g., certain Sharpie® products) – some PFAS SOPs (e.g., Michigan) specifically allow Fine or Ultra-Fine Point Sharpies® and TestAmerica Laboratories, Inc. routinely uses Sharpies® in the laboratory following unpublished analytical tests that reportedly showed no impact on PFAS sample results;
- Aluminum foil, as PFAS are sometimes used as a protective layer;
- Decon 90™ liquid detergent, which reportedly contain fluorosurfactants;
- Chemical (e.g., blue) ice packs, unless it is contained in a sealed bag. Blue ice has the potential to be contaminated from previous field sampling events;
- Materials containing polytetrafluoroethylene (PTFE) including Teflon™ and Hostaflon® (e.g., tubing, tape, plumbing paste, O-rings);
- Equipment with Viton™ components (i.e., fluoroelastomers);
- Stain- or water-resistant materials, as these are typically fluoropolymer-based;
- Material containing LDPE, particularly if used in direct contact with the sample (e.g., LDPE tubing, as PFAS can sorb to the porous tubing); and
- Material containing “fluoro” in the name – this includes, but is not limited to, fluorinated ethylene propylene (FEP), ethylene tetrafluoroethylene (ETFE), and polyvinylidene fluoride (PVDF).

1.3.2 Clothing, Personal Protective Equipment (PPE), and Consumer Products

Items that are safe to use on site when sampling for PFAS include the following:

- Boots made of polyurethane, polyvinyl chloride (PVC), rubber, or untreated leather;
- Other field boots covered by PFAS-free (e.g., polypropylene) over-boots;
- Rain gear made of polyurethane, PVC, wax-coated, vinyl, or rubber;
- Clothing made of synthetic (e.g., polyester) or natural (e.g., cotton) fibers;
- Safety glasses;
- Reflective safety vests;
- Hardhats;
- Disposable powder-free nitrile gloves;
- Uncoated HDPE suits (e.g., certain Tyvek® products);

- Sunscreens³ and insect repellants⁴ that have been tested and found to be PFAS-free; and
- Bottled water and hydration drinks.

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Water- or stain-resistant boots and clothing (e.g., products containing GORE-TEX®);
- Clothing recently laundered with a fabric softener;
- Coated HDPE suits (e.g., certain Tyvek® products);
- Sunscreen and insect repellants containing fluorinated compounds as ingredients, such as polyfluoroalkyl phosphate esters;
- Latex gloves;
- Cosmetics, moisturizers, hand cream, and other related products;
- Food wrappers and packaging; and
- Food and drinks other than bottled water or hydration drinks.

Field staff should try to find acceptable alternatives to these items that still allow them to complete the field work safely and efficiently. For example, wearing long-sleeved clothing and a hard hat or sun hat may eliminate the need to use sunscreen in some climates. If an item cannot be easily avoided, additional consideration should be given to QA/QC samples to evaluate the potential impact of sample cross-contamination (e.g., field blanks).

2. FIELD PROCEDURES

2.1 Pre-Mobilization Activities

2.1.1 Health and Safety Plan

Prior to each field event, the site health and safety plan should be reviewed and updated, as necessary. Health and safety plan requirements should be reviewed for consistency with this SOP

³ Examples of PFAS-free sunscreens include Alba Organics Natural, Aubrey Organics, Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30, Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30, Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30, Banana Boat Sport Performance Sunscreen Stick SPF 50, Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50, Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30, Coppertone Sunscreen Stick Kids SPF 55, Jason Natural Sun Block, Kiss my Face, L'Oréal Silky Sheer Face Lotion 50+, Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50, Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70, Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70, Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30, Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+, Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30, Yes to Cucumbers, and sunscreens for infants. Products with fluorinated compounds in their ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling. ⁴ Examples of PFAS-free insect repellent include Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellent, Herbal Armor, California Baby Natural Bug Spray, BabyGanics, OFF! Deep Woods® spray for clothing and skin, Sawyer® do-it-yourself permethrin treatment for clothing, Insect Shield Insect® pretreated clothing, DEET products, and sunscreen/insect repellent combination product Avon Skin so Soft Bug Guard-SPF 30. Products with fluorinated compounds in their ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling.

and modified as appropriate to resolve any differences (e.g., HDPE suits may be specified in the health and safety plan).

2.1.2 Laboratory Coordination

Field personnel should communicate with the laboratory that will conduct PFAS analysis regarding the following items:

- Laboratory accreditation for PFAS analysis (see Section 3.1);
- Appropriate sample containers, labels, and preservatives (see Section 2.2.2); • Sample storage conditions and holding time (see Section 2.2.3); and
- The number and type of QA/QC samples (see Section 2.3).

Because there is no standard United States Environmental Protection Agency method for analyzing PFAS samples in media other than drinking water, commercial laboratories typically offer analysis for a suite of approximately 24 PFAS using a modified version of Method 537 or recently published Method 537.1. Laboratories may therefore have developed their own variations to this method or another method. Project staff may consider the impact of differences in reported PFAS concentrations and the potential value of collecting and sending a split sample to a second commercial laboratory to assess variability in reported PFAS concentrations.

2.1.3 Equipment Decontamination

Equipment should be decontaminated prior to mobilization to the site if it appears to be contaminated or if there is reason to believe that it is contaminated. Equipment decontamination should follow the steps outlined in Section 2.4.

2.2 Sampling

2.2.1 Sampling PPE

Gloves: Disposable powder-free nitrile gloves should be worn at all times during sample collection and handling of sampling equipment.

At a minimum, field personnel should put on a new pair of nitrile gloves after the following activities:

- Handling samples, including QA/QC samples and blanks;
- Handling sampling equipment; and
- Between each sampling location.

At a minimum, personnel should (1) thoroughly wash their hands with detergent (preferably Alconox[®] or Luminox[®]) and PFAS-free water; (2) thoroughly dry their hands with paper towels; and (3) put on a new pair of nitrile gloves after the following activities:

- Contact with a material potentially containing PFAS;
- Change in sampling locations;

- Breaks in work;
- Washroom breaks; and
- Exit and entry into the project site exclusion zone.

2.2.2 Sampling Equipment

Sample Containers: Depending on the method of soil sample collection, soils may be collected and placed into HDPE containers with unlined screw caps. Soil samples may also be collected using plastic, stainless steel or brass sleeves with caps placed at the ends.

Soil Retrieval Equipment: Soil retrieval methods vary depending on the depth of soil that will be sampled (e.g., topsoil, subsurface soil cores), geologic setting, need to consider contaminant dragdown/cross-contamination, and other analytes of interest (e.g., geotechnical characterization, volatile organic compounds). This SOP focuses on three soil retrieval methods:

1. **Manual soil sampling** – Equipment may include hand augers, shovels, pick axes, pick mattocks, or other excavating tools, as well as bowls, pans, trays, spoons, trowels and forceps.
2. **Direct-push sampling** – Soil is typically retrieved using a direct-push technology (DPT) rig, a solid barrel direct push sampler, and a liner to facilitate removal of the soil from the sampler. Liners may be brass, stainless steel, polyvinyl chloride, polycarbonate, acetate, or other plastics. Care should be taken to select a liner that does not contain fluoropolymers.
3. **Solid-stem auger** – Solid-stem augers may be attached to a DPT rig and used to create a “pilot” hole if lithified or dense materials are causing refusal and preventing the advancement of a solid barrel direct push sampler.
4. **Split-spoon sampling** – A hollow stem auger rig is used to drill to the desired depth(s), as well as a stainless-steel split-spoon sampler.

An overview of other methods of soil sample collection is beyond the scope of this SOP; the reader is encouraged to review other published field sampling manuals and SOPs when formulating a site-specific work plan. Additional detail should also be provided in a site-specific work plan or stand-alone SOP to guide the process of compositing soil samples.

Preservatives: Sample preservatives are not used for soil samples prior to PFAS analysis.

2.2.3 Sample Collection and Labeling

Container Rinsing: Sample containers should not be rinsed prior to sampling.

Manual Soil Sampling: Surface soils may be collected using small hand tools (e.g., spoons, trowels, forceps). Subsurface soils may be retrieved using large hand tools (e.g., shovels, hand augers) or heavy equipment (e.g., hydraulic excavators) in combination with small hand tools. Manual soil samples are typically retrieved as follows:

- Hand tools and/or heavy equipment are used to access the required sample depth.
- If using small hand tools, soil is then sampled (see Steps 1 through 6 below).

- If using large hand tools or heavy equipment, retrieve the soil and place it on a flat PFAS free surface for sample collection (e.g., stainless steel tray, HDPE sheeting). Once the soil has been retrieved for sampling, follow these steps:
 1. Remove large gravel from the sample using small hand tools;
 2. Homogenize the soil collected over the desired sampling interval;
 3. Remove the cap from the sample container and fill the container with the soil sample with small hand tools. The container should be filled to the mass or volume specified by the laboratory;
 4. Use a paper towel to clean the outside of the sample container and the sample container threads if necessary. Close the sample container by screwing on the container cap.
 5. Label the sample (see “Labels” section below);
 6. Record the sample location (horizontal), sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location; and
 7. Complete soil boring logging per work plan requirements. Detailed records of soil conditions during sampling are helpful in creating and refining the conceptual site model, including sample location, depth, color, odor, lithology, hydrogeology, and readings derived from field monitoring equipment. Surface and shallow subsurface soil samples shall be described using the Unified Soil Classification System (USCS) and/or American Society for Testing and Materials (ASTM) guidance D2487 Standard Practices for Classification of Soils for Engineering Purposes, unless otherwise directed by a site specific work plan.

Direct-Push Soil Sampling: When drilling with a DPT rig (or a sonic drill rig), subsurface soil may be retrieved using a dual-tube sampler or a single rod sampler. Both types of samplers typically use a plastic liner to facilitate soil removal. Plastic liners are one-time use liners and will not be reused for sampling of multiple intervals or soil boring locations. Care should be taken that the liner material does not contain fluoropolymers.

Soil is typically sampled as follows:

1. Remove pavement or sub-base material that is obstructing rig access to subsurface soil.
2. Drill to the first sample depth.
3. When the sample depth is reached, remove the drive tooling and deploy the sample barrel with a liner and a drive tip.
4. Advance the sample barrel through the desired sample interval and then retrieve the sample by pulling up the rods.
5. Slide the liner containing the soil sample from the sample barrel and place it on a PFAS free surface (e.g., HDPE sheeting).

6. Wipe the outside of the liner with a paper towel and mark the depth on the outside of the liner with a marker.
7. Open the liner with a utility knife and complete soil boring logging per work plan requirements.
8. Complete soil boring logging per work plan requirements. Detailed records of soil conditions during sampling are helpful in creating and refining the conceptual site model, including sample location, depth, color, odor, lithology, hydrogeology, and readings derived from field monitoring equipment. Surface and shallow subsurface soil samples shall be described using the USCS and/or ASTM guidance D2487 Standard Practices for Classification of Soils for Engineering Purposes, unless otherwise directed by a sites specific work plan.
9. Remove the soil from the liner manually or using small hand tools from the desired sampling interval.
10. Homogenize the soil collected over the desired sampling interval.
11. Remove the cap from the sample container and fill the container with the soil sample with small hand tools. The container should be filled to the mass or volume specified by the laboratory.
12. Use a paper towel to clean the outside of the sample container and the sample container threads if necessary. Close the sample container by screwing on the container cap.
13. Label the sample (see “Labels” section below).
14. Record the sample location (horizontal) and depth, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location.

Split-Spoon Sampling: Split-spoon sampling is typically used with a hollow-stem auger drill rig. To conduct split-spoon soil sampling, follow these procedures:

1. Remove any pavement or sub-base material that is obstructing access to subsurface soil by the hollow-stem auger drill rig.
2. Begin drilling; periodically remove and containerize soil cuttings that are brought to the surface by the auger flights during drilling.
3. When the desired sample depth is reached, remove the center rod and deploy the splits poon sampler attached to the drill rod string. Insert a plastic liner prior to sampler deployment.
4. With the sampler shoe at the ground surface in the sample location, mark the center rod with the desired sample depth increments.
5. Drive the sampler using a hammer and record the number of blows required to drive the spoon through each 6-inch increment, the length of the tube that penetrates the material being sampled, the weight of the hammer, and the total distance dropped.

6. Cease driving upon reaching the sampler length or refusal. Refusal is when little to no progress is made for 50 hammer blows.
7. Pull up the center rod and sampler, remove the sampler from the drill rods, and place it on a PFAS-free surface (e.g., HDPE sheeting).
8. Open the split spoon sampler to access the soil, being careful not to disturb the soil.
9. Wipe the outside of the sealed liner with a paper towel and mark the depth on the outside of the liner with a marker.
10. Open the liner with a utility knife and complete soil boring logging per work plan requirements. Detailed records of soil conditions during sampling are helpful in creating and refining the conceptual site model, including sample location, depth, color, odor, lithology, hydrogeology, and readings derived from field monitoring equipment. Surface and shallow subsurface soil samples shall be described using the USCS and/or ASTM guidance D2487 Standard Practices for Classification of Soils for Engineering Purposes, unless otherwise directed by a site-specific work plan.
11. Remove the soil from the liner manually or using small hand tools from the desired sampling interval.
12. Homogenize the soil collected over the desired sampling interval.
13. Remove the cap from the sample container and fill the container with the soil sample with small hand tools. The container should be filled to the mass or volume specified by the laboratory.
14. Use a paper towel to clean the outside of the sample container and the sample container threads if necessary. Close the sample container by screwing on the container cap.
15. Label the sample (see “Labels” section below).
16. Record the sample location and depth, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location.

Labels: Some water-resistant inks may be potential sources of PFAS. PFAS-free container labels should be filled out using a ballpoint pen that does not have water-resistant ink, if possible. Field staff should try to avoid filling out container labels using felt pens and markers (e.g., certain Sharpie® products). Container labels should include the following information:

- A unique sample identifier;
- QA/QC sample type, if applicable;
- Sampling date and time (24-hour format);
- Sampler’s name or initials; and
- Method of sample preservation.

Except for temperature blanks, all QC samples should be labeled and included on the CoC record. Duplicate samples should not be indicated as duplicates.

Wet Weather Considerations: Field sampling during wet weather (e.g., rainfall and snowfall) should be conducted wearing appropriate clothing that does not pose a risk for cross contamination. Field personnel should try to avoid water-resistant clothing and boots. Rain gear made of polyurethane, PVC, vinyl, or rubber is an acceptable alternative. Samples and sample containers should not be opened prior to sample collection to avoid collecting precipitation. Should samples or sample containers become contaminated with precipitation, they should be discarded.

2.2.4 Sample Handling, Storage, and Shipment

Handling: Clean nitrile gloves should be worn when handling sample containers. Precautions should be taken to not drop or otherwise damage sample containers. Sample containers should **not** be placed in close proximity to a potential PFAS source.

Storage and Holding Times: Storage conditions and holding times should be determined by the laboratory. Measures should be taken to meet storage and holding time criteria (e.g., expedited shipping).

Shipment: Sample containers should be packed for shipment using the following steps:

1. Choose a cooler with structural integrity that will withstand shipment.
2. Secure and tape the drain plug with duct tape from the inside and outside.
3. Fill cooler at least one-third full with wet ice (try to avoid using chemical blue ice) double-bagged in sealed bags. Taping the ends of bags with duct tape will aid in waterproofing.
4. Check that the caps on all sample containers are tight and will not leak.
5. Check that the sample labels are intact, filled out, legible, and that the sample identifier exactly matches the CoC record.
6. Seal each sample container in a sample bag to prevent melt water from getting into the sample or degrading the sample label.
7. Place sample containers into the cooler with their caps upright.
8. Fill excess space within the cooler with bubble wrap (try to avoid using paper, cardboard, or polystyrene foam).
9. Seal the entire cooler with duct tape, particularly the lid, to prevent leaks.

Ship samples as non-hazardous material unless the samples meet the established Department of Transportation (DOT) criteria for a “hazardous material” or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) for air definition of “dangerous goods.” If the samples meet criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed. Prior to shipping samples, field personnel should complete the appropriate air waybill or manifest. A copy of the air waybill or manifest should be kept for recordkeeping.

2.3 Sampling QA/QC

2.3.1 Field Duplicates

Field duplicates are samples collected in the same manner and at the same time and location as a primary sample. They should be collected from locations of known or suspected contamination. Field duplicates are used to assess field and analytical precision and sample heterogeneity. Typically, at least one field duplicate is collected for every 10 primary samples. Field duplicates should be labeled with a unique sample identifier and not be indicated as a duplicate (i.e., submitted as “blind”).

2.3.2 Background Samples

Based on project objectives, background samples may be collected onsite or nearby the site where little or no PFAS contamination is expected. Background samples are used to assess the natural composition of the soil and determine that PFAS contamination in soils is localized rather than widespread. Typically, at least one background sample is collected during every sampling campaign; however, soil heterogeneity across the site (lateral or vertical) may warrant additional background samples.

2.3.3 Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike and matrix spike duplicate (MS/MSD) samples are aliquots of environmental samples that are spiked with a known concentration of PFAS by the laboratory. MS/MSD samples are used to assess interferences caused by the sample matrix. MS/MSD samples are not needed if the analytical laboratory is using an isotopic dilution method but are technically required to meet Department of Defense (DoD) accreditation requirements, if this accreditation is required by the project. If necessary, MS/MSD samples are to be collected in the same manner and at the same time and location as a primary sample (i.e., additional sample mass). It is preferred that this location have little to no PFAS contamination. Samples should have the same matrix to ensure a valid result; if the samples do not appear visually similar (e.g., color, grain size, sheen), choose another location for collection of MS/MSD samples. The number of required MS/MSD samples should be determined based on discussions with the laboratory. Typically, at least one MS/MSD sample is collected for every 20 primary samples. MS/MSD samples should be labeled with the same sample name and time as the primary sample and denoted as MS/MSD samples on the CoC and sample label.

2.3.4 Blanks

Blanks should be shipped and handled in the same manner as environmental samples. Field blanks should be labeled as such on sample bottles and on the CoC. The number and type of blanks should be determined based on discussions with the laboratory.

Equipment Blanks: Equipment blanks are used to assess sources of field and laboratory contamination. Equipment blanks are prepared by pouring PFAS-free water over or through decontaminated reusable field sampling equipment and collecting the rinsate in a sample container. Typically, at least one equipment blank is collected for every 10 primary samples. Note: if equipment that will come into contact with the soil sample is not being reused (i.e., if plastic liners

and caps will be used for soil samples), equipment blanks can be omitted from the field sampling program.

Field Blanks: Field blanks are used to assess ambient contamination within the field and laboratory. Field blanks should be prepared by filling a sample container with PFAS-free water in the field in the same manner as environmental samples. Field blanks are an effective way of assessing potential cross-contamination as a result of sample handling. Typically, one field blank is collected for each shipping container.

Temperature Blanks: Temperature blanks are used to assess the temperature of samples during shipping. Temperature blanks should be provided by the laboratory or prepared by filling a sample container with water prior to shipment of the sample containers. The blank should be kept in the cooler during sampling and shipment to the laboratory. Once the cooler returns to the laboratory, the temperature of the blank should be measured to ensure that recommended sample storage criteria are met (typically less than 6 degrees Celsius).

2.4 **Decontamination**

Decontamination should occur prior to leaving the sampling area or at a central decontamination location. Additionally, sampling equipment exposed to PFAS-contaminated soil should be decontaminated between sample locations.

Alconox[®] or Luminox[®] detergents are acceptable for decontamination purposes. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment used for collection of media to be submitted for analysis of 1,4-dioxane. Decon 90 should be avoided during decontamination activities. Decontamination wastes must be properly contained and disposed of in accordance with applicable local, state and federal regulations.

2.4.1 **Field Equipment Decontamination**

Drillers typically have multiple rods and samplers on hand and thoroughly decontaminate them as a group once they have been used.

Drill Rods and DPT Samplers: As drill rods are pulled up, they are wiped down with a rag rinsed in soapy water. Inner rods are placed into a 5-gallon bucket and rinsed with a rag using soapy water (Alquinox[®] or Luminox[®]). Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination of equipment used for collection of media to be submitted for analysis of 1,4-dioxane. DPT samplers are to be fully decontaminated after each use. DPT rods are to be fully decontaminated after each boring location using the following procedures:

1. If heavy petroleum residuals are encountered during sampling, use methanol or another appropriate solvent to remove any residues from sampling equipment;
2. Pressure wash thoroughly and vigorously using potable water and detergent (Alconox[®], Liquinox[®] or Luminox[®]) to remove any remaining residual contamination;
3. Rinse thoroughly with potable water (1st rinse);
4. Rinse thoroughly with PFAS-free water (2nd rinse); and

5. Leave the equipment to air dry on plastic sheeting (non-LDPE) to prevent contact with surface soils and in a location away from dust and fugitive contaminants to avoid cross contamination.

Samplers: Other sampling equipment (e.g., trowels, spoons, hand augers) should be placed into a 5-gallon bucket with soapy water (Alquinox®, Liquinox® or Luminox®) and wiped down with a rag. Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment used for collection of media to be submitted for analysis of 1,4-dioxane. Samplers can then be fully decontaminated after each use using the following procedures:

1. Remove any gross (e.g., soil) contamination from sampling equipment;
2. If heavy petroleum residuals are encountered during sampling, use methanol or another appropriate solvent to remove any residues from sampling equipment;
3. Clean using a polyethylene or PVC brush in a 5-gallon bucket;
4. Rinse thoroughly with potable water (1st rinse);
5. Rinse thoroughly with PFAS-free water (2nd rinse); and
6. Leave the equipment to air dry in a location away from dust and fugitive contaminants.

Other Field Equipment: All non-disposable sampling equipment that is in contact with contaminated soil, groundwater, or decontamination water (e.g., 5-gallon bucket, field meters) must be cleaned prior to and between uses at each soil sampling location according to the following procedures:

1. Remove any gross (e.g., soil) contamination from sampling equipment;
2. If heavy petroleum residuals are encountered during sampling, use methanol or another appropriate solvent to remove any residues from sampling equipment;
3. Wash water-resistant equipment thoroughly and vigorously with potable water containing detergent (Alconox®, Liquinox® or Luminox®) using a bristle brush or similar utensil to remove any remaining residual contamination. Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment used for collection of media to be submitted for analysis of 1,4-dioxane;
4. Rinse equipment thoroughly with potable water (1st rinse);
5. Rinse equipment thoroughly with PFAS-free water (2nd rinse);
6. For field instruments, rinse again with PFAS-free water (3rd rinse); and
7. Dry wet equipment with a paper towel or leave the equipment to air dry in a location away from dust or fugitive contaminants. All equipment should be dry before reuse.

Cleaning and decontamination of the equipment should be accomplished in stages and in such a way that the contamination does not discharge into the environment.

2.4.2 Personnel and PPE Decontamination

A decontamination area for personnel and portable equipment may be specified in the health and safety plan. The area may include basins or tubs to capture decontamination wastes, which can be transferred to larger containers as necessary. If decontamination is needed following soil sampling, personnel decontamination should follow these steps:

1. Gross (e.g., soil) contamination should be scraped and wiped from boots, safety glasses, hardhats, reflective vests, and other reusable PPE. Once gross contamination has been removed, gloves should be removed by rolling off the hands in such a way to avoid exposing skin to PFAS-contaminated materials;
2. A new pair of gloves should be put on and reusable PPE should be decontaminated using PFAS-free water mixed with detergent (preferably Alconox®, Liquinox® or Luminox®) and brushes, or similar means. After debris is removed, reusable PPE should be rinsed with PFAS-free water; and
3. Hands and any exposed body parts should be washed thoroughly using detergent (preferably Alconox®, Liquinox® or Luminox®) and PFAS-free water. Hands should be dried with paper towels.

(Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination when sampling for media to be submitted for analysis of 1,4-dioxane)

2.5 Food and Drink

Food and drink should not be brought within the exclusion zone. Food that is kept in the staging area should preferably be contained in HDPE or stainless-steel containers.

3. LABORATORY PROCEDURES

3.1 Accreditations

All samples will be analyzed by an analytical method included in the most current DEC Analytical Services Protocol (ASP) at a laboratory that is accredited pursuant to the NYSDOH Environmental Laboratory Accreditation Program (ELAP) for the category of parameters analyzed. There is not currently an ELAP certification program for the analysis of PFAS compounds other than those in drinking water. Consistent with NYSDEC policy (NYSDEC 2018), the samples for PFAS compounds will be performed using a modified USEPA Method 573 approach at a laboratory that has ELAP certification for PFOA and PFOS in drinking water.

4. DOCUMENTATION

4.1 Chain of Custody

4.1.1 Field Custody Procedures

A sample is considered to be in custody if the following conditions have been observed:

- It is in possession or view of the person in custody;

- It is locked in a secure area;
- It is placed in an area restricted to authorized personnel; or
- It is placed in a container and secured with an official seal, so that the sample cannot be reached without breaking the seal.

The following practices should be observed by field personnel to ensure sample custody:

- As few persons as possible will handle samples;
- The sample collector is personally responsible for the care and custody of samples collected until they are transferred to the laboratory;
- The sample collector will record sample data in the field notebook; and
- Sample labels will be completed for each sample.

4.1.2 Chain of Custody Record

All samples should be accompanied by a CoC record. The CoC record is typically provided by the laboratory. The CoC record should be fully completed in duplicate (e.g., a carbon copy). At the minimum, the following information should be included on a CoC record:

- Project name and number;
- Laboratory name and address;
- Name of person that collected the samples;
- Sample identifier;
- Sample date and time (time in 24-hour format);
- Laboratory analysis requested;
- Preservatives added to each sample;
- Sample matrix (e.g., soil, water);
- Number of containers per sample; and
- Airway bill tracking number.

As applicable, the following remarks should be added to the CoC record:

- Contractor name and address;
- MS/MSD sample volume (if necessary);
- A request for rapid turnaround time; and
- A note regarding the potential concentrations in a highly-contaminated sample.

Indication of a duplicate sample should **not** be included on a CoC record.

4.1.3 Sample Packaging

The CoC record should accompany all sample shipments. One CoC record should be prepared for each cooler and the cooler number recorded on the CoC. The samples in the cooler should be listed on the CoC record. The CoC record should be placed in a sealed plastic bag (e.g., Ziploc®) and taped to the inside lid of the cooler. If one sample is contained in two coolers (i.e., one sample has too many containers to fit in one cooler), then the original CoC should be placed in the first cooler and a copy of the CoC record should be placed in the second cooler. The duplicate copy of the CoC record should be retained by the sampler.

Custody seals should be signed and dated at the time of use. Sample shipping containers should be sealed in as many places as necessary to ensure that the container cannot be opened without breaking a custody seal. Tape should be placed over the seals to ensure that seals are not accidentally broken during shipment. If the sampler transports the samples to the laboratory without sample shipment, custody seals are not required.

4.1.4 Transfer of Custody

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler should sign, date, and note the time as “relinquished by” on the CoC record. The receiver should also sign, date, and note the time as “received by” on the CoC record. The date and time of the receiver and relinquisher should be the same.

When samples are transported by a commercial carrier, the carrier will not sign the CoC record. However, the airway bill tracking number should be recorded on the CoC record. Airway bills should also be retained with the CoC record as documentation of transport. For this reason, the date and time of the receiver and relinquisher will not match when shipping with a commercial carrier.

4.1.5 Laboratory Custody Procedures

A designated sample custodian should accept custody of the shipped samples and verify that the sample identification number matches the CoC record. Pertinent information about shipment, pickup, and courier should be entered in the “Remarks” section. The temperature of the temperature blanks at the time of receiving should be noted on the CoC record.

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Transport Canada, 2013. Perfluorochemical (PFAS) Field Sampling Protocol.

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USAF, FA8903-18-F-0066. Quality Assurance Project Plan, Perfluorinated Compound Supplemental Site Inspection, 2018. Draft.

USAF, HQ USAF/A7C, 2012. Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations.

United States Environmental Protection Agency (USEPA), Office of Emergency and Remedial Response, 1996. Sampler's Guide to the Contract Laboratory Program.

USEPA, Region III, 2009. Quality Control Tools: Blanks, Fact Sheet.

Attachment A. Daily Sampling Checklist

Date: _____

Site Name: _____

Weather (*temperature/precipitation*): _____

Please check all boxes that apply and describe any exceptions in the notes section below along with QA/QC methods used to assess potential sample cross-contamination as a result.

Field Clothing and PPE:

No water- or stain-resistant boots, waders, or clothing (e.g., GORE-TEX[®])

Field boots (or overboots) are made of polyurethane, PVC, rubber, or untreated leather

Waders or rain gear are made of neoprene, polyurethane, PVC, vinyl, wax-coated or rubber

Clothing has not been recently laundered with a fabric softener

No coated HDPE suits (e.g., coated Tyvek[®] suits)

Field crew has not used cosmetics, moisturizers, or other related products today

Field crew has not used sunscreen or insect repellants today, other than products approved as PFAS-free

Field Equipment:

Sample containers, liners and equipment in direct contact with the sample are made of HDPE, polypropylene, silicone, acetate or stainless steel, not LDPE or glass

Sample caps are made of HDPE or polypropylene and are not lined with Teflon[™]

No materials containing Teflon[™], Viton[™], or fluoropolymers

No materials containing LDPE are in direct contact with the sample (e.g., LDPE liners, Ziploc[®] bags)

No plastic clipboards, binders, or spiral hard cover notebooks

No waterproof field books

No waterproof or felt pens or markers (e.g., certain Sharpie[®] products)

No chemical (blue) ice, unless it is contained in a sealed bag

No aluminum foil

No sticky notes (e.g., certain Post-It[®] products)

Decontamination:

Reusable field equipment (e.g., inner drill rods, samplers) decontaminated prior to reuse

“PFAS-free” water is on-site for decontamination of field equipment

Alconox[®], Liquinox[®] or Luminox[®] used as decontamination detergent

Food and Drink:

No food or drink on-site, except within staging area

Food in staging area is contained in HDPE or stainless steel container

Notes:

Field Team Leader Name (Print): _____

Field Team Leader Signature: _____

Date/Time: _____

Collection of Shallow Soil Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) Protocol

General

The objective of this protocol is to give general guidance for the collection of soil samples for PFC analysis. The sampling procedure used must be consistent with the NYSDEC March 1991 SAMPLING GUIDELINES AND PROTOCOLS

http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf with the following materials limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFOA and other PFCs by Modified (Low Level) via the modified (low level) EPA Test Method **537**. Based on four laboratories, the PFC reporting limits range from 0.1 to 3 micrograms per kilogram. One 8-ounce high density polyethylene (HDPE) container is required for each sample. Pre-cleaned sample containers, coolers, sample labels and a chain of custody form will be provided by the laboratory.

Sampling Location and Survey

Shallow soil sampling will generally be confined to surface or near-surface soils and/or sediments with hand equipment. For screening purposes, sampling of this type should be conducted in potential depositional areas. Sample locations shall be located and recorded.

Equipment

At this time acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE), PVC, silicone, acetate and polypropylene. Additional materials may be acceptable if proven not to contain PFCs. All sampling equipment components and sample containers should not come in contact with aluminum foil, low density polyethylene (LDPE), glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. A list of acceptable equipment is provided below, but other equipment may be considered appropriate at a later date.

- stainless steel spoon;
- stainless steel bowl; and
- carbon steel hand auger without any coatings.

Equipment Decontamination

Standard two step decontamination using detergent and clean water rinse will be performed for equipment that does come in contact with PFC materials.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases a clean stainless steel spoon should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) shall then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to

~36 inches below surface) may be collected by digging a hole using a hand auger. When the desired subsurface depth is reached, a pre-cleaned hand auger shall be used to obtain the sample.

When the soil sample is obtained, it should be deposited into a stainless-steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized.

Sample Identification and Logging

A label shall be attached to each sample container with an identification consistent with the format indicated below. Each sample shall be included on the chain of custody (COC).

- Each sample shall be labelled as Street#, Street Name, date, Sample S#, Depth Interval (e.g. 2MainSt-3-30-16-S1-0-2).
- Each duplicate shall be labelled as a blind duplicate identified as “date, DUP, # (e.g. 3-30-16-DUP1).

Quality Assurance/Quality Control

- Immediately place samples in cooler maintained at $4 \pm 2^{\circ}$ Celsius.
- Collect one field duplicate for every sample batch, not to exceed 20 samples. The duplicate shall consist of an additional sample at a given location.
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC.
- Request appropriate data deliverable (Category A or B) and an electronic data deliverable.

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, duplicate sample, visual description of the material and any other observations or notes determined to be appropriate.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler must wear nitrile gloves while conducting field work and handling sample containers. Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFC materials must be avoided. All clothing worn by sampling personnel must have been laundered multiple times.

A.2

STANDARD OPERATING PROCEDURE

SURFACE SOIL SAMPLING

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.2
SURFACE SOIL SAMPLING**

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the logistics, collection techniques, and documentation requirements for collecting surface soil samples. The soil sampling record to be used during field activities is provided with this SOP.

This SOP will be implemented in accordance with the following governing documents:

Site Characterization Work Plan (SCWP), which provides an overview of the site background and describes the overall investigative goals and scope of work for the Site Characterization;

- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objective of surface soil sampling (soil samples between ground surface and 6 to 12 inches below land surface) is to obtain a representative sample of soil for laboratory analysis of contaminants of concern at a given site. This objective requires that the sample be both free of unsuitable material and be of sufficient quantity and quality for analysis by the selected analytical method.

1.3 Equipment

The following equipment is needed for surface soil sampling:

- Personal Protective Equipment (PPE) and air monitoring equipment as specified in the HASP.
- Sample containers as specified in the SCWP and QAPP. Note that samples that are to be analyzed for volatile organic compounds (VOCs) will be collected by the USEPA 5035 Method using the following glassware: one (1) 40 mL VOC vial pre-preserved with 15 mL of methanol, and two (2) 40 mL VOC vials pre-preserved with 5 mL of sodium disulfate. All samples submitted for VOC analysis will also include one small (40 mL to 4 oz) container, to allow the laboratory to record the moisture/dry weight characteristics.
- Wooden stakes and spray paint (highly visible) or survey pins.

- Field log book and soil sample form (included in SOP A.17).
- Sample bottle labels/tags.
- Chain-of-custody forms.
- Hand auger, if surface soil penetration is difficult.
- Stainless steel spoon.
- Stainless steel mixing bowl.
- Disposable syringe for VOC sampling.
- Digital scale (accurate to +/- 0.1 grams).
- Indelible marking pens.

2. PROCEDURES

The following procedure should be used for surface soil sampling.

1. Don PPE and begin air monitoring per the HASP.
2. All surface debris should be removed prior to sampling including wood, paper, sod, gravel, and trash. Identify the sample location and mark with a stake, flagging, or similar marker.
3. Collect the soil using a stainless-steel shovel, hand auger, trowel and/or spatula. Avoid collection of larger pieces of material (e.g., cobbles, larger rocks). If a matted root zone is present at the sample location, it should be removed prior to sample collection.
4. A pre-cleaned stainless-steel spoon or spatula should be used to take the soil sample and fill the sample containers except in the case of a sample for VOC analysis, which is collected using an open-barrel disposable syringe. Care should be taken to avoid sampling anything but soil. Stones, gravel, or vegetation should be removed from the sample since these materials will not be analyzed.
5. For VOC analysis prior to collecting the sample, USEPA Method 5035 specified preservative (5 mL sodium bisulfate for low level analysis and 15 mL methanol for high level analysis) will be added to sterilized 40 mL containers. Each pre-preserved container will then be weighed prior to sample collection, and the container/preservative weight will be recorded on the chain of custody. A digital scale capable of +/- 0.1-gram(s) accuracy will be used to weigh the sample containers in the field.
6. If a sample for VOC is desired it will be collected first using an open barrel, disposable syringe. VOC samples should **never** be homogenized or composited.
7. For a low level analysis the soil will be extruded into a pre-preserved VOC vial containing a stir bar, sodium bisulfate (5 mL) and distilled water.
8. If the sample is collected for high level volatile analysis, the sample will be extruded into a VOC vial containing “Purge and Trap” grade methanol (15 mL).

9. The syringe will be filled with undisturbed soil of the following approximate volumes: 5 grams of soil for low-level analysis (added to the soil of sodium bisulfate); and/or 15 grams of soil for high level analysis (added to the 15 mL of methanol).
10. Any particles of grains present on the container rim or cap will be removed to ensure an adequate seal of the vial. The VOC vial will be capped quickly and labeled/tagged with sample identifications, date, and time of collection. The container/preservative/sample will then be weighed, and the post-collection weight will also be recorded on the chain of custody. The objective sample weights (5 g for low-level analysis, and 15 g for high level analysis) will be achieved (+/- 10%) with the use of the digital scale. Should insufficient sample volume be added to the preserved container, a stainless-steel spatula will be used to add a small portion of sample until the target weight is achieved (or exceeded within 10%).
11. In the event that a field screening technique (e.g., PID/FID instrument reading, visual staining of the soil, or olfactory observation) indicates the presence of VOCs or hydrocarbons, note the observations or instrument readings in the field logs.
12. Collect additional material for the remaining parameters by collecting the sample with the stainless-steel spoon and transferring the soil into a stainless-steel bowl. Homogenize the sample by mixing the sample within the bowl using the stainless-steel spoon prior to filling the remaining sample containers.
13. Record the sample location, identification, and time in the field logbook. Complete the sample log sheet with the following:
 - sample identification number;
 - sample location (sketch of the sample point);
 - time and date sample was taken;
 - personnel performing the task;
 - visual description of the sample;
 - brief soil description (color, texture, appearance);
 - weights of preserved VOC containers before and after sample collection; and
 - any other pertinent observations.

After the samples have been collected, the sampling location will be marked with wooden stakes colored with highly visible spray paint and labeled/tagged with the location identification in order to survey the sample location.

- All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at 4°C (+2°C) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. Refer to the Standard Operating Procedure A.22 for sample shipping.
- Refer to the SCWP or QAPP for equipment decontamination procedures.

A.3

STANDARD OPERATING PROCEDURE

SOIL DESCRIPTION: VISUAL - MANUAL PROCEDURE OF THE UNIFIED CLASSIFICATION SYSTEM

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.3
SOIL DESCRIPTION: VISUAL - MANUAL PROCEDURE
OF THE UNIFIED CLASSIFICATION SYSTEM**

1. INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the method for describing soil samples in test pits, soil borings, and soil grab samples. The SOP conforms to ASTM Standard D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and other pertinent technical publications.

1.1 Objective

The objective of soil sample description is to provide geological information useful for the purpose of hydrogeological or geotechnical evaluation of a site.

1.2 Equipment

The following equipment may be necessary during soil description activities:

- sand grading chart;
- field logbook and applicable supplementary field data forms;
- pocket knife, spoon, small spatula;
- folding ruler or yard stick;
- portable table;
- polyethylene sheeting;
- hand lens;
- deionized water in squeeze bottle;
- required personal protective equipment (gloves, boot, eye wear, hard hat, etc.) □ air monitoring equipment (as required);
- duct tape;
- boring logs (if applicable); and
- small squirt bottle with dilute hydrochloric acid.

2. SECTION 2 PROCEDURES

2.1 General Soil Description

The general description of a soil sample should be in the following order:

1. Color

2. Density
3. Moisture content
4. Geologic modifiers or classifications
5. Major Constituent - capitalized
6. Minor Constituent (s)
7. Geologic Description (in parentheses)

Example: Tan, loose, wet, stratified, medium SAND, little fine sand, trace coarse sand, trace silt (Till).

When logging a soil sample collected from a split spoon where more than one soil type is present, describe each one separately on the applicable field form (e.g. soil boring log). Start the description from the top of the split spoon and log each change in stratigraphy in sequence to the bottom of the spoon. Provide an interval or length (i.e., 0-0.5 ft:) at the beginning of each separate sequence description, followed by a colon. Draw a line below the bottom of the complete sample description.

2.2 Color

The main color value should be stated, along with an appropriate modifier. For example

- light brown
- dark brown
- reddish brown
- brown

The presence of mottling should be included in the description, where present. For example:

- Gray, slightly mottled, dense, damp, poorly sorted angular fine to medium SAND, some silt, trace angular coarse sand, trace clay (lodgement glacial till).

2.3 Density

In borings, density should be based on the sum of the middle two 6-inch blow counts of a two-foot split spoon or the last two 6-inch blow counts of an 18-inch split spoon. Professional judgement should be used when applying the density modifier. If high blow counts are due to the presence of a cobble, boulder or large piece of gravel that impedes forward progress of the split spoon, density should be based upon the character of the material in the split spoon, if any, or omitted from the description. A notation should be made in the sample description when this situation occurs. Appropriate modifiers are described in the following table.

Granular Soils

Cohesive Soils

Blows/ft	Density	Blows/ft	Density
0-4	very loose	0-2	very soft

4-10	loose	2-4	soft
10-30	medium dense	4-8	medium stiff
30-50	dense	8-15	stiff
>50	very dense	15-30	very stiff
		>30	hard

In test pits, density is subjective and should be based upon the ease of excavation. The above adjectives for granular and cohesive soils should be used in the description.

2.4 Moisture Content

Moisture content should be described using the following modifiers:

- **Dry** - no moisture.
- **Damp**- very slight moisture content, no visible water droplets.
- **Moist** - very slight moisture content, soils will not stick together.
- **Wet** – enough moisture for soils to stick together.
- **Saturated** – water dripping from sample; soils below the water table.

2.5 Geologic Modifiers

Sedimentological descriptions aid in the geologic classification of a soil material. Only insert geologic modifiers when present.

2.6 Stratification

Note the presence and thickness of alternating layers of non-cohesive materials of different grain sizes and/or color with layers ***at least 6 mm*** thick.

2.7 Lamination or Varves

Note the presence and thickness of alternating very thin layers of fine materials or color, such as silt and clay, with layers ***less than 6 mm*** thick.

2.8 Sorting

A geological term used to describe how close in size the grains in a sample are to each other. For example, a well sorted sample contains grains of similar size; a poorly sorted sample contains grains of many sizes.

2.9 Grading

An engineering term used to describe the range in grain sizes present in a sample. For example, a narrowly graded sample contains grains of similar size; a widely graded sample contains grains of different sizes.

2.10 Angularity or Rounding

Geological terms that are used to describe the general appearance of visible grains in the soil sample. Useful in determining the origin and depositional environment of a material. Water transported materials may be rounded. Glacial tills will be more angular.

- **Angular** – Particles have sharp edges and relatively plane sides with unpolished surfaces.
- **Subangular** – Particles are similar to angular description but have rounded edges.
- **Subrounded** – Particles have nearly plane sides but have well-rounded corners and edges.
- **Rounded** – Particles have smoothly curved sides and no edges.

2.11 Shape

A term used to describe the shape of gravel, cobbles, and boulders. Terms are as follows where the particle shape shall be described where the length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle.

- **Flat** – Particles with width/thickness > 3 .
- **Elongated** – Particles with length/width > 3 .
- **Flat and Elongated** – Particles meet criteria for both flat and elongated.

2.12 Odor

Describe the odor if organic or unusual. Soils containing a significant amount of organic material have a distinct odor of decaying vegetation. Always utilize appropriate breathing zone air monitoring equipment as specified in the site-specific health and safety plan.

2.13 Hydrochloric Acid Reaction

As appropriate for the geologic environment, describe the reaction with hydrochloric acid (HCL) as none, weak, or strong. As calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is appropriate for certain projects.

- **None** – No visible reaction.
- **Weak** – Some reaction, with bubbles forming slowly.
- **Strong** – Violent reaction, with bubbles forming immediately.

2.14 Cementation

Describe the cementation of intact coarse-grained soils as follows.

- **Weak** – Crumbles or breaks with handling or little finger pressure.
- **Moderate** – Crumbles or breaks with considerable finger pressure.
- **Strong** – Will not crumble or break with finger pressure.

2.15 Identification of Peat

A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor. When present the sample shall be designated as highly organic soil.

2.6 Major/Minor Constituents

2.16 Grain-size scales

Grain size classification should be based on an accepted classification system such as, the Unified Soil Classification System. The predominant grain size should be listed in the soil description in all capital letters.

Boulder	> 300 mm
Cobble:	75 - 300 mm
C. Gravel:	19 - 75 mm
F. Gravel:	4.75 - 19 mm
C. Sand:	2.0 - 4.75 mm
M. Sand:	0.425 - 2.0 mm
F. Sand:	0.075 - 0.425 mm
Silt:	0.002 - 0.075 mm
Clay:	<0.002 mm

2.17 Proportions

For geologic description, proportions of grain sizes will be based upon the following nomenclature:

☐ Trace:	0-10%
☐ Little:	10-20%
☐ Some:	20-35%
☐ And:	35-50%

The major soil sample constituent is always capitalized and listed first.

Minor constituents also include ancillary materials such as mica flakes, dark minerals, or naturally occurring organic matter, such as humus, peat, or other vegetative material.

2.18 Geologic Description

Where possible based on existing site data, local research, or geologic understanding of the local region, include a geologic description of the sample. Examples include till, fluvial, glaciofluvial, fill material, Name of Formation. Do not utilize geologic description if not certain.

A.4

STANDARD OPERATING PROCEDURE SONIC AND DIRECT PUSH SOIL SAMPLING

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.4
SONIC AND DIRECT PUSH SOIL SAMPLING**

1. INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in conducting direct push soil sampling.

1.1 Objective

The objective of this SOP is to establish procedures for using a direct-push rig to conduct the subsurface soil sampling activities. Direct push sampling devices allow subsurface soil samples to be collected at depth-discrete intervals. The direct push (PowerProbe®, GeoProbe®, or similar) device may be operated using a dual tube methodology which allows the collection of subsurface soil samples through an outer casing that is set to maintain the integrity of the boring. Using the direct-push rig, borings are advanced by simultaneously driving an outer stainless-steel casing and inner Lexan® tube into the ground. Upon reaching the desired penetration depth, the inner Lexan® tube is extracted to collect the discrete subsurface soil samples, leaving the outer casing in place. To sample the next interval of soil, a new length of Lexan® tubing is then inserted into the outer casing (already in the ground) attached to a length of drive pipe, and another length of outer casing is attached to the top of the outer casing that is already in the ground.

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP);
- SOP A.3 Soil Description Visual – Manual Procedure of the Unified Classification System;
- SOP A.17 Field Documentation, Sample Designation, Custody and Handling;
- SOP A.18 Decontamination Procedure for Sampling Equipment;
- SOP A.19 Management and Disposal of Investigation Derived Waste;
- SOP A.21 Recording Sample Location with a GPS;
- SOP A.22 Procedure to Prepare Environmental and Geotechnical Samples for Shipment; and
- Quality Assurance Project Plan (QAPP).

1.3 Equipment

1.3.1 Documentation

- Field log forms;
- Writing tools (pencils, Sharpie®, etc.);

- Bottle labels;
- Equipment manuals;
- Analysis and sample bottle summary;
- Digital camera;
- Water proof field log book; and
- Mapping-grade GPS, as described in SOP A.21, for recording sample locations or navigating to pre-determined locations.

1.3.2 Storm Gear

- Rain gear (i.e., boots, ponchos); and
- Flashlights (preferably head flashlight) or work-place lights.

1.3.3 Task-Specific Equipment

The following materials will be available, as required, during the subsurface soil sampling:

- Personal protective equipment (PPE), including hard hats and personal flotation devices, as required by HASP;
- Weighted tape measure;
- Sonic device: pneumatic, electric, or mechanically driven vibratory core head;
- Core box to hold cores in the vertical position;
- Photoionization Detector/Flame Ionization Detector (PID/FID);
- Decontamination equipment (see SOP A.18);
- Sample containers and preservatives;
- Stainless-steel mixing bowls, spoons and trowels;
- Coolers;
- 100 Quart marine coolers (Section 2.4.2 and 2.4.3);
- Wet or dry ice;
- Cable ties;
- Aluminum Foil;
- Hand tools (Allen wrench set, hammer, screwdrivers, pliers, knife, wire strippers, measuring tape);
- Paper towels;
- Zip-lock bags;
- Trash bags (separate bags for IDW and general trash);

- Portable table;
- Plastic sheeting;
- Marine vessel equipped with sonic drill rig;
- Hand siphon or dedicated plastic cups for sample water removal;
- Cement ground; and
- Marine acceptable cement grout (if applicable).

2. PROCEDURES

2.1 Pre-Mobilization Activities

- Obtain the construction, diameter, depth, material, and map showing location for location to be sampled.
- Obtain a listing of the parameters that will be measured in the field or laboratory as part of this sampling program including the required analytical method, analytical lab, sample volume, nomenclature, preservatives, sample containers and holding time for each parameter from the QAPP.
- Obtain a listing of the frequency of duplicate, MS/MSD, field blank, equipment blank and trip blank sampling as per the QAPP.
- Verify that all equipment on order is being shipped to the site.

2.2 Sample Container Preparation

- Sample container procurement should be arranged with the various analytical laboratories several weeks prior to the event.
- Upon receipt of the cleaned sample bottles from the laboratories, bottles should be inventoried. Powder-free nitrile gloves should be worn whenever handling clean bottles.
- Containers shall be placed in clean coolers for transport to the field.
- Field equipment that must be cleaned and provided by the analytical laboratory should be ordered several weeks prior to the event.
- Verify that all equipment on order is being shipped to the site.

2.3 Pre-Sampling Procedures

Several steps are required before sampling. These steps ensure that instruments are functioning and properly and that the necessary equipment has been supplied for efficient and accurate sampling.

2.3.1 Inventory

Verify that the correct equipment has been received by the field site and that it is clean (decontaminated). Inventory sample containers to verify that the laboratory has provided the correct number of containers of the proper size and containing the correct preservative if required.

To the extent possible, pre-label/tag and bundle sample containers for each location to avoid confusion during sample collection.

Verify that the appropriate PPE and ancillary supplies (e.g., paper towels, decontamination solution) have been received by the field site. The appropriate protective equipment, as specified in the HASP, will be reviewed during a morning tailgate meeting. Contact the field manager or project manager immediately if there are discrepancies.

2.3.2 Mobilization

When appropriate, all sediment samples collected in flowing water bodies shall be collected first from the furthest point downcurrent. The remaining samples will be collected while proceeding upcurrent. This will minimize the potential for spurious observations and results due to disturbed upcurrent substrate from prior, upcurrent samples. Furthermore, marine vessels should be operated with care near to avoid disturbing surficial sediments.

The following steps comprise the mobilization procedure:

- Assemble field equipment.
- Don appropriate PPE, including hard hats and personal flotation devices on marine vessels.
- Carefully maneuver the marine vessel to the sample station.

Evaluate the area around the sampling location for safety concerns, hazards, adequate lighting conditions, and accessibility. Use workplace lighting as needed.

- Note any irregularities at the sampling location in the field form, including modifications to sample locations or depths stemming from a dynamic field investigation based upon field observations.

2.4 Sampling Procedures

The following procedures will be employed to collect subsurface soil samples:

1. Identify sample locations from the Work Plan based on pre-surveyed stake-out as per SOP A.21 and note the locations in field notebook by obtaining ties to physical features.
2. Don the appropriate personal protective equipment as specified in the HASP.
3. If sampling from a vessel in a waterway, the vessel operator will maneuver the vessel over the approximate core position as per SOP A.21, and the water depth will be determined. The vessel shall be appropriately anchored by lowering spuds or similar devices.
4. Assemble the dual probe (outer steel casing and inner Lexan[®] tube) sampling apparatus or similar direct push tool such as a macro-core MC5 soil sampler.
5. Drive the sampling tools to the appropriate sampling zone. If sufficient resistance is encountered to hinder direct push advancement, sonic techniques may be applied using a split steel casing and inner Lexan[®] tube.

6. When the desired depth for the collection of a subsurface soil sample is reached, retrieve the inner Lexan[®] tube and segregate the soil sample, as needed. If an alternative direct push tool is used, push to the appropriate depth and sample following the equipment operation instructions.
7. Record the soil type, color, odor, amount of recovery, in the appropriate field forms or field notebook per SOP A.3 and subsample the soil for analysis using the FID or PID.
8. Sample soils for laboratory analysis per requirements of the QAPP and Field Sampling Plan.
9. Evaluate the field screening tools or sample for the presence of visible NAPL and determine whether deeper drilling is appropriate at the current location. Document samples interpreted to contain visible NAPL with video and/or photograph, and record observations in field notebook.
10. Upon completion of the soil boring, grout the boring to ground surface unless the Field Sampling Plan calls for installation of a piezometer in the boring. In a marine environment a marine acceptable cement grout should be installed via a tremmie method.
11. Record all other appropriate information in the field notebook.
12. Identify the next sequential boring location, move to that location and return to step 2.

2.4.1 Modified Core Collection Procedure with the use of Sonic in the Soft Sediment as Required

A modified direct push method may be used by a sonic coring device for sampling both coarse, consolidated sediment and fine-grained, cohesive sediment up to depths of several feet. A summary of the procedures is provided here:

1. A marine vessel equipped with a sonic rig is maneuvered over the approximate sample location by the vessel operator. Cores co-located with other samples will be offset by a few feet. Positioning of the barge mounted drilling rig for each drilling location will be sited with a GPS device per SOP A.21. The vessel will be secured with spuds.
2. The surface water depth at the sample location above the sediment layer will be measured with a weighted tape measured and recorded.
3. Depth ranges necessary for core collection will be confirmed.
4. For each 5-foot-long core, a clean 5-foot-long, 4-inch diameter Lexan liner will be installed in the sonic split core barrel. Care will be taken so that there are no kinks or folds in the liner. A Shelby tube may also be used for the NAPL migration assessment cores depending on the requirements of the laboratory. Note that the length of sediment core collected will depend upon the field screening tools readings and may be greater than the estimated 10 feet.
5. Core collection will begin from the sediment surface and continue to the core collection depth range of interest. Drill rod(s) will be added to the drill string in order to advance the core barrel beyond the casing as necessary. The core barrel will be advanced and

then override casing will be advanced to the same depth as the core barrel to case the borehole.

6. Two 5-foot sediment cores will be collected by slowly advancing (without use of sonic technology to the extent practicable) the core barrel. Advancement should be gradual, on the order of several cm per second. If refusal is encountered above the depth of sampling, the sonic technology will be used on as low vibration as practicable to penetrate the refusal zone and advance the barrel.
7. Pull the core barrel upward from the surrounding sediment without the aid of sonic technology if practicable.
8. Maintain the sample in a vertical (upright) position, if possible, during subsequent handling to the extent practicable.
9. Record core penetration depth.
10. Remove the overlying water by (1) slowly pouring it out to minimize loss of the shallowest sediments, or (2) slowly siphoning it off. Ensure that the siphon does not contact the sediments during the water removal process. Small, dedicated plastic cups may be used if preferred.
11. After the overlying water is removed, characterize the core as per Section 2.4.2 or 2.4.3 as applicable.
12. The borehole will be grouted using a marine acceptable cement grout installed via tremmie method.
13. Decontaminate sampling equipment according to SOP A.18 before moving to the next sampling location.

2.4.2 Modified Core Processing Procedure for Measurement of NAPL Mobility Characteristics with the use of Sonic in the Soft Sediment as Required

Core processing procedures for sediment cores collected for NAPL mobility assessment are as follows:

1. Once the sediment core is retrieved as per section 2.4.1, the Lexan liner will be cleaned on the outside to potentially observe the distribution of NAPL.
2. Document sediment characteristics with digital photographs to the extent practical. The laboratory will provide a USCS log of the core following sample arrival.
3. Measure the length of sediment contained within the core liner and estimate a percentage recovery.
4. The driller will then cut the core into 30-inch sections by stabilizing the core in a jig and using a reciprocating saw with a fine blade. The cut will be made slowly to ensure parts of the core sample are not lost. If needed, the core may be placed horizontally on a clean sheet of plastic on the deck of the vessel.

5. If the end of a core section has any void space, then it will be filled with plastic wrap and/or Styrofoam to minimize core movement. The core will be sealed with Teflon film and duct tape on plastic end caps.
6. Each 30-inch section will be labeled in indelible ink with the location identification; date and time of collection; top and bottom depths/elevations (fractions of a foot should be recorded in tenths); place an arrow on the section indicating the upward direction; and, label multiple sections from one core sequentially with A, B, C, etc. starting with A on the top (shallowest) section.

2.4.3 Modified Sonic Core Processing Procedure for NAPL Migration Assessment with the use of Sonic in the Soft Sediment as Required

Core processing procedures for sediment cores collected for NAPL migration assessment are as follows:

1. Once the sediment core is retrieved, the Lexan liner or Shelby tube (depending on the laboratory requirements) will be cleaned on the outside to potentially observe the distribution of NAPL and to confirm the target sample collection range within the sediment core.
2. Document sediment characteristics with digital photographs.
3. Measure the length of sediment contained within the core liner and estimate a percentage recovery.
4. Geosyntec personnel will visually confirm the NAPL interval and identify a 30-inch section of the core targeted for NAPL migration assessment. The driller will cut this 30-inch section of undisturbed native sediment core from the larger core by stabilizing the core in a jig and using a reciprocating saw with a fine blade. The cut will be made slowly to ensure parts of the core sample are not lost. If the NAPL interval is not discernable due to the limited visibility through the Lexan liner then a pre-determined depth interval from the co-located CPT/LIF observations will be used.
5. The 30-inch core section will be capped and sealed in the field with plastic wrap and/or Styrofoam, sealed with Teflon film and duct tape on plastic end caps, and labeled with indelible ink with the appropriate sample designation, date, time, the depth range of the sample to the nearest tenth of a foot and an arrow indicating the upward direction of the sample.
6. The 30-inch section will be shipped according to SOP A.22 as appropriate.
7. For the remaining core material, cut the liner and place the core on dedicated plastic sheeting.
8. Geosyntec field personnel will note the soil type, color, odor, amount of recovery, NAPL presence, lithology, screening results of the sediment core for volatile organic compounds (VOCs) by PID/FID, and the depth of refusal ranges of the collected sediment core. Sediment and soil descriptions will be documented according to SOP A.3. Information will be documented in the field logbook and on lithological boring logs per SOP A.17.

Document sediment characteristics with digital photographs.

9. Sediment samples will be collected directly from the Lexan liner near the center of less disturbed material approximately every 1-foot interval for analysis by methods presented in the QAPP.
10. Subsamples for analysis will be removed immediately by placing them directly into laboratory prepared and supplied sample containers without homogenization. Samples will be preserved as specified in the QAPP. Prior to filling, sample jars should be appropriately labeled with indelible, waterproof ink.
11. All subsamples will be immediately placed on wet ice and will remain at 4°C ($\pm 2^\circ\text{C}$) prior to and during shipment to the laboratory.
12. Samples will be shipped as detailed in SOP A.22 as applicable.

2.5 Sample Disposition

Samples will be labeled, maintained in custody, and handled in accordance with SOP A.17. Samples shall be prepared for shipment in accordance with SOP A.22.

2.6 Documentation

Activities conducted as part of this SOP shall be documented in accordance with SOP A.17. Documentation shall include a record of daily conditions and activities, calibration activities, sampling activities, and all other information required to be recorded per SOP A.17.

2.7 Decontamination Procedures

Equipment will be decontaminated between sample locations. Decontamination shall be performed according to SOP A.18. Personnel and PPE decontamination shall be performed in accordance with the HASP.

2.8 Investigative Derived Waste

IDW, including decontamination fluids, used PPE, and other IDWs generated during activities associated with this SOP shall be handled and disposed of according to SOP A.19.

A.5

STANDARD OPERATING PROCEDURE GROUNDWATER SAMPLING OF MONITORING WELLS AND ANALYSIS OF PER - AND POLYFLUOROALKYL SUBSTANCES

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.5
GROUNDWATER SAMPLING OF MONITORING WELLS AND
ANALYSIS OF PER- AND POLYFLUOROALKYL SUBSTANCES**

1. INTRODUCTION

1.1 Purpose and Scope

Standard operating procedures (SOPs) were prepared to guide per- and polyfluoroalkyl substance (PFAS) sampling activities. This SOP describes recommended procedures to be used by field personnel when collecting groundwater samples from monitoring wells. Because PFAS are potentially present in a variety of materials that may come into contact with water samples, and because laboratory analytical method detection limits are low (low to sub nanogram per liter concentrations), conservative precautions are recommended to avoid sample cross-contamination and false positive results. The procedures in this SOP are consistent with best practices at the time of authoring.

1.2 Referenced Documents and SOPs

- SOP A.6 Groundwater and NAPL Level Measurement Procedures
- SOP A.7 Collection of Groundwater Samples
- SOP A.20 Procedure to Calibrate Field Instrument

1.3 Definitions and Acronyms

1.3.1 Definitions

Bladder pump	A positive displacement pump that is acceptable for collection of all analytes and depths. Can be small enough to sample from wells as small as 3/4-inch in diameter.
Dedicated equipment	Equipment that is installed in or used in just one monitoring well for purging and sampling, and that remains in that well for the duration of the monitoring program. Dedicated equipment does not need to be decontaminated between sampling events.
Inertia pump	A riser tube fitted with a one-way foot valve. Best used on small diameter wells (2 inches or less). Can be used if the depth to water is less than approximately 25 feet.
Peristaltic pump	A positive displacement pump that can be used to move fluids at a fixed rate. Peristaltic pumps are typically used if the depth to water is less than approximately 25 feet.

PFAS-free water	Water that has been analyzed by an accredited laboratory (see Section 3.1) and determined to be below the method detection limit (i.e., non-detect) for the suite of PFAS to be analyzed for in environmental samples. Method detection limits (MDLs) used during analysis of PFAS-free water should be at or below the MDLs used for environmental samples.
Potable water	Water that meets state and federal drinking water requirements. Note this water may or may not have detectable PFAS concentrations.
Submersible pump	A positive-pressure pump that is acceptable for collection of all analytes. Achievable depths are limited by the power of the pump and length of wiring. Well must be at least 2 inches in diameter.

1.3.2 Acronyms

ASTM	American Society for Testing and Materials
CoC	chain of custody
DO	dissolved oxygen
DoD	Department of Defense
DOT	Department of Transportation
ETFE	ethylene tetrafluoroethylene
FEP	fluorinated ethylene propylene
HDPE	high-density polyethylene
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LDPE	low-density polyethylene
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
ORP	oxidation-reduction potential
PFAS	per- and polyfluoroalkyl substances
PFTE	polytetrafluoroethylene
PPE	personal protective equipment
PVC	polyvinyl chloride

PVDF	polyvinylidene fluoride
QA	quality assurance
QC	quality control
QSM	quality systems manual
SOP	standard operating procedure
USGS	United States Geological Survey

Equipment and Products

Sections 1.3.1 and 1.3.2 detail items that are safe to use versus not recommended for use on the job site to protect PFAS samples from potential cross-contamination. Science-based evidence is not currently available to support a determination of the realistic impact of these commonly used field items and materials on PFAS samples. In the absence of scientific-based sampling guidance, field staff, contractors, and analytical laboratories should try to avoid using items that may pose a risk for cross-contamination and false positive results and instead use acceptable alternatives identified in this section. If the field team needs to use products and equipment on site that are not recommended, additional quality assurance/quality control (QA/QC) samples may be collected to evaluate any potential impact on PFAS environmental samples. This information is also provided in an abbreviated format as a checklist for field staff to reference (Attachment A).

1.3.3 Field Equipment

Items that are **safe to use** on site when sampling for PFAS include the following:

- Sampling containers, screw caps and other equipment made from high-density polyethylene (HDPE)¹, polypropylene, silicone, acetate, or stainless steel;
- Sample preservatives (e.g., Trizma®);
- QA/QC samples (e.g., temperature and field blanks);
- Sample container labels;
- Low-density polyethylene (LDPE)² materials not in direct contact with the sample (e.g., Ziploc® bags);
- Materials made of HDPE, silicone, acetate, or stainless steel;
- Masonite or aluminum clipboards;
- Ballpoint pens;
- Sampling forms, loose paper or field notebooks, chain of custody (CoC) record, and sample container labels;

¹ HDPE plastics are commonly identified by a recycling symbol with a number 2 inside it.

² LDPE plastics are commonly identified by a recycling symbol with a number 4 inside it.

- Alconox®, Liquinox® and Luminox® detergents (Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment used for collection of media to be submitted for analysis of 1,4-dioxane);
- Paper towels;
- Trash bags;
- HDPE sheeting;
- Hard-shell coolers;
- Shipping and handling labels;
- Regular (wet) ice;
- Bubble wrap;
- Duct tape and packing tape;
- Large (e.g., 55-gallon) containers;
- Submersible pumps, bladder pumps, peristaltic pumps, and inertia pumps that do not have Teflon components;
- Dedicated Silicon and/or HDPE tubing;
- Analytical field meter (e.g., temperature, pH, conductivity, oxidation-reduction potential [ORP], dissolved oxygen [DO], and turbidity); and
- Water level probe(s).

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Glass sample containers, due to PFAS adherence to glass surfaces;
- Water-resistant paper, notebooks, and labels (e.g., certain Rite in the Rain® products), due to use of PFAS in water-resistant inks and coatings;
- Sticky notes (e.g., certain Post-It® products), due to potential use of a paper coating product Zonyl™ or similar fluorotelomer compounds;
- Plastic clipboards, binders, and spiral hardcover notebooks;
- Pens with water-resistant ink;
- Felt pens and markers (e.g., certain Sharpie® products) – some PFAS SOPs (e.g., Michigan) specifically allow Fine or Ultra-Fine Point Sharpies® and TestAmerica Laboratories, Inc. routinely uses Sharpies® in the laboratory following unpublished analytical tests that reportedly showed no impact on PFAS sample results;
- Aluminum foil, as PFAS are sometimes used as a protective layer;
- Decon 90™ liquid detergent, which reportedly contain fluorosurfactants;

- Chemical (e.g., blue) ice packs, unless it is contained in a sealed bag. Blue ice has the potential to be contaminated from previous field sampling events;
- Materials containing polytetrafluoroethylene (PTFE) including Teflon[™] and Hostaflon[®] (e.g., tubing, tape, plumbing paste, O-rings);
- Equipment with Viton[™] components (i.e., fluoroelastomers);
- Stain- or water-resistant materials, as these are typically fluoropolymer-based;
- Material containing LDPE, particularly if used in direct contact with the sample (e.g., LDPE tubing, as PFAS can sorb to the porous tubing); and
- Material containing “fluoro” in the name – this includes, but is not limited to, fluorinated ethylene propylene (FEP), ethylene tetrafluoroethylene (ETFE), and polyvinylidene fluoride (PVDF).

1.3.4 Clothing, Personal Protective Equipment (PPE), and Consumer Products

Items that are **safe to use** on site when sampling for PFAS include the following:

- Boots made of polyurethane, polyvinyl chloride (PVC), rubber, or untreated leather;
- Other field boots covered by PFAS-free (e.g., polypropylene) over-boots;
- Rain gear made of neoprene, polyurethane, PVC, wax-coated, vinyl, or rubber;
- Clothing made of synthetic (e.g., polyester) or natural (e.g., cotton) fibers;
- Safety glasses;
- Reflective safety vests;
- Hardhats;
- Disposable powder-free nitrile gloves;
- Uncoated HDPE suits (e.g., certain Tyvek[®] products);
- Bottled water and hydration drinks; and

- Sunscreens³ and insect repellants⁴ that have been tested and found to be PFAS-free.

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Water- or stain-resistant boots and clothing (e.g., products containing GORE-TEX®);
- Clothing recently laundered with a fabric softener;
- Coated HDPE suits (e.g., certain Tyvek® products);
- Sunscreen and insect repellants containing fluorinated compounds as ingredients, such as polyfluoroalkyl phosphate esters;
- Latex gloves;
- Cosmetics, moisturizers, hand cream, and other related products;
- Food wrappers and packaging; and
- Food and drinks other than bottled water or hydration drinks.

Field staff should try to find acceptable alternatives to these items that still allow them to complete the field work safely and efficiently. For example, wearing long-sleeved clothing and a hard hat or sun hat may eliminate the need to use sunscreen in some climates. If an item cannot be easily avoided, additional consideration should be given to QA/QC samples to evaluate the potential impact of sample cross-contamination (e.g., field blanks).

2. FIELD PROCEDURES

2.1 Pre-Mobilization Activities

2.1.1 Health and Safety Plan

Prior to each field event, the site health and safety plan should be reviewed and updated, as necessary. Health and safety plan requirements should be reviewed for consistency with this SOP and modified as appropriate to resolve any differences.

³ Examples of PFAS-free sunscreens include Alba Organics Natural, Aubrey Organics, Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30, Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30, Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30, Banana Boat Sport Performance Sunscreen Stick SPF 50, Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50, Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30, Coppertone Sunscreen Stick Kids SPF 55, Jason Natural Sun Block, Kiss my Face, L'Oréal Silky Sheer Face Lotion 50+, Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50, Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70, Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70, Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30, Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+, Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30, Yes to Cucumbers, and sunscreens for infants. Products with fluorinated compounds as ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling.

⁴ Examples of PFAS-free insect repellent include Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellent, Herbal Armor, California Baby Natural Bug Spray, BabyGanics, OFF! Deep Woods® spray for clothing and skin, Sawyer® do-it-yourself permethrin treatment for clothing, Insect Shield Insect® pretreated clothing, DEET products, and sunscreen/insect repellent combination product Avon Skin so Soft Bug Guard-SPF 30. Products with fluorinated compounds in their ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling.

2.1.2 Laboratory Coordination

Field personnel should communicate with the laboratory that will conduct PFAS analysis regarding the following items:

- Laboratory accreditation for PFAS analysis (see Section 3.1);
- Appropriate sample containers, labels, and preservatives (see Sections 2.2.3 and 2.2.4);
- Sample storage conditions and holding time (see Section 2.2.5); and
- The number and type of QA/QC samples (see Section 2.3).

Because there is no standard United States Environmental Protection Agency method for analyzing PFAS samples in media other than drinking water, commercial laboratories typically offer analysis for a suite of approximately 24 PFAS using a modified version of Method 537 or recently published Method 537.1. Laboratories may have developed their own variations. Project staff may consider the impact of differences in reported PFAS concentrations and the potential value of collecting and sending a split sample to a second commercial laboratory to assess variability in reported PFAS concentrations.

2.1.3 Equipment Decontamination

Equipment should be decontaminated prior to mobilization to the site if it appears to be contaminated or if there is reason to believe that it is contaminated. Equipment decontamination should follow the steps outlined in Section 2.4.

2.2 Sampling

2.2.1 Pre-Sampling Activities

Prior to the sampling event, field staff can review information from previous groundwater monitoring events to inform their knowledge of well locations, field equipment, and field conditions. Field staff should also identify upgradient wells and downgradient wells relative to potential source area wells. Wells with the lowest anticipated PFAS concentrations should be sampled first.

At the beginning of each sampling day, field staff should prepare for sampling as follows:

1. Inspect field equipment to ensure that it is in good working order; and
2. Calibrate analytical field meter(s) according to the instrument manufacturers' specifications. Record calibration results on the appropriate form(s). Instruments that cannot be calibrated should not be used.

2.2.2 Sampling PPE

Gloves: Disposable powder-free nitrile gloves should be worn at all times during sample collection and handling of sampling equipment.

At a minimum, field personnel should put on a new pair of nitrile gloves after the following activities:

- Handling samples, including QA/QC samples and blanks;

- Handling sampling equipment; and
- Between each sampling location.

At a minimum, personnel should (1) thoroughly wash their hands with detergent (preferably Alconox[®] or Luminox[®]) and PFAS-free water. Liquinox[®] is also acceptable for PFAS sampling but shall not be used for decontamination while collecting media to be submitted for analysis of 1,4-dioxane); (2) thoroughly dry their hands with paper towels; and (3) put on a new pair of nitrile gloves after the following activities:

- Contact with a material potentially containing PFAS;
- Change in sampling locations;
- Breaks in work;
- Washroom breaks; and
- Exit and entry into the project site exclusion zone.

2.2.3 Sampling Equipment

Sample Containers: HDPE containers with screw caps are commonly used for sample collection. Different laboratories may supply sample containers of varying sizes. Sample container caps are typically unlined.

Preservatives: Field personnel should communicate with the laboratory to determine what, if any, sample preservatives will be used. Preservatives may include Trizma[®] or sodium thiosulfate to remove residual chlorine from chlorinated drinking water samples.

Pumps: A variety of pumps, including submersible pumps, bladder pumps, peristaltic pumps, or inertia pumps, may be used for groundwater sampling. The choice of sampling device should be based on site-specific considerations, including well diameter, depth to groundwater, and purge rates. Regardless of the type of pump, the pump components, fittings, O-rings, sampling tubing, and other sampling equipment should not include Teflon[™] or other PFAS-containing materials. Dedicated HDPE or silicon tubing is recommended for sampling each groundwater monitoring well.

Analytical Field Meter(s): Water quality parameters commonly evaluated during sampling of groundwater monitoring wells include temperature, pH, conductivity, ORP, DO, and turbidity. Analytical field meters to measure these parameters should be free of Teflon[™] and other PFAS materials (e.g., tubing, O-rings).

Water Level Meter: A water level meter is typically used to monitor drawdown during groundwater purging prior to sampling. Water level meters should be decontaminated prior to and after each sampling location using PFAS-free water, as described in Section 2.4.

2.2.4 Sample Collection and Labeling

Container Rinsing: Sample containers should not to be rinsed prior to sampling.

Well Purging and Sample Collection: If known, wells with the lowest PFAS concentrations should be sampled first and wells with the highest PFAS concentrations sampled last. Well purging

and sample collection should be conducted in accordance with SOPs A.6, A.7, A.8, and A.20. The following sampling method should be used:

1. Measure and record the static groundwater level using a groundwater elevation probe;
2. Place the pump or bottom of the dedicated tubing into the well within the screened interval;
3. Secure the outlet of the tubing from the well to the influent of the analytical field meter;
4. Start the pump;
5. Adjust the purge rate to minimize and stabilize drawdown, as measured by the water level probe;
6. Once drawdown is stable, start recording water quality parameters;
7. Routinely measure and record water level, temperature, pH, conductivity, ORP, DO, and turbidity throughout well purging at approximately 2- to 3-minute intervals. Record the parameters on a Groundwater Sampling Form;
8. Continue to measure and record the groundwater parameters until the parameters stabilize in accordance with SOPs A.6, A.7, A.8, and A.20;
9. Disconnect the tubing from the analytical field meter;
10. Remove the cap from the sample container;
11. Place the sample container under the water stream. Fill the container to the level specified by the laboratory (samples do not need to be collected headspace free) and then turn off the pump;
12. Close the container by screwing on the cap;
13. Using a paper towel, dry the outside of the sample container if necessary; and
14. Decontaminate reusable equipment prior to proceeding to the next groundwater monitoring well location, as described in Section 2.4.

Labels: Some water-resistant inks may be potential sources of PFAS. PFAS-free container labels should be filled out using a ballpoint pen that does not have water-resistant ink, if possible. Field staff should try to avoid filling out container labels using felt pens and markers (e.g., certain Sharpie® products). Container labels should include the following information:

- A unique sample identifier;
- QA/QC sample type, if applicable;
- Sampling date and time (24-hour format);
- Sampler's name or initials; and
- Method of sample preservation.

Except for temperature blanks, all QC samples should be labeled and included on the CoC record. Duplicate samples should not be indicated as duplicates.

Wet Weather Considerations: Field sampling during wet weather (e.g., rainfall and snowfall) should be conducted wearing appropriate clothing that does not pose a risk for cross contamination. Field personnel should try to avoid water-resistant clothing and boots. Rain gear made of polyurethane, PVC, vinyl, or rubber is an acceptable alternative. Samples and sample containers should not be opened prior to sample collection to avoid collecting precipitation. Should samples or sample containers become contaminated with precipitation, they should be discarded.

2.2.5 Sample Handling, Storage, and Shipment

Handling: Clean nitrile gloves should be worn when handling sample containers. Precautions should be taken to not drop or otherwise damage sample containers. Sample containers should **not** be placed in close proximity to a potential PFAS source.

Storage and Holding Times: Storage conditions and holding times should be determined by the laboratory. Measures should be taken to meet storage and holding time criteria (e.g., expedited shipping).

Shipment: Sample containers should be packed for shipment using the following steps:

1. Choose a cooler with structural integrity that will withstand shipment.
2. Secure and tape the drain plug with duct tape from the inside and outside.
3. Fill cooler at least one-third full with wet ice (try to avoid using chemical blue ice) double-bagged in sealed bags. Taping the ends of bags with duct tape will aid in waterproofing.
4. Check that the caps on all sample containers are tight and will not leak.
5. Check that the sample labels are intact, filled out, legible, and that the sample identifier exactly matches the CoC record.
6. Seal each sample container in a sample bag to prevent melt water from getting into the sample or degrading the sample label.
7. Place sample containers into the cooler with their caps upright.
8. Fill excess space within the cooler with bubble wrap (try to avoid using paper, cardboard, or polystyrene foam).
9. Seal the entire cooler with duct tape, particularly the lid, to prevent leaks.

Ship samples as non-hazardous material unless the samples meet the established Department of Transportation (DOT) criteria for a “hazardous material” or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) for air definition of “dangerous goods.” If the samples meet criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed. Prior to shipping samples, field personnel should complete the appropriate air waybill or manifest. A copy of the air waybill or manifest should be kept for recordkeeping.

2.3 Sampling QA/QC

2.3.1 Field Duplicates

Field duplicates are samples collected in the same manner and at the same time and location as a primary sample. They should be collected from locations of known or suspected contamination. Field duplicates are used to assess field and analytical precision and sample heterogeneity. Typically, at least one field duplicate is collected for every 10 primary samples. Field duplicates should be labeled with a unique sample identifier and not be indicated as a duplicate (i.e., submitted as “blind”).

2.3.2 Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike and matrix spike duplicate (MS/MSD) samples are aliquots of environmental samples that are spiked with a known concentration of PFAS by the laboratory. MS/MSD samples are used to assess interferences caused by the sample matrix. MS/MSD samples are not needed if the analytical laboratory is using an isotopic dilution method but are technically required to meet Department of Defense (DoD) accreditation requirements, if this accreditation is required by the project. If necessary, MS/MSD samples are to be collected in the same manner and at the same time and location as a primary sample (i.e., additional sample volume). It is preferred that this location have little to no PFAS contamination. Samples should have the same matrix to ensure a valid result; if the samples do not appear visually similar (e.g., discoloration, suspended solids), choose another location for collection of MS/MSD samples. The number of required MS/MSD samples should be determined based on discussions with the laboratory. Typically, at least one MS/MSD sample is collected for every 20 primary samples. MS/MSD samples should be labeled with the same sample name and time as the primary sample and denoted as MS/MSD samples on the CoC and sample label.

2.3.3 Blanks

Blanks should be shipped and handled in the same manner as environmental samples. Field blanks should be labeled as such on sample bottles and on the CoC. The number and type of blanks should be determined by discussions with the laboratory.

Equipment Blanks: Equipment blanks are used to assess sources of field and laboratory contamination. Equipment blanks are prepared by pouring PFAS-free water over or through decontaminated reusable field sampling equipment and collecting the rinsate in a sample container. Typically, at least one equipment blank is collected for every 10 primary samples.

Field Blanks: Field blanks are used to assess ambient contamination within the field and laboratory. Field blanks should be prepared by filling a sample container with PFAS-free water in the field in the same manner as environmental samples. Field blanks are an effective way of assessing potential cross-contamination as a result of sample handling. Typically, one field blank is collected for each shipping container.

Temperature Blanks: Temperature blanks are used to assess the temperature of samples during shipping. Temperature blanks should be provided by the laboratory and prepared by filling a sample container with PFAS-free water prior to shipment of the sample containers. The blank should be kept in the cooler during sampling and shipment to the laboratory. Once the cooler

returns to the laboratory, the temperature of the blank should be measured to ensure that recommended sample storage criteria are met (typically less than 6 degrees Celsius).

2.4 Decontamination

Decontamination should occur prior to leaving the sampling area or at a central decontamination location and at the end of each work day. Additionally, sampling equipment exposed to PFAS contaminated water should be decontaminated between sample locations.

Alconox[®] and Luminox [®] detergents are acceptable for decontamination purposes. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment used for collection of media to be submitted for analysis of 1,4-dioxane. Use of Decon 90 should be avoided. Decontamination wastes must be properly contained and disposed of in accordance with applicable local, state and federal regulations.

2.4.1 Field Equipment Decontamination

All non-disposable sampling equipment that is in contact with groundwater (e.g., field probes) must be cleaned prior to and between uses at each groundwater sampling location according to the following procedures:

1. Remove any gross (e.g., soil) contamination from sampling equipment.
2. If heavy petroleum residuals are encountered during sampling, use methanol or another appropriate solvent to remove any residues from sampling equipment.
3. Wash water-resistant equipment thoroughly and vigorously with potable water containing detergent (Alconox[®] or Luminox[®]) using a bristle brush or similar utensil to remove any remaining residual contamination. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment used for collection of media to be submitted for analysis of 1,4-dioxane.
4. Rinse equipment thoroughly with potable water (1st rinse).
5. Rinse equipment thoroughly with PFAS-free water (2nd rinse).
6. For field instruments, rinse again with PFAS-free water (3rd rinse).
7. Dry wet equipment with a paper towel or leave the equipment to air dry in a location away from dust or fugitive contaminants. All equipment should be dry before reuse.

Cleaning and decontamination of the equipment should be accomplished in stages and in such a way that the contamination does not discharge into the environment. Dedicated or disposable sampling equipment should be considered to minimize the need for decontamination.

2.4.2 Personnel and PPE Decontamination

A decontamination area for personnel and portable equipment may be specified in the health and safety plan. The area may include basins or tubs to capture decontamination wastes, which can be transferred to larger containers as necessary. Decontamination following groundwater monitoring well sampling should follow these steps:

1. Gross (e.g., soil) contamination should be scraped and wiped from boots, safety glasses, hardhats, reflective vests, and other reusable PPE. Once gross contamination has been removed, gloves should be removed by rolling off the hands in such a way to avoid exposing skin to PFAS-contaminated materials.
2. A new pair of gloves should be put on and reusable PPE should be decontaminated using PFAS-free water mixed with detergent (preferably Alconox[®] or Luminol[®]) and brushes, or similar means. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. After debris is removed, reusable PPE should be rinsed with PFAS-free water.
3. Hands and any exposed body parts should be washed thoroughly using detergent (preferably Alconox[®] or Luminol[®]) and PFAS-free water. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. Hands should be dried with paper towels.

2.5 Food and Drink

Food and drink should not be brought within the exclusion zone. Food that is kept in the staging area should preferably be contained in HDPE or stainless-steel containers.

3. LABORATORY PROCEDURES

3.1 Accreditations

All samples will be analyzed by an analytical method included in the most current DEC Analytical Services Protocol (ASP) at a laboratory that is accredited pursuant to the NYSDOH Environmental Laboratory Accreditation Program (ELAP) for the category of parameters analyzed. There is not currently an ELAP certification program for the analysis of PFAS compounds other than those in drinking water. Consistent with NYSDEC policy (NYSDEC 2018), the samples for PFAS compounds will be performed using a modified USEPA Method 573 approach at a laboratory that has ELAP certification for PFOA and PFOS in drinking water.

4. DOCUMENTATION

4.1 Chain of Custody

4.1.1 Field Custody Procedures

A sample is considered to be in custody if the following conditions have been observed:

- It is in possession or view of the person in custody;
- It is locked in a secure area;
- It is placed in an area restricted to authorized personnel; or
- It is placed in a container and secured with an official seal, so that the sample cannot be reached without breaking the seal.

The following practices should be observed by field personnel to ensure sample custody:

- As few persons as possible will handle samples;

- The sample collector is personally responsible for the care and custody of samples collected until they are transferred to the laboratory;
- The sample collector will record sample data in the field notebook; and
- Sample labels will be completed for each sample.

4.1.2 Chain of Custody Record

All samples should be accompanied by a CoC record. The CoC record is typically provided by the laboratory. The CoC record should be fully completed in duplicate (e.g., a carbon copy). At the minimum, the following information should be included on a CoC record:

- Project name and number;
- Laboratory name and address;
- Name of person that collected the samples;
- Sample identifier;
- Sample date and time (time in 24-hour format);
- Laboratory analysis requested;
- Preservatives added to each sample;
- Sample matrix (e.g., soil, water);
- Number of containers per sample; and
- Airway bill tracking number.

As applicable, the following remarks should be added to the CoC record:

- Contractor name and address;
- MS/MSD sample volume (if necessary);
- A request for rapid turnaround time; and
- A note regarding the potential concentrations in a highly-contaminated sample.

Indication of a duplicate sample should **not** be included on a CoC record.

4.1.3 Sample Packaging

The CoC record should accompany all sample shipments. One CoC record should be prepared for each cooler and the cooler number recorded on the CoC. The samples in the cooler should be listed on the CoC record. The CoC record should be placed in a sealed plastic bag (e.g., Ziploc[®]) and taped to the inside lid of the cooler. If one sample is contained in two coolers (i.e., one sample has too many containers to fit in one cooler), then the original CoC should be placed in the first cooler and a copy of the CoC record should be placed in the second cooler. The duplicate copy of the CoC record should be retained by the sampler.

Custody seals should be signed and dated at the time of use. Sample shipping containers should be sealed in as many places as necessary to ensure that the container cannot be opened without breaking a custody seal. Tape should be placed over the seals to ensure that seals are not accidentally broken during shipment. If the sampler transports the samples to the laboratory without sample shipment, custody seals are not required.

4.1.4 Transfer of Custody

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler should sign, date, and note the time as “relinquished by” on the CoC record. The receiver should also sign, date, and note the time as “received by” on the CoC record. The date and time of the receiver and relinquisher should be the same.

When samples are transported by a commercial carrier, the carrier will not sign the CoC record. However, the airway bill tracking number should be recorded on the CoC record. Airway bills should also be retained with the CoC record as documentation of transport. For this reason, the date and time of the receiver and relinquisher will not match when shipping with a commercial carrier.

4.1.5 Laboratory Custody Procedures

A designated sample custodian should accept custody of the shipped samples and verify that the sample identification number matches the CoC record. Pertinent information about shipment, pickup, and courier should be entered in the “Remarks” section. The temperature of the temperature blanks at the time of receiving should be noted on the CoC record.

5. REFERENCES

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Attachment A. Daily Sampling Checklist

Date: _____

Site Name: _____

Weather (*temperature/precipitation*): _____

Please check all boxes that apply and describe any exceptions in the notes section below along with QA/QC methods used to assess potential sample cross-contamination as a result.

Field Clothing and PPE:

No water- or stain-resistant boots or clothing (e.g., GORE-TEX®)

Field boots (or overboots) are made of polyurethane, PVC, rubber, or untreated leather Rain gear are made of polyurethane, PVC, vinyl, wax-coated or rubber

Clothing has not been recently laundered with a fabric softener

No coated HDPE suits (e.g., coated Tyvek® suits)

Field crew has not used cosmetics, moisturizers, or other related products today

Field crew has not used sunscreen or insect repellants today, other than products approved as PFAS-free

Field Equipment:

Sample containers and equipment in direct contact with the sample are made of HDPE, polypropylene, silicone, acetate or stainless steel, not LDPE or glass

Sample caps are made of HDPE or polypropylene and are not lined with Teflon™

No materials containing Teflon™, Viton™, or fluoropolymers

No materials containing LDPE in direct contact with the sample (e.g., LDPE tubing, Ziploc® bags)

No plastic clipboards, binders, or spiral hard cover notebooks

No waterproof field books

No waterproof or felt pens or markers (e.g., certain Sharpie® products)

No chemical (blue) ice, unless it is contained in a sealed bag

No aluminum foil

No sticky notes (e.g., certain Post-It® products)

Decontamination:

Reusable field equipment (e.g., dip sampler) decontaminated prior to reuse

“PFAS-free” water is on-site for decontamination of field equipment
Alconox®, Liquinox® or Luminox® used as decontamination detergent

Food and Drink:

No food or drink on-site, except within staging area

Food in staging area is contained in HDPE or stainless steel container

Notes:

Field Team Leader Name (Print): _____

Field Team Leader Signature: _____

Date/Time: _____

Collection of Groundwater Samples for Per- and Polyfluoroalkyl Substances (PFAS) from Monitoring Wells Sample Protocol

Samples collected using this protocol are intended to be analyzed for perfluorooctanoic acid (PFOA) and other perfluorinated compounds by Modified (Low Level) Test Method 537.

The sampling procedure used must be consistent with the NYSDEC March 1991 Sampling Guidelines and Protocols http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf with the following materials limitations.

At this time acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE) and polypropylene. Additional materials may be acceptable if proven not to contain PFAS. **NOTE: Grunfos pumps and some bladder pumps are known to contain PFAS materials (e.g. Teflon™ washers for Grunfos pumps and LDPE bladders for bladder pumps).** All sampling equipment components and sample containers should not come in contact with aluminum foil, low density polyethylene (LDPE), glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. Standard two step decontamination using detergent and clean water rinse will be performed for equipment that does come in contact with PFAS materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials must be avoided. Many food and drink packaging materials and “plumbers thread seal tape” contain PFAS.

All clothing worn by sampling personnel must have been laundered multiple times. The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill two pre-cleaned 250 mL HDPE or polypropylene bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at $4 \pm 2^\circ$ Celsius.

Collect one equipment blank for every sample batch, not to exceed 20 samples.

Collect one field duplicate for every sample batch, not to exceed 20 samples.

Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples.

Request appropriate data deliverable (Category A or B) and an electronic data deliverable.

Groundwater Sampling for Emerging Contaminants

July 2018

Issue: NYSDEC has committed to analyzing representative groundwater samples at remediation sites for emerging contaminants (1,4-dioxane and PFAS) as described in the below guidance.

Implementation

NYSDEC project managers will be contacting site owners to schedule sampling for these chemicals. Only groundwater sampling is required. The number of samples required will be similar to the number of samples where “full TAL/TCL sampling” would typically be required in a remedial investigation. If sampling is not feasible (e.g., the site no longer has any monitoring wells in place), sampling may be waived on a site-specific basis after first considering potential sources of these chemicals and whether there are water supplies nearby.

Upon a new site being brought into any program (i.e., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of groundwater as part of the standard “full TAL/TCL” sampling. Until an SCO is established for PFAS, soil samples do not need to be analyzed for PFAS unless groundwater contamination is detected. Separate guidance will be developed to address sites where emerging contaminants are found in the groundwater. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane, which already has an established SCO.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by an independent 3rd party data validator. QA/QC samples should be collected as required in DER10, Section 2.3(c). The electronic data submission should meet the requirements provided at: <https://www.dec.ny.gov/chemical/62440.html>

The work plan should explicitly describe analysis and reporting requirements.

PFAS sample analysis: Currently, ELAP does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (ex. soil, sediments, and groundwater) are required, by DER, to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537 or ISO 25101.

Modified EPA Method 537 is the preferred method to use for groundwater samples due to the ability to achieve 2 ng/L (ppt) reporting limits. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve similar reporting limits, the project manager should discuss this with a DER chemist. Note: Reporting limits for PFOA and PFOS should not exceed 2 ng/L.

PFAS sample reporting: DER has developed a PFAS target analyte list (below) with the intent of achieving reporting consistency between labs for commonly reportable analytes. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. This list may be updated in the future as new information is learned and as labs develop new capabilities. If lab and/or matrix specific issues are encountered for any particular compounds, the NYSDEC project manager will make case-by-case decisions as to whether particular analytes may be temporarily or

permanently discontinued from analysis for each site. Any technical lab issues should be brought to the attention of a NYSDEC chemist.

Some sampling using this full PFAS target analyte list is needed to understand the nature of contamination. It may also be critical to differentiate PFAS compounds associated with a site from other sources of these chemicals. Like routine refinements to parameter lists based on investigative findings, the full PFAS target analyte list may not be needed for all sampling intended to define the extent of contamination. Project managers may approve a shorter analyte list (e.g., just the UCMR3 list) for some reporting on a case by case basis.

1,4-Dioxane Analysis and Reporting: The method detection limit (MDL) for 1,4-dioxane should be no higher than 0.35 µg/l (ppb). Although ELAP offers certification for both EPA Method 8260 SIM and EPA Method 8270 SIM, DER is advising the use of method 8270 SIM. EPA Method 8270 SIM provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents.

Full PFAS Target Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctanesulfonamides	Perfluorooctanesulfonamide	FOSA	754-91-6
Perfluorooctanesulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Bold entries depict the 6 original UCMR3 chemicals

A.6

STANDARD OPERATING PROCEDURE
WATER AND NAPL LEVEL MEASUREMENT
PROCEDURES

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.6
WATER AND NAPL LEVEL MEASUREMENT PROCEDURES**

1. INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for conducting water level measurements and assessing non-aqueous phase liquid (NAPL) presence and quantity in monitoring wells during field investigations at hazardous and non-hazardous waste sites.

1.1 Objective

The objective of water level measurements is to gain accurate measurements (to within 0.01 ft) of the depth of ground water for use during well installation, in the recording of data for the preparation of ground water elevation contour maps, purge volume calculations during ground water sampling, slug tests, packer tests, and pump tests. Additionally, the objective of measuring the water/oil interface is to confirm NAPL presence and estimate the quantity of NAPL present.

1.2 Reference Documents and SOPs

- SOP A.18 Decontamination Procedure for Sampling Equipment.

1.3 Equipment

The following list of equipment may be utilized during water level measurements. Site-specific conditions may warrant the use of additional or deletion of items from this list.

- electronic water level indicator or oil/water interface meter (graduated);
- tap Water;
- Alconox, liquinox or other non-phosphate concentrated laboratory grade soap
Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment when collecting media to be submitted for analysis of 1,4-dioxane;
- deionized water;
- pump sprayer;
- pint squeeze bottles;
- any necessary personal protective equipment (gloves, eyewear, Tyvek suits);
- air monitoring instruments as required (HNU, OVM, etc.);
- field logbook and applicable supplementary field data forms;
- well keys;
- previous measurement data (if available); and

- plunker on tape.

2. PROCEDURES

The following procedures should be followed during water level measurements. Procedures utilized during water level measurements where non-aqueous phase liquids are present should be modified to include the use of the oil/water interface meter. When the objective is to record NAPL depth and/or thickness, an oil/water interface meter should be used. Procedures may vary depending on the equipment used and contaminants present at the site. As such, use of the oil/water interface meter or electronic water level indicator should adhere to the manufacturers' specifications. Site specific conditions may warrant the use of stringent air monitoring and potentially more significant decontamination scenarios.

1. Record the condition of the well (protective casing, concrete collar, lock in place etc.).
2. Check that the water level tape has no obvious kinks or damage.
3. Put on latex or other sterile gloves. Stand upwind of the well; unlock and open the well. If a vented cap is present, conduct well mouth air monitoring from the vent. If a nonvented well cap is present, remove the cap and monitor the well mouth immediately. Record all pertinent air monitoring results (sustained, dissipating, background, odor).
4. Identify the previous measuring point marking or notch on the riser or casing (if present). Record this location in the field logbook or on the applicable field form (e.g. water level monitoring form).
5. Using a previously decontaminated electronic oil/water interface meter or water level indicator, turn on the meter, check the audible indicator, reel the electronic probe into the well riser (with the increments visible) slowly until the meter sounds, grasp the tape with hand, withdraw the tape and lower it again slowly until the sound is again audible. Check the depth to water on the tape and make a mental note of the depth to within 0.01 feet. Lower the probe again slowly and repeat the measurement for accuracy. A one-foot error is the most common measurement type during water level measurements. Be sure to read the depth correctly on the tape.
6. Record the depth to water from the measuring point in the field logbook or on the applicable field form (e.g. water level monitoring form).
7. When using an oil/water interface probe to record NAPL depth and/or thickness advance the probe slowly until the audible indicator sound changes. Check the depth to water on the tape and make a mental note of the depth to within 0.01 feet. Lower the probe again slowly and repeat the measurement for accuracy. A one-foot error is the most common measurement type during water level measurements. Be sure to read the depth correctly on the tape.
8. Repeat as necessary.
9. Decontaminate the probe and meter and any obviously soiled tape. Refer to SOP A.18 equipment decontamination.

A.7

STANDARD OPERATING PROCEDURE
COLLECTION OF GROUNDWATER SAMPLES

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.7
COLLECTION OF GROUNDWATER SAMPLES**

1. INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to provide instructions for groundwater sampling using the USEPA low-flow with minimal drawdown well purging protocol and sampling with a bailer when non-aqueous phase liquid (NAPL) is present.

1.1 Objective

The objective of groundwater sampling is to obtain a representative sample of groundwater for laboratory analysis of contaminants of concern at a given site. This objective requires that the sample be both free of unsuitable material and be of sufficient quantity and quality for analysis by the selected analytical method.

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP)
- Quality Assurance Project Plan (QAPP)
- SOP A.6 Water Level Measurement Procedure
- SOP A.8 Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures
- SOP A.17 Field Documentation, Sample Designation, Custody and Handling
- SOP A.18 Decontamination Procedure for Sampling Equipment
- SOP A.19 Management and Disposal of Investigative Derived Waste
- SOP A.20 Procedure to Calibrate Field Instrument
- SOP A.21 Recording Sample Location with a GPS
- SOP A.22 Procedure to Prepare Samples for Shipment

1.3 Equipment

1.3.1 Documentation

- field log forms and applicable supplementary field data forms;
- writing tools (pencils, Sharpie[®], etc.);
- bottle labels;
- equipment manuals;
- analysis and sample bottle summary;
- digital camera;

- water proof field log book; and
- mapping-grade GPS, as described in SOP A.21, for recording sample locations or navigating to pre-determined locations.

1.3.2 Storm Gear

- rain gear (i.e., boots, ponchos); and
- flashlights (preferably head flashlight) or work-place lights.

1.3.3 Task-Specific Equipment

- boots, waders, and other personal protective equipment (PPE) as required by HASP;
- gloves: clean, non-talc nitrile;
- water level tape;
- water quality Sondes (YSI 6-series) with flow-through cell and probes for measuring field parameters;
- spare batteries for equipment;
- interface meter;
- instrumentation and calibration solutions for field probes;
- decontamination equipment (see SOP A.18);
- laboratory-supplied reagent grade water for blank samples (note that different analytical groups may require water prepared and certified by the laboratory to different standards from other analytical groups [i.e., reagent water supplied for trace metals analysis blanks will need to be certified to lower levels of metals than that for regular metals analysis]);
- sample containers and preservatives (see QAPP);
- 0.45-µm, high-capacity water sample filters;
- Teflon-lined tubing, connections, and tools, as appropriate; sufficient tubing to dedicate to each well;
- graduated cylinder or 1-liter bottle and stopwatch;
- 5-gallon bucket and funnel for purge water;
- sorbent pads;
- cable ties;
- hand tools (Allen wrench set, hammer, screwdrivers, pliers, knife, wire strippers, measuring tape);
- paper towels;

- Zip-lock bags;
- trash bags (one for IDW and one for general trash);
- clean plastic sheeting;
- marine vessel;
- wooden stakes and highly visible spray paint;
- peristaltic, bladder, submersible, or Waterra pump capable of a flow rate between 50 and 500 mL/minute and appropriate power supply, including compressor if needed. The pump type will principally depend on the depth to water and well diameter. Bladder or submersible pumps are preferred, peristaltic pumps are acceptable only for wells where the depth to water is less than approximately 25 feet. Waterra pumps are only recommended for narrow diameter wells that cannot be sampled using a bladder or peristaltic pump;
- bottom-filling Teflon™ bailer;
- SEBS resin tubing – provided by the analytical laboratory and certified as meeting the requirements of USEPA Method 1669 and double bagged;
- fluoropolymer tubing – provided by the analytical laboratory and certified as meeting the requirements of USEPA Method 1669 and double bagged (if using peristaltic pump);
- battery and spare battery to power pump;
- battery charger;
- coolers; ice; and
- voltmeter for trouble-shooting peristaltic pump malfunction.

2. PROCEDURES

2.1 Pre-Mobilization Activities

1. Obtain the construction, diameter, depth, material, screened interval, and map showing location for each monitoring well to be sampled.
2. Obtain a listing of the parameters that will be measured in the field or laboratory as part of this sampling program including the required analytical method, analytical lab, sample volume, nomenclature, preservative, sample containers and holding time for each parameter as detailed in the QAPP. The parameters that will be measured in the field are the low-flow stabilization parameters including temperature, pH, salinity, specific conductance, oxidation reduction potential (ORP), dissolved oxygen (DO), and turbidity. These parameters will be recorded during low flow purging and immediately prior to collection of samples for laboratory analysis. In addition, certain geochemical parameters, such as ferrous iron, may be measured in the field through test kits. Remaining parameters will be measured in the laboratory.

3. Obtain a listing of the frequency of the applicable field quality control (QC) samples; duplicates, MS/MSD pairs, field blanks, equipment blanks and trip blanks sampling as per the QAPP.
4. Verify that all equipment on order is being shipped to the site.

2.1.1 Sample Container and Tubing Preparation

1. Sample container procurement should be arranged with the analytical laboratory several weeks prior to the event.
2. Field equipment that must be cleaned and provided by a supplier should be ordered several weeks prior to the event.
3. Upon receipt of the cleaned sample bottles from the laboratories, bottles should be inventoried.
4. Equipment blanks should be collected from the tubing provided by the analytical lab if applicable.
5. Powder-free nitrile gloves should be worn whenever handling clean bottles.
6. Containers shall be placed in clean coolers for transport to the field.

2.2 Pre-Sampling Procedures

Several steps are required before sampling any of the wells. These steps ensure that instruments are functioning and properly calibrated and that the necessary equipment has been supplied for efficient and accurate sampling.

2.2.1 Inventory

Verify that the correct equipment has been received by the field site and that it is clean (decontaminated). Inventory sample containers to verify that the laboratory has provided the correct number of containers of the proper size and containing the correct preservative if required. To the extent possible, pre-label/tag and bundle sample containers for each well to avoid confusion during sample collection.

Verify that the appropriate PPE and ancillary supplies (e.g., paper towels, decontamination solution) have been received by the field site. The appropriate protective equipment, as specified in the HASP, will be reviewed during a morning tailgate meeting. Contact the field manager or project manager immediately if there are discrepancies.

2.2.2 Calibration

Calibrate the multi-parameter sonde consistent with the manufacturer's specifications before sampling and at the start of each field day. A check of the calibration shall be performed at least once more during the field day. Instruments will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on the applicable field form (e.g. field calibration form). Calibration will also be checked if any readings during sampling are suspect. Calibration procedures are described in SOP A.20.

2.2.3 Well Inspection

Inspect the well for the presence of lock and cap, surface seal integrity, obstructions, evidence of tampering, debris, or surface water collecting in flush mounts. Note any irregularities in the applicable field form (e.g. groundwater sampling field form). If the well casing is damaged and there are anomalies in the calculated water level at the well, then the casing damage may indicate compromised sample quality.

2.3 Well Purging and Sampling

Sampling is performed in teams according to the health and safety protocol for the site. Under most tasks, sampling is performed using a five-step procedure that will be followed upon arrival at each well:

1. Set-up;
2. Purging;
3. Measurement of field parameters and field testing;
4. Sampling; and
5. Clean-up and decontamination.

Detailed procedures for performing each of these steps are provided in the following subsections.

2.3.1 Set-up

All necessary equipment for purging, sampling, and storage will be brought to the well before the well is opened. Equipment will be placed on a clean plastic sheet near the well. General parameters describing the well and field condition (e.g., well identification, depth, weather, date, and time) will be documented on a field data sheet. PPE, as required by the HASP, will be donned prior to opening well. Sampling begins by opening the well and measuring the depth to the water table. The tubing, multi-parameter sonde, and reservoir for purged water are then set up.

2.3.2 Purging by Low Flow Protocol

Wells are purged using the low flow/minimum drawdown protocol as described by Puls and Barcelona (1996) and summarized below. The general procedural requirements for low-flow purging are listed below.

1. Lower the pump slowly down the well, positioning the pump intake at the middle of the well screen and tubing will be connected to a flow-through cell and a discharge line will be run from the flow-through cell to a bucket.
2. Minimize disturbance of the water column in the well by initiating pumping at a low rate (see below). Dedicated tubing (left in-place between sampling events) is also recommended to minimize disturbance to the water column before and during sampling.
3. Begin pumping at a steady rate of 100 mL/min and measure the depth to water frequently (e.g., every minute for the first few minutes) to ensure that less than 0.1 ft of drawdown occurs. The pumping rate may be increased if drawdown is less than 0.1 ft, but the pumping rate will not exceed 500 mL/min. In some silty and/or clayey formations, drawdown may

exceed 0.1 ft when pumping at 100 mL/min. If this occurs, refer to Section 2.3.3 Variations from Low Flow Protocol, below, for alternatives to the low flow/minimum drawdown protocol.

4. Field parameters and depth to water will be recorded on field data sheets a minimum of every five minutes while purging or after initial purge, post-purge, and following sample collection. Purging will continue until temperature, pH, salinity, specific conductance, ORP, DO, and turbidity stabilize (three consecutive readings), which is defined as follows:
 - ± 0.1 units for pH;
 - $\pm 3\%$ for specific conductance;
 - $\pm 10\%$ for salinity;
 - ± 10 mV for ORP;
 - $\pm 10\%$ for temperature;
 - $\pm 10\%$ for turbidity; and
 - $\pm 10\%$ for DO.
5. DO and turbidity tend to stabilize last and are better measures of sufficient purging.
6. In the case that the above criteria for stabilization are not met before three well volumes have been pumped, then a maximum of five well volumes will be pumped before samples are collected. Also, if stabilization has not occurred after 30 minutes of purging regardless of well volume status, samples will be collected at this point. If the well cannot sustain this purge rate, then the well will be purged dry and allowed to recover prior to sampling.

2.3.3 Variations from Low Flow Protocol

Wells in low-yield formations such as silt or clay soils may not yield sufficient water for purging (e.g., 100 mL/min) without more than 0.1 ft of drawdown. In these cases, a modified low-flow method will be used. Currently, there is no published protocol for sampling low-recharge wells. Two modifications described below have been endorsed at one site by USEPA for sampling and purging wells that yield less than 100 mL/min at a drawdown of 0.1 ft.

Alternative Method 1: Less than half the casing volume is located above the well screen

Purge the well with the pump intake located at the midpoint of the well screen by constant pumping at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. Measure and record the field parameters and water depth at a minimum of five-minute intervals or at the end of every purge cycle, although it may be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity). Cease pumping and allow the water level to recover until the standing water column in the well (length from water level to bottom of well) equilibrates to at least 90% of the static water column. Repeat the purging and cessation cycle until a minimum of one casing volume is removed from the well. The well will then be allowed to recover sufficient volume to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Alternative Method 2: More than half the casing volume is located above the well screen

The well will be purged with the pump intake located at midpoint of the well screen at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. This will remove at least one-half of a casing volume of water from the well. The well is then allowed eight hours to recover, after which time a volume of water equal to the casing volume of the screened interval will be removed, removing approximately a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is to be collected from the midpoint of the screened interval.

Other Modifications to Low Flow Sampling

Other modifications of the low-flow protocol may be required. Low-recharge wells screened across the water table are not amenable to either of the methods described above. It may not be practical to sample extremely low recharge wells using any of the cited modifications, in which case, it will be necessary to evacuate all casing water and re-sample as soon as sufficient recharge has entered the well to provide a sample. A modified approach will be necessary for some of the work plans, as directed within those work plan elements. Data from such wells will be qualified to indicate the potential for sample bias.

2.3.4 Field Measurements

Field parameter measurements will be recorded following parameter stabilization (purging) and before sampling. The pumping rate and sampler intake location in the well are not to be adjusted after purging. The field parameters typically measured are temperature, pH, salinity, specific conductance, ORP, DO, and turbidity.

2.3.5 Sample Collection by Pump

Samples will be collected after field parameters have stabilized and measurements recorded. The pump rate and sample intake location will not be adjusted between purging and sampling. Samples are to be obtained from the influent line (prior) to the flow-through cell (i.e., field parameters cannot be measured during sampling). The following sampling strategy is to be followed at each location in its entirety prior to beginning a new location.

Additionally, all individuals involved in sample collection will be trained by a sampler experienced in the collection method prior to collection of samples.

Sample containers are to be filled in the order listed below as applicable to the task specific analytical program. Note that many sample containers contain preservatives; hence, it is necessary to fill each container carefully enough to avoid or minimize overfilling, which may dilute the preservative to unacceptable levels.

1. If collected, volatile organic compound (VOC) samples will be collected first. Sample containers are to be completely filled so that a positive meniscus forms over the opening of the container. The container lid will be moistened with groundwater and screwed to the container body. The container is then turned upside down and inspected for air bubbles. If air bubbles exist in the container, then it is “topped off” to eliminate bubbles. This procedure is repeated until there are no entrapped bubbles in the container. Filled samples are stored at <6°C but not frozen.

2. Then, if collected, the following samples are collected:
 - a) Total petroleum hydrocarbons (TPH) – water will be dispensed into two 1,000 mL amber glass bottles without preservative, sealed, and stored at <6°C but not frozen.
 - b) Polycyclic Aromatic Hydrocarbons (PAHs) – water will be dispensed into two 1,000 mL amber glass bottles without preservative, sealed, and stored at <6°C but not frozen.
 - c) Semi-volatile organic compound (SVOC) and Polycyclic Aromatic Hydrocarbons (PAH) – water will be dispensed into two 1,000 mL amber glass bottles without a preservative, sealed, and stored at <6°C but not frozen.
 - d) PCBs and pesticides - water will be dispensed into two 1,000 mL amber glass bottles without a preservative, sealed, and stored at <6°C but not frozen.
 - e) Metals – groundwater will be split into two portions; one filtered sample and one unfiltered sample. The filtered sample (for dissolved metals analysis) will be field-filtered using a clean, disposable, 0.45-µm filter attached in-line to the sample tubing. Filtered water will be dispensed into a 500 mL wide-mouth plastic bottle with HNO₃ as a preservative to achieve a pH below 2, sealed and stored at <6°C but not frozen. Unfiltered water (for total metals analysis) will be dispensed directly in to a 500 mL wide mouth plastic bottle with HNO₃ as a preservative to achieve a pH below 2, sealed, and stored at <6°C but not frozen.
3. If NAPL mobility characteristics are to be analyzed, the following analyses are to be performed:
 - a) Fluid Properties: Density via ASTM D1481, viscosity via ASTM D445, interfacial tension and surface tension via ASTM D971 at three different temperatures. These are used in understanding the potential for the NAPL to migrate. Water will be dispensed into a 250 mL glass bottle without a preservative, sealed, and stored at <6°C but not frozen.
 - b) OILPRINT[™]: This test follows IP method 318/75M and is a high-resolution chromatographic test for petroleum hydrocarbons (C4 to C35+) fingerprint analysis used for NAPL identification. The type of NAPL will also affect the ability for the NAPL to migrate. Analysis will be from the samples collected for fluid properties.

2.3.6 Sample Collection by Bailer

Groundwater samples collected from wells that are not purged and for which field measurements are not collected, the following procedure is prescribed:

1. Prior to sampling, sorbent pads will be placed around the well to capture potential drips from the sampling activities;
2. Slowly lower a decontaminated interface meter down the well to confirm NAPL presence. Collect and record water and NAPL level measurements according to procedures outlined in SOP A.6;

3. Lower a clean dedicated bottom-filling Teflon™ bailer into the groundwater above the NAPL interface. Collect a groundwater sample and slowly raise the bailer out of the well to avoid disturbing the NAPL and without touching the sidewalls to avoid contaminating the sample;
4. Transfer groundwater from bailer into appropriate sample containers as per the QAPP; and
5. Repeat groundwater sample collection until the desired volume for samples is achieved.

Sample containers are to be filled in the order provided in Section 2.3.5. Note that many sample containers contain preservatives; hence, it is necessary to fill each container carefully enough to avoid or minimize overfilling, which may dilute the preservative to unacceptable levels.

2.3.7 Observations During Sampling

Field sampling staff will identify and log any observations into a field notebook or in the applicable field form for each well. These observations may include but are not limited to: excessive bubbling within the tubing or in the sample containers as they are filled; odors such as sulfide; excessive turbidity, solids, or formation of precipitates in the samples; color changes in the water; and unusual sounds made by the equipment.

2.3.8 Storage and Shipping

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at <6°C but not frozen prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. Refer to the SOP A.22 for sample shipping.

2.4 Sample Disposition

Samples will be labeled, maintained in custody, and handled in accordance with SOP A.17. Samples shall be prepared for shipment in accordance with SOP A.22.

2.5 Documentation

Activities conducted as part of this SOP shall be documented in accordance with SOP A.17. Documentation shall include a record of daily conditions and activities, calibration activities, sampling activities, and all other information required to be recorded per SOP A.17.

2.5.1 Decontamination Procedures

Equipment will be decontaminated between sample locations. Decontamination shall be performed according to SOP A.18. Personnel and PPE decontamination shall be performed in accordance with the HASP.

2.5.2 Investigative Derived Waste (IDW)

IDW, including decontamination fluids, used PPE, and other IDWs generated during activities associated with this SOP shall be handled and disposed of according to SOP A.19.

A.8

STANDARD OPERATING PROCEDURE
GROUNDWATER SAMPLING USING THE
LOW-FLOW PROTOCOL

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.8
GROUNDWATER SAMPLING USING THE
LOW-FLOW PROTOCOL**

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to provide instructions for groundwater sampling using the USEPA low-flow/minimal drawdown well purging protocol. Included in this SOP are field forms for sampling and meter calibration, instructions, and directions for documentation.

This SOP will be implemented in accordance with the following governing documents:

- Site Characterization Work Plan (SCWP), which provides an overview of the site background and describes the overall investigative goals and scope of work for the Site Characterization;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objective of low flow sampling techniques is to collect a representative groundwater sample from a monitoring well.

1.3 Equipment and Supplies

Pump and probe selection may differ depending on the well diameter, groundwater constituents, and depth to groundwater, but generally, sampling will require the following equipment:

- Peristaltic, bladder, submersible, or Waterra pump capable of a flow rate between 50 and 500 mL/minute and appropriate power supply, including compressor if needed. The pump type will principally depend on the depth to water and well diameter. Bladder or submersible pumps are preferred, peristaltic pumps are acceptable only for wells where the depth to water is less than about 25 feet, and Waterra pumps are only recommended for narrow diameter wells that cannot be sampled using a bladder or peristaltic pump.
- Field probe and flow-through cell (e.g., YSI) for measuring pH, temperature, conductance (and/or specific conductance), dissolved oxygen (DO), and oxidation-reduction potential (ORP) of groundwater, and a turbidity meter.
- Calibration solutions for the field probes, per manufacturer's requirements.

- Water level tape.
- Teflon-lined tubing, connections, and tools as appropriate; sufficient tubing to dedicate to each well.
- In-line filter apparatus (0.45-micron).
- Graduated cylinder or 1-liter bottle and stopwatch.
- 5-gallon bucket and funnel for purge water.
- Field forms for meter calibration and groundwater sample collection (included in SOP).
- Personal Protective Equipment (PPE) (as specified in the HASP).
- Air monitoring equipment as specified in HASP.
- Decontamination supplies as specified in SCWP and QAPP.
- Sample containers and cooler.
- Clean plastic sheeting, paper towels, and miscellaneous supplies.
- pH paper.
- Field test kits for ferrous iron, sulfide, and alkalinity.

2. PROCEDURES

2.1 Pre-Mobilization Activities

- Obtain the construction, diameter, depth, material, screened interval, and map showing location for each monitoring well to be sampled.
- Obtain a listing of the parameters that will be measured in the field or laboratory as part of this sampling program including the required analytical method, sample volume, and holding time for each parameter. The parameters that will be measured in the field are the low-flow stabilization parameters including temperature, pH, specific conductance, ORP, DO, and turbidity. These parameters will be recorded during low flow purging and immediately prior to collection of samples for laboratory analysis. In addition, certain geochemical parameters, such as ferrous iron, will be measured in the field through test kits. Remaining parameters will be measured in the laboratory.
- Verify that all equipment on order is being shipped to the site.

2.2 Pre-Sampling Procedures

Several steps are required before sampling any of the wells. These steps ensure that instruments are functioning and properly calibrated and that the necessary equipment has been supplied for efficient and accurate sampling.

2.2.1 Inventory

Verify that the correct equipment has been received by the field site and that it is clean (decontaminated). Inventory sample containers to verify that the laboratory has provided the

correct number of containers of the proper size and containing the correct preservative if required. To the extent possible, pre-label/tag and bundle sample containers for each well to avoid confusion during sample collection.

Verify that the appropriate PPE and ancillary supplies (e.g., paper towels, decontamination solution) have been received by the field site. The appropriate protective equipment, as specified in the HASP, will be reviewed during a morning tailgate meeting. Contact the field manager or project manager immediately if there are discrepancies.

2.2.2 Calibration

Calibrate the field probes consistent with the manufacturer's specifications before sampling and at the start of each field day. Record the calibration data on the field calibration form provided in this SOP. A check of the calibration shall be performed at least once more during the field day. Instruments will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on field calibration forms. Calibration will also be checked if any readings during sampling are suspect.

2.2.3 Well Inspection

Inspect the well for the presence of lock and cap, surface seal integrity, obstructions, evidence of tampering, debris, or surface water collecting in flush mounts. Note any irregularities in the groundwater sampling field form included with this SOP.

2.3 Well Purging and Sampling

Sampling is performed in teams according to the health and safety protocol for the site. Sampling is performed using a five-step procedure that will be followed upon arrival at each well:

1. set-up;
2. purging;
3. measurement of field parameters and field testing;
4. sampling; and
5. clean-up and decontamination.

Detailed procedures for performing each of these steps are provided in the following subsections.

2.3.1 Set-up

All necessary equipment for purging, sampling, and storage will be brought to the well before the well is opened. Equipment will be placed on a clean plastic sheet near the well. General parameters describing the well and field condition (e.g., well identification, depth, weather, date, and time) will be documented on a field data sheet. PPE, as required by the HASP, will be donned prior to opening well, and air monitoring will be performed per HASP requirements while opening well. Sampling begins by opening the well and measuring the depth to the water table. The tubing, field probe, and reservoir for purged water are then set up.

2.3.2 Purging (Low Flow Protocol)

Wells are purged using the low flow/minimum drawdown protocol as described by Puls and Barcelona (1996) and summarized below. The general procedural requirements for low-flow purging are listed below.

- Lower the pump slowly down the well, positioning the well intake at the middle of the well screen.
- Minimize disturbance of the water column in the well by initiating pumping at a low rate (see below). Dedicated tubing (left in-place between sampling events) is also recommended to minimize disturbance to the water column before and during sampling.
- Begin pumping at a steady rate of 100 mL/min and measure the depth to water frequently (e.g., every minute for the first few minutes) to ensure that less than 0.1 ft of drawdown occurs. The pumping rate may be increased if drawdown is less than 0.1 ft, but the pumping rate will not exceed 500 mL/min. In some silty and/or clayey formations, drawdown may exceed 0.1 ft when pumping at 100 mL/min. If this occurs, refer to the sections on *Variations from Low Flow Protocol* for alternatives to the low flow/minimum drawdown protocol.
- Field parameters and depth to water will be recorded on field data sheets a minimum of every five minutes while purging. Purging will continue until pH, temperature, specific conductance, ORP, DO, and turbidity stabilize (three consecutive readings), which is defined as follows:
 - ± 0.1 units for pH;
 - $\pm 3\%$ for specific conductance; ○ ± 10 mV for ORP;
 - $\pm 10\%$ for temperature;
 - $\pm 10\%$ for turbidity; and
 - $\pm 10\%$ for DO.

DO and turbidity tend to stabilize last and are better measures of sufficient purging. Drawdown should be minimized during purging and/or sampling, not exceeding 0.1 ft, if possible.

- In the case that the above criteria for stabilization are not met before three well volumes have been pumped, then a maximum of five well volumes will be pumped before samples are taken. Also, if stabilization has not occurred after two hours of purging regardless of well volume status, samples will be collected at this point.

2.3.3 Variations from Low Flow Protocol

Wells in low-yield formations such as poorly fractured bedrock and silt or clay soils may not yield sufficient water for purging (e.g., 100 mL/min) without more than 0.1 ft of drawdown. In these cases, a modified low-flow method will be used. Currently, there is no published protocol for sampling low-recharge wells. Two modifications described below have been endorsed at one site

by USUSEPA for sampling and purging wells that yield less than 100 mL/min at a drawdown of 0.1 ft.

Alternative Method 1: Less than half the casing volume is located above the well screen

Purge the well with the pump intake located at the midpoint of the well screen by constant pumping at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. Measure and record the field parameters and water depth at a minimum of five-minute intervals or at the end of every purge cycle, although it may be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity). Cease pumping and allow the water level to recover until the standing water column in the well (length from water level to bottom of well) equilibrates to at least 90% of the static water column. Repeat the purging and cessation cycle until a minimum of one casing volume is removed from the well. The well will then be allowed to recover sufficient volume to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Alternative Method 2: More than half the casing volume is located above the well screen

The well will be purged with the pump intake located at midpoint of the well screen at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. This will remove at least one-half of a casing volume of water from the well. The well is then allowed eight hours to recover, after which time a volume of water equal to the casing volume of the screened interval will be removed, removing approximately a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is to be collected from the midpoint of the screened interval.

Other Modifications to Low Flow Sampling

Other modifications of the low-flow protocol may be required. Low-recharge wells screened across the water table are not amenable to either of the methods described above. It may not be practical to sample extremely low recharge wells using any of the cited modifications, in which case, it will be necessary to evacuate all casing water and re-sample as soon as sufficient recharge has entered the well to provide a sample. Data from such wells will be qualified to indicate the potential for sample bias.

2.3.4 Field Measurements

Field parameter measurements will be recorded following parameter stabilization (purging) and before sampling. The pumping rate and sampler intake location in the well are not to be adjusted after purging. The field parameters measured are pH, temperature, specific conductance, DO, ORP, and turbidity.

2.3.5 Sampling

Samples will be collected after field parameters have stabilized and measurements recorded. The pump rate and sample intake location will not be adjusted between purging and sampling. Samples are to be obtained from the influent line (prior) to the flow-through cell (i.e., field parameters cannot be measured during sampling). The following sampling strategy is to be followed at each location in its entirety prior to beginning a new location.

Sampling Methods by Analytical Group

Sample containers are to be filled in the order listed below and on the field data sheet using the following protocols. Note that many sample containers contain preservatives; hence, it is necessary to fill each container carefully enough to avoid or minimize overfilling, which may dilute the preservative to unacceptable levels. For each analysis, one of the corresponding containers will be tested with pH paper to confirm that the pH meets the corresponding limits stated in this SOP.

1. Volatile organic compound (VOC) samples will be collected first. Sample containers are to be completely filled so that a meniscus forms over the opening of the container. The container lid will be moistened with groundwater and screwed to the container body. The container is then turned upside down and inspected for air bubbles. If air bubbles exist in the container, then it is “topped off” to eliminate bubbles. This procedure is repeated until there are no entrapped bubbles in the container. Filled samples are stored at 4°C (+2°C).
2. Geochemistry-related parameters are to be sampled in the following order and with the following procedure:
 - a) Alkalinity, ferrous iron, and sulfide measurements will be collected in the field per the field kit manufacturer’s instructions.
 - b) Major anions (sulfate, orthophosphate) – water will be dispensed into two 500 mL plastic bottles, sealed and stored at 4°C (+2°C).
 - c) Total Organic Carbon (TOC) – water will be dispensed into a 125 mL amber glass bottle with H₃PO₄ as a preservative to achieve a pH below 2, sealed, and stored at 4°C (+2°C).
3. After all of the geochemistry-related parameters are collected, the following samples are collected:
 - d) Semi-volatile organic compound (SVOC) – water will be dispensed into two 1,000 mL amber glass bottles without a preservative, sealed, and stored at 4°C (+2°C).
 - e) Metals – groundwater will be split into two portions; one filtered sample and one unfiltered sample. The filtered sample (for dissolved metals analysis) will be field-filtered using a clean, disposable, 0.45-µm filter attached in-line to the sample tubing. Filtered water will be dispensed into a 500 mL wide-mouth plastic bottle with HNO₃ as a preservative to achieve a pH below 2, sealed and stored at 4°C (± 2°C). Unfiltered water (for total metals analysis) will be dispensed directly in to a 500 mL wide mouth plastic bottle with HNO₃ as a preservative to achieve a pH below 2, sealed, and stored at 4°C (± 2°C).
 - f) Cyanide – water will be dispensed into one 1-L plastic bottle, preserved with NaOH to a pH of > 12, sealed, and stored at 4°C (± 2°C).

2.3.6 Observations During Sampling

Field sampling staff will identify and log any observations that may be considered unusual into a field notebook or on the groundwater sampling field form for each well. These observations may include but are not limited to: excessive bubbling within the tubing or in the sample containers as they are filled; odors such as sulfide; excessive turbidity, solids, or formation of precipitates in the samples; color changes in the water; and unusual sounds made by the equipment. In addition, sampling personnel will note the condition of the well upon arrival and inspection. If the well casing is damaged and there are anomalies in the calculated water level at the well, then the casing damage may indicate compromised sample quality.

2.3.7 Storage and Shipping

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at 4°C ($\pm 2^\circ\text{C}$) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. Refer to the SOP A.22 for sample shipping.

2.4 Documentation

Field documentation includes completed calibration records, groundwater sampling field forms, and other field notes deemed relevant. It is essential that field data sheets be filled out completely and legibly at each location, and that entries are consistent for each location and among different personnel. As referenced above, groundwater sampling data and calibration forms are provided with this SOP. The following information will be recorded:

- job, site, date, and sampler;
- well identification and description;
- depth to water;
- casing volume calculation;
- depth of pump intake during purging and sampling;
- equipment used (field probes, tubing, model and serial numbers);
- purge rate, field parameters (temperature, conductivity, DO, ORP, pH, and turbidity) and depth to water recorded every 5 minutes;
- sampling parameters;
- stabilized field parameters;
- identification, time, container types, preservatives, and analytical methods for samples; and
- space for comments.

ATTACHMENT A

BACKGROUND ON LOW-FLOW/MINIMAL DRAWDOWN PURGING

MONITORING WELL SAMPLING

The objective of groundwater sampling is to obtain a sample that is representative of groundwater quality under ambient flow conditions. To achieve this objective, a representative groundwater sample should contain: (i) the average concentration of all chemical constituents present in the target aquifer volume; (ii) constituents in the same phase and chemical speciation as present in-situ; and (iii) only the chemical constituents that are mobile under ambient groundwater flow conditions. The purpose of this section is to describe sampling practices that are most appropriate for investigations and to discuss key issues relevant to sampling. This discussion relies in part on sampling guidance developed by the USEPA.

Traditional methods of groundwater sampling call for purging three to five casing volumes of water from a well prior to sampling (Robbins and Martin-Hayden 1991, Barcelona *et al.* 1994, Wilson *et al.* 1995). These methods are no longer recommended by USEPA because they can induce bias through sample disturbance and particle mobilization, and produce larger volumes of purge water that increase exposure potential and disposal costs. Currently, USEPA recommends the low flow protocol for obtaining groundwater samples, although new sampling methods such as diffusion samplers are gaining regulatory acceptance in some situations. The low flow protocol and modifications to the low flow protocol that may be needed under some conditions are discussed in the following sections.

Note that although this document recommends low flow purging as the most widely accepted and reliable sampling method, modifications of the low flow protocol or other sampling protocols may be applicable in certain circumstances.

LOW FLOW PURGING

The purpose of low flow purging is to draw sufficient water into the casing from the formation to produce a representative sample without generating excessive groundwater velocities outside the casing, which can bias the sample. Properly implemented in an appropriately constructed monitoring well, low flow purging induces lateral flow from the formation directly through the well screen and into the sampler intake. Several measurements that are often important for investigation and are particularly sensitive to sampling bias caused by high flow purging include concentrations of dissolved gasses (O₂, CO₂, methane, ethane) total metals, and ORP. An additional advantage of low flow purging is that mixing between water entering the casing and stagnant water existing in the casing is minimized, thus achieving stabilization of the purging parameters described below with less extracted volume than conventional purging.

Low flow purging uses the same stabilization criteria as conventional purging (i.e., stable temperature, DO, conductivity, Eh, pH, and turbidity), but requires careful flow regulation (typically at a rate of 0.1 to 0.5 L/min) to limit drawdown to the extent practical (less than 0.1 ft is the goal). Since low flow purging requires steady removal of water with minimal disturbance, grab samplers (e.g., bailers) cannot be used with the low flow protocol and are not recommended for either purging or sampling. According to Puls and Barcelona (1996), a representative sample

can be collected when three successive measurements (taken at 5-minute intervals) are within ± 0.1 units for pH, $\pm 3\%$ for conductivity, ± 10 mV for Eh, and $\pm 10\%$ for turbidity and DO. The low flow sampling protocol provides for accurate measurement of in-situ values of these parameters (with the possible exception of temperature), which are important geochemical data for characterization. pH and temperature measurements tend to stabilize first, and are not particularly sensitive measures of complete purging, whereas DO and turbidity will stabilize last and are better measures of sufficient purging.

Puls and Barcelona (1996) have outlined the procedural requirements of low-flow purging as follows:

- The sampling device should be placed in the middle of the well screen to prevent the entrainment of solids from the bottom of the well into the sample (similar positioning for subsequent sampling rounds is critical for comparability of data).
- Minimize disturbance of the water column in the well by installing sampling equipment carefully or using equipment dedicated to each well, and initiating pumping at a low rate.
- Employ steady pumping at a rate that maintains less than 0.1 ft of drawdown. In most formations, this will correspond to a flow rate of 0.1 to 0.5 L/min, but may be less than 0.1 L/min in silts and clays or greater than 1 L/min in coarse sands and gravels or from large diameter wells. Sevee *et al.* (2000) provides design equations that can be used for estimating the pumping rate that yields 0.1 ft of drawdown, given well size and aquifer hydraulic conductivity.
- Purging should continue until pH, temperature, conductivity, Eh, DO, and turbidity stabilize. These measurements should be made in a sealed, flow through cell. Of these parameters, turbidity is the best parameter for measuring sufficient purging. Satisfactory purging may require removal of more than one casing-volume of water, but typically requires less than three casing volumes.
- A dedicated, pre-installed pump or tubing is recommended to minimize the time required to sample each well. Use of dedicated pumps also prevents cross contamination of wells that can result from incomplete decontamination and causes less mixing of casing water prior to purging. The cost-effectiveness of using dedicated pumps should be assessed based on site-specific sampling requirements.

Samples should be obtained from a sampling port upstream of the flow-through cell after parameter stabilization is achieved. Samples may be field-filtered if DQOs require measurement of dissolved versus mobile chemicals. Filtering should not be used to compensate for poor sampling technique, although in some cases the generation of turbidity artifacts may be unavoidable (e.g., fine-grained formation, poorly installed wells). When filtering is needed for either reason, in-line cartridge filters are recommended because they reduce handling and exposure of the sample to the atmosphere. If maintaining accurate particle-size cutoffs is a concern in filtering, a cascade system should be used (i.e., 1-micron pre-filter, followed by filtration through 0.45-micron or other smaller size filter).

In summary, the low flow protocol is preferred because it:

- typically minimizes the volume of purge water for disposal;

- provides most accurate measurements of volatile constituents;
- ensures collection of samples representative of in-situ conditions;
- collects samples containing only the mobile fraction of particulates; and
- is less vulnerable to inconsistencies among sampling staff over time.

Low flow sampling also has several disadvantages that must be kept in mind when planning sampling programs:

- higher initial capital costs, particularly if a pump is dedicated for each monitoring well;
- more time is often required to obtain a sample, which can increase total cost;
- more sophisticated equipment is used which requires more training; and
- more equipment needs to be transported to the field (e.g., conventional purging requires only a bailer whereas low-flow purging requires a pump, air cylinder, battery, or other power source).

Careful consideration of the appropriate sampling practice is critical to investigation. Traditional sampling techniques can provide inaccurate, misleading, or incomplete information relative to many aspects of geochemistry relevant for assessment. The importance of low flow sampling at sites is emphasized by Woodward (2000) who presents a case study that illustrates that many years of traditional sampling failed to support an argument that was later demonstrated relatively easily once low flow sampling was used. In this case, traditional sampling methods indicated aerobic conditions not conducive to the degradation of the contaminants. Low-flow sampling techniques revealed that in-situ conditions were in fact anaerobic.

MODIFIED LOW FLOW PROTOCOL (LOW RECHARGE WELLS)

Wells in low yield formations such as bedrock and clay may not be conducive to low flow purging and sampling. In these cases, pumping even at low rates may cause more than 0.1-ft of drawdown in the well or evacuate the well casing altogether. Note, however, that in these cases traditional purging is also inadequate, and it is even more important to remain cognizant of and strive to implement the goals of low flow sampling.

The practical lower limit on purge rate is a function of the casing volume, logistical constraints (time, available equipment, accessibility of the monitoring well), the required sample volume for analysis, and the tendency for sample quality to be altered as it passes through the sampling equipment. At very low pumping rates, the volume of the flow through cell must be decreased, and sample tubing length, thickness, and material may become critical. Barcelona *et al.* (1985) provide guidelines for tubing length, diameter, and thickness to minimize gas diffusion across tubing walls.

If, after consideration of these factors, it is determined that the low flow protocol is impractical, a modified low flow method should be used. Currently, there is no established protocol for sampling low recharge wells. The USEPA low flow protocol has provided guidance for low flow sampling in low permeability units and several investigators have addressed the issue of bias in VOC measurements resulting from purging of low recharge rate wells. The low flow guidance and the findings of these studies are consistent with the following modifications to the low flow protocol.

These modifications have recently been endorsed by the USEPA for sampling and purging of wells that yield less than 100 mL/min at a drawdown of 0.1 m. During implementation of these methods, constant pumping with a peristaltic or bladder pump is recommended and field parameters should be measured, although it may be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity).

Method 1

The well is purged from the midpoint of the well screen at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen. Pumping is ceased and the water level in the well is allowed to recover to static conditions. The well is purged a second time at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen at which time pumping is ceased, this is repeated until a minimum of one casing volume is removed from the well. The well is allowed to recover sufficiently to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Method 2

This method is suggested for wells that have more than half of their casing volume of water located above the well screen. The well is purged from the middle of the well screen at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen. This removes at least one-half of a casing volume of water from the well. The well is then allowed eight hours to recover, after which time a volume of water equal to the casing volume of the screened interval is removed, essentially resulting in the removal of a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is collected from the midpoint of the screened interval. If a modified low-flow protocol is required at a site, the choice of which protocol to implement should be made based on site conditions and regulatory preferences.

OTHER MODIFICATIONS

Other modifications of the low-flow protocol may be deemed appropriate on a site specific basis. Large diameter wells, for example, may require exceedingly long purge times at typical low-flow rates. Methods employed to sample such wells in a cost effective manner should consider the potential to mobilize particulates, expose the sample to the atmosphere, obtain accurate field parameter measurements, and minimize waste.

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A.9

STANDARD OPERATING PROCEDURE CONSTRUCTION OF MONITORING WELLS

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.9
CONSTRUCTION OF MONITORING WELLS**

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to provide instructions for monitoring well installation and construction. The field form for monitoring well completion is included with this SOP.

This SOP will be implemented in accordance with the following governing documents:

- Site Characterization Work Plan (SCWP), which provides an overview of the site background and describes the overall investigative goals and scope of work for the Site Characterization;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

This SOP describes the protocol to be followed during the installation of monitoring wells, groundwater extraction and vapor extraction wells, and piezometers. Drilling and logging of soil borings for well installation will be in conformance with the standard operating procedures for the drilling and sampling of soil borings.

1.3 Equipment

The field engineer/geologist overseeing the construction of the monitoring well should have the following equipment in the field during well installation:

- field log book, pens, and well construction/completion form (included in SOP);
- weighted measuring device;
- water level tape;
- level or plumb bob;
- calculator;
- well specifications for screened interval, filter pack length and construction, pipe diameter and type, etc. (provided in the SCWP); and

- appropriate Personal Protective Equipment (PPE) and air monitoring equipment per the HASP.

2. PROCEDURES

2.1 Monitoring Well Installation

An underground utility check will be performed before drilling begins. An underground utility check will, at a minimum, consist of contacting local utility alert services, if available.

The field engineer/geologist shall inventory the well construction materials prior to the start of well construction. If sufficient materials are not on-site and/or are in unacceptable condition, well construction will not begin until all appropriate materials are on-site. All proposed monitoring wells will be constructed from materials specified in the SCWP (e.g., two-inch diameter, Schedule-40 polyvinyl chloride (PVC)). All well materials shall be new and clean. Soiled materials will be cleaned prior to use, and decontaminated if there is a potential that well materials contacted contaminated surfaces.

2.2 Well Screen and Casing

The well casing and screen will generally consist of threaded stainless steel or schedule 40 (minimum) PVC pipe, although Teflon, polyethylene, steel, and polypropylene pipe are occasionally used. The casing material is defined in the SCWP; however, the inside diameter of the casing should be large enough to permit unobstructed passage of an appropriate water-level probe and equipment for purging wells and water sample collection. Screen slot size specifications will be determined after filter pack specifications have been determined as discussed in Section 2.3.

All well casings and screens will be joined through threaded connections equipped with seals; solvent welds are not suitable due to the potential for contamination from the solvent glue.

The well screen will generally consist of machine-slotted PVC or wire-wrapped stainless-steel screen. The screened sections will provide flow between the target zone and the well, allowing efficient well development and representative sample collection. Prior to the installation of the screen, the project geologist or engineer will determine the proper screen slot size.

2.3 Filter Material

Filter material will be well-graded, clean sand with a specific gravity of at least 2.5. The filter material will be either a standard sand gradation designed for a range of anticipated soil types or a sand gradation specifically designed to fit the soils collected from the anticipated well completion zone. If the latter approach is pursued, grain size distribution analyses will be performed on the medium planned for monitoring. The filter pack and well screen will then be designed using the methods defined in Driscoll, *Groundwater and Wells* (1986).

2.4 Setting Screens and Riser Casing

If not previously done, PPE will be donned and air monitoring will be begun per HASP requirements. Upon completion of drilling and/or geophysical logging, the boring will be sounded with a weighted measuring tape to verify the total depth of the boring. Six inches of filter pack

sand shall be poured into the boring and allowed to fall to the bottom of the boring. The boring shall be sounded after placing the sand to verify its thickness.

The well casing and well screen will then be assembled *ex situ* and lowered into the boring. If the boring is too deep to assemble *ex situ* and lower into the boring, it may be assembled in manageable lengths and each length attached as the well casing and screen are lowered into the boring. If the well casing and screen are assembled as they are lowered into the boring, extreme caution must be used to ensure materials (including the well casing and screen) do not accidentally fall down the well.

Well casing materials will be measured to the nearest 0.1 ft and steam cleaned before being used for well construction (materials in protective packaging do not require steam cleaning unless exposed to dirty or contaminated surfaces prior to installation). The bottom of the well will be fitted with a secure bottom-end cap. No PVC cement or other solvents will be used to fasten the well casing joints, well screen joints, or end caps.

Stainless steel centralizers shall be used for all sections of well in bedrock. Centralizers will be used immediately above and below the well screen and every 30 to 50 feet along the length of the casing. Centralizers need not be placed on well assemblies installed within augers or drill casings because the auger or drill casing will adequately center the well casing and screen in the borehole.

For borings drilled by the mud rotary method, potable water may be added to the drill mud and circulated in the borehole after completing the boring. Circulation will continue until the suspended sediment in the return fluid decreases. If borehole conditions are relatively stable, the mud will be thinned before the casing assembly is lowered into the specified depth. This is preferred because it reduces the potential for clogging the well screen with thick mud. Conversely, if borehole conditions are relatively unstable, the mud will be thinned after the casing is placed at the specified depth but prior to installing the annular fill materials. After installing the well assembly, a slurry of filter sand and potable water will then be placed into the annular space.

For borings drilled using the hollow-stem auger method, the filter sand will be placed after the well assembly has been lowered to the specified depth through the augers. The augers will be incrementally raised as the filter sand is placed by free fall through the augers. Increments of one to two feet are recommended. The depth to the top of the filter pack will be measured after each increment to detect possible bridging (bridging is the interlocking of sand particles between the well and boring which results in a void in the well annulus). If bridging occurs, it will be broken by washing the filter materials into proper place with potable water, by repeatedly raising and lowering the augers slightly, or by tapping the bridge with a steel rod. The amount of water, if any, added to the borehole must be noted on the well completion form.

For monitoring wells, the filter sand will be placed in a calculated quantity sufficient to fill the annular space to a level of approximately 2 ft above the top of the well screen (the length of the filter pack will be defined in the field work plan). For extraction or pumping wells, the level of filter sand above the well screen will be based on site conditions. The depth to the top of the filter pack will be verified by measuring, using a weighted tape.

Once the depth to the top of the filter material has been verified, fine sand (choker sand) will be placed in the annular space as a transition seal between the filter material and the bentonite seal. Bentonite will be poured to fill the annular space to a minimum of two feet above the choke to seal

the screening interval. If bentonite is to be placed below standing water, a high-solids bentonite grout will be pumped through a tremie pipe, or bentonite chips may be poured through the annulus (bentonite pellets may be used in place of chips only if it is certain that the coating on pellets will have no impact on groundwater or aquifer chemistry). If bentonite is to be placed above standing water, a high-solids bentonite grout should be used or bentonite chips may be placed in 6-inch lifts. Unless prohibited by well conditions, each lift should be hydrated using approximately 1 gallon of potable water per lift of bentonite chips. The completed bentonite transition seal will be allowed to hydrate for at least 30 minutes prior to placing the grout. The depth to the top of the transition seal will be verified by measuring, using a weighted tape.

A neat cement grout, cement/bentonite grout, or high-solids bentonite grout will be placed from the top of the transition seal to the ground surface. The grout seal will be placed in hollow-stem auger borings by free fall through the augers as they are incrementally raised, or by pumping through flexible hose or tremie pipe lowered to near the bottom of the zone being grouted. The grout must be tremied if there is standing water in the augers above the transition seal. Typical specifications of grout mixtures include the following:

- neat cement grout composed of Class A, Type I Portland Cement mixed with not more than seven gallons of clean water per bag (one cubic foot or 94 pounds) of cement with a density of 15 to 16 pounds per gallon, or to manufacturer's specifications;
- bentonite-cement grout composed of powdered bentonite (less than 5% by weight) mixed at not more than eight gallons of water to the bag, with a density of 14 to 15 pounds per gallon, or to manufacturer's specifications; or
- high solids sodium bentonite grout with a minimum of 20% solids and mixed per manufacturer's specifications with water and/or other required additives.

2.5 Surface Completion

Upon completion of the well, the riser pipe will be cut cleanly so that the top of the well is level, and a mark or notch made on the top of the riser pipe identifying a measuring point for all water level measurements at the well. The well will then be fitted with a suitable slip-on cap, threaded end cap, or waterproof cap will be fitted on the top of the riser casing to reduce the potential for entry of surface runoff or foreign matter. Either a steel protective well cover (e.g., stovepipe), or a vault (e.g., roadbox) that will have a traffic-rated cover will be completed at the ground surface. All wells will be locked for security and will be designed to limit surface water infiltration. Protective well casing and vaults shall be sufficiently large for the well cap and lock, and shall be fixed in place using cement, concrete or a similar material.

2.6 Documentation

A well construction/completion form for each well will be completed in the field by the field geologist/engineer. Well installation and construction data will be summarized in the log book. Well development notes and field measurements of water quality parameters will be summarized on corresponding well development forms.

2.7 Cleaning of Drilling Equipment

Cleaning the drill rig and associated drill equipment will follow the procedures discussed in the SCWP, QAPP, and SOPs contained in Appendices A.1, A.2, A.4, and A.17 through A.20. Decontamination fluid will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

A.10

STANDARD OPERATING PROCEDURE
MONITORING WELL DEVELOPMENT

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.10
MONITORING WELL DEVELOPMENT**

1. INTRODUCTION

1.1 Overview

This standard operating procedure (SOP) describes the protocol to be followed during the development of monitoring wells. The field form for monitoring well development is included with this SOP.

This SOP will be implemented in accordance with the following governing documents:

- Site Characterization Work Plan (SCWP), which provides an overview of the site background and describes the overall investigative goals and scope of work for the Site Characterization;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objectives of monitoring well development are to remove sediment that may have accumulated during well installation, to consolidate the filter pack around the well screen, and to enhance the hydraulic connection between the target zone and the well.

1.3 Equipment

The following equipment will be used during well development:

- Personal Protective Equipment (PPE) and air monitoring equipment per the HASP;
- submersible pump, peristaltic pump, and/or bailer;
- surge block;
- container for purge water (drums or fractionation tank);
- container with known volume (e.g., five-gallon bucket) for flow estimation;
- water level indicator;
- stopwatch or timer;
- clear glass jars (at least two);

- turbidity meter;
- well development record form (included in SOP); • field log book; and
- pens.

2. PROCEDURES

2.1 General

Monitoring well development shall be performed, as soon as practical, after well installation, but not sooner than 24 hours following placement of the grout seal. Weather conditions may increase grout set time and, consequently, further delay development.

PPE will be donned and air monitoring begun per HASP requirements before the well is approached.

Development of wells shall be accomplished with a submersible pump, peristaltic pump, and/or bailer that shall preferably remain solely dedicated to that well. Bailers shall be used to develop wells only where the volume of water is so small that other development methods are clearly inappropriate. Pumps used for well development shall be periodically raised and allowed to drain back into the hole in order to induce flow out through the well screen.

A surge block may be used to flush the filter pack of fine sediment in instances where field personnel expect that development may be improved by surging. Surging will be conducted slowly to reduce disruption to the filter pack and screen. Following surging, the well will be pumped or bailed again to remove sediment drawn in by the surging process until suspended sediment is reduced to acceptable levels (see below). Water shall not be added to the well to aid in development.

A well is considered fully developed when all the following criteria are met:

- the well water is clear to the unaided eye (based on observations of water clarity through a clear glass jar) and turbidity readings have stabilized to +/- 10% over three consecutive readings;
- the sediment thickness remaining in the well is less than one percent of the screen length; and
- the total volume of water removed from the well equals five times the standing water volume in the well (including the well screen and casing plus saturated annulus, assuming 30 percent porosity) plus the volume of drilling fluid lost.

The cap and all internal components of the well casing above the water table shall be rinsed with deionized water to remove all traces of soil, sediment, and cuttings. This washing shall be conducted before and/or during development.

Non-dedicated pumps shall be decontaminated prior to use in the next well, and dedicated tubing and/or bailers shall be used during subsequent sample collection from the well.

2.2 Documentation

The following data shall be recorded for development:

- well designation;
- date of well installation;
- date of development;
- static water level before and after development;
- quantity of drilling fluid lost during drilling;
- quantity of standing water in well and annulus (30-percent porosity of saturated annulus assumed for calculation) prior to development;
- depth from top of well casing to top of sediment inside well, before and after development;
- physical character of removed water, including changes during development in clarity, color, particulates, and odor;
- turbidity readings;
- type and size/capacity of pump and/or bailer used;
- typical pumping rate;
- estimate of recharge rate; and
- quantity of water removed and time for removal.

This information shall be documented on a well development form.

A.11

STANDARD OPERATING PROCEDURE
SEDIMENT SAMPLING AND ANALYSIS OF PER-
AND POLYFLUOROALKYL SUBSTANCES

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.11
SEDIMENT SAMPLING AND ANALYSIS OF PER- AND
POLYFLUOROALKYL SUBSTANCES**

1. INTRODUCTION

1.1 Purpose and Scope

Standard operating procedures (SOPs) were prepared to guide per- and polyfluoroalkyl substance (PFAS) sampling activities. This SOP describes recommended procedures to be used by field personnel when collecting sediment samples beneath streams, creeks, lakes or other surface water bodies. Because PFAS are potentially present in a variety of materials that may come into contact with sediment samples, and because laboratory analytical method detection limits are low (low to sub micrograms per kilogram concentrations), conservative precautions are recommended to avoid sample cross-contamination and false positive results. The procedures in this SOP are consistent with best practices at the time of authoring.

1.2 Definitions and Acronyms

1.2.1 Definitions

PFAS-free water	Water that has been analyzed by an accredited laboratory (see Section 3.1) and determined to be below the method detection limit (i.e., non-detect) for the suite of PFAS to be analyzed for in environmental samples. Method detection limits (MDLs) used during analysis of PFAS-free water should be at or below the MDLs used for environmental samples.
Potable water	Water that meets state and federal drinking water requirements. Note this water may or may not have detectable PFAS concentrations.

1.2.2 Acronyms

ASTM	American Society for Testing and Materials
CoC	chain of custody
DoD	Department of Defense
DOT	Department of Transportation
ETFE	ethylene tetrafluoroethylene
FEP	fluorinated ethylene propylene
HDPE	high-density polyethylene
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

LDPE	low-density polyethylene
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
PFAS	per- and polyfluoroalkyl substance
PTFE	polytetrafluoroethylene
PPE	personal protective equipment
PVC	polyvinyl chloride
PVDF	polyvinylidene fluoride
QA	quality assurance
QC	quality control
QSM	quality systems manual
SOP	standard operating procedure
USGS	United States Geological Survey

1.3 **Equipment and Products**

Sections 1.3.1 and 1.3.2 detail items that are safe to use versus not recommended for use on the job site to protect PFAS samples from potential cross-contamination. Science-based evidence is not currently available to support a determination of the realistic impact of these commonly used field items and materials on PFAS samples. In the absence of scientific-based sampling guidance, field staff, contractors, and analytical laboratories should try to avoid using items that may pose a risk for cross-contamination and false positive results and instead use acceptable alternatives identified in this section. If the field team needs to use products and equipment on site that are not recommended, additional quality assurance/quality control (QA/QC) samples may be collected to evaluate any potential impact on PFAS environmental samples. This information is also provided in an abbreviated format as a checklist for field staff to reference (Attachment A).

1.3.1 **Field Equipment**

Items that are **safe to use** on site when sampling for PFAS include the following:

- High-density polyethylene (HDPE)¹, silicone, acetate, and stainless-steel sampling equipment and materials (e.g., sampling containers and screw caps, bowls, pans, trays, spoons, trowels, forceps);
- Low-density polyethylene (LDPE)² materials not in direct contact with the sample (e.g., Ziploc® bags);

¹ HDPE plastics are commonly identified by a recycling symbol with a number 2 inside it.

² LDPE plastics are commonly identified by a recycling symbol with a number 4 inside it.

- Plastic sleeves, core liners, and caps that do not contain Teflon[™] or other fluoropolymers (e.g., acetate, polyvinyl chloride, polycarbonate);
- Masonite or aluminum clipboards;
- Ballpoint pens;
- Sampling forms, loose paper or field notebooks, chain of custody (CoC) record, and sample container labels;
- Alconox[®], Liquinox[®] and Luminox[®] detergents (Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane);
- Paper towels;
- Trash bags;
- HDPE sheeting;
- Hard-shell coolers;
- Shipping and handling labels;
- Regular (wet) ice;
- Bubble wrap;
- Duct tape and packing tape; and
- Large (e.g., 55-gallon) containers.

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Tubes, liners and other components including caps or plugs made of Teflon[™] or other fluoropolymers;
- Glass sample containers, due to PFAS adherence to glass surfaces;
- Water-resistant paper, notebooks, and labels (e.g., certain Rite in the Rain[®] products), due to use of PFAS in water-resistant inks and coatings;
- Sticky notes (e.g., certain Post-It[®] products), due to potential use of a paper coating product Zonyl[™] or similar fluorotelomer compounds;
- Plastic clipboards, binders, and spiral hardcover notebooks;
- Pens with water-resistant ink;
- Felt pens and markers (e.g., certain Sharpie[®] products) – some PFAS SOPs (e.g., Michigan) specifically allow Fine or Ultra-Fine Point Sharpies[®] and TestAmerica Laboratories, Inc. routinely uses Sharpies[®] in the laboratory following unpublished analytical tests that reportedly showed no impact on PFAS sample results;
- Aluminum foil, as PFAS are sometimes used as a protective layer;

- Decon 90™ liquid detergent, which reportedly contain fluorosurfactants;
- Chemical (e.g., blue) ice packs, unless it is contained in a sealed bag. Blue ice has the potential to be contaminated from previous field sampling events;
- Materials containing polytetrafluoroethylene (PTFE), including Teflon™ and Hostaflon® (e.g., tubing, tape, plumbing paste, O-rings);
- Equipment with Viton™ components (i.e., fluoroelastomers);
- Stain- or water-resistant materials, as these are typically fluoropolymer-based;
- Material containing LDPE, particularly if used in direct contact with the sample (e.g., LDPE tubing, as PFAS can sorb to the porous tubing); and
- Material containing “fluoro” in the name – this includes, but is not limited to, fluorinated ethylene propylene (FEP), ethylene tetrafluoroethylene (ETFE), and polyvinylidene fluoride (PVDF).

1.3.2 Clothing, Personal Protective Equipment (PPE), and Consumer Products

Items that are **safe to use** on site when sampling for PFAS include the following:

- Boots made of polyurethane, polyvinyl chloride (PVC), rubber, or untreated leather;
- Other field boots covered by PFAS-free (e.g., polypropylene) over-boots;
- Waders and rain gear made of neoprene, polyurethane, PVC, wax-coated, vinyl, or rubber;
- Clothing made of synthetic (e.g., polyester) or natural (e.g., cotton) fibers;
- Safety glasses;
- Reflective safety vests;
- Hardhats;
- Disposable powder-free nitrile gloves;
- Uncoated HDPE suits (e.g., certain Tyvek® products);
- Sunscreens³ and insect repellants⁴ that have been tested and found to be PFAS-free; and

³ Examples of PFAS-free sunscreens include Alba Organics Natural, Aubrey Organics, Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30, Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30, Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30, Banana Boat Sport Performance Sunscreen Stick SPF 50, Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50, Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30, Coppertone Sunscreen Stick Kids SPF 55, Jason Natural Sun Block, Kiss my Face, L’Oréal Silky Sheer Face Lotion 50+, Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50, Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70, Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70, Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30, Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+, Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30, Yes to Cucumbers, and sunscreens for infants. Products with fluorinated compounds in their ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling. ⁴ Examples of PFAS-free insect repellent include Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect

- Bottled water and hydration drinks.

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Breathable waders made of nylon or polyester with a GORE-TEX[®] membrane;
- Water- or stain-resistant boots and clothing (e.g., products containing GORE-TEX[®]);
- Clothing recently laundered with a fabric softener;
- Coated HDPE suits (e.g., certain Tyvek[®] products);
- Sunscreen and insect repellants containing fluorinated compounds as ingredients, such as polyfluoroalkyl phosphate esters;
- Latex gloves;
- Cosmetics, moisturizers, hand cream, and other related products;
- Food wrappers and packaging; and
- Food and drinks other than bottled water or hydration drinks.

Field staff should try to find acceptable alternatives to these items that still allow them to complete the field work safely and efficiently. For example, wearing long-sleeved clothing and a hard hat or sun hat may eliminate the need to use sunscreen in some climates. If an item cannot be easily avoided, additional consideration should be given to QA/QC samples to evaluate the potential impact of sample cross-contamination (e.g., field blanks).

2. FIELD PROCEDURES

2.1 Pre-Mobilization Activities

2.1.1 Health and Safety Plan

Prior to each field event, the site health and safety plan should be reviewed and updated, as necessary. Health and safety plan requirements should be reviewed for consistency with this SOP and modified as appropriate to resolve any differences.

2.1.2 Laboratory Coordination

Field personnel should communicate with the laboratory that will conduct PFAS analysis regarding the following items:

- Laboratory accreditation for PFAS analysis (see Section 3.1);
- Appropriate sample containers, labels, and preservatives (see Section 2.2.2);
- Sample storage conditions and holding time (see Section 2.2.3); and

repellent, Herbal Armor, California Baby Natural Bug Spray, BabyGanics, OFF! Deep Woods[®] spray for clothing and skin, Sawyer[®] do-it-yourself permethrin treatment for clothing, Insect Shield Insect[®] pretreated clothing, DEET products, and sunscreen/insect repellent combination product Avon Skin so Soft Bug Guard-SPF 30. Products with fluorinated compounds in their ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling.

- The number and type of QA/QC samples (see Section 2.3).

Because there is no standard United States Environmental Protection Agency method for analyzing PFAS samples in media other than drinking water, commercial laboratories typically offer analysis for a suite of approximately 24 PFAS using a modified version of Method 537 or recently published Method 537.1. Laboratories may have developed their own variations. Project staff may consider the impact of differences in reported PFAS concentrations and the potential value of collecting and sending a split sample to a second commercial laboratory to assess variability in reported PFAS concentrations.

2.1.3 Equipment Decontamination

Equipment should be decontaminated prior to mobilization to the site if it appears to be contaminated or if there is reason to believe that it is contaminated. Equipment decontamination should follow the steps outlined in Section 2.4.

2.2 Sampling

2.2.1 Sampling PPE

Gloves: Disposable powder-free nitrile gloves should be worn at all times during sample collection and handling of sampling equipment.

At a minimum, field personnel should put on a new pair of nitrile gloves after the following activities:

- Handling samples, including QA/QC samples and blanks; and
- Handling sampling equipment.

At a minimum, personnel should (1) thoroughly wash their hands with detergent (preferably Alconox[®] or Luminol[®]. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane.) and PFAS-free water; (2) thoroughly dry their hands with paper towels; and (3) put on a new pair of nitrile gloves after the following activities:

- Contact with a material potentially containing PFAS;
- Change in sampling locations;
- Breaks in work;
- Washroom breaks; and
- Exit and entry into the project site exclusion zone.

2.2.2 Sampling Equipment

Sample Containers: HDPE containers with screw caps are commonly used for sample collection. Different laboratories may supply sample containers of varying sizes. Sample container caps are typically unlined.

Preservatives: Sample preservatives are not used for sediment samples prior to PFAS analysis.

Sediment Sampling Equipment: Sediment sampling methods vary depending on the depth of sediment sample required, nature of the surface water body (e.g., river vs. stream), depth of water, distance of the sediment sample location from the bank/shore and other factors. The selection of the sediment sample collection method is beyond the scope of this SOP. The project team is encouraged to review other published field sampling manuals and general sediment sampling procedures when formulating a site-specific work plan. This SOP focuses on two sediment sampling methods that are commonly used in shallow and deeper waters.

1. **Sediment scoop sampling** – If the surface water body is wadeable, a surface sediment sample can be collected manually using a stainless-steel scoop. If the water is too deep to wade, but is less than eight feet deep, an HDPE or metal conduit may be attached to the stainless-steel scoop to collect samples.
2. **Sediment core sampling** – Core samples are useful to minimize the loss of fine-grained sediment material at the sediment-water interface and can be used to collect samples of sediments underlying shallow or deep water. This method can provide a profile to assess historic contamination as a result of sediment deposition. Manually deployed push tubes, gravity corer, or vibratory corer may be used to collect the sediment samples. Manually deployed push tubes can be attached to a standard auger extension and handle to allow them to be corkscrewed into the sediment. A gravity corer inserts into the substrate through its own weight, and as a result the depth of penetration is determined by the amount of weight on the corer. A vibratory corer is typically used to collect samples without compaction or spreading of soft, loosely consolidated sediments.

Other methods for sediment sampling include dredging and diver-assisted sediment sampling. Dredging can be used to sample sediment from surface water bodies greater than 8 feet deep that have free vertical clearance. Samples can be collected using ponar dredges, mini-ponar dredges, or young grabs. In deep water, divers can directly access sediment and implement a variety of methods listed above.

Additional detail should also be provided in a site-specific work plan or stand-alone SOP to guide the process of compositing sediment samples, if desired prior to laboratory analysis. Incremental sampling can be used to generate a composite sample that is representative of a defined area of interest. Next, sample locations must be selected using an unbiased statistical method (e.g., collection of one sample randomly selected inside each square of a grid). Incremental sampling is then conducted, which involves the collection of equal-volume increments from each sample location. Sample increments are then combined and subsampled to create the target sample. This can be accomplished by placing the sediment from each collected sample into a pan or bowl and mixing to homogenize the sediment before placing it into the sample container. Multi-incremental sampling therefore lowers the total number of samples to be analyzed, saving analytical costs. It also provides a more representative average concentration present in sediments within the area of interest.

2.2.3 Sample Collection and Labeling

Container Rinsing: Sample containers should not be rinsed prior to sampling.

Sequence of Sampling: When taking multiple samples from a moving body of water, samples should first be taken from downstream locations, followed by upstream locations, to minimize sediment disturbance.

Sediment Scoop Sampling: Sediment samples may be collected with a stainless-steel spoon or scoop directly from the surface water bed when access allows. Sampling in areas of aquatic vegetation should be avoided.

For shallow streams and pools, the following sample collection steps should be followed:

1. Wade into the surface water body towards the sample location from downstream until you get to the specified location;
2. Stand facing upstream (into the current);
3. Remove the sample container cap above the water surface;
4. Orient the stainless-steel scoop so that the sample is collected in the upstream direction;
5. Scoop the sediment along the bottom of the surface water body in the direction of the current;
6. Care should be taken to minimize the loss of fine-grained material when lifting the scoop up through the current;
7. Excess water can be removed or drained from the scoop before placing the sediment into the sample container;
8. All foreign matter including stones, shells, roots, and detritus should be removed;
9. Fill the sample container to the volume indicated by the lab;
10. Use a paper towel to clean the outside of the sample container and the sample container threads. Close the sample container by screwing on the container cap; and
11. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location.

For deeper bodies of water (i.e., too deep to wade but less than eight feet), the following sample collection steps should be followed:

1. Approach the sample location using a boat, or, if the water body is narrow enough, from a bank;
2. Slowly lower the conduit with attached stainless-steel scoop to the sample location;
3. Orient the stainless-steel scoop so that the sample is collected in the upstream direction;
4. Scoop the sediment in the upstream direction;
5. Care should be taken to minimize the loss of fine-grained material when lifting the scoop up through the current;
6. Excess water can be removed or drained from the scoop before placing the sediment into the sample container;

7. All foreign matter including stones, shells, roots, and detritus should be removed;
8. Fill the sample container to the line indicated by the lab;
9. Use a paper towel to clean the outside of the sample container and the sample container threads. Close the sample container by screwing on the container cap; and
10. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location.

Sediment Core Sampling: Sediment samples may be collected using a core sampler in either shallow or deep waters.

The following sample collection steps should be followed when using a manually-deployed push tube:

1. Wade into the surface water body towards the sample location from downstream or approach using a boat until you get to the specified location;
2. Face upstream (into the current);
3. Push the tube into the substrate until approximately four inches or less of the tube is present above the sediment-water interface;
4. For hard or coarse substrate, gently rotate or corkscrew the tube while pushing to allow for greater penetration and decrease core compaction;
5. Cap the top of the tube while it is still in the substrate;
6. Slowly extract the tube and cap the other end before it exits the water;
7. Use a paper towel to clean the outside of the tube;
8. Prior to sampling, place the tube horizontally and allow enough time for the water to drain out until fine sediment particles appear in the waste liquid;
9. Open the sampler to access the soil by cutting twice along the liner length using a hookblade utility knife and fill sample container;
10. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms; and
11. Move to the next sample location. A clean liner should be used for each new sample.

The following sample collection steps should be followed when using a gravity core sampler. For non-wadeable water, gravity cores are typically collected from a boat.

1. Assemble the gravity core in accordance with manufacturer instructions;
2. Lower the corer into the surface body water down allowing it to free fall to the substrate;
3. Allow the corer to penetrate the sediment under its own weight;
4. Depending on the type of gravity corer, either close the valve when it has reached the desired depth into the substrate or watch for the valve to automatically close;

5. Pull the gravity corer back to the surface;
6. Retrieve the sediment sample by sliding the liner out of the corer. This should be done over a PFAS-free surface (e.g., HDPE trash bag or sheeting);
7. Open the sampler to access the soil by cutting twice along the liner length using a hookblade utility knife and fill sample container;
8. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms; and
9. Move to the next sample location. A clean liner should be used for each new sample.

The following steps should be followed when using a vibratory core tube to collect samples from a boat. The boat must be capable of providing enough electricity to the vibratory corer and must have enough room to set up a tripod to hold the corer.

1. Assemble the vibratory corer in accordance with the manufacturer instructions;
2. Lower the corer into the surface body water guiding it down to maintain a vertical position;
3. Turn on the vibrating core to allow for penetration once it reaches the substrate;
4. After specified substrate depth is achieved, turn off the vibrations;
5. Pull the vibratory core tube towards the surface;
6. Cap the core just below the waterline;
7. Retrieve the sediment sample by sliding the liner out of the corer. This should be done over a PFAS-free surface (e.g., HDPE trash bag or sheeting);
8. Open the sampler to access the soil by cutting twice along the liner length using a hook blade utility knife and fill sample container;
9. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms; and
10. Move to the next sample location. A clean liner should be used for each new sample.

Labels: Some water-resistant inks may be potential sources of PFAS. PFAS-free container labels should be filled out using a ballpoint pen that does not have water-resistant ink, if possible. Field staff should try to avoid filling out container labels using felt pens and markers (e.g., certain Sharpie® products).

Container labels should include the following information:

- A unique sample identifier;
- QA/QC sample type, if applicable;
- Sampling date and time (24-hour format);
- Sampler's name or initials; and

- Method of sample preservation.

Except for temperature blanks, all QC samples should be labeled and included on the CoC record. Duplicate samples should not be indicated as duplicates.

Wet Weather Considerations: Field sampling during wet weather (e.g., rainfall and snowfall) should be conducted wearing appropriate clothing that does not pose a risk for cross contamination. Field personnel should try to avoid water-resistant clothing and boots. Rain gear made of polyurethane, PVC, vinyl, or rubber is an acceptable alternative. Samples and sample containers should not be opened prior to sample collection to avoid collecting precipitation. Should samples or sample containers become contaminated with precipitation, they should be discarded.

2.2.4 Sample Handling, Storage, and Shipment

Handling: Clean nitrile gloves should be worn when handling sample containers. Precautions should be taken to not drop or otherwise damage sample containers. Sample containers should **not** be placed in close proximity to a potential PFAS source.

Storage and Holding Times: Storage conditions and holding times should be determined by the laboratory. Measures should be taken to meet storage and holding time criteria (e.g., expedited shipping).

Shipment: Sample containers should be packed for shipment using the following steps:

1. Choose a cooler with structural integrity that will withstand shipment.
2. Secure and tape the drain plug with duct tape from the inside and outside.
3. Fill cooler at least one-third full with wet ice (try to avoid using chemical blue ice) double-bagged in sealed bags. Taping the ends of bags with duct tape will aid in waterproofing.
4. Check that the caps on all sample containers are tight and will not leak.
5. Check that the sample labels are intact, filled out, legible, and that the sample identifier exactly matches the CoC record.
6. Seal each sample container in a sample bag to prevent melt water from getting into the sample or degrading the sample label.
7. Place sample containers into the cooler with their caps upright.
8. Fill excess space within the cooler with bubble wrap (try to avoid using paper, cardboard, or polystyrene foam).
9. Seal the entire cooler with duct tape, particularly the lid, to prevent leaks.

Ship samples as non-hazardous material unless the samples meet the established Department of Transportation (DOT) criteria for a “hazardous material” or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) for air definition of “dangerous goods.” If the samples meet criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed. Prior to shipping samples, field personnel should complete the appropriate air waybill or manifest. A copy of the air waybill or manifest should be kept for recordkeeping.

2.3 Sampling QA/QC

2.3.1 Field Duplicates

Field duplicates are samples collected in the same manner and at the same time and location as a primary sample. They should be collected from locations of known or suspected contamination. Field duplicates are used to assess field and analytical precision and sample heterogeneity. Typically, at least one field duplicate is collected for every ten primary samples. Field duplicates should be labeled with a unique sample identifier and not be indicated as a duplicate (i.e., submitted as “blind”).

2.3.2 Background Samples

Based on project objectives, background samples may be collected onsite or nearby the site where little or no PFAS contamination is expected. Background samples are used to assess the natural composition of the sediment and determine that PFAS contamination in soils is localized rather than widespread. Typically, at least one background sample is collected during a sampling program.

2.3.3 Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike and matrix spike duplicate (MS/MSD) samples are aliquots of environmental samples that are spiked with a known concentration of PFAS by the laboratory. MS/MSD samples are used to assess interferences caused by the sample matrix. MS/MSD samples are not needed if the analytical laboratory is using an isotopic dilution method but are technically required to meet DoD accreditation requirements, if this accreditation is required by the project. If necessary, MS/MSD samples are to be collected in the same manner and at the same time and location as a primary sample (i.e., additional sample volume). It is preferred that this location have little to no PFAS contamination. Samples should have the same matrix to ensure a valid result; if the samples do not appear visually similar (e.g., color, suspended solids), choose another location for collection of MS/MSD samples. The number of required MS/MSD samples should be determined based on discussions with the laboratory. Typically, at least one MS/MSD sample is collected for every 20 primary samples. MS/MSD samples should be labeled with the same sample name and time as the primary sample and denoted as MS/MSD samples on the CoC and sample label.

2.3.4 Blanks

Blanks should be shipped and handled in the same manner as environmental samples. Field blanks should be labeled as such on sample bottles and on the CoC. The number and type of blanks should be determined based on discussions with the laboratory.

Equipment Blanks: Equipment blanks are used to assess sources of field and laboratory contamination. Equipment blanks are prepared by pouring PFAS-free water over or through decontaminated reusable field sampling equipment and collecting the rinsate in a sample container. Typically, at least one equipment blank is collected for every 10 primary samples.

Temperature Blanks: Temperature blanks are used to assess the temperature of samples during shipping. Temperature blanks should be provided by the laboratory or prepared by filling a sample container with PFAS-free water prior to shipment of the sample containers. The blank should be kept in the cooler during sampling and shipment to the laboratory. Once the cooler returns to the

laboratory, the temperature of the blank should be measured to ensure that recommended sample storage criteria are met (typically less than 6 degrees Celsius).

2.4 Decontamination

Decontamination should occur prior to leaving the sampling area or at a central decontamination location and at the end of each work day. Additionally, sampling equipment exposed to PFAS contaminated water should be decontaminated between sample locations.

Alconox[®] and Luminox[®] detergents are acceptable for decontamination purposes. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. Use of Decon 90 should be avoided. Decontamination wastes must be properly contained and disposed of in accordance with applicable local, state and federal regulations.

2.4.1 Field Equipment Decontamination

Stainless steel scoops and any other non-disposable sampling equipment that is in contact with sediment samples are to be fully decontaminated after each use using the following procedures:

1. Wash thoroughly using potable water and detergent (Alconox[®], Liquinox[®] or Luminox[®]) to remove any remaining residual contamination. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination of sampling equipment when collecting media to be submitted for analysis of 1,4-dioxane;
2. Rinse thoroughly with potable water (1st rinse);
3. Rinse thoroughly with PFAS-free water (2nd rinse);
4. For field instruments, rinse again with PFAS-free water (3rd rinse); and
5. Dry wet equipment with a paper towel or leave the equipment to air dry in a location away from dust or fugitive contaminants. All equipment should be dry before reuse.

2.4.2 Personnel and PPE Decontamination

A decontamination area for personnel and portable equipment may be specified in the health and safety plan. The area may include basins or tubs to capture decontamination wastes, which can be transferred to larger containers as necessary. If decontamination is needed at the end of the day following sediment sampling, personnel decontamination should follow these steps:

1. Gross (e.g., soil) contamination should be scraped and wiped from boots, safety glasses, hardhats, reflective vests, and other reusable PPE. Once gross contamination has been removed, gloves should be removed by rolling off the hands in such a way to avoid exposing skin to PFAS-contaminated materials;
2. A new pair of gloves should be put on and reusable PPE should be decontaminated using PFAS-free water mixed with detergent (preferably Alconox[®] or Luminox[®]) and brushes, or similar means. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. After debris is removed, reusable PPE should be rinsed with PFAS-free water; and

3. Hands and any exposed body parts should be washed thoroughly using detergent (preferably Alconox® or Luminox®) and PFAS-free water. Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. Hands should be dried with paper towels.

2.5 Food and Drink

Food and drink should not be brought within the exclusion zone. Food that is kept in the staging area should preferably be contained in HDPE or stainless-steel containers.

3. LABORATORY PROCEDURES

3.1 Accreditations

All samples will be analyzed by an analytical method included in the most current DEC Analytical Services Protocol (ASP) at a laboratory that is accredited pursuant to the NYSDOH Environmental Laboratory Accreditation Program (ELAP) for the category of parameters analyzed. There is not currently an ELAP certification program for the analysis of PFAS compounds other than those in drinking water. Consistent with NYSDEC policy (NYSDEC 2018), the samples for PFAS compounds will be performed using a modified USEPA Method 573 approach at a laboratory that has ELAP certification for PFOA and PFOS in drinking water.

4. DOCUMENTATION

4.1 Chain of Custody

4.1.1 Field Custody Procedures

A sample is considered to be in custody if the following conditions have been observed:

- It is in possession or view of the person in custody;
- It is locked in a secure area;
- It is placed in an area restricted to authorized personnel; or
- It is placed in a container and secured with an official seal, so that the sample cannot be reached without breaking the seal.

The following practices should be observed by field personnel to ensure sample custody:

- As few persons as possible will handle samples;
- The sample collector is personally responsible for the care and custody of samples collected until they are transferred to the laboratory;
- The sample collector will record sample data in the field notebook; and
- Sample labels will be completed for each sample.

4.1.2 Chain of Custody Record

All samples should be accompanied by a CoC record. The CoC record is typically provided by the laboratory. The CoC record should be fully completed in duplicate (e.g., a carbon copy). At the minimum, the following information should be included on a CoC record:

- Project name and number;
- Laboratory name and address;
- Name of person that collected the samples;
- Sample identifier;
- Sample date and time (time in 24-hour format);
- Laboratory analysis requested;
- Preservatives added to each sample;
- Sample matrix (e.g., sediment, water);
- Number of containers per sample; and
- Airway bill tracking number.

As applicable, the following remarks should be added to the CoC record:

- Contractor name and address;
- MS/MSD sample volume (if necessary);
- A request for rapid turnaround time; and
- A note regarding the potential concentrations in a highly-contaminated sample.

Indication of a duplicate sample should **not** be included on a CoC record.

4.1.3 Sample Packaging

The CoC record should accompany all sample shipments. One CoC record should be prepared for each cooler and the cooler number recorded on the CoC. The samples in the cooler should be listed on the CoC record. The CoC record should be placed in a sealed plastic bag (e.g., Ziploc®) and taped to the inside lid of the cooler. If one sample is contained in two coolers (i.e., one sample has too many containers to fit in one cooler), then the original CoC should be placed in the first cooler and a copy of the CoC record should be placed in the second cooler. The duplicate copy of the CoC record should be retained by the sampler.

Custody seals should be signed and dated at the time of use. Sample shipping containers should be sealed in as many places as necessary to ensure that the container cannot be opened without breaking a custody seal. Tape should be placed over the seals to ensure that seals are not accidentally broken during shipment. If the sampler transports the samples to the laboratory without sample shipment, custody seals are not required.

4.1.4 Transfer of Custody

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler should sign, date, and note the time as “relinquished by” on the CoC record. The receiver should also sign, date, and note the time as “received by” on the CoC record. The date and time of the receiver and relinquisher should be the same.

When samples are transported by a commercial carrier, the carrier will not sign the CoC record. However, the airway bill tracking number should be recorded on the CoC record. Airway bills should also be retained with the CoC record as documentation of transport. For this reason, the date and time of the receiver and relinquisher will not match when shipping with a commercial carrier.

4.1.5 Laboratory Custody Procedures

A designated sample custodian should accept custody of the shipped samples and verify that the sample identification number matches the CoC record. Pertinent information about shipment, pickup, and courier should be entered in the “Remarks” section. The temperature of the temperature blanks at the time of receiving should be noted on the CoC record.

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Attachment A. Daily Sampling Checklist

Date: _____

Site Name: _____

Weather (*temperature/precipitation*): _____

Please check all boxes that apply and describe any exceptions in the notes section below along with QA/QC methods used to assess potential sample cross-contamination as a result.

Field Clothing and PPE:

No water- or stain-resistant boots, waders, or clothing (e.g., GORE-TEX®)

Field boots (or overboots) are made of polyurethane, PVC, rubber, or untreated leather

Waders or rain gear are made of neoprene, polyurethane, PVC, vinyl, wax-coated or rubber

Clothing has not been recently laundered with a fabric softener

No coated HDPE suits (e.g., coated Tyvek® suits)

Field crew has not used cosmetics, moisturizers, or other related products today

Field crew has not used sunscreen or insect repellants today, other than products approved as PFAS-free

Field Equipment:

Sample containers and equipment in direct contact with the sample are made of HDPE, polypropylene, silicone, acetate or stainless steel, not LDPE or glass

Sample caps are made of HDPE or polypropylene and are not lined with Teflon™

No materials containing Teflon™, Viton™, or fluoropolymers

No materials containing LDPE are in direct contact with the sample (e.g., LDPE tubing, Ziploc® bags)

No plastic clipboards, binders, or spiral hard cover notebooks

No waterproof field books

No waterproof or felt pens or markers (e.g., certain Sharpie® products)

No chemical (blue) ice, unless it is contained in a sealed bag

No aluminum foil

No sticky notes (e.g., certain Post-It® products)

Decontamination:

Reusable field equipment (e.g., dip sampler) decontaminated prior to reuse

“PFAS-free” water is on-site for decontamination of field equipment

Alconox[®], Liquinox[®] or Luminox[®] used as decontamination detergent

Food and Drink:

No food or drink on-site, except within staging area

Food in staging area is contained in HDPE or stainless-steel container

Notes:

Field Team Leader Name (Print): _____

Field Team Leader Signature: _____

Date/Time: _____

A.12

STANDARD OPERATING PROCEDURE
SURFACE WATER AND SEDIMENT SAMPLING

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.12
SURFACE WATER AND SEDIMENT SAMPLING**

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the logistics, collection techniques, and documentation requirements for collecting surface water and sediment samples. The surface water and sediment sampling record to be used during sampling activities is provided with this SOP.

This SOP will be implemented in accordance with the following governing documents:

- Site Characterization Work Plan (SCWP), which provides an overview of the site background and describes the overall investigative goals and scope of work for the Site Characterization;
- Health and Safety Plan (HASP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards; and
- Quality Assurance Project Plan (QAPP), which is written to establish protocols necessary to ensure that the data generated are of a quality sufficient to ensure that valid conclusions are drawn from the site characterization.

1.2 Objective

The objective of surface water and sediment sampling is to obtain a representative sample of these media for laboratory analysis of contaminants of concern at a given site. This objective requires that the sample be both free of unsuitable material and be of sufficient quantity and quality for analysis by the selected analytical method.

1.3 Equipment

The following equipment is needed for surface water sampling:

- boots, waders, and Personal Protective Equipment (PPE) as required by HASP;
- sample containers per the SCWP;
- indelible markers;
- wooden stakes and highly visible spray paint;
- decontaminated Pyrex® measuring cup;
- field log book and sample log form (included in SOP);
- boat, if appropriate;

- YSI or equivalent multi-parameter water meter (temperature, pH, conductivity, dissolved oxygen (DO), ORP); and
- turbidity meter.

The following equipment is needed for sediment sampling:

- boots, waders, and PPE as required by the HASP;
- decontaminated stainless steel spoons, hand auger, or ponar dredge (for river/stream sediments);
- indelible markers;
- digital scale (accurate to +/- 0.1 grams);
- disposable sampling syringe;
- stainless-steel mixing bowl;
- sample containers per the SCWP;
- wooden stakes and highly visible spray paint; and
- field log book and sample log form.

2. PROCEDURES

2.1 Order of Samples

If both stream sediment and water samples are to be collected concurrently, the water samples should be taken first in order to avoid introducing sediment into the water column from sediment collection activities.

In flowing streams or runoff channels, samples should be collected first from the furthest point downstream. The remaining samples will be taken while proceeding upstream.

2.2 Surface Water Sampling Procedure

The person collecting the samples in most cases will have to enter the water body. For flowing streams this will necessitate the donning of PPE (i.e., boots or waders, and latex inner gloves and chemical-resistant outer gloves). All samples in flowing water bodies will be taken facing upstream. Samples taken from standing puddles, pools, and drainage ditches should be taken without disturbing the sediments. This may be accomplished by the use of a remote sampler (e.g., a sample bottle held on a long pole with a gimballed yoke).

Surface water sampling will entail field parameter measurement. A YSI or equivalent multiparameter meter capable of measuring pH, ORP, temperature, conductivity, and DO will be calibrated at the beginning of each sampling day according to the manufacturer's instructions. A separate turbidity meter will be used.

Note that some bottleware comes pre-preserved.

The sampling procedure for surface water is listed below.

1. Prior to collecting any water samples, place a completed waterproof sample label/tag on each container. Complete the label/tag according to the SWCP and QAPP. Fill in the information with a waterproof ink pen before sample collection. This will prevent difficulty in filling out a wet label/tag.
2. Face upstream. Wearing gloves, submerge measuring cup, without disturbing any sediment.
3. Slowly fill the volatile organic compound (VOC) vials first. Fill the first pre-preserved vial to slightly below the rim by pouring from the measuring cup. Slightly overfill the vial, creating a positive meniscus. Invert the cap and moisten it with sample water, and carefully place and screw on the cap. Turn the vial upside down and tap lightly to check for air bubbles. Air bubbles of any size should not be present, since they can introduce significant error in the analysis of the sample. If any air bubbles are present, remove the cap and add drops of sample water to create a meniscus, and cap again, checking again for air bubbles. Repeat the process until the vial is capped and free of bubbles. Repeat process for the other two vials.
4. Using the same measuring cup to sample water, continue to fill the remaining pre-preserved sample bottles. Where samples are to be submitted for dissolved metals, and field filtration is required, 500 mL of water collected from the sampling point will be filtered in the field using a portable pump and sterile, dedicated filtration devices. The filtered sample will be preserved subsequent to the filtration.
5. The temperature, pH, DO, ORP, turbidity, and conductivity of the sampled water should be determined immediately after sample collection. Where possible, field measurements of these parameters will be measured *in situ*, rather than from a sample container. Measurements will be taken by direct placement of the probe in the water body. These measurements will not be taken from any sample bottles being sent to the analytical laboratory for chemical analysis.
6. All samples will be immediately placed on ice (preferably double-bagged ice packs) to remain at 4°C (+2°C) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. Refer to SOP A.22 for sample shipping.
7. Detail in the field log book the sample location, identification, and time. Complete the site specific sample log sheet and include the following:
 - sample identification;
 - location of the sample (sketch of the sample point);
 - time and date sample was taken;
 - personnel performing the task;
 - description of the sample (color, odor, turbidity, etc.);
 - runoff conditions; and
 - other pertinent observations.

8. Place a spray-painted wooden stake at the edge of the stream or near the sample point with the location identification number on it. The stake will be located by survey or global positioning system (GPS) unit for inclusion on a site map.

2.3 Sediment Sampling Procedure

The following procedure will be followed for sediment sampling.

1. Don PPE as described in Section 2.2.
2. Select a sample location that is representative of sediment depositional areas. This might mean a sandbar in the middle of a stream, the inside corner of a stream bed in a meander, or a deep pool where water velocities are reduced.
3. Use a pre-cleaned, dedicated stainless steel spoon (that will fit inside the sample jar), to collect the sample except for samples for VOC analysis, which will be collected using an open barrel, disposable syringe.
4. All samples should be taken within the top 6 inches of the stream bed. Remove any vegetation debris (leaves, roots, bark) along with any large stones from the sample so that only the finer soil material is collected. Samples should be obtained using the appropriate sampling device.
5. Excess liquids collected along with the sediment sample will be allowed to decant from the sampler prior to sample containerization.
6. Sediment samples for VOC analysis shall be collected directly from the dredge/auger sampling device using an open barrel, disposable syringe.
7. The syringe will be filled with undisturbed soil of the following volumes: 5 grams of soil for low-level analysis (added to the 5 mL of sodium bisulfate); and/or 15 grams of soil for high level analysis (added to the 15 mL of methanol).
8. For high level VOC analysis, the soil will be extruded from the syringe into a preserved VOC vial, containing “purge and trap” grade methanol (15 mL).
9. For low level VOC analysis, the soil will be extruded from the syringe into a preserved VOC vial, containing sodium bisulfate (5 mL), a stir bar, and distilled water.
10. Any particles or grains present on the container rim or cap will be removed to ensure an adequate vial seal. The VOC vial will be capped quickly and labeled/tagged with sample identification, date, and time of collection. The container/preservative/sample will then be weighed, and the post-collection weight will also be recorded on the chain of custody. The objective sample weights (5 grams for low-level analysis, and 15 grams for high level analysis) will be achieved (+/- 10%) with the use of the digital scale. Should insufficient sample volume be added to the preserved container, a stainless-steel spatula will be used to add a small portion of sample until the target weight is achieved (or exceeded within 10%).
11. In the event that a field screening technique (instrument reading, visual staining of the soil, or olfactory observation) indicates the presence of VOCs or hydrocarbons, note the observations or instrument readings in the field logs.

12. Once the VOC fraction has been acquired, obtain sample material for the other parameters to be analyzed.
13. Detail in the field log book the sample location, identification, and time. Complete the site specific sample log sheet and include the following:
 - sample identification;
 - location of the sample;
 - time and date sample was taken;
 - personnel performing the task;
 - visual or sensory description of the sample;
 - brief sediment description (color, texture, appearance);
 - runoff conditions; and
 - other pertinent observations.
14. Place a wooden stake at the edge of the stream or near the sample point with the sample identification number on it. This stake will be located by survey or GPS unit for inclusion on a site map.

A.13

STANDARD OPERATING PROCEDURE

SURFACE WATER SAMPLING AND ANALYSIS OF
PER- AND POLYFLUOROALKYL SUBSTANCES

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.13
SURFACE WATER SAMPLING AND ANALYSIS OF PER-
AND POLYFLUOROALKYL SUBSTANCES**

1. INTRODUCTION

1.1 Purpose and Scope

Standard operating procedures (SOPs) were prepared to guide per- and polyfluoroalkyl substance (PFAS) sampling activities. This SOP describes recommended procedures to be used by field personnel when collecting surface water samples. Because PFAS are potentially present in a variety of materials that may come into contact with water samples, and because laboratory analytical method detection limits are low (low to sub nanogram per liter concentrations), conservative precautions are recommended to avoid sample cross-contamination and false positive results. The procedures in this SOP are consistent with best practices at the time of authoring.

1.2 Definitions and Acronyms

1.2.1 Definitions

PFAS-free water	Water that has been analyzed by an accredited laboratory (see Section 3.1) and determined to be below the method detection limit (i.e., non-detect) for the suite of PFAS to be analyzed for in environmental samples. Method detection limits (MDLs) used during analysis of PFAS-free water should be at or below the MDLs used for environmental samples.
Peristaltic pump	A positive displacement pump that can be used to move fluids at a fixed rate. Peristaltic pumps are typically used if the depth to water is less than approximately 25 feet.
Potable water	Water that meets state and federal drinking water requirements. Note this water may or may not have detectable PFAS concentrations.

1.2.2 Acronyms

ASTM	American Society for Testing and Materials
CoC	chain of custody
DoD	Department of Defense
DOT	Department of Transportation
ETFE	ethylene tetrafluoroethylene
FEP	fluorinated ethylene propylene
HDPE	high-density polyethylene

IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LDPE	low-density polyethylene
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
PFAS	per- and polyfluoroalkyl substance
PTFE	polytetrafluoroethylene
PPE	personal protective equipment
PVC	polyvinyl chloride
PVDF	polyvinylidene fluoride
QA	quality assurance
QC	quality control
QSM	quality systems manual
SOP	standard operating procedure
USGS	United States Geological Survey

1.3 Equipment and Products

Sections 1.3.1 and 1.3.2 detail items that are safe to use versus not recommended for use on the job site to protect PFAS samples from potential cross-contamination. Science-based evidence is not currently available to support a determination of the realistic impact of these commonly used field items and materials on PFAS samples. In the absence of scientific-based sampling guidance, field staff, contractors, and analytical laboratories should try to avoid using items that may pose a risk for cross-contamination and false positive results and instead use acceptable alternatives identified in this section. If the field team needs to use products and equipment on site that are not recommended, additional quality assurance/quality control (QA/QC) samples may be collected to evaluate any potential impact on PFAS environmental samples. This information is also provided in an abbreviated format as a checklist for field staff to reference (Attachment A).

1.3.1 Field Equipment

Items that are **safe to use** on site when sampling for PFAS include the following:

- Dip samplers, scoops, bailers, sampling containers, screw caps and other equipment made from high-density polyethylene (HDPE)¹, polypropylene, silicone, acetate, or stainless steel;

¹ HDPE plastics are commonly identified by a recycling symbol with a number 2 inside it.

- Low-density polyethylene (LDPE)² materials not in direct contact with the sample (e.g., Ziploc[®] bags);
- Sample preservatives (e.g., Trizma[®]);
- QA/QC samples (e.g., temperature and field blanks);
- Sample container labels;
- Materials made of HDPE, silicone, acetate, or stainless steel;
- Peristaltic pumps that do not have Teflon components;
- Masonite or aluminum clipboards;
- Ballpoint pens;
- Sampling forms, loose paper or field notebooks, chain of custody (CoC) record, and sample container labels;
- Alconox[®], Liquinox[®] and Luminox[®] detergents (Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane);
- Paper towels;
- Trash bags;
- HDPE sheeting;
- Hard-shell coolers;
- Shipping and handling labels;
- Regular (wet) ice;
- Bubble wrap;
- Duct tape and packing tape;
- Dedicated Silicon and/or HDPE tubing;
- Analytical field meter (e.g., temperature, pH, conductivity, oxidation-reduction potential [ORP], dissolved oxygen [DO], and turbidity);
- Water level probe(s), and
- Large (e.g., 55-gallon) containers.

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Glass sample containers, due to PFAS adherence to glass surfaces;

² LDPE plastics are commonly identified by a recycling symbol with a number 4 inside it.

- Water-resistant paper, notebooks, and labels (e.g., certain Rite in the Rain® products), due to use of PFAS in water-resistant inks and coatings;
- Sticky notes (e.g., certain Post-It® products), due to potential use of a paper coating product Zonyl™ or similar fluorotelomer compounds;
- Plastic clipboards, binders, and spiral hardcover notebooks;
- Pens with water-resistant ink;
- Felt pens and markers (e.g., certain Sharpie® products) – some PFAS SOPs (e.g., Michigan) specifically allow Fine or Ultra-Fine Point Sharpies® and TestAmerica Laboratories, Inc. routinely uses Sharpies® in the laboratory following unpublished analytical tests that reportedly showed no impact on PFAS sample results;
- Aluminum foil, as PFAS are sometimes used as a protective layer;
- Decon 90™ liquid detergent, which reportedly contain fluorosurfactants;
- Chemical (e.g., blue) ice packs, unless it is contained in a sealed bag. Blue ice has the potential to be contaminated from previous field sampling events;
- Materials containing polytetrafluoroethylene (PTFE), including Teflon™ and Hostaflon® (e.g., tubing, tape, plumbing paste, O-rings);
- Equipment with Viton™ components (i.e., fluoroelastomers);
- Stain- or water-resistant materials, as these are typically fluoropolymer-based;
- Material containing LDPE, particularly if used in direct contact with the sample (e.g., LDPE tubing, as PFAS can sorb to the porous tubing); and
- Material containing “fluoro” in the name – this includes, but is not limited to, fluorinated ethylene propylene (FEP), ethylene tetrafluoroethylene (ETFE), and polyvinylidene fluoride (PVDF).

1.3.2 Clothing, Personal Protective Equipment (PPE), and Consumer Products

Items that are **safe to use** on site when sampling for PFAS include the following:

- Boots made of polyurethane, polyvinyl chloride (PVC), rubber, or untreated leather;
- Other field boots covered by PFAS-free (e.g., polypropylene) over-boots;
- Waders and rain gear made of neoprene, polyurethane, PVC, wax-coated, vinyl, or rubber;
- Clothing made of synthetic (e.g., polyester) or natural (e.g., cotton) fibers;
- Safety glasses;
- Reflective safety vests;
- Hardhats;
- Disposable powder-free nitrile gloves;

- Uncoated HDPE suits (e.g., certain Tyvek® products);
- Sunscreens³ and insect repellants⁴ that have been tested and found to be PFAS-free; and
- Bottled water and hydration drinks.

Items **to be avoided (i.e., not recommended) for use** on site include the following:

- Breathable waders made of nylon or polyester with a GORE-TEX® membrane;
- Water- or stain-resistant boots and clothing (e.g., products containing GORE-TEX®);
- Clothing recently laundered with a fabric softener;
- Coated HDPE suits (e.g., certain Tyvek® products);
- Sunscreen and insect repellants containing fluorinated compounds as ingredients, such as polyfluoroalkyl phosphate esters;
- Latex gloves;
- Cosmetics, moisturizers, hand cream, and other related products;
- Food wrappers and packaging; and
- Food and drinks other than bottled water or hydration drinks.

Field staff should try to find acceptable alternatives to these items that still allow them to complete the field work safely and efficiently. For example, wearing long-sleeved clothing and a hard hat or sun hat may eliminate the need to use sunscreen in some climates. If an item cannot be easily avoided, additional consideration should be given to QA/QC samples to evaluate the potential impact of sample cross-contamination (e.g., field blanks).

³ Examples of PFAS-free sunscreens include Alba Organics Natural, Aubrey Organics, Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30, Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30, Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30, Banana Boat Sport Performance Sunscreen Stick SPF 50, Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50, Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30, Coppertone Sunscreen Stick Kids SPF 55, Jason Natural Sun Block, Kiss my Face, L'Oréal Silky Sheer Face Lotion 50+, Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50, Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70, Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70, Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30, Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+, Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30, Yes to Cucumbers, and sunscreens for infants. Products with fluorinated compounds in their ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling. ⁴ Examples of PFAS-free insect repellent include Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellent, Herbal Armor, California Baby Natural Bug Spray, BabyGanics, OFF! Deep Woods® spray for clothing and skin, Sawyer® do-it-yourself permethrin treatment for clothing, Insect Shield Insect® pretreated clothing, DEET products, and sunscreen/insect repellent combination product Avon Skin so Soft Bug Guard-SPF 30. Products with fluorinated compounds in their ingredients (e.g., polyfluoroalkyl phosphate esters) should not be worn during sampling.

2. FIELD PROCEDURES

2.1 Pre-Mobilization Activities

2.1.1 Health and Safety Plan

Prior to each field event, the site health and safety plan should be reviewed and updated, as necessary. Health and safety plan requirements should be reviewed for consistency with this SOP and modified as appropriate to resolve any differences.

2.1.2 Laboratory Coordination

Field personnel should communicate with the laboratory that will conduct PFAS analysis regarding the following items:

- Laboratory accreditation for PFAS analysis (see Section 3.1);
- Appropriate sample containers, labels, and preservatives (see Section 2.2.2);
- Sample storage conditions and holding time (see Section 2.2.3); and
- The number and type of QA/QC samples (see Section 2.3).

Because there is no standard United States Environmental Protection Agency method for analyzing PFAS samples in media other than drinking water, commercial laboratories typically offer analysis for a suite of approximately 24 PFAS using a modified version of Method 537 or recently published Method 537.1. Laboratories may therefore have developed their own variations to this method or another method. Project staff may consider the impact of differences in reported PFAS concentrations and the potential value of collecting and sending a split sample to a second commercial laboratory to assess variability in reported PFAS concentrations.

2.1.3 Equipment Decontamination

Equipment should be decontaminated prior to mobilization to the site if it appears to be contaminated or if there is reason to believe that it is contaminated. Equipment decontamination should follow the steps outlined in Section 2.4.

2.2 Sampling

2.2.1 Sampling PPE

Gloves: Disposable powder-free nitrile gloves should be worn at all times during sample collection and handling of sampling equipment.

At a minimum, field personnel should put on a new pair of nitrile gloves after the following activities:

- Handling samples, including QA/QC samples and blanks; and
- Handling sampling equipment.

At a minimum, personnel should (1) thoroughly wash their hands with detergent (preferably Alconox[®] or Luminex[®]) and PFAS-free water (Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-

dioxane); (2) thoroughly dry their hands with paper towels; and (3) put on a new pair of nitrile gloves after the following activities:

- Contact with a material potentially containing PFAS;
- Change in sampling locations;
- Breaks in work;
- Washroom breaks; and
- Exit and entry into the project site exclusion zone.

2.2.2 Sampling Equipment

Sample Containers: HDPE containers with screw caps are commonly used for sample collection. Different laboratories may supply sample containers of varying sizes. Sample container caps are typically unlined.

Dip Sampler, Scoop or Bailer: If access to surface water is limited, the use of a dip sampler, scoop or bailer may be required. Samples from major surface water bodies can also be collected from a boat. The selection of the surface water sample collection method is beyond the scope of this SOP and should be discussed within the project team.

Peristaltic Pump: If water depth is shallow, the use of a peristaltic pump may be required. Pump components, fittings, O-rings, sampling tubing, and other sampling equipment should not include Teflon™ or other PFAS-containing materials. Dedicated HDPE or silicon tubing is recommended. The selection of the surface water sample collection method is beyond the scope of this SOP and should be discussed within the project team.

Preservatives: Field personnel should communicate with the laboratory to determine what, if any, sample preservatives will be used. Field personnel should specifically indicate to the laboratory that surface water sampling is being conducted and the sampling method(s) being used; pre-preserved bottles are not required.

2.2.3 Sample Collection and Labeling

Container Rinsing: Sample containers should not be rinsed prior to sampling.

Sequence of Sampling: When taking multiple samples from a moving body of water, samples should first be taken from downstream locations first, followed by upstream locations, to minimize sediment disturbances that may affect water quality.

Direct Sampling: Surface water samples may be collected directly (i.e., by hand) from the shoreline when access allows.

For shallow streams and pools, the following sample collection steps should be followed:

1. Remove the sample container cap above the water surface;
2. Orient the sample container horizontally, with the container opening facing upstream if the water is moving;

3. Dip the container mouth into the stream and allow for it to fill. If needed, slowly move the container in a downstream to upstream motion to help fill the sample container. Care should be taken to limit collection of debris. The container should be filled to the volume specified by the laboratory;
4. Lift the container above the water surface;
5. Use a paper towel to clean the outside of the sample container and the sample container threads. Close the sample container by screwing on the container cap; and
6. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location. For deeper bodies of water (i.e., deeper than the container), the following sample collection steps should be followed:
 - a. Orient the sample container horizontally, with the container mouth facing upstream if the water is moving;
 - b. Dip the entire container below the water surface;
 - c. Remove the sample container cap with the container below the water surface. Allow for the container to fill. Care should be taken to limit collection of debris;
 - d. Once the container is filled to the volume specified by the laboratory, close the sample container by screwing on the container cap with the sample container still below the water surface;
 - e. Raise the sample container above the water surface;
 - f. Use a paper towel to clean the outside of the sample container; and
 - g. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location.

Dip Sampler: Surface water samples may be collected from the bank using a dip sampler when access to the surface water is limited. The following sample collection steps should be followed when using a dip sampler:

1. Assemble the dip sampler in accordance with manufacturer instructions;
2. Insert the sample container into the dip sampler;
3. Remove the sample container cap;
4. Extend the dip sampler to the sample location;
5. Dip the sample container below the water surface. Fill the container to the volume specified by the laboratory. Care should be taken to limit collection of debris;
6. Lift the sample container above the water surface and retrieve the sample container from the dip sampler;
7. Use a paper towel to clean the outside of the sample container and the sample container threads if necessary. Close the sample container by screwing on the container cap; and

8. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location.

Peristaltic Pump: Surface water samples may be collected from the bank using a peristaltic pump. Peristaltic pumps are an effective sampling device when (1) sampling from a shallow or pool where direct sampling is difficult, and (2) a sample from a specific water depth is desired. The following sample collection steps should be followed when using a peristaltic pump:

1. Assemble the peristaltic pump in accordance with manufacturer instructions;
2. Lower the pump intake to the desired depth;
3. Pump three sample-tubing volumes to field rinse the sample tubing. Collect this water as IDW;
4. Remove the sample container cap;
5. Fill the container to the volume specified by the laboratory;
6. Use a paper towel to clean the outside of the sample container and the sample container threads if necessary. Close the sample container by screwing on the container cap; and
7. Record the sample location, sample date and time, and other applicable information in the field notebook and on sampling forms before moving on to the next sample location.

Labels: Some water-resistant inks may be potential sources of PFAS. PFAS-free container labels should be filled out using a ballpoint pen that does not have water-resistant ink, if possible. Field staff should try to avoid filling out container labels using felt pens and markers (e.g., certain Sharpie® products). Container labels should include the following information:

- A unique sample identifier;
- QA/QC sample type, if applicable;
- Sampling date and time (24-hour format);
- Sampler's name or initials; and
- Method of sample preservation.

Except for temperature blanks, all QC samples should be labeled and included on the CoC record. Duplicate samples should not be indicated as duplicates.

Wet Weather Considerations: Field sampling during wet weather (e.g., rainfall and snowfall) should be conducted wearing appropriate clothing that does not pose a risk for cross contamination. Field personnel should try to avoid water-resistant clothing and boots. Rain gear made of polyurethane, PVC, vinyl, or rubber is an acceptable alternative. Samples and sample containers should not be opened prior to sample collection to avoid collecting precipitation. Should samples or sample containers become contaminated with precipitation, they should be discarded.

2.2.4 Sample Handling, Storage, and Shipment

Handling: Clean nitrile gloves should be worn when handling sample containers. Precautions should be taken to not drop or otherwise damage sample containers. Sample containers should **not** be placed in close proximity to a potential PFAS source.

Storage and Holding Times: Storage conditions and holding times should be determined by the laboratory. Measures should be taken to meet storage and holding time criteria (e.g., expedited shipping).

Shipment: Sample containers should be packed for shipment using the following steps:

1. Choose a cooler with structural integrity that will withstand shipment.
2. Secure and tape the drain plug with duct tape from the inside and outside.
3. Fill cooler at least one-third full with wet ice (try to avoid using chemical blue ice) double-bagged in sealed bags. Taping the ends of bags with duct tape will aid in waterproofing.
4. Check that the caps on all sample containers are tight and will not leak.
5. Check that the sample labels are intact, filled out, legible, and that the sample identifier exactly matches the CoC record.
6. Seal each sample container in a sample bag to prevent melt water from getting into the sample or degrading the sample label.
7. Place sample containers into the cooler with their caps upright.
8. Fill excess space within the cooler with bubble wrap (try to avoid using paper, cardboard, or polystyrene foam).
9. Seal the entire cooler with duct tape, particularly the lid, to prevent leaks.

Ship samples as non-hazardous material unless the samples meet the established Department of Transportation (DOT) criteria for a “hazardous material” or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) for air definition of “dangerous goods.” If the samples meet criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed. Prior to shipping samples, field personnel should complete the appropriate air waybill or manifest. A copy of the air waybill or manifest should be kept for recordkeeping.

2.3 Sampling QA/QC

2.3.1 Field Duplicates

Field duplicates are samples collected in the same manner and at the same time and location as a primary sample. They should be collected from locations of known or suspected contamination. Field duplicates are used to assess field and analytical precision and sample heterogeneity. Typically, at least one field duplicate is collected for every ten primary samples. Field duplicates should be labeled with a unique sample identifier and not be indicated as a duplicate (i.e., submitted as “blind”).

2.3.2 Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike and matrix spike duplicate (MS/MSD) samples are aliquots of environmental samples that are spiked with a known concentration of PFAS by the laboratory. MS/MSD samples are used to assess interferences caused by the sample matrix. MS/MSD samples are not needed if the analytical laboratory is using an isotopic dilution method but are technically required to meet DoD accreditation requirements, if this accreditation is required by the project. If necessary, MS/MSD samples are to be collected in the same manner and at the same time and location as a primary sample (i.e., additional sample volume). It is preferred that this location have little to no PFAS contamination. Samples should have the same matrix to ensure a valid result; if the samples do not appear visually similar (e.g., color, suspended solids), choose another location for collection of MS/MSD samples. The number of required MS/MSD samples should be determined based on discussions with the laboratory. Typically, at least one MS/MSD sample is collected for every 20 primary samples. MS/MSD samples should be labeled with the same sample name and time as the primary sample and denoted as MS/MSD samples on the CoC and sample label.

2.3.3 Blanks

Blanks should be shipped and handled in the same manner as environmental samples. Field blanks should be labeled as such on sample bottles and on the CoC. The number and type of blanks should be determined based on discussions with the laboratory.

Equipment Blanks: Equipment blanks are used to assess sources of field and laboratory contamination. Equipment blanks are prepared by pouring PFAS-free water over or through decontaminated reusable field sampling equipment and collecting the rinsate in a sample container. Typically, at least one equipment blank is collected for every 10 primary samples.

Field Blanks: Field blanks are used to assess ambient contamination within the field and laboratory. Field blanks should be prepared by filling a sample container with PFAS-free water in the field in the same manner as environmental samples. Field blanks are an effective way of assessing potential cross-contamination as a result of sample handling. Typically, one field blank is collected for each shipping container.

Temperature Blanks: Temperature blanks are used to assess the temperature of samples during shipping. Temperature blanks should be provided by the laboratory or prepared by filling a sample container with PFAS-free water prior to shipment of the sample containers. The blank should be kept in the cooler during sampling and shipment to the laboratory. Once the cooler returns to the laboratory, the temperature of the blank should be measured to ensure that recommended sample storage criteria are met (typically less than 6 degrees Celsius).

2.4 Decontamination

Decontamination should occur prior to leaving the sampling area or at a central decontamination location and at the end of each work day. Additionally, sampling equipment exposed to PFAS contaminated water should be decontaminated between sample locations.

Alconox[®] and Luminol[®] detergents are acceptable for decontamination purposes. Liquinox[®] is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. Use of Decon 90 should be avoided. Decontamination

wastes must be properly contained and disposed of in accordance with applicable local, state and federal regulations.

2.4.1 Field Equipment Decontamination

Dip Samplers: Dip samplers and any other non-disposable sampling equipment that is in contact with surface water samples are to be fully decontaminated after each use using the following procedures:

1. Wash thoroughly using potable water and detergent (Alconox®, Liquinox® or Luminox®) to remove any remaining residual contamination (Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane);
2. Rinse thoroughly with potable water (1st rinse);
3. Rinse thoroughly with PFAS-free water (2nd rinse);
4. For field instruments, rinse again with PFAS-free water (3rd rinse); and
5. Dry wet equipment with a paper towel or leave the equipment to air dry in a location away from dust or fugitive contaminants. All equipment should be dry before reuse.

2.4.2 Personnel and PPE Decontamination

A decontamination area for personnel and portable equipment may be specified in the health and safety plan. The area may include basins or tubs to capture decontamination wastes, which can be transferred to larger containers as necessary. If decontamination is needed at the end of the day following surface water sampling, personnel decontamination should follow these steps:

1. Gross (e.g., soil) contamination should be scraped and wiped from boots, safety glasses, hardhats, reflective vests, and other reusable PPE. Once gross contamination has been removed, gloves should be removed by rolling off the hands in such a way to avoid exposing skin to PFAS-contaminated materials.
2. A new pair of gloves should be put on and reusable PPE should be decontaminated using PFAS-free water mixed with detergent (preferably Alconox®, Liquinox® or Luminox®) and brushes, or similar means. Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. After debris is removed, reusable PPE should be rinsed with PFAS-free water.
3. Hands and any exposed body parts should be washed thoroughly using detergent (preferably Alconox®, Liquinox® or Luminox®) and PFAS-free water. Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane. Hands should be dried with paper towels.

2.5 Food and Drink

Food and drink should not be brought within the exclusion zone. Food that is kept in the staging area should preferably be contained in HDPE or stainless-steel containers.

3. LABORATORY PROCEDURES

3.1 Accreditations

All samples will be analyzed by an analytical method included in the most current DEC Analytical Services Protocol (ASP) at a laboratory that is accredited pursuant to the NYSDOH Environmental Laboratory Accreditation Program (ELAP) for the category of parameters analyzed. There is not currently an ELAP certification program for the analysis of PFAS compounds other than those in drinking water. Consistent with NYSDEC policy (NYSDEC 2018), the samples for PFAS compounds will be performed using a modified USEPA Method 573 approach at a laboratory that has ELAP certification for PFOA and PFOS in drinking water.

4. DOCUMENTATION

4.1 Chain of Custody

4.1.1 Field Custody Procedures

A sample is considered to be in custody if the following conditions have been observed:

- It is in possession or view of the person in custody;
- It is locked in a secure area;
- It is placed in an area restricted to authorized personnel; or
- It is placed in a container and secured with an official seal, so that the sample cannot be reached without breaking the seal.

The following practices should be observed by field personnel to ensure sample custody:

- As few persons as possible will handle samples;
- The sample collector is personally responsible for the care and custody of samples collected until they are transferred to the laboratory;
- The sample collector will record sample data in the field notebook; and
- Sample labels will be completed for each sample.

4.1.2 Chain of Custody Record

All samples should be accompanied by a CoC record. The CoC record is typically provided by the laboratory. The CoC record should be fully completed in duplicate (e.g., a carbon copy). At the minimum, the following information should be included on a CoC record:

- Project name and number;
- Laboratory name and address;
- Name of person that collected the samples;
- Sample identifier;
- Sample date and time (time in 24-hour format);

- Laboratory analysis requested;
- Preservatives added to each sample;
- Sample matrix (e.g., soil, water);
- Number of containers per sample; and
- Airway bill tracking number.

As applicable, the following remarks should be added to the CoC record:

- Contractor name and address;
- MS/MSD sample volume (if necessary);
- A request for rapid turnaround time; and
- A note regarding the potential concentrations in a highly-contaminated sample.

Indication of a duplicate sample should **not** be included on a CoC record.

4.1.3 Sample Packaging

The CoC record should accompany all sample shipments. One CoC record should be prepared for each cooler and the cooler number recorded on the CoC. The samples in the cooler should be listed on the CoC record. The CoC record should be placed in a sealed plastic bag (e.g., Ziploc®) and taped to the inside lid of the cooler. If one sample is contained in two coolers (i.e., one sample has too many containers to fit in one cooler), then the original CoC should be placed in the first cooler and a copy of the CoC record should be placed in the second cooler. The duplicate copy of the CoC record should be retained by the sampler.

Custody seals should be signed and dated at the time of use. Sample shipping containers should be sealed in as many places as necessary to ensure that the container cannot be opened without breaking a custody seal. Tape should be placed over the seals to ensure that seals are not accidentally broken during shipment. If the sampler transports the samples to the laboratory without sample shipment, custody seals are not required.

4.1.4 Transfer of Custody

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler should sign, date, and note the time as “relinquished by” on the CoC record. The receiver should also sign, date, and note the time as “received by” on the CoC record. The date and time of the receiver and relinquisher should be the same.

When samples are transported by a commercial carrier, the carrier will not sign the CoC record. However, the airway bill tracking number should be recorded on the CoC record. Airway bills should also be retained with the CoC record as documentation of transport. For this reason, the date and time of the receiver and relinquisher will not match when shipping with a commercial carrier.

4.1.5 Laboratory Custody Procedures

A designated sample custodian should accept custody of the shipped samples and verify that the sample identification number matches the CoC record. Pertinent information about shipment, pickup, and courier should be entered in the “Remarks” section. The temperature of the temperature blanks at the time of receiving should be noted on the CoC record.

5. REFERENCES

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Attachment A. Daily Sampling Checklist

Date: _____

Site Name: _____

Weather (*temperature/precipitation*): _____

Please check all boxes that apply and describe any exceptions in the notes section below along with QA/QC methods used to assess potential sample cross-contamination as a result.

Field Clothing and PPE:

No water- or stain-resistant boots, waders, or clothing (e.g., GORE-TEX®)

Field boots (or overboots) are made of polyurethane, PVC, rubber, or untreated leather

Waders or rain gear are made of neoprene, polyurethane, PVC, vinyl, wax-coated or rubber

Clothing has not been recently laundered with a fabric softener

No coated HDPE suits (e.g., coated Tyvek® suits)

Field crew has not used cosmetics, moisturizers, or other related products today

Field crew has not used sunscreen or insect repellants today, other than products approved as PFAS-free

Field Equipment:

Sample containers and equipment in direct contact with the sample are made of HDPE, polypropylene, silicone, acetate or stainless steel, not LDPE or glass

Sample caps are made of HDPE or polypropylene and are not lined with Teflon™

No materials containing Teflon™, Viton™, or fluoropolymers

No materials containing LDPE are in direct contact with the sample (e.g., LDPE tubing, Ziploc® bags)

No plastic clipboards, binders, or spiral hard cover notebooks

No waterproof field books

No waterproof or felt pens or markers (e.g., certain Sharpie® products)

No chemical (blue) ice, unless it is contained in a sealed bag

No aluminum foil

No sticky notes (e.g., certain Post-It® products)

Decontamination:

Reusable field equipment (e.g., dip sampler) decontaminated prior to reuse

“PFAS-free” water is on-site for decontamination of field equipment

Alconox[®], Liquinox[®] or Luminox[®] used as decontamination detergent

Food and Drink:

No food or drink on-site, except within staging area

Food in staging area is contained in HDPE or stainless-steel container

Notes:

Field Team Leader Name (Print): _____

Field Team Leader Signature: _____

Date/Time: _____

A.14

STANDARD OPERATING PROCEDURE

SOIL GAS PROBE INSTALLATION, PNEUMATIC
TESTING, AND SOIL GAS SAMPLING

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.14
SOIL GAS PROBE INSTALLATION, PNEUMATIC
TESTING AND SOIL GAS SAMPLING**

Soil Gas Probe Installation

1. INTRODUCTION

This standard operating procedure (SOP) describes the design and methods for the installation of shallow soil gas probes of sufficient quality to assess potential human health risks due to subsurface vapor intrusion to indoor air.

2. SOIL GAS PROBE DESIGN AND INSTALLATION

2.1 Compliance with Site Dig Permits and Utility Clearances

Site specific permits may be required prior to subsurface activities. Necessary permits will be secured in advance of any drilling activities. Underground utilities (water, sewer, electricity, gas, cable, telephone, etc.) will be reviewed prior to drilling.

2.2 Soil Coring via GeoProbe®

Boreholes will be installed to a depth of eight feet below ground surface with a GeoProbe® direct push system (or equivalent). This method minimizes the disturbance to the geologic materials surrounding a soil gas probe subsequently installed in the borehole. The probe depth may be adjusted to target a more porous layer in the vadose zone if one is present a few feet above or below that depth. A 2-inch diameter core barrel will be used, since this provides sufficient core volume for field screening, geologic logging, and selected laboratory analyses (if required).

2.3 Geologic Logging

Soil cores will be photographed and inspected to record details of the color, texture, moisture, density, cohesion, plasticity, staining, and odor. The cores will be field screened with a photoionization detector (PID) immediately upon opening the core.

2.4 Soil Gas Probe Installation

Each soil gas probe will consist of ¼-inch diameter Nylaflow® or Teflon® tubing connected with a compression fitting to a ¼-inch-diameter stainless steel sampling point. Probes will be installed inside the borehole and a sand filter pack will be placed in the annulus to a height of 6 inches above the top of the screen. Granular bentonite will be placed in two lifts of 3 inches above the filter pack and hydrated with a small amount of distilled water after each lift. A thick slurry of powdered bentonite and water will be added to seal the remainder of the borehole annulus to ground surface.

The top of the probe will be fitted with a compression-fit brass or stainless-steel ball valve to maintain an air-tight seal between installation and sampling. Permanent probes will be completed with a traffic rated flush mount protective casing.

3. DOCUMENTATION

Field documentation will include the following information:

- name and number of project;
- name of field personnel;
- date and time of sampling event;
- list of the primary activities performed;
- identification of probes drilled and installed;
- relevant information (weather, attendees, equipment problems, departures from standard procedures and the reasons and responses) observed throughout the day;
- field instrument information and calibration data (includes time and reading for each instrument calibration check; and
- volume of probe dead space volume for each soil gas probe.

SOIL GAS PROBE CONSTRUCTION

Probe ID _____ Site Location _____
Project Name _____ Field Personnel _____
Project Number _____ Recorded By _____

Permit Number _____ Drilling Contractor _____
Installation Date(s) _____ Driller _____
Drilling Method _____
Borehole Diameter _____

Materials Used

Riser Pipe: Diameter _____ cm/inches
Construction _____
☐ PVC schedule _____
☐ Stainless Steel
☐ Other _____

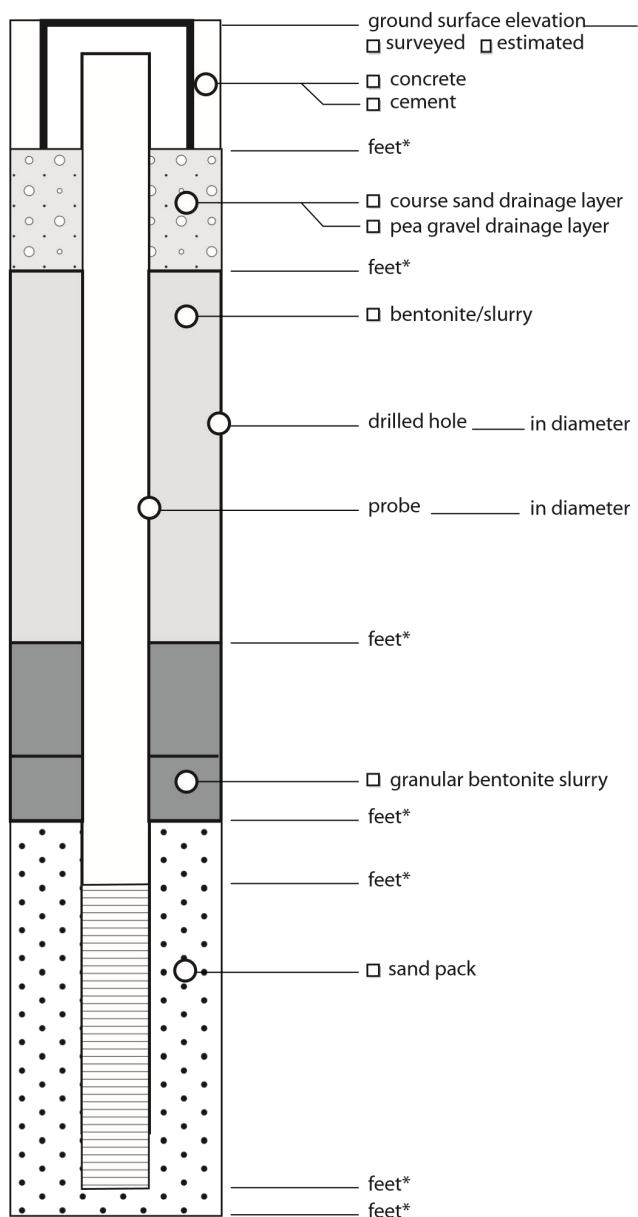
Screen : Length _____ cm/inches
Diameter _____ cm/inches
Construction
☐ PVC schedule _____
☐ Stainless Steel
☐ Other _____

Top Cap: ☐ Brass ☐ Stainless ☐ PVC

Protective Casing:
☐ Flush mount
☐ Above grade

Length _____ cm/inches
Stickup _____ cm/inches
Construction ☐ Cast Aluminum
☐ Cast Steel
☐ Other _____

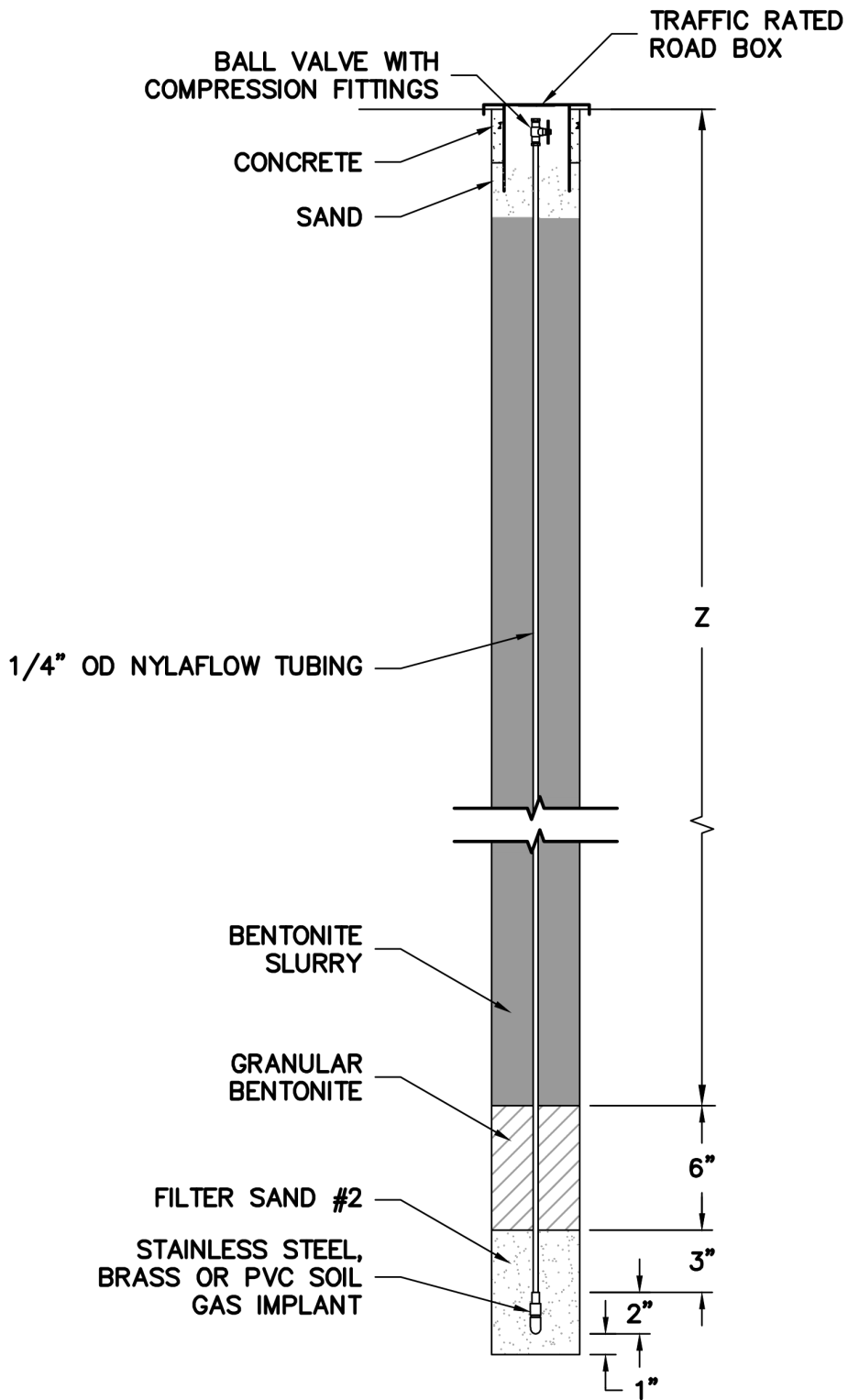
Casing Installation: Depth _____ cm/inches
Diameter _____ cm/inches



Measuring Point is Top of Well Casing
Unless Otherwise Noted

* Depth Below Ground Surface

TEMPORARY SOIL GAS PROBE DETAIL



Geosyntec
consultants

DATE:	NOV 2013	SCALE:	N.T.S.
PROJECT NO.	DETAIL	FILE NO.	SOILGASPROBE
DOCUMENT NO.		FIGURE NO.	

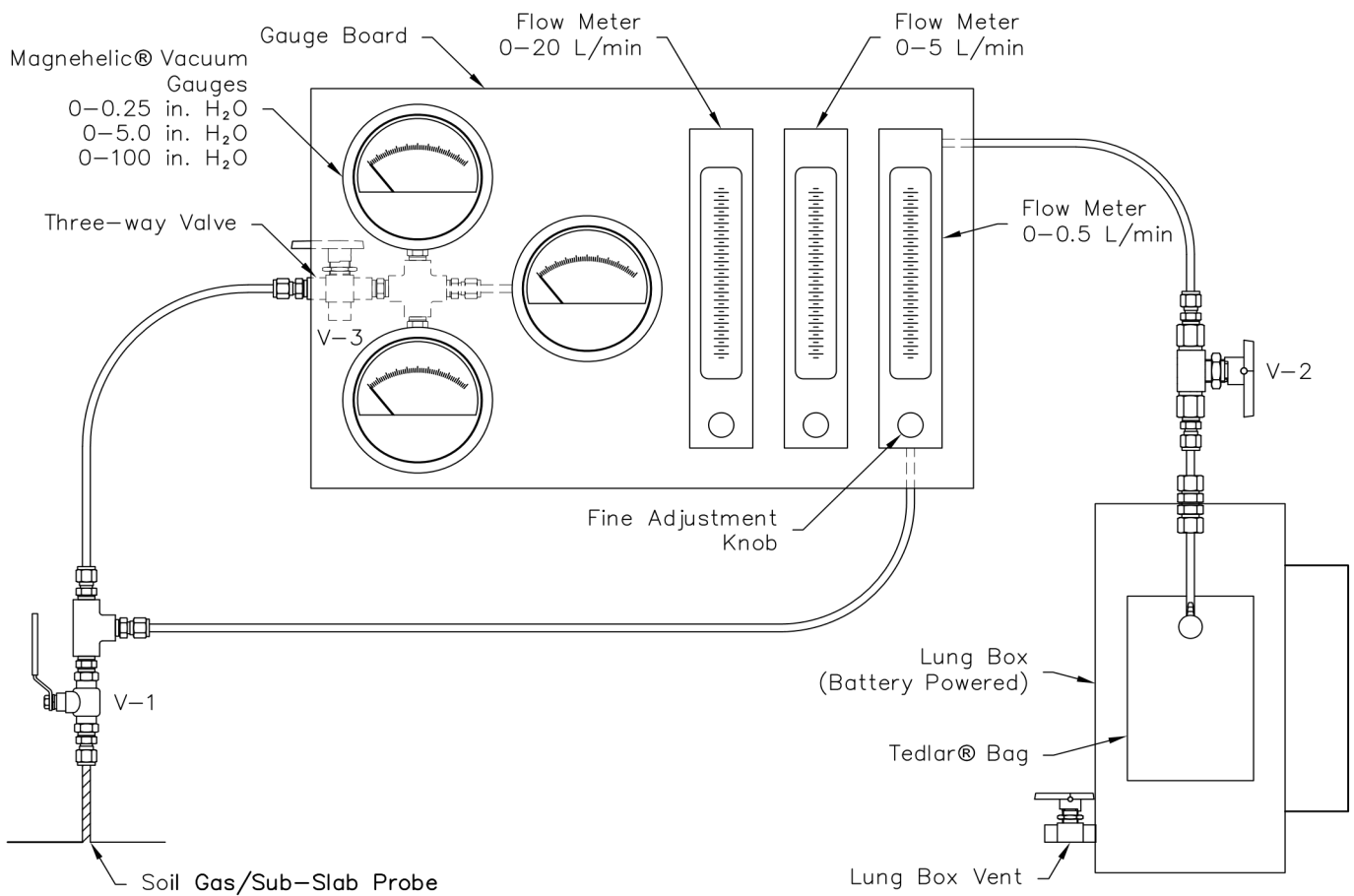
**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.14
SOIL GAS PROBE INSTALLATION, PNEUMATIC
TESTING AND SOIL GAS SAMPLING**

Pneumatic Testing

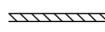
4. PNEUMATIC TESTING

Pneumatic testing is the procedure for measuring the flow and vacuum, which can be used to calculate the soil gas permeability of the surrounding geologic materials.

To measure the soil gas flow and corresponding vacuum, the equipment will be assembled as shown on Figure 1. The fine adjustment knob on the rotameter will be closed. Valves V-1 and V-2 will be opened as the lung box is turned on. The fine adjustment knob is then slowly opened until there is a measurable flow of 100 milliliters per minute (mL/min). The corresponding vacuum, as well as the flow rate, will be recorded. The rotameters must be vertical to accurately measure flow. Depending on the gas permeability of the subsurface materials, it may be necessary to switch to a higher scale vacuum gauge (0-5 in H₂O or 0-100 in H₂O) using the three-way valve (V-3). Both flow and vacuum should be clearly measurable within the scales of the vacuum gauge and rotameter. The flow rate will be increased to 200 mL/min and the vacuum observed will be recorded. This will be repeated at a flow rate of 500 mL/min. The flow and vacuum readings will stabilize almost instantaneously; therefore, the total volume of soil gas removed during the flow and vacuum test will be typically less than 1 L.



Legend

-  New Nylaflow® Tubing
-  Non-Dedicated Tubing

Pneumatic Testing Assembly

Geosyntec
consultants

Guelph

July 2009

Figure

1

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.14
SOIL GAS PROBE INSTALLATION, PNEUMATIC
TESTING AND SOIL GAS SAMPLING**

Soil Gas Sampling

5. INTRODUCTION

This standard operating procedure (SOP) describes the methods for sampling sub-slab and soil gas probes of sufficient quality to assess potential human health risks due to subsurface vapor intrusion to indoor air and subsequent inhalation exposures.

6. VACUUM SHUT-IN LEAK TEST

The sampling equipment will be assembled as shown in Figure 1, and will be checked for leaks by conducting a “shut-in” test prior to purging. Valves V-1 and V-3 will be closed (valves V-2 and V-4 open) and then the lung box and Tedlar® bag will be used to exert a vacuum on the sampling train (80 - 100 inches of water [in-H₂O]). Valve V-2 will then be closed and the vacuum observed for at least 60 seconds to ensure it does not dissipate.

If the test indicates a leak, the connections should be disconnected and carefully reconnected one at a time until the leak is fixed. The leak test must be repeated until all leaks have been fixed.

7. HELIUM LEAK TEST

After the “shut –in” test, a Tedlar bag will be attached to the tubing inside the lung-box and the lid of the lung box will be secured. V-2 will remain closed while the valve under the shroud (V1 and V-4) will be opened and the shroud filled with helium (10 to 30%). The minimum and maximum concentrations of helium observed in the shroud during the collection of each Tedlar bag sample will be recorded. The lung box will be turned on and V-2 opened to begin purging. The Tedlar bag will fill at flow rate constrained by the flow controller, typically about 200 mL/min. The time to fill the Tedlar bag should be recorded. The Tedlar bag will visibly fill inside the lung box. As it approaches $\frac{3}{4}$ full, valve V-2 will be closed and the lung box will be turned off.

The lid of the lung box will be opened, the valve on the Tedlar bag closed, and the Tedlar bag removed from the lung box. The Tedlar bag will be connected to the helium meter and the stabilized reading will be recorded.

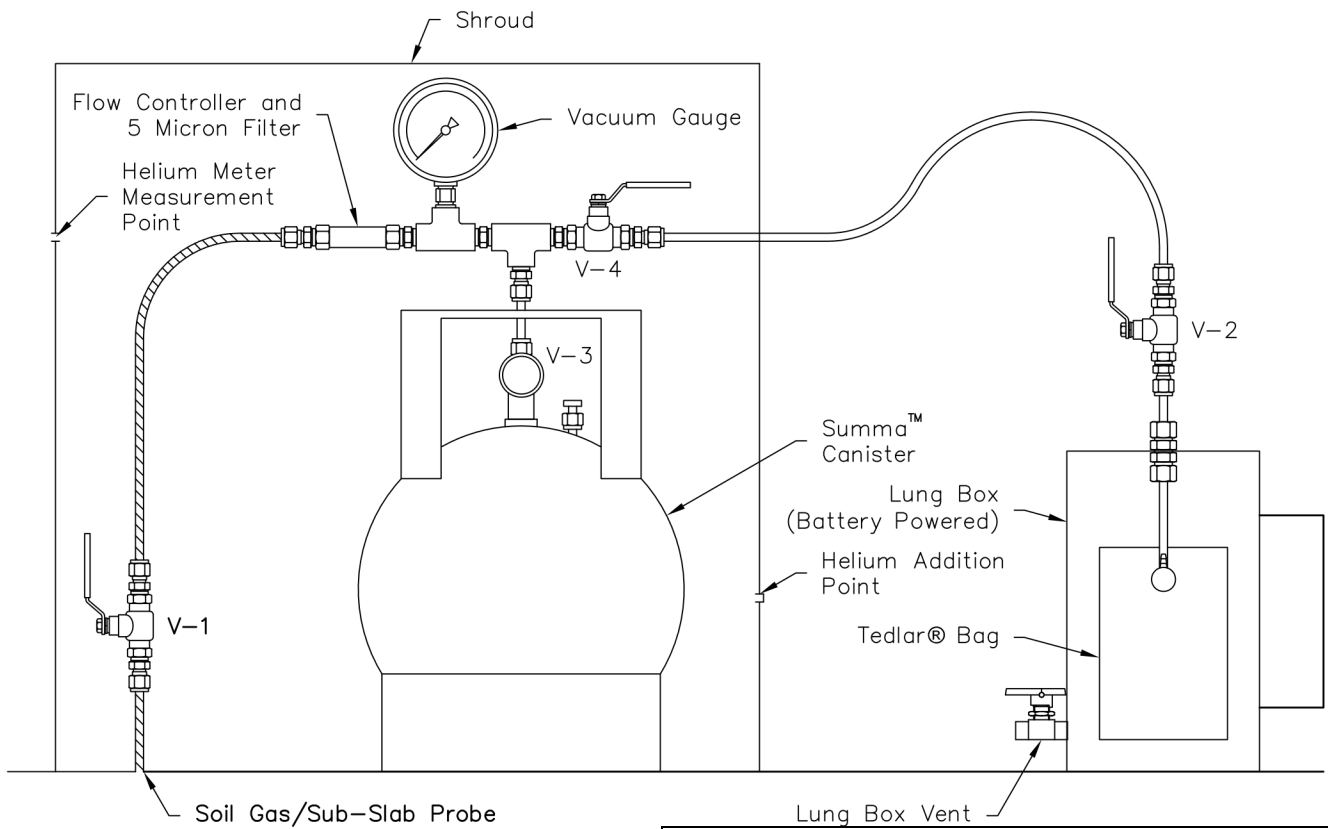
If the concentration of helium in the Tedlar bag is greater than 5% of the concentration in the shroud, the probe seal and fittings should be checked to determine the location of the leak. Once the leak has been fixed, resume purging and field screening. The purging and field screening procedure will be repeated for a minimum of three sets of readings.

8. SUMMA CANISTER LEAK TEST

Valve V-1 and V-4 will be closed and then valve V-3 (summa canister valve) will be opened to induce a vacuum on the sample train. The vacuum in the sample train will be observed for a short duration (30 seconds) to ensure it does not dissipate as a final check that the sample train does not contain any leaks. Valve V-1 will then be opened and the sample collection time recorded. The vacuum gauge on the Summa canister should be monitored and closed when the residual vacuum in the canister is about 5 in Hg.

9. EQUIPMENT BLANK

The equipment blank is collected by connecting a Summa canister to a fully assembled soil gas probe (screen, tubing, and valve) prior to installation via Swagelok fittings through a 200 milliliter per minute (mL/min) flow controller. The Summa canister valve is opened to draw the contents of the tubing and outdoor air into the canister through the probe tip and Swagelok valve.



Legend

-  New Nylaflow® Tubing
-  Non-Dedicated Tubing

Soil Gas Purging and Sampling Assembly



Figure

2

Guelph

July 2009

SOIL GAS PROBE MEASUREMENTS

① Project Name: _____ Probe No.: _____ ☐ Sub-slab probe ☐ Soil gas probe
 Date: _____ Project Number: _____ Mini Rae 2000 Serial No.: _____ Lamp: 10.6 / 11.7 eV
 Site Location: _____ Landtech GEM 2000 Landfill Gas Meter Serial No. M: _____
 Weather: _____ MDG 2002 Helium detector Serial No.: _____
 Field Personnel: _____ Tracer Gas: ☐ Helium ☐ Other _____
 Recorded By: _____

② Surface Type: ☐ Asphalt ☐ Concrete ☐ Grass ☐ Other _____
 Surface Thickness _____ inches/centimeters ☐ Unknown
 (i.e., asphalt or concrete)

③ 1 Casing Volume
☐ Sub-slab
 <0.1 L
 Soil gas probe _____ (L)

④ Initial Vacuum (prior to pumping) _____ in. H₂O

⑦ Field tubing blank reading (ppm_v) completed? ☐ Yes ☐ No PID Reading _____ ppm_v

⑧ Shut in test prior to purging completed? Yes ☐ No ☐

⑤ Shut in test prior to pneumatic test completed, _____ in. H₂O held for _____ seconds.

⑥ Start of Pneumatic Test: _____

Elapsed Time (min.)	Pump Flow Rate (LPM)	Well Head Vacuum in. H ₂ O
	0.1	
	0.2	
	0.5	

9 Purging										Tracer Gas			VOCs by PID (ppm _v)
Date	Start Time	End Time	Elapsed Time (min.)	Bag Volume (L)	Purge Rate (LPM)	Cumulative Volume (L)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Shroud (%)		Sample (ppm _v , %) (circle one)	
										Min	Max		

⑩ Helium concentration in field screened samples is less than 5% of minimum concentration in the shroud? ☐ Yes ☐ No
Note: 1% helium = 10,000 ppm_v

⑪ Shut in test prior to sample collection completed? Yes ☐ No ☐

⑫ Sample Collection Note: maximum flow rate is 200 ml/min when collecting samples							
Date	Time	Sample ID	Summa Canister ID	Flow Controller #	Vacuum Gauge #	Initial Vacuum (in. Hg)	Final Vacuum (in. Hg)

Comments: _____

A.15

STANDARD OPERATING PROCEDURE

MAGNETIC SURVEYS

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.15
MAGNETIC SURVEYS**

1. INTRODUCTION

1.1 Objective

This document describes procedures for performing magnetic profiling to detect buried ferrous metal objects. Such objects may include drums and tanks. A buried ferrous metal object will cause an anomaly to be superimposed upon the Earth's natural magnetic field of approximately 54,000 gammas (for the northeastern United States).

Magnetometry can also be used to search for archaeological features and to study geological structures and faults.

1.2 Pre-Survey Planning

The survey's resolution requirements will be defined prior to conducting the survey. Detecting smaller objects (e.g., a single buried drum) may require closely-spaced traverses (typically 5 or 10-foot spacings). Laterally-extensive survey targets, such as pipes or large areas of buried metal, may be adequately resolved with larger traverse spacings or individual traverses along specific alignments.

Power lines, or aboveground metal objects within approximately 20 feet of a survey traverse, may adversely affect magnetic measurements. Anomalies caused by buried metal objects may be difficult to distinguish from anomalies caused by aboveground objects.

1.3 Equipment Preparation

An equipment checklist (to be provided by the geophysical services contractor) will be completed before loading the field vehicle. Project-specific requirements will be indicated on the checklist.

The magnetometer and all instrumentation will be functionally checked per the manufacturer's instructions before mobilization and prior to each survey. The field geophysicist will initial and date the checklist when all equipment is loaded for mobilization, and a copy of the completed checklist will be placed in the project files.

1.4 Site Preparation

Proposed magnetic traverses will be positioned by a theodolite, compass bearings, or taped distance measurements, referenced to roads, buildings, or other semi-permanent features. Brush cutting, if needed, shall be performed before geophysical data collection to enable the field geophysicist to walk at a uniform pace.

Orange traffic cones shall delineate the survey region if needed to minimize interference with pedestrian or vehicular traffic.

1.5 Data Acquisition

A field book or data sheet shall be maintained during each survey to record magnetic traverse positions, nearby semi-permanent features such as monitoring wells, surface metal, or other field observations. Each field book or data sheet shall be labeled with the client's name, site name, job number, and dates of fieldwork.

A reference grid or distance stations shall be marked on the ground surface at regular intervals (typically 20 to 50 feet) using chalk, spray paint, or labeled pin flags or stakes as appropriate. Distances shall be determined with a fiberglass measuring tape or distance-measuring wheel, as appropriate. Traverse deviations (e.g., obstacles or traverse bends) shall be noted in the field book or data sheet. Traverse orientations shall be recorded in the field book or data sheet, or on a plan map (if available). Pin flags and stakes will be left in place at the survey's conclusion, if possible, to aid in future grid reconstruction and correlation of other assessment methods (e.g., test pitting) to the survey results.

The depth of investigation depends on the masses of the metallic targets of interest and field conditions. For example, a single buried drum, buried five feet deep, will usually cause an anomaly of approximately a few hundred gammas.

A base station shall be selected, and its location noted in the field book prior to data acquisition. The base station should be located in a convenient, magnetically quiet area. A reading shall be taken at the beginning and end of the survey, as well as once per hour, to correct for diurnal magnetic variations. Alternatively, a second magnetometer may be set up at the base station to record data continuously at set intervals (typically between one and five minutes). This data is downloaded at the end of each day and used to correct the magnetic survey data for diurnal variation.

If used in the continuous collection mode, magnetic data is acquired and digitally recorded continuously along pre-staked traverse lines. The operator walks at a steady pace with the sensor typically held between two and eight feet above the ground. Holding the sensor at a greater height will minimize interference from surface metal objects. Data values are typically recorded at 0.5-second time intervals (approximately 2-foot distance intervals, at an ordinary walking pace). The beginning and end of each traverse shall be denoted as well as intermediate distance marks at periodic intervals appropriate to the survey's scale.

Magnetometers may also be used to collect data at discrete points. This method is useful where rough terrain prevents walking at a steady pace along traverses. When used in this mode, each measurement location will be noted in the field book. If data is not being digitally recorded, the magnetic value will also be recorded in the field book.

1.6 Data Analysis

Magnetic data values are visible on a digital screen as data is acquired. The operator will observe the values as they are acquired to confirm proper functioning of the magnetic instrument.

Digitally-recorded magnetic data shall be transferred in the field to a laptop computer for contouring or plotting. Draft contour maps are typically prepared on-site using a Kriging grid algorithm. These contour maps will be examined for magnetic anomalies that resemble metallic objects, or other conditions judged to be relevant to the survey objectives. A second geophysicist shall check all preliminary magnetic interpretations prior to finalization of the survey report.

A report shall be prepared to accompany the interpreted plan map. This report shall contain final contour maps and shall describe (at a minimum): a) the survey methods and positions of interpreted anomalies, b) survey limitations (e.g., physical obstacles, areas of surface metal, etc.), and c) recommended test pit locations, if appropriate.

A.16

STANDARD OPERATING PROCEDURE
GROUND PENETRATING RADAR SURVEYS

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.16
GROUND PENETRATING RADAR SURVEYS**

1. INTRODUCTION

1.1 Objective

This document describes standard procedures for performing ground penetrating radar (GPR) profiling for buried objects or stratigraphic mapping. GPR signals can be used to detect materials with contrasting electrical properties, including: a) metallic pipes or underground storage tanks in granular soils, and b) soil and rock strata.

1.2 Pre-Survey Planning

The resolution requirements for the GPR survey shall be identified based on the specific survey objectives. Detecting smaller objects (e.g., USTs smaller than 1,000 gallons) may require closely-spaced GPR traverses (typically 2.5-foot perpendicular traverse spacings). Larger objects, or stratigraphic features, may be adequately resolved with larger traverse spacings or individual traverses along specific alignments.

1.3 Equipment Preparation

An equipment checklist will be completed by the geophysical services contractor before loading equipment into the field vehicle. All instrumentation will be functionally checked before mobilization. The field geophysicist will initial and date the checklist when all equipment is loaded, and a copy of the completed checklist will be placed in the project files. At the Site, the GPR instrumentation shall be assembled and connected per the manufacturer's instructions.

1.4 Site Preparation

Proposed GPR traverses will be positioned by taped distance measurements, and theodolite or compass bearings referenced to roads, buildings, or other semi-permanent features. Brush cutting, if needed, shall be performed before geophysical data collection to avoid cutting GPR connecting cables with sharp tools. Minor obstacles shall be moved to the side of each traverse, if possible.

Orange traffic cones shall delineate the survey region if needed to minimize interference with pedestrian or vehicular traffic.

1.5 Data Acquisition

A field book or data sheet shall be maintained during each survey to record GPR traverse positions, nearby semi-permanent features such as monitoring wells, or other field observations. Each field book or data sheet shall be labeled with the client's name, site name, job number, and dates of field work.

GPR data stations shall be marked on the ground surface using chalk, spray paint, or labeled pin flags as appropriate. GPR distance stations shall be determined with a fiberglass measuring tape or distance-measuring wheel, as appropriate. Traverse deviations (e.g., obstacles or traverse

bends) shall be noted in the field book or data sheet, or directly upon a hard-copy GPR recording. Traverse orientations shall be recorded in the field book or data sheet, or on a plan map (if available).

GPR instrument gains shall be adjusted to optimize the depth of signal penetration for the desired survey objective, prior to the start of a survey. The gains shall be adjusted during the survey, if needed, to improve the recorded data quality in changing soil conditions.

Each GPR antenna to be used during a survey shall be towed steadily along the survey traverses, by hand or with the assistance of a motorized vehicle. The beginning and end of each GPR traverse shall be denoted by two closely-spaced marks on each recording, created by pressing an antenna marker switch. Intermediate distance marks at periodic intervals appropriate to the survey's scale shall also be added to each GPR recording using the same marker switch.

If needed, GPR traverses shall be re-recorded using a variety of instrument settings (including recording time window, amplifier gains, and filter settings) to help optimize the recorded results. The contractor will notify the field manager as soon as possible if the recorded GPR data is judged to not meet the data quality objectives for the survey (due to surface obstructions, adverse soil conditions, or other factors beyond the geophysical contractor's control).

1.6 Data Analysis

Analog GPR recordings shall be interpreted by visual inspection of the hard-copy profiles. Reflection patterns judged to represent target objects (or target materials) shall be indicated by annotations on the GPR recordings (or photocopies thereof) and on a plan map.

Digitally-recorded GPR data shall be interpreted by visual inspection of each data-file on a computer monitor or hard-copy printout. Reflection patterns judged to represent target objects (or target materials) shall be indicated by annotations on the printouts (if available) and/or on a plan map.

Estimated reflection depths shall also be indicated on the hard-copy recordings or printouts (if available) and/or on a plan map. These depth estimates shall be based upon GPR signal velocities from geologically-similar sites.

All GPR interpretations shall be checked by a second geophysicist prior to finalizing the survey report.

A report shall be prepared to accompany the interpreted plan map. This report shall describe (at a minimum): a) the estimated survey depth range achieved by GPR at the subject site, b) the positions and appearance of observed reflections, c) survey limitations (e.g., physical obstacles, limited GPR signal penetration, etc.), and d) inferred sources of the observed GPR reflections.

A.17

STANDARD OPERATING PROCEDURE

FIELD DOCUMENTATION, SAMPLE
DESIGNATION, CUSTODY AND HANDLING
PROCEDURES

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.17
FIELD DOCUMENTATION, SAMPLE DESIGNATION, CUSTODY AND
HANDLING PROCEDURES**

1. INTRODUCTION

1.1 Objective

The objective of this standard operating procedure (SOP) is to maintain the integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record keeping will be implemented in the field to allow samples to be traced from collection to final disposition. All information relevant to field operations must be properly documented to ensure that activities are accounted for and can be reconstructed from written records. Several types of logbooks will be used for this purpose and should be consistently used by field crews (e.g., field logbooks, field data sheets). This document describes the procedures to be followed for field documentation, sample designation, handling, and custody.

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP);
- Quality Assurance Project Plan (QAPP); and
- SOP A.22 Procedure to Prepare Samples for Shipment.

2. FIELD DOCUMENTATION

2.1 Field Documentation

During field sampling events, field logbooks and field data sheets are used to record all daily field activities. The purpose of the field logbook is to document events that occur and record data measured in the field.

Data entry will be made in a bound, waterproof field logbook with consecutively numbered pages using indelible ink for each sampling event; all entries will be signed and dated and no erasures will be made. All corrections should consist of a single line-out deletion, followed by the sampler's initials and the date. The sampler will sign and date the last page at the end of each day, and a line will be drawn through the remainder of the page.

The project name, site name and location, and dates of sampling activity should be written on the cover of the field logbook. If more than one logbook is used during a single sampling event, then the upper right-hand corner of the logbook will be annotated (e.g., 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Alternatively, multiple logbooks could be used for different sampling activities (e.g., one logbook for surface water sampling and one for groundwater sampling). When multiple logbooks are used for a single sampling activity (e.g., 2 or more sampling teams operating simultaneously during a single surface water sampling event) logbooks should be annotated alphabetically to indicate which of those books is the primary,

secondary, etc. logbook for that sampling activity, followed by the number of the logbook. For example, if surface water sampling requires 3 teams and each have a logbook to record daily activity over the sampling event then the primary book will be labeled “Log Book A-1” and the others as “B-1” and “C-1.” When only one team is on site, they will use the primary (A) logbook. Field logbooks will be stored in a secure manner when not in use in the field.

In addition to the field logbook, supplementary field data forms may be used during a field sampling event to record the relevant information (e.g. field calibration forms, groundwater monitoring form). At a minimum, the sampler will record the following information daily in the field logbook or on a field sampling form, as applicable:

- Project name, project location, project number and daily objective;
- Project start date and end date;
- Date and time of entry (24-hour clock);
- Time and duration of daily sampling activities;
- Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change;
- Name of person making entries and other field personnel, including the times that they are present;
- Onsite visitors, if any, including the times that they are present;
- The name, agency, and telephone number of any field contacts;
- The sample number and analysis code for each sample to be submitted for laboratory analysis;
- All field measurements made, including the time that the measurement was collected;
- The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates;
- Type of sample gear used (e.g., pump type or model, gill net mesh size, size of core barrel);
- The location and description of the work area, including sketches and map references, if appropriate;
- Specific information on each type of sampling activity;
- The sample type (i.e., groundwater, soil, surface sediment), and sample number;
- Cross-references of numbers for duplicate samples;
- A description of the sample (source and appearance, such as soil or sediment type, color, and odor);
- Log of photographs (number taken, photo number on roll or memory card, brief description of photo) taken at the sampling location, if any;

- Variations, if any, from specified sampling protocols and reasons for deviation;
- References to other logbooks used to record information (e.g., field data sheets, health and safety log); and
- The signature of the person making the entry.

Monitoring or sampling equipment information, including installation information, any maintenance performed on each piece of equipment, calibration information, and other observations relating to the operation or condition of the equipment, will be recorded on field forms, in field logbooks, and/or in a separate field logbook maintained for a specific type of monitoring or sampling equipment. Upon completion of the field sampling event, the field team leader will be responsible for submitting all field logbooks and field data forms to the project data manager to be copied. Hard copy and an electronic copy shall be maintained in the project files.

3. SAMPLE DESIGNATION AND HANDLING

3.1 Sample Labels

A self-adhesive, non-removable label will be affixed to each sample container and completed with an indelible marker prior to sample collection. Sample labels will contain the following information:

- Site name;
- Project number;
- A unique sample identification number (see QAPP for correct sample designation nomenclature);
- Initials of sample collector(s);
- Time and date collected;
- Analysis required; and
- Sample preservative (if applicable).

If samples are likely to contain high concentrations of VOCs or other analytes, the samples will be identified on the chain-of custody forms. Field duplicate or replicate samples will require special procedures for sample designation to ensure that they are submitted as blind samples to the laboratory. The well identification or sample location will not be included in the sample identification number and the collection time will be left blank but recorded in the field log book. The sample and corresponding field QC sample information will be documented in the field records.

3.2 Sample Handling

Each sample container will be sealed in a separate plastic bag following collection. Samples will then be stored in an insulated cooler containing ice packs or ice sealed in a plastic bag. If samples are not immediately shipped to the laboratory, they may be stored in a secure refrigerator/freezer and maintained at the proper temperature. Samples selected for laboratory analysis will be

transferred to insulated coolers for overnight shipment to the laboratory. All samples shipped will be carefully checked against the chain-of-custody form (discussed below). Each cooler will be packed in a manner that will prevent damage to sample containers during shipment in accordance with SOP A.22.

3.3 Sample Custody and Documentation

Chain-of-custody forms will be used to trace the possession and handling of all samples, from their collection, through analysis, until their final disposition. These forms will document the names of the relinquishing and receiving parties, the time and date of the transfer of custody, and the reason for the transfer of custody. One chain-of-custody form will accompany each cooler shipped to the laboratory. In the event that multiple coolers of samples are being sent to the same location, a unique, task specific, sample shipment group identifier and the number of coolers will be added to the top and special instructions portions of each chain-of-custody. The identifier will include the sample task (e.g., SW for surface water, SED for sediment), sample shipment group (SSG), date (year followed by day of year), and cooler destination (e.g., PITT for Test America Pittsburgh, NC for Test America North Canton). The chain-of-custody form will be placed in a sealed plastic bag inside the cooler. A custody seal will be placed on each cooler after packing and prior to shipment. For multiple cooler shipments, the sample shipment group identifier listed on the chain-of-custody will be written on the custody seal, as well as the cooler number designation (e.g., cooler 1 of 2, cooler 2 of 2). Shipping of samples to the laboratory will be accomplished by Federal Express or equivalent overnight service. Samples will remain in the custody of the sampling team until custody is relinquished to the courier service that will transfer the samples to the laboratory. Each sample shipment will be tracked via the courier weigh bill number to ensure that prompt delivery of the shipment to the laboratory has occurred.

Upon receipt by the laboratory sample custodian, the Sample Custodian will note on the form whether the custody seal is intact, the cooler temperature, the presence of air bubbles in any of the water samples submitted for VOC analysis, any damaged sample containers and/or discrepancies between the sample label and information on the form, and sign and date the form. A copy of the chain-of-custody form will then be transmitted to the Project Manager or their designate for their records.

A.18

STANDARD OPERATING PROCEDURE
DECONTAMINATION PROCEDURE FOR
SAMPLING EQUIPMENT

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.18
DECONTAMINATION PROCEDURE FOR SAMPLING EQUIPMENT**

1. INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to direct field personnel in the methods for decontamination of field equipment used in the investigation of sites with chemical Constituents of Potential Concern (COPCs).

1.1 Objective

The objective of equipment decontamination is to remove potential contaminants from a sampling device or item of field equipment prior to, between, and after collection of samples for laboratory analysis and limit personnel exposure to residual contamination that may be present on used field equipment.

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP);
- Quality Assurance Project Plan (QAPP); and
- SOP A.19 Management and Disposal of Investigative Derived Waste.

1.3 Task-Specific Equipment

The following equipment may be utilized when decontaminating equipment. Site-specific conditions may warrant the use or deletion of items from this list.

- Alconox, liquinox or other non-phosphate concentrated laboratory grade soap (Liquinox® is acceptable for PFAS sampling but shall not be used for decontamination when collecting media to be submitted for analysis of 1,4-dioxane);
- Distilled/deionized water from the analytical laboratory;
- Pump sprayers;
- 1-pint squeeze bottles;
- Pesticide-grade acetone;
- 10 percent nitric acid;
- One (1) percent nitric acid;
- Five large plastic wash basins (i.e., 24 inches by 30 inches by 6 inches deep);
- Coarse scrub brushes;
- Small wire brushes;

- Aluminum foil (Aluminum foil shall not be used as part of PFAS sampling);
- Polyethylene sheeting;
- High pressure portable steam cleaner and power supply; and
- Personal protective equipment (PPE) as required by HASP.

2. PROCEDURES

2.1 General

The following procedures should be used for decontaminating field equipment. Procedures will vary with equipment used and potential contaminants present at the site.

2.2 Procedure for Non-Aqueous and Aqueous Sampling Equipment

Soil and sediment sampling equipment, such as grab samplers, split spoon samplers, dredges, shovels, augers, trowels, spoons, bowls, and spatulas will be cleaned using the following procedure. New, unused core liners should be rinsed with site water at the sample location prior to deployment. Larger sample equipment such as the box corer and devices which employ a sample liner will be decontaminated per Section 2.3. Aqueous sampling equipment is to be cleaned in the same manner, although if the aqueous samplers will be used to collect samples for trace level mercury analysis, all materials must be decontaminated in the laboratory according to EPA Method 1669.

1. Place five wash basins in an established decontamination area that has a low permeability liner (e.g., polyethylene) and secondary containment. The decontamination area must be of sufficient size to allow placement of the five plastic wash basins in a line and provide an air drying area for equipment. Decontamination aboard marine vessels will need to follow the same procedures; however, the use of five staged wash bins may not be feasible due to space issues.
2. Fill the first wash basin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of the soap or rinsing the soap residue off the equipment will be difficult.
3. Using a clean coarse scrub brush, wash the sampling equipment in the soap solution in the first basin, removing all traces of visible dirt. Be sure to wash inside surfaces of equipment as well as the exterior surfaces. Allow excess soap to drain off the equipment when finished.
4. Rinse the equipment with tap water in the second basin, using a clean coarse scrub brush or pressure sprayer to aid in the rinse, if necessary.
5. If the equipment is being used to sample for metals, rinse the equipment with nitric acid in the third basin. A 10 percent solution is used on stainless steel equipment. A one percent solution is used on all other equipment. If no metals sampling is being performed, this step may be omitted.
6. Spray down the equipment in the third basin, using potable tap water. Collect rinsate for disposal per SOP A.19.

7. Spray down the equipment in the fourth basin, using pesticide-grade acetone, if sampling for organic compounds is to be performed. Collect any excess acetone for disposal per SOP A.19. If no samples for organic compounds are being collected, this step may be omitted.
8. Allow the equipment to completely air dry on clean polyethylene sheeting.
9. Rinse the equipment in the fifth basin, using distilled/deionized water received from the analytical laboratory.
10. Allow the equipment to completely air dry on clean polyethylene sheeting.
11. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport. Only immediate re-use of equipment on the same day without wrapping in foil is acceptable.
12. Spent cleaning solutions shall be drummed for disposal along with any other contaminated fluids generated during the field investigation for disposal per SOP A.19.
13. Record the decontamination procedure in the field logbook or on appropriate field form.

Note that if temperature or humidity conditions preclude air drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air dry equipment completely prior to reuse should be noted in the field logbook. In this case, additional rinses with distilled/deionized water should be used and recorded.

2.3 Procedure for Large Heavy Equipment

Because heavy equipment pieces (e.g., ATVs, drill rigs) are much larger than sampling equipment and generally come in less direct contact with sampling aliquots, a modified decontamination procedure is appropriate. The following steps outline the decontamination protocol for heavy equipment:

1. Place plastic sheeting on the ground large enough to accommodate equipment to be decontaminated. A decontamination pad may be necessary. The wash pad may consist of a bermed area lined with plastic sheeting with a sump at one corner. A sump pump should be used to remove water from the sump and transfer it to a drum.
2. Use a high-pressure portable steam cleaner to remove potentially contaminated material from the equipment.
3. Scrub equipment with detergent and water to clean soiled surfaces.
4. Thoroughly rinse all surfaces.

A.19

STANDARD OPERATING PROCEDURE

MANAGEMENT AND DISPOSAL OF
INVESTIGATION DERIVED WASTE

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.19
MANAGEMENT AND DISPOSAL OF INVESTIGATION DERIVED
WASTE**

1. INTRODUCTION

This Standard Operating Procedure (SOP) establishes protocols for testing, storage, and disposal of Investigative Derived Waste (IDW). Disposal of laboratory test equipment and supplies will be handled in accordance with the laboratory QAPP.

1.1 Objective

IDW generated during this RI/FS may include:

- Sediments;
- Surface water;
- Photoionization Detector/Flame Ionization Detector (PID/FID);
- Personal Protective Equipment (PPE);
- Disposable sampling equipment;
- Spent decontamination liquids; and
- Plastic sheeting, containers, etc.

The management of these IDW will be conducted to limit exposure of site personnel to hazardous materials and to prevent introduction of contaminated materials to uncontaminated environmental media at the site.

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP); and
- Quality Assurance Project Plan (QAPP).

2. GENERAL MEDIA

Investigation derived waste will be handled and characterized in accordance with the requirements of DER-10. All IDW identified as potentially contaminated with hazardous materials, including NAPL, will be collected at the point of generation and later stored in a designated and clearly marked IDW management area. All containers/drums will also be clearly labeled to indicate the source of the IDW. The IDW storage area will be inspected daily to ensure that storage procedures are adequate to keep the IDW isolated and contained. Potentially contaminated IDW will be identified based on its origin and olfactory and visual evidence (e.g., presence of NAPL). Laboratory testing will be required to determine the proper disposition of these IDW.

The volume of waste will be minimized whenever applicable. Soil, sediment, liquid, and personal PPE IDW will be segregated and separately containerized. The PPE and plastic sheeting will be disposed of as nonhazardous waste unless it has been grossly contaminated. Spent decontamination liquids will be containerized in drums and tested to determine the proper disposal method.

Field personnel will document IDW generation daily in a drum log. A pending analysis label will be affixed to the drum containing the following information:

- Unique ID;
- Generator/Contact Information;
- Date of waste generation;
- Contents of the drum (i.e., soil, groundwater, acetate liners, etc.);
- Origin of contents;
- Site name and address; and
- Percent of drum filled.

After completion of PDI activities, IDW will be sampled for waste characterization and disposed in accordance with DER-10 Section 3.3(e)3.

3. SOIL

Soil cuttings from on-site borings will be handled as follows, in accordance with DER-10 Section 3.3(e)1:

- Soil cuttings will be stored on plastic sheeting and covered with plastic sheeting if they remain on the ground at the end of the day.
- Soil cuttings will be disposed within the borehole from which they were generated to within twelve inches of the ground surface.
- Soil cuttings that do not fit in the borehole or otherwise cannot be disposed in the borehole will be containerized in a steel drum, labeled with appropriate identifying information, and relocated to a secure onsite location for temporary storage.
- The borehole area will be restored after backfilling by backfilling at least the top twelve inches of the borehole with compacted bentonite chips.

4. GROUNDWATER

Water generated through well development, well purging, groundwater sampling and/or by decontamination of investigation equipment will be handled as follows, in accordance with DER-10 Section 3.3(e)5:

- Water will be containerized in a steel drum as it is generated.
- Water will be stored on-site temporarily in an area with secondary containment while awaiting characterization for disposal.

5. SURFACE WATER

Surface water waste may be generated as excess sample material. The required testing and handling of these IDWs will depend on their origin and characteristics. Olfactory, visual observations, and field screening with PID/FID will be used to determine if the surface waters contain potentially elevated levels of hazardous materials. Based on previous site investigations, surface waters are anticipated to not meet the characteristics of hazardous waste. Therefore, unless field observations indicate otherwise, excess sample volumes will be disposed of at the point and time of collection back to the water body.

6. SEDIMENTS

Waste sediments will be generated as excess sample material. The required testing and handling of these IDWs will depend on their origin and characteristics. Olfactory, visual observations, and field screening with PID/FID will be used to determine if the sediments contain potentially elevated levels of contaminants of potential concern (COPC) and direct where confirmation samples will be collected for hazardous waste characterization per the QAPP. It is anticipated that sediments meeting the characteristics of hazardous waste will be encountered. Therefore, as dictated by field measurements, excess sample material will be collected at the point of generation and later stored in a designated and clearly marked IDW management area.

A.20

STANDARD OPERATING PROCEDURE

PROCEDURE TO CALIBRATE FIELD
INSTRUMENTS

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.20
PROCEDURE TO CALIBRATE FIELD INSTRUMENT**

1. INTRODUCTION

1.1 Objective

The objective of collecting *in situ* water quality and air quality data is to obtain representative physical/chemical parameters of the waterway being studied. This objective requires that the instrument be calibrated accurately. Therefore, this standard operating procedure (SOP) establishes procedures for calibrating a multiparameter water meter, and a photoionization detector/flame ionization detector (PID/FID).

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP);
- Quality Assurance Project Plan (QAPP); and
- SOP A.18 Decontamination Procedure for Sampling Equipment.

1.3 Task-Specific Equipment

- Boots, waders, and other personal protective equipment (PPE) as required by HASP;
- Water quality sondes (YSI 6-series);
- Stainless-steel weights;
- Sample containers;
- Coolers;
- Ice;
- Tape measure;
- Paper towels;
- Trash bags (one for IDW and one for general trash);
- Spare equipment batteries;
- Calibration solutions; and
- Laptop computer (for data download, verification of proper data storage on the YSI, and direct data logging) with ECOWIN software; and Decontamination equipment (see SOP A.18).

2. PROCEDURES

2.1 Calibration of Water Quality Sonde

Water quality sondes are to be calibrated at the beginning of each sample day and checked for accuracy at the end of each sample day.

2.1.1 Daily Calibration

Water quality sondes shall be used to monitor *in situ* turbidity levels (in NTU), temperature, dissolved oxygen (DO), pH, conductivity, and oxidation-reduction potential (ORP). Sondes will be calibrated at the beginning of each work day. Calibration will be performed using calibration solutions and procedures prescribed by the manufacturer instructions. The general method of calibration for each sensor is described below.

- DO: two-point calibration including zero and 100% saturation (in air);
- Conductivity: single-point calibration;
- Temperature: factory-calibrated (temperatures of all calibration standards should be recorded during calibration);
- pH: two-point calibration including pH values of 4.0, 7.0, or 10.0.;
- ORP: single-point calibration; and
- Turbidity: two-point calibration including standards 0 NTU, 10.0 NTU, 12.7 NTU, 100.0 NTU, 126.0 NTU, 800.0 NTU or 1000.0 NTU.

The sonde will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on the applicable field forms (e.g. field calibration form). Calibration will also be checked if any readings during sampling are suspect.

2.1.2 End-of-Day Check

At the end of each day, the sondes used for manual sampling should be checked against known standards to confirm that probes are reading correctly. This is done by submerging the probe in the calibration solution used at the beginning of the day and recording the readings, following equipment decontamination per SOP A.18. If the reading is not within the accuracy limits of the probe compared to the calibration value, the information should be recorded in the log book and on the Field Log for the locations visited that day.

2.1.3 Decontamination

The sonde will be decontaminated between each sampling location. Decontamination shall be performed according to SOP A.18. Personnel and PPE decontamination shall be performed in accordance with the HASP.

2.2 Calibration of the PID/FID

PIDs/FIDs are to be calibrated at the beginning of each sample day and checked for accuracy at the end of each sample day.

2.2.1 Daily Calibration

A PID/FID equipped with a 10.6 eV lamp shall be used to screen sediment samples for VOC impacts. PID/FIDs will be calibrated in a clean environment at the beginning of each workday using a two-point field calibration for zero and span gas. The zero calibration, which is made with fresh air, is followed by a second calibration using a 100 ppm isobutylene gas cylinder. Readings will be recorded and should closely match the respective span gas value. Calibration will adhere to procedures prescribed by the manufacturer instructions.

The PID/FID will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on the applicable field forms (e.g. field calibration form). Calibration will also be checked if any readings during sampling are suspect. The battery should be charged overnight.

2.2.2 End-of-Day Check

At the end of each sampling day, the PID/FID will be checked for accuracy by analyzing fresh air and 100 ppm isobutylene. The readings should be recorded and fall within the accuracy limits of the probe compared to the calibration value. If the readings are outside of the accuracy limits, then it should be noted in the log book and on the Field Log for the locations visited that day.

A.21

STANDARD OPERATING PROCEDURE
RECORDING STATION LOCATION POSITION WITH
A GPS

**LYDALL PERFORMANCE MATERIALS (US), INC. –
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.21
RECORDING STATION LOCATION POSITION WITH A GPS**

1. INTRODUCTION

1.1 Objective

The objective of this standard operating procedure (SOP) is to establish standard procedures for recording sample location position with a global positioning system (GPS). Recording the location of field acquired data is essential to understanding contaminant distribution and necessary if returning to the location of collection is necessary during future sampling activities.

This SOP provides basic steps to guide the process of collecting, editing, and reporting accurate spatial data using Global Positioning System (GPS) technology. The intended audience of this document includes all personnel involved in planning and conducting GPS surveys, as well as processing and reporting GPS data sets. This SOP is not intended as a detailed user manual for specific brands of GPS receivers, operating systems or software applications.

1.2 GPS Receiver Types

There are three classes of GPS receivers:

- Recreational “hand-held” receivers: for basic navigation; accurate to within 15 meters with a 95% confidence.
- Mapping-grade receivers: for storing mappable features; accurate in the 1 to 5-meter range; allow for post-collection differential correction.
- Geodetic-grade receivers: for applications that require extremely high accuracy, often to less than a centimeter.

The project-specific needs will determine the type of GPS receiver that is required to be used. A geodetic-grade receiver is not covered in this SOP, as its use would be limited to a surveyor specifically trained and subcontracted to the project for this purpose. Use of the hand-held receiver and mapping receiver are covered; however, the specific unit’s owner’s manual should additionally be consulted. Generally, fixed locations, such as soil and sediment samples, will be captured using a mapping-grade GPS and mobile resources, such as general areas of surface water collection or biota surveys, will be captured using a hand-held GPS.

1.3 Equipment

- GPS receiver and antenna;
- GPS owner’s manual;
- Writing tools (pencils, Sharpie[®]);

- Field log book and applicable supplementary field data forms;
- Spare batteries and/or battery charger;
- Compass; and
- Tape measure.

2. PLANNING AND IMPLEMENTING A GPS SURVEY

The following sections outline the basic steps involved in systematic planning and conducting a GPS survey. In order to complete a successful GPS survey, several steps must be taken prior to using the receiver in the field. These steps will apply to the use of any of the various GPS receivers.

Field teams are encouraged to ensure that personnel are cross-trained to perform GPS coordination activities. Alternatively, field team may consider appointing and training interested staff members to serve as GPS coordinators. Most of the steps in the pre-survey and post-survey process will be conducted in conjunction with, or entirely by, the GPS coordinator. Equipment may be on loan to those employees who have been trained on the use of the GPS receiver. Those who require training or feel that retraining is necessary must notify the GPS coordinator well in advance of a proposed GPS survey so arrangements can be made for training.

2.1 Pre-planning Activities

The Field Team Leader should develop the following planning items in cooperation with the GPS coordinator.

2.1.1 Define Objectives of the Survey

It is important to initially establish the ultimate objectives of a GPS survey, including Data Quality Objectives (DQOs). Recognition of these objectives early in the project planning process will help to focus the rest of the planning phase. The accuracy requirements for the positional data must be defined and should be consistent with available program guidance on positional accuracy. In the absence of published program guidance on positional accuracy tiers to meet specific program needs, the following Interim Quality Categories provide benchmarks for establishing quality controls based on the intended use. Data collections for Category I use would dictate more stringent quality controls and potentially higher accuracies than Category IV use.

Category I: For enforcement, litigation, direct support of rules & regulations, projects of national significance and highly influential scientific assessment

Category II: Development of rules & regulations and influential scientific information

Category III: Validation, general applications and feasibility studies

Category IV: Screening, exploratory and pure knowledge

From the discussion above, some distinct survey objectives may include:

- Registration of remotely sensed photography or imagery with ground control locations to support enforcement actions;

- Evaluation of locational data quality of existing data to validate survey maps; and
- Collection of new data following precise coordinates in a monitoring plan to support rule development.

NOTE: On a case-by-case basis, the user should consider the impact of various factors when determining the appropriate QA Category. These factors include, but may not be limited to:

- National Geospatial Data Policy (NGDP) Accuracy Tiers;
- Dwell Time;
- Number of Monuments, etc.; and
- QA categorization of Dilution of Precision (DOP) is provided as a suggestion/example below - section (2.1.7) Equipment Testing and Logistics.

2.1.2 Define Project Area

This step is designed to establish the overall project area and define the limits of the survey. Maps and/or aerial photos should be utilized extensively to familiarize the crew with the area prior to the actual field work. For identifying the study area and surrounding environment, 7.5-minute topographic maps are ideal. For locating particular sites by address, a local street map will be required. A complete understanding of the transportation network in the project area will also enable the field crew to maximize the effectiveness of their field time. Much of this information may already be available in digital form and may be used directly in conjunction with GPS site planning as well as validating the capture of the GPS locations.

2.1.3 Determine Observation Window and Schedule of Operations

This step involves determining the precise window of satellite availability and scheduling accordingly. With approximately 31 GPS satellites and 9 GLONASS satellites available for use, satellite links generally are restricted for very short periods of time (usually less than 40 minutes in a continuous block of time and less than 1 hour during a 12-hour time period) during the day, in open environments. However, in cities with many nearby tall buildings, GPS signals may be difficult to receive. Updated satellite configuration and orbit information can be accessed via the Internet. "Trimble Planning Software" from Trimble Navigation is an easy-to-use software program, which provides information critical to the various components of planning a GPS survey: satellite availability, elevations, azimuths, and Geometric Dilution of Precision (GDOP) calculations. However, there are many other easy to use software programs to assist users in updating. Some sites may be specifically designed for desktop, laptop, or handheld devices. Site sources and URLs may change frequently, therefore, users are encouraged to find the best site for their hardware and purpose, and ensure that the source of update is recorded in a notebook. For differential corrections against a base station, the rover must "see" the same satellites as the base. Accuracy is heavily dependent upon the amount of observation time and number of observations taken at each point. It is generally agreed that observation time can be reduced by increasing the quality of observation, i.e., observing a maximum number of satellites during viewing periods.

NOTE: "Trimble Planning Software" [2.74 (.zip file)] can be downloaded from http://www.trimble.com/planningsoftware_ts.asp

Download and install "Installation Program for Planning" software. Download the GPS satellite almanac from Trimble GPS Data Resources. If you are in an area with obstructions, select FileStation and click obstacles to enter the elevation and azimuth to define the obstruction. You should then be able to display the DOP relating to that location to better plan your survey. If you are occupying multiple stations at the same time, use File - Multistation in addition to defining the information for each station.

2.1.4 Establish Control Configuration

For high accuracy work, generally sub-meter range, known control points and/or benchmarks should be located for both horizontal and vertical control. This is usually accomplished by researching the records of various federal, state, and local agencies such as the National Geodetic Survey (NGS) or the state geodetic survey. It is advisable to have, if possible, at least two control points each for both vertical and horizontal positions so that there is a double check for all control locations. Vertical accuracy is typically half of the horizontal accuracy. Any additional control points may be done by using centimeter GPS. NGS benchmark information can be obtained at <http://www.ngs.noaa.gov>. NOTE: When high accuracy readings, such as sub-meter range, are required for a project, such as a Category I, the user must have substantial technical know-how, perhaps high-end GPS hardware and definitely advance preparation. For the Category I project types, users may consider contracting for professional land surveyor services. Data obtained by non-certified personnel may be inadmissible in litigation. Project Officers are encouraged to contact their local Office of General Council for consultation regarding concerns of admissibility.

It is important that the reference datum within which the monument is located be defined. For horizontal coordinates, the North American Datum of 1927 (NAD 27) or the newer Datum of 1983 (NAD 83) will be specified. For vertical control coordinates, the National Geodetic Vertical Datum of 1929 (NGVD 29) or the new North American Vertical Datum of 1988 (NAVD 88) will be referenced. If the NGS has redefined the benchmark coordinates to correspond to the newer datums, coordinates will be available for both datums. In translating GPS elevations to vertical elevations, the geoid used should be identified.

2.1.5 Select Survey Locations

Obtain a list of the facilities or features targeted for data collection. One suggested approach is to organize the site lists alphabetically by city and alphabetically by street name within each city as well as by zip code. This approach will facilitate initial route planning to visit each survey location and serve as a master list. If possible, plot the general location on a field map and highlight a local street map to serve as a general navigation aid. Similarly, project personnel should also plot potential base stations to serve as control points on a 7.5-minute topographic map and local street map. The survey points/areas should have continuous and direct line-of-sight to the path of the satellites in the sky. If the survey point to be obtained is located on private property, care should be taken to pursue appropriate notification and access protocol. This includes preparation of a letter of introduction and formal contact with the property owner/manager.

2.1.6 Co-ordinate Pre-Survey Plans

The Field Team Leader should contact the GPS Coordinator to identify and discuss the following items prior the GPS survey:

- **Objectives.** Objectives of the survey, particularly Data Quality Objectives since DQOs will highlight required data accuracies (sub-meter, 1-5 meters) and in turn, dictate the type of equipment needed.
- **Identification.** Identification of the numbers of features to be mapped and time allotted for the survey.
- **Availability.** The availability of the GPS equipment for the required dates. Features. What features will be mapped, sample point location identification, and how they should be represented (points, lines, areas).
- **Checklist.** A checklist of each feature to be mapped so that none will be overlooked in the field.
- **Site Maps.** Site maps for determining survey location with the identification features to be mapped and mapping sequence.
- **Reconnaissance.** Determine the presence of any obstructions to satellite signals such as buildings or tree canopies.
- **Data Format and Storage.** Data capture requirements and data format to facilitate postprocessing at the conclusion of the survey.

2.1.7 Equipment Testing and Logistics

Action items for equipment testing and logistics include determination of equipment availability (laptop PDA, GPS units, and transport vehicle), checking equipment for necessary repair and maintenance (batteries charged in PDA and GPS unit, laptop or PDA loaded with necessary software and map data), and ensuring that the receiver is functioning properly. Operation manuals provided by the vendor should be referenced to complete system checks on the equipment.

Modern GPS units contain many settings that can serve as quality checks during data acquisition. For instance, a minimum number of visible satellites can be specified for data acquisition. The unit will provide a warning signal if less than the minimum specified are available. Four satellites in view are the minimum required, but additional satellites can provide the receiver with stronger signals to select from and perhaps better geometry for calculation. GPS receivers can also calculate a DOP value for horizontal (HDOP), for time (TDOP) and general position (PDOP). Position Dilution of Precision (PDOP) is most often referenced with lower values leading to more accurate measures. PDOP values of 6 or less are generally acceptable and limits on PDOP can be programmed into the unit or software that interfaces with the receiver. See table titled DOP Values in Relation to Data Quality Categories below:

2.1.8 DOP Values in Relation to Quality Categories

DOP Value	Rating	Description	Suggested for Quality Category
1	Ideal	Highest possible confidence level.	I
2-3	Excellent	Meets all but most demanding needs.	I or II
4-6	Good	Appropriate for most needs.	II, III, or IV
7-8	Moderate	For less demanding uses. Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.	IV
DOP Value	Rating	Description	Suggested for Quality Category
9-20	Fair	Low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.	Not recommended
>20	Poor	Very low confidence level. Measurements are inaccurate by as much as half a football field and should be discarded	Not recommended

2.2 Survey Execution

The actual GPS survey consists of:

2.2.1 Establishing a Schedule of Operations

This step involves determining the window of satellite configuration availability and scheduling the GPS sessions. The schedule is dependent on the size of the crew, the level of accuracy desired, and the logistics of setup and travel between control points. Maximum data quality and collection efficiency can be obtained by arranging data collection periods to coincide with periods of 3-D or better satellite visibility.

2.2.2 Pre-Survey: The Day Before

Charge all batteries, make note if GPS unit(s) can be charged through the automobile. Many GPS collection systems utilize a battery system which requires either 8-hour or overnight charging. Review the travel routes to survey sites and base stations, if required, and coordinate with local personnel. Review use of unfamiliar equipment and understanding of procedures.

2.2.3 Pre-Data Collection: Establishing a Base Control Station(s)

The type of survey will dictate if any base control stations in the field are required. If required and the location(s) is not secure or if the data collection period is particularly long, part of the survey crew may be required to remain at the site. Logistical considerations will need to be scheduled, i.e., shut down periods for downloading files, changing battery packs, and when to terminate collection. Once a setup at a base station begins, the GPS units will need to be initialized. Depending upon the location and familiarity with equipment, this activity can take anywhere from a few minutes to a couple of hours.

2.2.4 Data Collection: Performing the GPS Survey

The crew must warm up, check, and program the receiver for proper operation. Most vendors currently recommend collecting fixes for discrete point data for a period of 3-5 minutes, at 1-or 2-second intervals. Vendor documentation should be consulted for the recommended time on station and sample interval to obtain the most accurate results. Depending on the unit being utilized, sufficient battery power must be available. For high accuracy work, the receiving antenna should be leveled on a tripod and centered exactly over the control point location. Log sheets containing critical information on position, weather, timing, height of instrument, and local coordinates must be maintained. Once the session is completed, the receiving equipment must be disassembled and stored. The log and tape files should then be documented and saved. If the survey to be performed will span numerous days, it is likely that the data will be transferred from the GPS to a laptop PC with some regularity. Data from the base station as well as the roving unit will need to be collected with equal frequency.

2.3 Data Assessment, Processing and Validation

Post-processing should be conducted after returning from the field. Tools for post-processing are more easily used and controlled in an office environment. The common steps in post-processing are transferring the data from the field to office workstations, conducting the initial stages of processing, computation of the solutions for critical factors, data conversion for use in a GIS, and the final documentation and reporting. Each of these stages is discussed in detail below. Data assessment and validation should integrate in each stage.

2.3.1 Data Transfer

There are currently two common methods of collecting data in the field: using a GPS unit with a data logger or using a GPS unit attached to a laptop/notebook/PDA computer. With the latter method some users subsequently perform all processing directly on the same device. More commonly, data are transferred into a computer. This consists of reading the raw data from the GPS unit into a structured data base for processing. As with any computer data, backup copies should be made immediately. Validation should consist of reviewing the contents of the data logger or computer file against the survey plan and field notes to ensure that the data transfer has occurred properly and that file and directory names are adequate to link the data to specific field operations or features.

2.3.2 Data Assessment and Initial Processing

The electronic GPS data stream may not be immediately useable. It normally consists of satellite navigation messages, phase measurements, user input field data and other information that must be transferred to various files for processing before computations can be accomplished. Depending upon the hardware and software vendor, many of these operations are transparent to the user.

In some instances, depending on the type of maintenance and upgrades that are going on to the NAVSTAR constellation at the time of the survey, utilization of the actual ephemeris rather than the ephemeris projected prior to the survey date may improve solution accuracy. Actual ephemerides are available 2 weeks after a given survey date.

In the data screening and editing, there are at least three considerations that might be taken in editing. Outlier position data can be removed from a data file. This editing should be guided by establishing an absolute deviation threshold, using the mean coordinate as a reference. The threshold criteria might be varied to determine the sensitivity of the solutions to this editing. Data points collected immediately after a break in the data stream, such as in the event of masking, should be edited out because these positions will be less reliable.

The majority of processing operations are typically performed "automatically" by the application software. Occasionally, the scientist (or operator) may need to override automatic computer operations. In these instances, scientist (or operator) should document the judgments made and identify the manual operations in the appropriate notebook.

2.3.3 Computation

This component uses the preprocessed data to compute the network of sites and give a full solution showing geographical coordinates (latitude, longitude and ellipsoidal height), distances of the vectors between each pair of sites in the network, and several assessments of accuracy of the various transformations and residuals of critical computations. This is usually accomplished by the vendor post-processing software and may be transparent to the user.

2.3.4 Data Conversion to GIS

Data conversion is accomplished by use of data export utilities provided by the GPS vendor. These utilities should accompany the data processing software packaged with the GPS equipment. Example formats are: ArcView, ArcGIS, dBase, ASCII, MapInfo, AutoCAD, etc. Before exporting, ensure that the correct coordinate system and datums are chosen. The default coordinate system should be the Geographic Coordinate System which provides unprojected latitude/longitude values. The default datum is NAD83 for horizontal coordinates and NAVD88 for vertical coordinates. Note that GPS units initially capture data using the WGS84 horizontal datum but can be usually converted to the NAD83 datum during the data export process. Care should be taken in reporting the proper datum upon completion of the conversion process.

3. TYPICAL RECORDING PROCEDURES

This section provides the typical procedures to be followed when recording the location of field acquired data.

1. Turn GPS on outside in an open area. Wait for antenna to receive satellite signals. Continue to wait until a minimum number of satellites are acquired to achieve an appropriate PDOP (see Section 2.1 for ranges).
2. Move the GPS to the location of the sample. Try to remain still or if on a boat ensure that the boat is still. Press the appropriate key strokes to mark a waypoint (see Owner's Manual).
3. Record the waypoint name in the field logbook. It is good practice to also record the coordinates (latitude and longitude). If the GPS is capable of downloading waypoint names and associated coordinates to a file readable by PC, then recording the coordinates in the logbook may be skipped.
4. If the GPS cannot be placed on the location of the sample record the distance and compass direction to the location as an "offset". This information should be recorded in the field logbook and used to correct the position at a later time.
5. At the end of each day, if equipped, the data file should be downloaded to a PC and transmitted to the project data manager for incorporation into the project geographic information system (GIS).
6. If the coordinates are recorded by hand in the field log book, they should be entered into a spreadsheet with the sample location name and submitted to the project data manager for incorporation into the project GIS.

A.22

STANDARD OPERATING PROCEDURE

PROCEDURE TO PREPARE ENVIRONMENTAL
AND GEOTECHNICAL SAMPLES FOR SHIPMENT

**LYDALL PERFORMANCE MATERIALS (US), INC.–
HOOSICK FALLS, N.Y.
STANDARD OPERATING PROCEDURE A.22
PROCEDURE TO PREPARE ENVIRONMENTAL AND
GEOTECHNICAL SAMPLES FOR SHIPMENT**

1. INTRODUCTION

1.1 Objective

The objective of this standard operating procedure (SOP) is to establish packaging and shipping requirements and guidelines for shipping environmental and geotechnical samples. Proper packaging and shipping is necessary to ensure the protection of the integrity of samples shipped for analysis.

The term “Environmental Sample” refers to any sample that has less than reportable quantities of any hazardous constituents according to Department of Transportation (DOT) 49 CFR - Section 172.

1.2 Referenced Documents and SOPs

- Department of Transportation (DOT) 49 CFR - Section 172;
- Health and Safety Plan (HASP);
- Quality Assurance Project Plan (QAPP);
- SOP A.17 Field Documentation, Sample Designation, Custody and Handling Procedures;
- Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils (ASTM D1586); and
- Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes (ASTM D1587).

1.3 Task-Specific Equipment

- Coolers with an appropriate return address taped to the inside lid;
- 4-foot tall fiberboard or polyethylene shipping drums with integral bottom and sealable top or wooden crate (for geotechnical samples);
- Heavy-duty, large plastic garbage bags;
- Plastic Zip-lock bags, small and large or glass jars with twist on caps;
- Writing tools (pencils, Sharpie[®], etc.);
- Fiber tape or clear plastic packing tape;
- Duct tape;

- Packing peanuts, saw dust, or other flowable inert bulk packing material (optional);
- Bubble wrap (optional for plastic sample containers; required for glass sample containers);
- Wet ice or dry ice (for environmental samples, depending on sample requirements and availability);
- Chain-of-Custody seals;
- Completed Chain-of-Custody record or CLP custody records if applicable;
- Completed Bill of Lading; and
- Tape measure or folding rule for core samples; and □ Sealing wax and heater.

1.4 Collection Methods

Environmental samples may be collected in bottles or jars (Section 2.1) or in core liners (Section 2.2). Soil/sediment samples for geotechnical analysis may be collected in jars by split-spoon sampling in accordance with ASTM D1586 (Section 2.3), in thin-wall tubes in accordance with ASTM D1587 (Section 2.4), or in plastic bags by sonic drilling (Section 2.5).

2. PROCEDURES

2.1 Chain of Custody

The field chain-of-custody record must be used to record the custody of all samples or other physical evidence collected and maintained. Chain-of-custody records will be maintained in accordance with SOP A.17 and the QAPP.

2.2 Shipping Bottled or Jarred Samples for Environmental Analysis

The following steps must be followed when packing jarred samples for shipment:

1. Select a sturdy cooler in good repair. If dry ice will not be used for shipment, secure and tape the drain plug (inside and outside) with duct tape. However, if samples are to be shipped on dry ice, tape the drain plug in the open position to allow venting.
2. Confirm that labels and chain-of-custody records are completed properly.
3. Be sure the caps on all bottles are tight (will not leak). Place all bottles in separate and appropriately-sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Glass bottles will be wrapped in bubble wrap.
4. All sample bottles and jars will be placed in the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather than horizontally.
5. Place two inches of bubble wrap or packing peanuts into a heavy-duty, large garbage bag in the cooler and then place the bottles and cans in the bag with sufficient space to allow for the addition of ice between the bottles, jars, and cans.

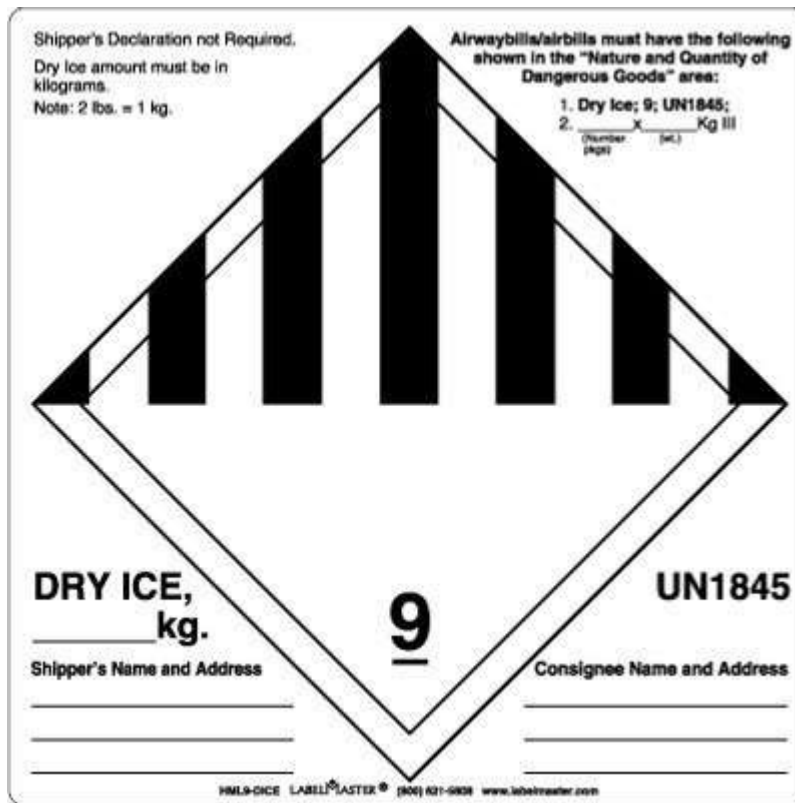
6. Put wet ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place these ice bags on top of, or between, the samples. Place a temperature blank in the cooler. If necessary, any additional space in the cooler (after sufficient ice has been included) should be filled with more bubble wrap or packing peanuts to prevent the samples from shifting within the cooler during shipping. Securely fasten the top of the large garbage bag with tape (preferably duct tape).
7. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-top bag, close the bag and tape it to the inner side of the cooler's lid, and then close the cooler.
8. Completed Chain-of-Custody seals are affixed to the top opposite sides of the cooler. Wrap clear tape over custody seals. Fiber tape shall be wrapped around the cooler opening and around the width of the cooler a minimum of two and a half times so that the cooler cannot be opened without breaking the seal.
9. The shipping containers must be marked with FRAGILE, THIS END UP, and arrow labels, which indicate the proper upward position of the container. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted to be on the outside of the container used to transport environmental samples and shall not be used. The exception to this is for samples that are to be shipped frozen on dry ice. These sample containers must be labeled with the proper dry ice label (see attached) with the quantity of dry ice indicated.
10. The sample coolers are typically shipped by overnight express courier to the laboratory. Securely attach the courier's shipping label with tracking number to the outside of the cooler. A copy of the shipping invoice is retained by the Site Manager and becomes part of the sample custody documentation.
11. The field manager should contact the laboratory ahead of time to inform laboratory personnel of the number of samples, analytes, courier service, and other pertinent information to ensure the integrity of sample results. All shipping procedures will comply with DOT regulations (49 CFR 173 to 177) and the International Air Transportation Association (IATA).

2.3 Shipping Core Samples for Environmental Analysis (Non-Geotechnical Samples)

The following steps must be followed when packing sediment cores for non-geotechnical analysis for shipment:

1. Fill void space of cores with plastic wrap and/or Styrofoam to minimize core movement. In the field, seal the core with Teflon film and duct tape on plastic end caps. Label core sections with the location identification; top and bottom depths/elevations (fractions of a foot should be recorded in tenths); place an arrow on the section indicating the upward direction; and, label multiple sections from one core sequentially with A, B, C, etc. starting with A on the top (shallowest) section.
2. Select a large marine cooler (72, 94 or 100 quarts) in good repair and insert a shock absorbent layer consisting of foam, bubble wrap, or packing peanuts in the bottom of

- the cooler. Secure and tape the drain plug (inside and outside) with duct tape. If wet ice is to be used in shipment, seal the wet ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal.
3. Wrap each section of core in one layer of bubble wrap. As soon as possible, place a single layer of sediment core samples on top of the wet or dry ice.
 4. Place a layer of dry ice pellets over the core. Place another layer of bubble wrap, and another set of cores with additional dry ice pellets, with a layer of bubble wrap covering. Continue alternating layers of core, packing material and dry ice, but do not exceed three layers of core. Fill the remaining void space with dry ice.
 5. When packing sediment cores for analytical laboratory analysis, place a temperature blank in the cooler. If necessary, any additional space in the cooler (after sufficient ice has been included) should be filled with more bubble wrap or packing peanuts to prevent the samples from shifting within the cooler during shipping. Securely fasten the top of the large garbage bag with tape (preferably duct tape).
 6. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-top bag, close the bag and tape it to the inner side of the cooler's lid, and then close the cooler.
 7. Completed Chain-of-Custody seals are to be affixed to the top opposite sides of the cooler. Wrap clear tape over custody seals. Fiber tape shall be wrapped around the cooler opening and around the width of the cooler a minimum of two and a half times so that the cooler cannot be opened without breaking the seal.
 8. The cooler must be marked with "FRAGILE," "THIS END UP" and arrow labels, which indicate the proper upward position of the container. A label containing the name and address of the shipper shall be placed on the outside of the container.
 9. The sample containers must be labeled with the proper dry ice label (see attached) with the quantity of dry ice indicated.
 10. Securely attach the courier's shipping label with tracking number to the outside of the cooler. A copy of the shipping invoice is retained by the Site Manager and becomes part of the sample custody documentation.
 11. The field manager should contact the laboratory ahead of time to inform laboratory personnel of the number of samples, analytes, courier service, and other pertinent information to ensure the integrity of sample results. All shipping procedures will comply with DOT regulations (49 CFR 173 to 177) and the International Air Transportation Association (IATA).



Dry ice label to be affixed to all coolers containing dry ice.

2.4 Shipping Split Spoon Samples for Geotechnical Analysis

The following steps must be followed when packing split spoon samples for shipment:

1. All split spoon samples are to be collected as discussed in ASTM D1586. Be sure that the samples are kept in either sealable Ziplock bags or glass jars with twist on caps.
2. Check to see that labels and chain-of-custody records are completed properly.
3. Select a sturdy shipping container such as plastic bucket with a cap or plastic bin with a cap.
4. Fill bottom of shipping container several inches deep with bulk packing material.
5. Pack the shipping container with samples. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather than horizontally.
6. Any additional space in the shipping container should be filled with more bubble wrap or packing peanuts to prevent the samples from shifting within the cooler during shipping.

7. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-lock bag, close the bag and tape it to the inner side of the shipping container's lid, and then close the container.
8. Completed Chain-of-Custody seals are affixed to the top opposite sides of the container. Wrap clear tape over custody seals. Fiber tape shall be wrapped around the container opening and around the width of the container a minimum of two and a half times half so that the cooler cannot be opened without breaking the seal.
9. The shipping containers must be marked with THIS END UP, and arrow labels, which indicate the proper upward position of the container. A label containing the name and address of the shipper shall be placed on the outside of the container.
10. Securely attach the courier's shipping label with tracking number to the outside of the container. A copy of the shipping invoice is retained by the Site Manager and becomes part of the sample custody documentation.
11. The field manager should contact the laboratory ahead of time to inform laboratory personnel of the number of samples, courier service, and other pertinent information to ensure the integrity of sample results. All shipping procedures will comply with DOT regulations (49 CFR 173 to 177) and the International Air Transportation Association (IATA).

2.5 Shipping Thin-Wall Tube Samples for Geotechnical Analysis

The following steps must be followed when packing thin-wall tube spoon samples for shipment:

1. All thin wall tube samples are to be collected as discussed in ASTM D1587. Once removed from the ground, maintain the sample in a vertical (upright) position during all subsequent handling and shipping.
2. Measure length of the recovered sample (from the top of the tube and from the bottom of the tube) and record recovery versus attempted sample length. Exercise care to not lose any liquid from the tube when recovering and capping.
3. If either end of sample is not flush with the ends of the tube, it will be necessary to seal the exposed end of the soil sample with sealing wax and pack the remaining void.
4. Pack remaining void between sealed end of soil and end of tube with rolled bubble wrap that fits snugly into the inside of the tube.
5. Seal the ends of the tube with push-on plastic caps. Tape caps to tube using duct tape.
6. Label tube with sample identification information. Wrap each tube with one or two layers of bubble-wrap and tape tightly.
8. Select a sturdy shipping container such as a heavy duty drum or custom made wooden crate with internal braces to support the samples in an upright position.
9. Fill bottom of shipping container several inches deep with bulk packing material.

10. Place tube samples vertically (upright) inside shipping container keeping several inches of space between samples and wall of drum.
11. Any additional space in the shipping container should be filled with more bubble wrap or packing peanuts to prevent the tubes from shifting within the container during shipping.
12. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-top bag, close the bag and tape it to the inner side of the shipping container's lid, and then close the container.
13. Completed Chain-of-Custody seals are affixed to the top opposite sides of the container. Wrap clear tape over custody seals.
14. Seal top of shipping container.
15. Label drum "THIS END UP" and "CONTAINER MUST REMAIN UPRIGHT".
16. The field manager should contact the laboratory ahead of time to inform laboratory personnel of the number of samples, courier service, and other pertinent information to ensure the integrity of sample results. All shipping procedures will comply with DOT regulations (49 CFR 173 to 177) and the International Air Transportation Association (IATA).

2.6 Shipping Sonic Core Samples for Geotechnical Analysis

The following steps must be followed when packing sonic core samples for shipment:

1. All samples selected from a sonic core must be placed in a double sealed plastic zip-lock bag (typically one bag sealed within another sealed bag).
2. Check to see that labels and chain-of-custody records are completed properly.
3. Select a sturdy shipping container such as a plastic bin with a hinged lid. Bins should be able to handle multiple samples.
4. Wrap each section of core in one layer of bubble wrap.
5. Fill bottom of shipping container several inches deep with bulk packing material.
6. Pack the shipping container with samples. Any additional space in the shipping container should be filled with more bubble wrap or packing peanuts to prevent the samples from shifting within the cooler during shipping.
8. Place the completed Chain-of-Custody Record for the laboratory into a plastic zip-lock bag, close the bag and tape it to the inner side of the shipping container's lid, and then close the container.
9. Completed Chain-of-Custody seals are affixed to the top opposite sides of the container. Wrap clear tape over custody seals.
10. A label containing the name and address of the shipper shall be placed on the outside of the container.

11. Securely attach the courier's shipping label with tracking number to the outside of the container. A copy of the shipping invoice is retained by the Site Manager and becomes part of the sample custody documentation.
12. The field manager should contact the laboratory ahead of time to inform laboratory personnel of the number of samples, courier service, and other pertinent information to ensure the integrity of sample results. All shipping procedures will comply with DOT regulations (49 CFR 173 to 177) and the International Air Transportation Association (IATA).