

# NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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## Via E-mail

Kevin Krueger, P.E.  
Unisys Corporation  
Corporate Environmental Affairs  
3199 Pilot Knob Road  
Eagan, MN 55121

December 6, 2024

**Re: Quality Assurance Project Plan (QAPP)/Field Sampling Plan (FSP)  
Former Sperry Remington Site – North Portion – NYSDEC Project #C808022  
777 South Main Street, City of Elmira, Chemung County, NY**

Dear Kevin Krueger:

The New York State Department of Environmental Conservation (NYSDEC), in consultation with New York State Department of Health (NYSDOH), **approve** the document entitled Quality Assurance Project Plan (QAPP)/Field Sampling Plan (FSP), Former Sperry Remington Site dated November 22, 2024.

Please provide a compiled final report, including this cover letter to the Agency and document repository.

Please contact me at (585) 226-5351 if you have questions regarding this letter.

Sincerely,



Kaleigh Zappia  
Assistant Engineer (Environmental)

J. Huha / A. Krasnopoler / E. Tollefsrud  
D. Pratt / M. Cruden / D. Loew  
S. Bogardus / J. Deming  
H. Austin / T. Tuori / J. Magliocca

22 November 2024

Ms. Kaleigh Zappia  
New York State Department of Environmental Conservation  
Division of Environmental Remediation, Region 8  
6274 East Avon-Lima Road  
Avon, New York 14414-9519

**Subject: Response to Comments – Quality Assurance Project Plan (QAPP)/Field Sampling Plan (FSP)**

Former Sperry Remington Site – North Portion (#c808022)  
777 South Main Street, City of Elmira, Chemung County, New York

Dear Ms. Zappia:

On behalf of Unisys Corporation (Unisys), Geosyntec Consultants, Inc., and its New York engineering affiliate, B&B Engineers & Geologists of New York, P.C. (collectively, Geosyntec) are responding to the New York State Department of Environmental Conservation’s (NYSDEC or Agency) 13 November 2024, comments on the QAPP/FSP for the Former Sperry Remington Site – North Portion (#c808022), dated 17 July 2024.

The following presents each comment provided by NYSDEC (shown in italics) and Unisys’ response. For ease of review, headings and numbering used in the NYSDEC comment letter are retained herein.

**General Comments**

1. *Inconsistencies observed within Project Organization (i.e. project team members report text and Appendix A provided resumes) must be corrected.*

**Response:** The section has been updated and appropriate resumes have been included in the Appendix.

2. *Sampling collection must be in accordance with applicable regulations, replace instances of “in general accordance” with “in accordance” throughout the document text.*

**Response:** The text has been revised to remove the word “general” before accordance.

3. *Update Table 1 – Analytical Reference Limits and Screening Values – Solids. Units reference for PFAS/537.1 appear incorrect. Update to correct units for Solid Media. Include a note on the table that PFAS/537.1 is included for comparison against historical data only.*

**Response:** Table 1 has been updated with the correct units and a note has been added as requested.

4. *Update Table 2 – Analytical Reference Limits and Screening Values – Water Samples. Units reference for PFAS/1633 appear incorrect. Update to correct units for Water Samples.*

**Response:** Table 2 has been updated with the correct units.

If you have any questions or need further information, please contact the undersigned.

Sincerely,



Krista Brodersen  
Senior Scientist  
Geosyntec Consultants, Inc.



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Senior Engineer  
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**QUALITY ASSURANCE PROJECT PLAN (QAPP)/  
FIELD SAMPLING PLAN (FSP)**

**FORMER SPERRY REMINGTON SITE – NORTH PORTION  
777 SOUTH MAIN STREET  
CITY OF ELMIRA, CHEMUNG COUNTY, NY  
NYSDEC PROJECT #C808022**

*Prepared for*  
***New York State Department of Environmental Conservation***  
***Division of Environmental Remediation, Region 8***  
*6274 East Avon-Lima Road*  
*Avon, New York 14414-9519*

*Prepared by*  
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Project Number MN0832K

September 2018

Updated May and November 2024


## RECORD OF REVISIONS


No.	Date	Description of Major Revisions
0	September 2018	Original QAPP/FSP
1	May 2024	Updated Section “1.2 – Project Organization” to current project team.
		Updated Section “2.2.7 – Analytical Methods” to include PFAS.
		Updated Section “3.4.1 – Surface Soil Sampling” to include PFAS sample collection and PID headspace screening.
		Updated Section “3.4.2 – Subsurface Soil Sampling” to include PFAS sample collection, PID headspace screening, and sonic drilling procedures.
		Updated Section “3.4.2.1 – Soil Recovery Protocol” regarding minimum sample attempts and procedure.
		Updated Section “3.4.2 – Low-Flow Groundwater Sampling” to reflect use of peristaltic pumps as primary sampling equipment.
		Added Section “3.4.8 – Soil Gas Probe Installation.”
		Added Section “3.4.9 – Soil Gas Sampling.”
2	November 2024	Updated Section 1.2 and revised Appendix A with current Geosyntec project team and resumes.
		Updated units referenced in Table 1.
		Updated units referenced in Table 2.

**QUALITY ASSURANCE PROJECT PLAN (QAPP)/  
FIELD SAMPLING PLAN (FSP)  
REMEDIAL INVESTIGATION WORK PLAN  
FORMER SPERRY REMINGTON SITE – NORTH PORTION  
NYSDEC PROJECT #C808022**

Geosyntec Consultants, Inc. and Its Affiliate  
Beech and Bonaparte Engineering, PC  
10211 Wincopin Circle, 4<sup>th</sup> Floor  
Columbia, Maryland 21044

Prepared by:  Date: 9/7/2018  
Matthew Schallinger – Staff Scientist

Updated by:  Date: 5/7/2024  
Stephen Perdziola – Geologist

Reviewed by:  Date: 5/7/2024  
Krista Brodersen – Geosyntec Project Manager

Approved by:  Date: 5/7/2024  
Kristoffer Henderson – Geosyntec Quality Assurance Officer

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## ABBREVIATIONS AND ACRONYMS

°C	degrees Celsius
CFR	Code of Federal Regulations
CLP	EPA Contract Laboratory Program
COC	chain-of-custody
COPCs	constituent of potential concern
CSM	conceptual site model
DO	dissolved oxygen
DOT	Department of Transportation
DPT	direct push technology
DQO	data quality objectives
DRO	diesel range organics
DUSR	data usability summary report
EDD	electronic data deliverable
EIMS	environmental information management system
EM	electromagnetic
FID	flame ionization detector
ft	feet
ft bgs	feet below ground surface
FSP	Field Sampling Plan
GPR	ground-penetrating radar
GPS	global positioning system
GRO	gasoline range organics
HASP	health and safety plan
HVS	High Volume Sampling
ID	identification
IDM	investigation derived material
in Hg	inches of mercury
LCD	laboratory control duplicate
LCS	laboratory control sample
LPM	laboratory project manager
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NAD 83	north america datum 1983
NAVD88	north america vertical datum 1988
NIST	National Institute for Standards and Testing
NTU	nephelometric turbidity unit
NYSDEC	New York State Department of Environmental Conservation
ORP	oxidation-reduction potential
PAOC	potential areas of concern

## ABBREVIATIONS AND ACRONYMS (CONTINUED)

PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCBs	polychlorinated biphenyls
PFAS	per-and polyfluoroalkyl substances
PPE	personal protective equipment
PID	photoionization detector
RL	reporting limit
TAL	target analyte list
TCL	target compound list
QA	quality assurance
QAM	quality assurance manager
QAPP	Quality Assurance Project Plan
QC	quality control
RI	remedial investigation
RL	reporting limit
RPD	relative percent difference
SSHS	Southside High School
SOPs	Standard Operating Procedures
SPT	standard penetration testing
SVOCs	semi-volatile organic compounds
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound
%	percent
$\mu\text{g}/\text{m}^3$	micrograms per cubic meter

## 1. INTRODUCTION

This Quality Assurance Project Plan (QAPP)/Field Sampling Plan (FSP) was prepared by Geosyntec Consultants (Geosyntec) to present the quality assurance/quality control (QA/QC) measures and describe methods and procedures that will be followed during completion of the remedial investigation (RI) activities for the Former Sperry Remington Site – North Portion #808022 (Site) on the property of Elmira High School (EHS) located at 777 South Main Street in Elmira, Chemung County, New York. This QAPP/FSP was developed using the guidelines presented in United States Environmental Protection Agency (USEPA), *Requirements for Quality Assurance Project Plans, EPA Quality Assurance/R-5* (USEPA, 2001), the guidance presented in the New York State Department of Environmental Conservation (NYSDEC) DER-10 *Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010), and the guidance presented in the *NYSDEC Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl Substances* (NYSDEC, 2023).

This plan provides direction for field activities associated with the Site-wide RI, which includes: i) soil investigation, including sampling by direct push technology (DPT) and sonic drilling methods; ii) a groundwater investigation, including well installation, development, inspection and sampling events; and iii) soil vapor investigation, including installation and sampling of soil vapor probes.

This QAPP/FSP has been developed using the graded approach set forth in EPA QA/R5. This QAPP/FSP provides the quantitative data quality objectives (DQOs) that will be met for each project task. The overall task specific DQOs will be described in each project specific task work plan as they are developed. This QAPP/FSP is meant as the generic document under which each task is performed and applies for the duration of the on-site sampling program. This QAPP/FSP will be reviewed and updated as application specific information becomes known or is complete.

The project QAPP/FSP will be required reading for members of the project team participating in sample collection, will be in the possession of field teams, and will be distributed to laboratories performing analytical work associated with the Site-wide RI. This document has been developed to ensure that data acquired during the RI are thoroughly documented, verifiable, and defensible, and that the quality of the data meets requirements for its intended use. Project QA objectives and QC requirements have been used to develop the DQOs described in the following sections for acquiring valid usable data. Criteria for data quality were established in terms of the precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters. This QAPP/FSP outlines the sampling strategy and establishes field procedure requirements.

## 1.1 Project Objectives/Problem Definition

This QAPP/FSP pertains to investigation activities described in the Site-wide RI Work Plan. The general purpose of the RI Work Plan is to i) delineate the areal and vertical extent of chemicals of potential concern (COPCs) in media at or emanating from the Site, ii) determine the surface and subsurface characteristics of the Site, including topography, geology and hydrogeology, and depth to groundwater, iii) identify the sources of COPCs, the migration pathways, and actual or potential receptors of COPCs on or through the air, soil, bedrock, sediment, groundwater, surface water, utilities, and structures at the Site, without regard to property boundaries; and iv) collect and evaluate data necessary for a fish and wildlife resource impact analysis. The specific objectives include the following:

- Collect analytical data to characterize AOCs for COPCs;
- Collect analytical data to characterize the nature and extent of COPCs in environmental media at the Site;
- Collect analytical data to characterize the nature and extent of COPCs emanating from the Site;
- Supplement and verify existing information on the environmental setting and COPCs;
- Collect data describing human populations and environmental systems that may be susceptible to exposure to COPCs at the Site;
- Collect groundwater data to characterize the stability of COPCs in the groundwater; and
- Specific objectives by media, AOC, and potential exposure route.

## 1.2 Project Organization

The primary project team assembled to oversee, direct, and complete the investigation activities at the Site consists of personnel from Geosyntec. Geosyntec will be responsible for development of the project's technical direction, supervision, and implementation of investigation activities including oversight of subcontractors, data management, and data quality assessment. The project team and corresponding projects roles are summarized below:

- Unisys Corporation Project Manager, Kevin Krueger, P.E. Mr. Krueger is primarily responsible for the project direction and decisions concerning technical issues and strategies, budget, and schedule.
- Project Director, Jennifer Huha, P.G., PMP, Geosyntec. Ms. Huha will provide strategic direction to the project team as well as oversight and guidance during project execution. She will also verify that adequate resources are available, and client expectations are met.

- Project Manager, Krista Brodersen, Geosyntec. Ms. Brodersen has responsibility for technical, financial, and scheduling matters and overall management of the project.
- RI Task Manager, Stephen Perdziola, P.G., Geosyntec. Mr. Perdziola has responsibility for technical, financial, and scheduling matters and overall management of the RI-related activities. He is also responsible for completion of field activities in accordance with the Work Plan and QAPP/FSP and is the communication link between the Geosyntec Project Manager and the field team.
- Database Manager, Dave Towsey, Geosyntec. Mr. Towsey has responsibility for maintaining the project database, archiving project data files, uploading laboratory electronic data deliverables (EDDs) and data qualifiers into the project database, and data transmittal to regulating agencies.
- Quality Assurance Manager (QAM), Kristoffer Henderson, Geosyntec. Mr. Henderson will have the overall responsibility for QA. Mr. Henderson or his designee will communicate directly to the Geosyntec Project Manager and Laboratory Manager on matters pertaining to QA, data validation, and laboratory analyses.
- Health and Safety Officer, Alec Hayes, Geosyntec. Mr. Hayes will be responsible for safely implementing field activities and ensuring that they comply with the Site Health and Safety Plan (HASP).
- Analytical Laboratories, Eurofins. Laboratories will be responsible for solid and water sample analyses for the project. The laboratories will ultimately be responsible for the data produced and will ensure that laboratory data are generated in compliance with this QAPP/FSP, NYSDEC Analytical Services Protocols, internal laboratory procedures, and other applicable guidance.
- Geosyntec will procure various subcontractors to implement the Work Plan scope of work. The subcontractors will include a subsurface utility locator/clearer, land surveyor, and driller. The subcontractors are responsible for conducting the work in accordance with the Work Plans, contractual agreements and for communicating issues concerning the budget, schedule, or achievement of the technical specifications to the Geosyntec Field Team Leader.

Resumes for Geosyntec personnel identified above are provided for reference in **Appendix A**.

### **1.3 QAPP Revision or Amendment**

It is expected that the procedures outlined in this QAPP/FSP will be followed. However, procedural modifications may be warranted depending on field conditions, equipment limitations, or limitations imposed by the procedure(s). Modification to this QAPP/FSP will be approved in

advance by the Project Manager and the QAM. Deviations from the QAPP/FSP will be documented.

## 2. DATA QUALITY OBJECTIVES AND CRITERIA

DQOs are qualitative and quantitative statements that clarify the project objectives, specify the most appropriate type of data for the project decisions, determine the most appropriate conditions from which to collect data, and specify tolerable limits on decision errors. The DQO process is a series of planning steps based on scientific methods that are designed to ensure that the type, quantity, and quality of environmental data used for decision-making are appropriate for the intended application. In addition to the project objectives, the DQOs specify data collection boundaries and limitations, the most appropriate type of data to collect, and the level of decision error that will be acceptable for the decision. This section describes the outcome of the DQO process for data collection activities to be conducted at the Site.

### 2.1 Data Quality Objectives for Measurement Data

The overall quality objective of the project is to provide valid data of known and documented quality from environmental media (soil, soil vapor, and groundwater) to adequately characterize the AOCs and refine the conceptual site model (CSM).

Section 3 of the RI Work Plan details the overall scope of work that will be undertaken. During the investigation, laboratory analyses of environmental samples will serve as a primary source of data. In addition, the following field activities will generate supporting data:

- Field instrument (photoionization detector) screening of soil samples;
- Field analysis of groundwater quality parameters (pH, specific conductance, oxidation reduction potential, dissolved oxygen, and turbidity) during monitoring well purging; and
- Visual inspection and documentation of observed conditions.

**Tables 1 and 2** summarize the environmental screening criteria for solid and aqueous samples, respectively, that will be used as the basis for evaluating analytical data from the RI.

### 2.2 Project Quality Assurance/Quality Control Objectives

Data from certified laboratory analyses of field samples will serve as the primary basis for reaching final conclusions from the RI. These data will be derived through standard methods and will be assessed against the PARCCS parameters listed below using appropriate methods and field and laboratory QC samples to determine their usability for meeting the DQOs in this QAPP/FSP. The QC criteria are defined in this section, along with analytical methods and project-required reporting limits (RLs).

### 2.2.1 Precision

Precision refers to the reproducibility or degree of agreement among duplicate measurements of a single analyte. The closer the numerical values of the measurements, the more precise the measurement. Poor precision stems from random errors (i.e., mechanisms which can cause both high and low measurement errors at random). Precision is usually stated in terms of standard deviation, but other estimates, such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum values), and relative range are common, and may be used pending review of the data.

Precision will be determined through the collection of field duplicates and the analysis of laboratory duplicates, matrix Spike (MS)/matrix spike duplicate (MSD) and laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) pairs for the work performed at the Site. The overall precision of measurement data is a mixture of sampling and analytical factors. Sampling precision will be measured through the laboratory analysis of field duplicate samples. Laboratory precision will be measured through the analysis of laboratory duplicates, MS/MSD and LCS/LCSD pairs.

Precision will be determined from replicate samples and will be expressed as the relative percent difference (RPD) between replicate/duplicate sample results, computed as follows:

$$RPD = \frac{X_1 - X_2}{(X_1 + X_2) / 2} \times 100$$

where  $X_1$  and  $X_2$  are reported concentrations for each replicate sample and subtracted differences represent absolute values. For field duplicates, the precision goals for this project are as follows:

- (i) RPD = 50% for solid samples if both results are greater than five times the quantitation limit; and
- (ii) RPD = 30% for liquid samples if both results are greater than five times the quantitation limit.

RPD values are shown in Tables 1 and 2 for MS/MSD and LCS/LCSD results for solid and aqueous matrices. For laboratory duplicate analysis, the default laboratory RPD goals will be used.

### 2.2.2 Accuracy

Accuracy refers to the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement. The converse of accuracy is bias, in which a systematic mechanism tends to consistently introduce errors in one direction or the other. Bias in environmental sampling can occur in one of three ways; these mechanisms and their associated diagnostic and management methods are as follows:



- High bias, which can stem from cross-contamination of sampling, packaging, or analytical equipment and materials. Cross-contamination is monitored through blank samples, such as equipment blanks, field blanks, trip blanks, filter blanks, and method blanks. These samples assess the potential for cross-contamination from sampling equipment, ambient conditions, packaging and shipping procedures, field filters, and laboratory equipment, respectively. Data validation protocols described in Section 5 present a structured approach for data qualification based on blank samples.
- Low bias, which can stem from the dispersion and degradation of target analytes; an example is the volatilization of chlorinated solvents during field sampling. The effects of these mechanisms are difficult to quantify. Sampling accuracy can be maximized, however, by the adoption and adherence to a strict field QA program. Specifically, sampling procedures will be performed following standard protocols described in Section 3; for example, eliminating headspace in sampling vials for Volatile Organic Compounds (VOCs) will reduce the potential for dispersion of VOCs during sampling. Through regular review of field procedures, deficiencies will be documented and corrected in a timely manner.
- High or low bias, due to poor recoveries, poor calibration, or other system control problems. The effects of these mechanisms on analytical accuracy may be expressed as the percent recovery of an analyte that has been added to the environmental sample at a known concentration before analysis. Analytical accuracy and bias in the laboratory will be determined through the analysis of method blanks, LCSs and MS/MSDs and surrogates as applicable. As with blank samples, data validation protocols provide a structured formula for data qualification based on erroneously high or low analyte recoveries.

Accuracy, when potentially affected by high or low recoveries as described in the third bullet above, is presented as percent recovery (%R), defined as:

$$\%R = \frac{\text{Measured Value}}{\text{True Value}} \times 100\%$$

Laboratory control limits will be used to evaluate accuracy and are shown in Tables 1 and 2 for solid and aqueous matrices.

### 2.2.3 Representativeness

Representativeness qualitatively expresses the degree to which the sample collection and analytical protocols adequately reflect the environmental conditions present at the sampling location. If the results are reproducible, the data obtained can be said to represent the environmental condition. Representativeness is ensured by collecting sufficient numbers of samples of an environmental medium, properly chosen with respect to place and time. The precision of a representative set of

samples reflects the degree of variability of the sampled medium, as well as the effectiveness of the sampling techniques and laboratory analysis. The sampling network is expected to provide data representative of the soil and groundwater conditions in specific areas of concern at the Site. Representativeness in the laboratory is ensured by using the proper analytical procedures, attaining the quantitative DQOs, and meeting sample holding times.

#### 2.2.4 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured using established and approved analytical methods, consistency in the basis of analysis (e.g., wet weight, volume, etc.), consistency in reporting units, and analysis of standard reference materials. By using standard sampling and analytical procedures, data sets will be comparable.

#### 2.2.5 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same for data uses in that sufficient amounts of valid data are to be generated.

There are limited historical data on the completeness achieved by individual methods. However, the USEPA Contract Laboratory Program (CLP) data have been found to be 80 to 85 percent complete on a nationwide basis.

The percent completeness for each set of samples will be calculated as follows:

$$\%Completeness = \frac{Valid\ Data}{Total\ Data\ Planned} \times 100\%$$

The QA objective for completeness for parameters will be 90 percent.

#### 2.2.6 Sensitivity and Reference Limits

Sensitivity is the capability of a test or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) or a variable interest. Reference limits for analyses conducted by the certified laboratory include method detection limits (MDLs) and reporting limits (RLs).

**MDL** is a statistically determined concentration using a specific number of spiked samples in some cases a specific number of method blanks. It is the minimum concentration of a substance (analyte) that can be measured and reported with 99 percent (%) confidence that the analyte is present at a concentration greater than zero as determined from the analysis of a sample in a given matrix containing the analyte. The MDL is generally lower than the concentration at which the laboratory

can quantitatively report. Accordingly, sample results greater than the MDL but less than the RL will be laboratory qualified as “estimated.”

The **RL** is the minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified within specified limits of precision and bias during routine analytical operating conditions. The laboratory selects the RL for analytes at concentration levels that exceed the calculated MDLs by a factor of 3 to 10 and are within the method calibration range. Frequently, RLs for specific samples are adjusted for dilution, changes to sample volume/size and extract/digestate volumes, percentage solids, and cleanup procedures.

The MDLs and RLs for this project for both solid and aqueous sample matrices are presented in **Tables 1 and 2**, respectively.

### **2.2.7 Analytical Methods**

The analytical laboratory selected for this project will be the Eurofins Laboratories at Pittsburgh, Pennsylvania and North Canton, Ohio. Those two laboratories are certified by New York State through the National Environmental Laboratory Accreditation Program (NELAP) for the analytical methods required for the project. Laboratory analytical methods used to analyze field samples will include the following analyses:

- Target Compound List (TCL) VOCs – SW-846 method 8260C (solid and water) including 10 VOC of highest concentration tentatively identified compounds (TICs).
- TCL Semi-Volatile Organic Compounds (SVOCs) – SW-846 method 8270D (solid and water) including 20 highest concentration TICs.
- Polychlorinated Biphenyls (PCBs) – SW-846 method 8082A (solid and water). Total PCBs will be calculated as the sum of individual Aroclors. If an individual Aroclor is detected, including J-qualified results, in the summation calculation for total PCBs, Aroclors that are U-qualified will be assigned a value of zero (0). If all analyzed individual Aroclors were U-qualified, total PCB values will be shown as being non-detect (ND). If J-qualified results are included in the summation for total PCBs, the total PCBs result will be J-qualified.
- Target Analyte List (TAL) Metals Except Mercury – SW-846 method 6010C or 6020D (solid and water).
- Hexavalent Chromium – SW-846 method 7196A for solid samples.
- Mercury – SW-846 method 7471B for soil and 7470A for water.
- PFAS – EPA Method 1633 for routine analysis of environmental media and 537.1 Modified for analysis in Private Water Supply Wells.

### **3. DATA GENERATION AND ACQUISITION**

#### **3.1 Overview**

This section describes the sampling strategies and field procedures that will be implemented to support the RI to provide data required to meet the DQOs described in Section 2. Environmental measurements to be obtained during implementation of the RI include the following:

- data from observations and screening conducted during soil sampling via hand auger, sonic drilling, or DPT;
- water level data and integrity inspections from Site monitoring wells;
- data from screening and analysis of samples of the following media:
  - soil samples collected via hand auger, sonic drilling, or DPT; and
  - groundwater samples from existing and newly installed groundwater monitoring wells;

In addition, the following activities will be conducted in support of the RI:

- work necessary to clear planned sampling locations for underground utilities and structures;
- land surveying to obtain sample location coordinates and elevations;
- decontaminating of field equipment;
- sampling (if necessary) and managing investigative derived materials (IDM).

The strategy and procedure for each of these items is addressed in the remainder of this section. In addition, analytical parameters, field and laboratory QC strategies, equipment testing, inspection, and maintenance, inspection and acceptance of supplies and consumables, and non-direct measurements are discussed in this section.

#### **3.2 Special Training and Certification**

##### **3.2.1 Health and Safety Training**

Field activities will be performed by individuals with appropriate training (i.e., Code of Federal Regulations [CFR] 1910.120) and in accordance with the site-specific HASP). Before field activities commence, the site-specific HASP shall be reviewed and signed by Geosyntec personnel conducting field work.

### **3.2.2 Subcontractor Training**

Subcontractors performing work during the investigation will be required to conduct activities in accordance with applicable health and safety regulations (e.g., CFR 1910.120) and site-specific requirements. A copy of the HASP will be provided to each subcontractor. However, subcontractors will be responsible for the health and safety of their personnel while working at the Site. Each day before work commences, a tailgate health and safety meeting shall be conducted by the contractor field team lead.

### **3.3 Sampling Process Design**

The basis for the development of the RI scope of work is described in the Work Plan and subsequent addenda (if any). Laboratory analyses of soil and groundwater samples will serve as the primary source of data to support the completion of the investigation. Field screening and analysis will be used to assist in the conceptual characterization of Site conditions and to direct the collection of samples for laboratory analysis.

### **3.4 Field Methods and Procedures for Data Collection**

This section describes the procedures that will be implemented to collect data during implementation of the Work Plan. It includes a description of the procedures for field collection, analysis, and handling of soil and water samples. Field activities will be carried out in accordance with this QAPP/FSP and the project HASP.

#### **3.4.1 Surface Soil Sampling**

To obtain the required surface soil samples (i.e., 0 to 2 inches below ground surface [bgs]), the following procedures shall be used:

- Obtain appropriate laboratory prepared sample containers prior to sampling and don appropriate level of Personal Protective Equipment (PPE) according to the approved HASP.
- Mobilize to sampling location.
- If sampling in area with grass cover, cut a small section of sod from sampling location and lay to side, as needed.
- Using a hand auger, excavate a hole in the soil approximately two (2) inches deep. Alternative methods such as utilizing a decontaminated shovel, trowel, spatula, or dedicated (disposable) scoop may also be used.
- A geologist or their designee will be responsible for geologic logging of soil, to maintain consistency. Soil will be visually inspected to record details of the surface cover type (e.g.,

asphalt, concrete, sod, etc.), color, texture, moisture, density, cohesion, plasticity and/or indications of staining or obvious odor, and digital photographs will be taken.

- If applicable, collect VOC grab soil sample using a terra core sampling kit as soon as possible before homogenizing sample.
- If applicable, composite a portion of the soil sample and place directly into laboratory-supplied sample containers for PFAS analysis in accordance with NYSDEC Sampling, Analysis, and Assessment of Per-and polyfluoroalkyl Substances – April 2023 (Appendix B).
- The remainder of the collected soil is placed in an airtight polyethylene bag, leaving enough air space for headspace reading. Contents are brought to room temperature through contact with ambient air or other means of warming. Sample is to be homogenized to thoroughly mix the contents to allow soil to mix with air in headspace.
- If applicable, collect a soil headspace reading using a PID. Influent probe of the PID is placed through bag and VOC concentration is measured from the headspace. Record the highest reading that remains steady for 1-2 seconds.
- Place soil in laboratory provided sample containers for shipment to and analysis at the laboratory.
- Follow the sample handling and labeling procedures outlined in Section 3.7 and 3.8 of this document.
- Abandon two (2) inch deep hole to ground surface with commercially available topsoil. Replace sod and apply tap water.
- Arrange for survey of sample locations using professional surveyor outlined in Section 3.5.2. Complete field forms and enter sampling and location information in the bound field book as outlined in Section 3.8.5 in this document.
- Decontaminate sampling equipment as outlined in Section 3.5.5.
- Manage IDM as outlined in Section 3.5.5.

### **3.4.2 Subsurface Soil Sampling**

Subsurface soil sampling will be conducted using either hand auguring methods, sonic drilling or DPT. Between sampling locations, reusable equipment will be cleaned prior to sample collection to prevent cross-contamination of samples. With hand auguring, the borehole will be advanced until the desired sample depth is reached.

Soil cores will be visually logged for soil cover and soil type, and inspected for staining, debris or other evidence of anthropogenic materials. The soil cores will be additionally screened for soil vapors using a PID, if applicable. Soil samples will be collected from soil cores or collected as several subsamples dependent upon the total length advanced (i.e., if soil core is advanced 2 ft for sample targeting 2-4 ft bgs, core will be treated as one sample, if soil core is advanced 4 ft for samples targeting 2-4 and 4-6 ft bgs, core will be treated as two samples). Irrespective of the sampling location, each soil core segment sample will be collected from material exhibiting the highest PID readings (if applicable), visual observation, the presence of odors, or at the discretion of the sampler. If PID readings are not higher than background and no staining or odors are observed, the sample will be collected from a composited core.

Specific procedures for planned soil sampling activities via DPT are provided below.

- Obtain appropriate laboratory prepared sample containers prior to sampling and don appropriate level of PPE as described in the HASP.
- Mobilize DPT rig to the sampling location. During mobilization to sampling locations on sensitive grassy areas, the drilling rig will be moved on plywood or similar material to help prevent damage (e.g. rutting) to the ground surface. The DPT rig will not set up directly on the ground surface in sensitive areas.
- If sampling in area with grass cover, cut a small section of sod from sampling location and lay to side, as needed.
- Utilize plastic sheeting to minimize tooling contact with ground surface, as needed.
- Drive the decontaminated soil probe to the desired terminal depth, collecting soil cores into the acetate liner placed within the core barrel sampler. Remove soil core barrel and associated rod from borehole and remove soil sample within acetate liner. The acetate liner will be cut with a utility knife to observe, log, and record lithology.
- A geologist or designee will be responsible for geologic logging of soil cores, to maintain consistency. Soil cores will be visually inspected to record details of the color, texture, moisture, density, cohesion, plasticity and/or indications of staining or obvious odor, and digital photographs will be taken.
- Upon cutting the acetate liner, the sample will be scanned using a PID if applicable. PID readings will be recorded.
- If applicable, a VOC grab soil sample will be collected using a terra core sampling kit as soon as possible before homogenizing. The VOC grab soil samples will be collected directly from the acetate liner using a terra core sampling kit. The samples will be collected from the depth interval with the highest PID reading or in the central portion of the segment if elevated readings are not observed.

- If applicable, a portion of the remaining soil in the acetate liner will be composited and placed directly into laboratory-supplied sample containers for PFAS analysis in accordance with NYSDEC Sampling, Analysis, and Assessment of Per-and polyfluoroalkyl Substances – April 2023 (Appendix B).
- The remainder of the collected soil is then placed in an airtight polyethylene bag, leaving enough air space for headspace reading. Contents are brought to room temperature through contact with ambient air or other means of warming. Sample is to be homogenized to thoroughly mix the contents to allow soil to mix with air in headspace.
- A soil headspace reading will be collected using a PID if applicable. The influent probe of the PID will be placed through bag and VOC concentration will be measured from the headspace. The highest reading that remains steady for 1-2 seconds will be recorded.
- The soil will be placed in laboratory provided sample containers for shipment to and analysis at the laboratory.
- The sample handling and labeling procedures outlined in Section 3.7 and 3.8 of this document will be followed.
- To collect soil samples below the first interval, place a decontaminated soil collection barrel and cutting shoe with a new acetate liner in the open bore-hole and drive probe to collect the next soil interval.
- These steps are repeated until the desired maximum sample depth is reached or probe refusal is reached (point where probe will not penetrate soils due to obstruction and/or hard material).
- To abandon, fill open borehole with bentonite chips to within 2-inches of the ground surface. Fill remainder of borehole from 2-inches to the ground surface with commercially available topsoil. Replace sod and apply tap water.
- Arrange for survey of sample locations using professional surveyor outlined in Section 3.5.2.
- Complete field forms and enter sampling and location information in the bound field book as outlined in Section 3.8.5 in this document.
- Decontaminate sampling equipment as outlined in Section 3.5.5.
- Manage IDM as outlined in Section 3.5.5.

Specific procedures for planned soil sampling activities via sonic drilling are provided below.



- Obtain appropriate laboratory prepared sample containers prior to sampling and don appropriate level of PPE as described in the HASP.
- Mobilize sonic rig to the sampling location. During mobilization to sampling locations on the sensitive grassy areas the drilling rig will be moved on plywood or similar material to help prevent damage (e.g. rutting) to the ground surface. The sonic rig will not set up directly on the ground surface in sensitive areas.
- If sampling in area with grass cover, cut a small section of sod from sampling location and lay to side, as needed.
- Utilize plastic sheeting to minimize tooling contact with ground surface, as needed.
- Rotasonic drilling methods will be used to advance the borehole. The core barrel will be advanced into the subsurface. Continuous soil cores will be collected. To ensure no downhole sample contamination and to protect hole integrity, override casing will be advanced over the core barrel. Samples will typically be collected in 5 or 10 foot core runs. A conventional 3x5 system will be used, with an approximate 3.5” OD core barrel used for sample collection and an approximate 5.5” OD override casing.
- In some instances, potable water may need to be added to facilitate advancement of the override casing. This should only be done when necessary. If water is added into the borehole, it should be noted on the boring log. Sample collection into the core barrel will be conducted “dry” prior to the addition of water for that interval.
- During drilling operations, relative rate of penetration indicative of fast or slow drilling will be recorded.
- Samples will be extruded from the core barrel and placed in polyethylene bags for logging and sampling.
- The polyethylene bags will be cut with a utility knife to observe, log, and record lithology.
- A geologist or designee will be responsible for geologic logging of soil cores, to maintain consistency. Soil cores will be visually inspected to record details of the color, texture, moisture, density, cohesion, plasticity, and/or indications of staining or obvious odor, and digital photographs will be taken.
- Upon cutting the polyethylene bags, scan the sample using a PID if applicable. Record elevated PID readings.
- If applicable, collect VOC grab soil sample using a terra core sampling kit as soon as possible before homogenizing sample. Collect VOC grab soil samples directly from the polyethylene bag using a terra core sampling kit. The samples will be collected from the

interval with the highest PID reading or in the central portion of the segment if elevated readings are not observed.

- If applicable, composite a portion of the remaining soil in the polyethylene bag and place directly into laboratory-supplied sample containers for PFAS analysis in accordance with NYSDEC Sampling, Analysis, and Assessment of Per-and polyfluoroalkyl Substances – April 2023 (Appendix B).
- The remainder of the collected soil is placed in an airtight polyethylene bag, leaving enough air space for headspace reading. Contents are brought to room temperature through contact with ambient air or other means of warming. Sample is to be homogenized to thoroughly mix the contents to allow soil to mix with air in headspace.
- Collect a soil headspace reading using a PID if applicable. Influent probe of the PID is placed through bag and VOC concentration is measured from the headspace. Record the highest reading that remains steady for 1-2 seconds.
- Place soil in laboratory provided sample containers for shipment to and analysis at the laboratory.
- Follow the sample handling and labeling procedures outlined in Section 3.7 and 3.8 of this document.
- To collect soil samples below the first interval, the core barrel will be advanced through the override casing to the target depth. The override casing will be advanced to the target depth prior to core barrel removal.
- These steps are repeated until the desired maximum sample depth is reached.
- To abandon, fill open borehole with bentonite chips to within 2-inches of the ground surface. Fill remainder of borehole from 2-inches to the ground surface with commercially available topsoil. Replace sod and apply tap water.
- Arrange for survey of sample locations using professional surveyor outlined in Section 3.5.2.
- Complete field forms and enter sampling and location information in the bound field book as outlined in Section 3.8.5 in this document.
- Decontaminate sampling equipment as outlined in Section 3.5.5.
- Manage IDM as outlined in Section 3.5.5.

### 3.4.3 Soil Recovery Protocol

Recovery of apparently less than 100 percent of sample soil from advanced DPT rods can be expected when sampling subsurface soil, for a variety of reasons. Low recoveries may arise due to refusal in the subsurface from large cobbles or boulders, voids, or inherently loose material. It is also possible to retrieve apparently less than full recovery due to the compaction or compression of sample in the liner as it is advanced through material layers of differing densities and textures. Lower than anticipated recovery does not invalidate the sample but needs to be considered in terms of project objectives. In accordance with DER-10, the following protocol will be applied to each retrieved sample liner as a best practice for addressing soil recoveries in manner that meets project objectives and provides usable data.

First, the length of the retrieved sample will be measured to the nearest inch and compared to the length of the sample interval. When the retrieved sample is greater than 50% of the length of the sample interval, no further assessment is needed. When the retrieved sample is less than 50% of the length of the sample interval, the following assessment will be made:

- 1) Assess the base of the sample for the presence of material (gravel, cobble, etc.) as large as the diameter of the sampling device. Where this is observed, the finding will be that the material beneath this depth was compacted into underlying soil and not retrieved. In this case, step off the original borehole six to twelve inches, reset the drill rods and advance the cutting shoe to the beginning of the sample interval. Push the required distance to obtain the sample from the desired interval. Another option under this scenario is to use a large diameter core barrel (e.g., two-and-three-quarters [2 <sup>3</sup>/<sub>4</sub>] inch).
- 2) If no large material is found in the liner, the finding will be that material either has been compressed or has not been retained. To resolve which is more likely than not to be the condition, an assessment will be made of the texture of the retrieved sample. If the sample is predominantly fine-grained material, the finding will be that the material has been compressed in the sample liner. In this case, the sample will be apportioned equally among intended target sample intervals. If insufficient sample quantity is available, it may be necessary to step off the original borehole, reset the drill rods and resample the desired interval to obtain sufficient sample quantity.
- 3) If no large material is found in the liner but the sample is predominantly coarse-grained material, the finding will be that the material has not been retained in the sample liner. A sample catch basket at the front end of the advancing rods will be used to help retain the sample in the sleeve and prevent material from falling out of the sleeve during retrieval. Another option if collapsing conditions are encountered is to employ the use of a dual tube sampler where an inner and outer tube are advanced together throughout the sampling interval. In this case, the outer tube is used for stabilization and the inner tube is for sample recovery. This method will prevent borehole collapse and prevent material from upper intervals falling to the bottom of the borehole.

Multiple step offs may be required to obtain a satisfactory recovery. A minimum of three attempts will be made to obtain a satisfactory sample. If after three attempts a sample with recovery greater than 50% is not collected, the samples will be composited for laboratory analysis and recovery less than 50% noted on the sampling log.

### 3.4.4 Monitoring Well Inspection and Synoptic Water Level Measurements

Prior to groundwater sampling, an attempt to locate the monitoring wells identified in the Work Plan will be made and, if successfully located, will be visually inspected for integrity. If possible, the depth to water level in each well will be measured from a reference point on the inner well casing to the nearest 0.01-foot using a clean electronic water level monitoring meter. The specific procedures to be used for each well are presented below:

- Navigate to the monitoring well location and locate the monitoring well.
- Once located, open the well casing and note the condition of the well casing, concrete pad, and overall condition of the monitoring well. Take a photograph of the monitoring well.
- Determine the location of the surveyed elevation mark. For monitoring wells, general markings include either a notch in the riser pipe or a permanent ink (generally black ink) mark on the riser pipe.
- Obtain a water level measurement from the surveyed elevation mark by lowering the water level probe down the well until the audible sound of the unit is detected or the light on an electronic sounder illuminates indicating that the probe is below the water. The precise measurement should be determined (to nearest 0.01 feet) by repeatedly raising and lowering the tape to converge on the exact measurement.
- Measure the depth to the bottom of the well by continuing to lower the water level probe down the well until slack is noted in the tape. The precise measurement should be determined (to nearest 0.1 feet) by repeatedly raising and lowering the tape to converge on the exact measurement. It should be noted, based on the response and feeling of the water tape during repeated measurements, whether the well has a soft or hard bottom.
- Record the water level and depth to bottom measurement as well as the location identification number, date, and time in the field logbook and/or field form.
- Decontaminate the water level probe as discussed in Section 3.5.5. Generally, only that portion of the tape that enters the water table needs to be decontaminated.

### 3.4.5 Low-Flow Groundwater Sampling

Samples will be collected from existing and newly installed groundwater monitoring wells identified in the Work Plan using low-flow sampling protocols. Purging of the groundwater will be performed at relatively low flow rates (between 0.1 and 0.5 liters per minute) in order to minimize drawdown of the surrounding water table and minimize stress on the formation. Water purged from the wells will be monitored for the following water quality field parameters: temperature, pH, specific conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity to document changes in water quality. Samples will be collected when three consecutive readings indicate stability in the field parameters. The procedures to be followed during groundwater sampling are:

- Obtain appropriate laboratory prepared sample containers prior to sampling and don appropriate level of PPE as described in the HASP.
- Obtain a depth to water measurement with either an interface probe or a water line.
- Utilize a peristaltic or other pump with clean polyethylene and silicone tubing to purge the wells. The tubing should be set to the midpoint of the screened interval or in the case of an open borehole to the midpoint of the water column. For dedicated tubing- attach pump discharge tubing to the flow through cell.
- Operate the pump at a low flow rate (between 0.1 and 0.5 liters per minute). Use a graduated cylinder or other graduated container to estimate the flow rate. Adjust pump settings to achieve desired flow rate that also minimizes drawdown of the initial water level (i.e., <0.3 ft of the initial water level).
- Purge water and other IDM generated during groundwater sampling will be managed as outlined in Section 3.5.5.
- Water quality field parameters, using a calibrated water quality meter (see below) will be recorded every three to five minutes or each time the internal volume of the flow cell is replaced with water during purging. Additionally, color, clarity and/or noticeable odors will be documented. Water will continue to be purged from the wells until the drawdown of water level has stabilized and three consecutive measurements have stabilized according to the following criteria:
  - pH,  $\pm 0.1$ ;
  - temperature,  $\pm 10\%$ ;
  - specific conductivity,  $\pm 3\%$ ;
  - ORP,  $\pm 10$  millivolts
  - DO,  $\pm 10\%$ ; and
  - turbidity,  $\pm 10\%$  or  $< 10$  nephelometric turbidity units (NTUs)

- Field water quality measurements will be obtained using calibrated portable instruments capable of measuring DO, ORP, pH, temperature, turbidity, and specific conductance. The water quality meter will be calibrated as discussed in Section 3.5.4. Results will be recorded as follows: DO to the nearest 0.1 milligrams per liter (mg/L), ORP to the nearest 0.1 millivolt (mV), specific conductance to the nearest 1 microSiemens per centimeter ( $\mu\text{S}/\text{cm}$ ), turbidity to the nearest 0.1 NTU, pH to the nearest 0.1 pH unit, and temperature to the nearest 1 degree Celsius ( $^{\circ}\text{C}$ ). If applicable, the membrane on the DO probe will be periodically checked for integrity and will be replaced according to manufacturer's specifications if it is found to be torn or if air bubbles are distinguishable under the membrane. Results of manufacturer-recommended calibration checks and maintenance conducted on the field measurement instrument will be recorded in the field logbook or on a field data sheet as discussed in Section 3.8.5.
- Put on disposable nitrile sampling gloves prior to procuring sample. Immediately following purging activities (after the groundwater has reached stabilization), laboratory-provided sample containers (with the appropriate type and volume of preservative) will be filled directly from the sample pump discharge tube while maintaining the flow rate established during purging to minimize potential agitation of the groundwater. Care should be taken as to not allow the tubing to touch the inside of the sample container during filling. If applicable, PFAS samples shall be collected first using the sample collection and handling methods included in the guidance document provided in **Appendix B**. VOC samples will then be collected in 40-mL glass vials with no head space. Carefully, but quickly, slip the cap with the septum onto the vial with the Teflon™ face of the septum towards the water. Tighten the cap securely, invert the vial and tap the cap to assure that there are no air bubbles inside. If bubbles are present, open vial, add a few more drops of sample water and reseal. Following VOC sampling, sample bottles will be filled for the other desired analytes. Care should be taken such that the tubing is not allowed to touch the sample bottle and such that preservative (if present) is not washed out of the sample bottle.
- Follow the sample handling and labeling procedures outlined in Section 3.7.3 and 3.7.4 of this document.
- Check to make sure the vial caps are tight and then place on ice immediately.
- Complete field forms and enter sampling information in the bound field book as outlined in Section 3.8.5 in this document.
- Decontaminate sampling equipment as outlined in Section 3.5.5.

### 3.4.6 Split Spoon Collection

Split spoons will be used to collect lithologic data during monitoring well installations. The lithology will be documented intermittently by inserting the spoons from approximately 0-2 feet

bgs and every approximately five feet thereafter. The standard procedure for using split spoons follows below.

- Don appropriate PPE including sampling gloves as specified by the HASP.
- Obtain decontaminated standard split-spoon (24 or 60 inches long by 1.5 inches inside diameter).
- Obtain soil samples by inserting the split spoon samplers ahead of the air rotary or hollow stem auger drill bit, noting the blow counts.
- Put on disposable nitrile sampling gloves prior to handling samples.
- Upon retrieval of each split-spoon, remove the soil with a decontaminated stainless-steel spatula and place in the laboratory-supplied containers noting the quantity of soil recovered.
- Field staff will log soils recovered in the split-spoons using the USCS. Soil retrieved from the split-spoons will be visually inspected to record details of the color, texture, moisture, density, cohesion, plasticity, and/or indications of staining or obvious odor, and digital photographs will be taken.
- Obtain location coordinates from hand-held GPS instrument, and mark location on enlargement of sampling Site specific map.
- Complete field boring log.

### **3.4.7 Groundwater Monitoring Well Installation**

Groundwater monitoring wells will be installed in overburden soil via hollow stem auger or sonic drilling to allow for the collection of groundwater samples. Each monitoring well will be constructed with flush-threaded, two-inch diameter, schedule 40 polyvinyl chloride (PVC) casing with 0.01- inch machine slot schedule 40 PVC screen. Prior to drilling, well locations will be cleared for underground utilities and structures in accordance with Section 3.5.1 of the QAPP/FSP. The location and elevation of monitoring wells will be documented in accordance with Section 3.5.2 of this document. IDM generated from soil sampling and monitoring well installation will be managed in accordance with Section 3.5.3 of the QAPP/FSP.

During drilling, field personnel will visually characterize the cuttings and monitor the rate of drilling advancement. Samples will be collected in accordance with Section 3.4.5 of the QAPP/FSP to record geologic observations on an appropriate field log (e.g., boring log, well construction record) that will include relevant information from the sampling activity including blow counts and Unified Soil Classification System (USCS) description.

Completion of the soil borings as wells will include the following procedures:

- Gauge the depth to groundwater with either an interface probe or water line. This information along with the depth of the boring will determine the length of screen and casing as well as thickness of annulus of the boring which may affect the construction materials needed to complete the boring as a well. Place two feet of washed Morie No. 1 silica sand (or equivalent) in the bottom of the borehole. Verify the depth after allowing enough time for the sand to settle through the water column in the borehole.
- Remove protective plastic used to seal the well screen from the factory and place the plug at bottom end of screen.
- Lower screen (plug at bottom), adding sections of riser pipe as needed so that the bottom of screen is placed at bottom of the borehole.
- Casing will be added to bring the well up above the ground surface or pre-cut casing will be added so that the casing is 2 inches below the ground surface for placement of a flush-mount well cover or 2 inches below the top of the protective steel casing for above ground completion of the well.
- A sand filter pack will be installed in the annulus of the screened portion of the borehole. The filter pack will consist of a washed Morie No. 1 silica sand (or equivalent). The annulus will be filled in lifts; between lifts, the filter pack will be surged and the top of the filter pack will be checked with a weighted tape measure. Surging of the filter pack will continue until settlement of the filter pack is no longer observed. The filter pack will be installed to a depth that is at least 2 ft and no more than 4 ft above the top of the screened interval. The final depth of the filter pack will be checked with a weighted tape measure and recorded on the field form.
- Construct a low permeability seal at the top of the sand pack using a minimum 2-ft thick section of hydrated bentonite pellets. Again, the depth of the bentonite plug will be checked with a weighted tape measure. Hydrate the pellets with potable water to form the seal. Depending on the type of bentonite pellet used hydration time will vary. Allow uncoated bentonite pellets to hydrate for approximately 30 minutes before installing the grout seal and allow coated bentonite pellets to hydrate for at least one hour before installing the grout seal. The final depth of the bentonite seal will be measured using a weighted tape and recorded on the field form.
- After the appropriate amount of time has passed to allow the bentonite seal to hydrate the remaining portion of the borehole will be sealed using a cement/bentonite grout. The grout mixture will typically consist of 94 pounds (lbs) Type I/II portland cement, 5 lbs of granular bentonite, and five to six gallons of water. The grout mixture will be mixed until an even



consistency is achieved. The borehole will be grouted from the bottom up. A tremie pipe will be used to deliver the grout to the bottom of the borehole.

- Two types of surface completion could be used, depending on Site condition.
  - For a stickup completion,
    - i. Fill the remaining portion of the annulus with grout to within three feet of the ground surface. Allow the grout to cure for at least eight hours. Add additional grout if needed to bring the grout to within three feet of ground surface.
    - ii. Set in place a section of steel protective casing with a hinged lid and lock using neat cement or concrete.
  - For a flush-mount completion,
    - iii. Fill annulus with grout within approximately 12 inches of the ground surface.
    - iv. Set the flush-mount well cover approximately level with the ground surface.
- To deflect surface runoff from the wellhead, a protective concrete apron will be installed, centered on each monitoring well, with specifications of a minimum diameter of 18 inches and of a minimum thickness of twelve (12) inches. Wire mesh will be used to reinforce the concrete pad and a four-inch-thick layer of crushed stone or coarse well sand will be placed beneath the concrete pad. The wire mesh and crushed stone layer will reduce the effects and risk of frost heaving. If there is a freezing risk at the time of the well installation, the well pad will be covered with an insulated blanket or plastic sheeting and hay. This will allow the pad to cure properly and reduce the risk of the concrete pad from freezing.
- A metal tag or some other form of permanent identification of the well will be used to denote the well's ID number and depth.

### 3.4.8 Well Development

Each new monitoring well will be developed using a “purge and surge” method to promote communication between the well screen, filter pack, and the surrounding aquifer. The following procedures will be implemented to accomplish this task:

- Determine the appropriate level of Health and Safety according to the approved HASP.

- Obtain a depth to water measurement with either an interface probe or a water line and determine the volume of water in each well by using:

$$V = (B)(r^2)(h)$$

Where: V = volume of water (cubic feet [ft<sup>3</sup>])  
 B = 3.14  
 r = radius of well (ft)  
 h = height of column of water in well (ft)

- Determine three well volumes in gallons by using the relationship.

$$V \times \left( \frac{7.48 \text{ gallons}}{\text{ft}^3} \right) \times 3$$

- Use a decontaminated submersible pump to purge the wells (at a constant rate if possible so as not to purge dry) of three well volumes or until clear of sediment (i.e., purge water is less than 50 NTUs). The pump intake will initially be set 5-ft above the bottom of the well, if possible. If not, 1-ft above the bottom of the well will suffice.
- Record turbidity measurements during purging. Calibrate the field instruments according to the procedures outlined in Section 3.5.4 of this QAPP/FSP.
- During the purging process, the well will be surged periodically either by raising and lowering the pump or by use of a surge block. It is recommended that surging takes place over 2 ft intervals along the entire well screen. Field personnel should record the time and number of surges completed on a Well Development field form.
- Well development will be considered complete when at least three casing volumes of water have been removed and turbidity readings have stabilized at  $\pm 10\%$ ; a turbidity reading of less than 50 NTUs will be targeted.
- Manage purged water in accordance with the IDM instructions provided in Section 3.5.3 of this document.
- A field log will be kept during development of each well. The log will include at a minimum:
  - date and time of development;
  - ID number of well;
  - depth to bottom measurement before and after development;
  - water level measurements;
  - total depth of well;
  - boring and well casing inside diameter and outer diameter;

- method of development used;
- water quality parameters;
- amount of water evacuated (in gallons) from well; and
- duration of development (in minutes).

### 3.4.9 Soil Gas Probe Installation

Soil gas probe installation will follow Geosyntec's standard operating procedure (**Appendix C**) and meet the requirements for installation included in Section 2.7.1 of the NYSDEC *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). The following procedures will be implemented:

- Mobilize DPT rig to the sampling location. During mobilization to sampling locations on sensitive grassy areas the drilling rig will be moved on plywood of similar material to help prevent damage (e.g. rutting) to the ground surface.
- Utilize plastic sheeting to minimize tooling contact with ground surface, as needed.
- Drive the decontaminated soil probe to the desired soil gas probe depth, collecting soil cores into the acetate liner placed within the core barrel sampler. Remove soil core barrel and associated rod from borehole and remove soil sample within acetate liner. The acetate liner will be cut with a utility knife to observe, log, and record lithology.
- A 2-inch diameter core barrel will be used, since this provides sufficient core volume for field screening, geologic logging, and select laboratory analyses (if required).
- A geologist or designee will be responsible for geologic logging of soil cores, to maintain consistency. Soil cores will be visually inspected to record details of the color, texture, moisture, density, cohesion, plasticity and/or indications of staining or obvious odor, and digital photographs will be taken.
- Scan the segments at minimum depth intervals using a PID following procedures outlined in Section 3.4.2.
- If required, collect soil samples following procedures outlined in Section 3.4.2.
- Each soil gas probe will consist of 1/4-inch diameter Nylaflo® or Teflon® tubing connected with a compression fitting to a 1/4-inch-diameter stainless steel sampling point.
- Probes will be installed inside the borehole at a minimum of 5 feet below grade and a sand filter pack will be placed in the annulus to a height of 6 inches above the top of the soil gas probe sampling point.

- 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 or hydrated bentonite chips 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.

### 3.4.10 Soil Gas Sampling

Soil gas sampling will follow Geosyntec’s standard operating procedure (**Appendix C**) and meet the requirements for sample collection included in Section 2.7.1 in the NYSDEC *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (October 2006). The following procedures will be implemented:

- Obtain appropriate laboratory prepared sample containers prior to sampling and don appropriate levels of PPE as described in HASP.
- Perform summa canister check.
  - Prior to the start of soil gas sampling, connect a vacuum gauge to the summa canister to record the initial vacuum in the canister. The initial vacuum reading will be used to document that the canister did not leak during shipment from the laboratory. A summa canister should not be used for sample collection if the initial vacuum reading is less than 25 inches of mercury (in-Hg) compared to a standard laboratory provided vacuum of 30 in-Hg.
- Perform vacuum shut-in leak test.
  - The sampling equipment will be assembled as shown in **Figure 1** of **Appendix C** and will be checked for leaks by conducting a “shut-in” test prior to purging. The soil gas probe valve and summa canister valve will be closed 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-H<sub>2</sub>O). The vacuum will be 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 leaks have been fixed.
- Perform purging, field screening, and 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. The summa canister valve will remain closed while the valves under the shroud 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 Tedlar bag will fill at a 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, the valve to the lung box 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, photoionization (PID), and landfill gas meter (oxygen, carbon dioxide and methane) in sequence, by opening the Tedlar bag valve, and recording the stabilized readings. 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. Flow rate during purging will not exceed 0.2 liters per minute to minimize outdoor air infiltration.
- Perform summa cannister leak test.
  - The summa canister valve will be opened to induce a vacuum on the sample train. The system will then be closed to leave a vacuum of about 30 in Hg in 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 leaks.
- Summa canister sampling.
  - After the summa canister leak test, the valve to the soil gas probe will then be opened. Then the Summa canister valve will be opened to begin the sample collection. The sample collection start time should be recorded. Flow rate during sample collection will not exceed 0.2 liters per minute to minimize outdoor air infiltration. The vacuum gauge on the summa canister should be monitored and the Summa canister valve should be closed when the residual vacuum in the canister is about 5 in-Hg. The sample collection finish time should be recorded. Following sample collection, the final vacuum of the Summa canister will be recorded. The final vacuum reading will be included on the chain of custody so that the receiving laboratory can confirm if the Summa canister has leaked during transit.

- The duration of soil gas sampling will be a minimum of 2 hours as requested by NYSDEC.
- Soil gas sampling from permanent points must occur at least 24 hours after installation.

### **3.5 Field Methods and Procedures for Other Project and Support Activities**

#### **3.5.1 Utility Location Procedures**

Utility surveys will be conducted in each location where invasive investigation activities deeper than six inches will be conducted in order to clear underground utilities, structures, or debris that may affect the investigation or may present health and safety or property damage risks. An area within a five-foot radius of each proposed location will be cleared using the following protocol:

- Find/confirm the most recent version of as-built Site drawings and review to identify potential utilities/structures/debris;
- Contact the local public utility locating service;
- Contact Site Representative to discuss utility locations;
- Perform a site reconnaissance to locate utilities/structures on as-built drawings and to find evidence of undocumented utilities/structures/debris;
- Mark the proposed sampling locations and the known underground utility lines/structures/debris in the immediate vicinity using color-coded surveyor paint;
- Use ground penetrating radar (GPR)/ electromagnetic (EM) geophysical equipment and procedures to assure underground obstruction clearance, as needed.

Wherever possible, a transmitter/receiver unit will be attached to the exposed pipe or utility to trace metallic pipes or utilities that are either indicated on facility utility maps or obvious by surface expression. The location of the utility will be marked on the ground using color-coded surveyor paint. If a utility is identified within three feet of the proposed sampling/drilling location, the sampling/drilling point will be moved and the clearance procedures repeated.

#### **3.5.2 Land Survey Procedures**

A New York State registered land surveyor will survey the horizontal location and elevation of existing groundwater monitoring wells at the Site. Surveyed locations will be accurate to plus or minus 0.01 foot vertically and plus or minus 0.1 foot horizontally. Horizontal data will be reported

in reference to the North American Datum 1983 (NAD83) New York State Plane; vertical data will be reported in reference to the North American Vertical Datum 1988 (NAVD88). Monitoring well elevations will be measured at a reference point at the north side of the top of each inner well casing to the nearest 0.01 foot. Soil boring sampling locations will be surveyed by a registered land surveyor. Sampling locations will be staked (or marked through another method of identification) and identified in the interim between media sampling and land surveying activities.

### **3.5.3 Management of Investigation-Derived Materials**

IDM generated during the RI activities will include disposable PPE, disposable sampling equipment, soil boring cuttings, decontamination water, and purge water. PPE, disposable sampling equipment, and soil boring cuttings will be collected and placed in 55-gallon Department of Transportation (DOT)-approved drums or a lined and covered roll-off for characterization (if necessary) and off-site disposal. Liquid IDM (decontamination water and purge water) will be collected and stored in 55-gallon drums or frac tanks for waste characterization (if necessary) and off-site disposal.

### **3.5.4 Field Instrument Calibration and Operation**

Instruments and equipment used during sampling and analysis (e.g. PID or water quality meters) will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Operation, calibration, and maintenance will be performed by trained personnel daily. Calibration will be performed at the beginning of each sampling day. If instruments appear to be reading incorrectly, additional calibration may be required. Maintenance and calibration information will be documented and will be available upon request.

Appropriate corrective actions will be taken if a field instrument fails the instrument specific calibration QC criteria. Corrective action steps will be as follows:

- Check the instrument;
- Investigate the cause of failure;
- Recalibrate the instrument;
- If the instrument recalibration still fails, call the instrument manufacturer or rental company technical support for assistance;
- If the problem persists, send the instrument for service;
- If the instrument is a rental, contact the rental office for immediate replacement of the instrument; and
- If practicable, keep a backup instrument on Site.

### **3.5.5 Field Equipment Decontamination**

Decontamination of non-dedicated and non-disposable sampling equipment will be performed prior to sampling and between sampling locations to prevent the introduction of extraneous material into samples and to prevent cross-contamination between sample locations. Sampling equipment will be decontaminated as described below.

#### **3.5.5.1 Decontamination of Soil Sampling Equipment**

This procedure applies to equipment used in the collection of environmental soil samples submitted for organic and inorganic constituent analysis. Examples of relevant items of equipment include DPT shoes, trowels, scoops/spoons, and other small items. Decontamination will be performed before sampling events and between sampling points.

- Place three 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 three plastic wash bins in a line and provide an air-drying area for equipment.
- Fill the first wash basin with potable 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 off the equipment will be difficult. Periodic changing of the water is required.
- Using a clean coarse scrub brush, wash the sampling equipment in the soap solution in the first basin, removing visible residues. Be sure to wash inside surfaces of equipment as well as the exterior surfaces. Allow excess soap to drain off the equipment when finished.
- Fill the second basin with potable water (first rinse) and rinse the equipment. A coarse scrub brush or pressure sprayer may be used to aid in the rinse, if necessary. Periodic changing of the water is required.
- Rinse the equipment with distilled/deionized water in the third basin. Periodic changing of the water is required.
- Additional decontamination may be implemented as needed.
- Allow the equipment to air-dry in a clean area or blot with chemical-free paper towels before reuse.

#### **3.5.5.2 Decontamination of Submersible Pumps**

This procedure will be used to decontaminate submersible sampling pumps before and between monitoring well development locations.



- Place three 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 three plastic wash bins in a line.
- Fill the first wash basin with potable 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 off the equipment will be difficult. Periodic changing of the water is required.
- Using a clean coarse scrub brush, wash the pump and power cord thoroughly in the soap solution in the first basin, removing visible residues. While submersed in the soap solution, the pump should be turned on and a minimum of one gallon pumped through the system. Allow excess soap to drain off the equipment when finished.
- Fill the second basin with potable water and rinse the pump and power cord. While submersed, the pump should be turned on and a minimum of one gallon pumped through the system. Periodic changing of the water is required.
- Fill the third basin with distilled/deionized water and rinse the pump and power cord. While submersed, the pump should be turned on and a minimum of one gallon pumped through the system. Periodic changing of the water is required.
- Additional decontamination may be implemented as needed.
- Allow the equipment to air-dry in a clean area or blot with chemical-free paper towels before reuse.

### **3.5.5.3 Decontamination of Measuring Equipment**

This procedure will be used to decontaminate measuring equipment, such as water level indicators and water quality meters before and between measuring points.

- Fill two clean basins or spray bottles with potable water.
- Add sufficient soap powder to one basin or spray bottle to form a thin layer of soap suds.
- Immerse the device in the soap containing basin and gentle agitate. Scrub the device if is soiled. Periodic changing of the water is required. Alternatively, the equipment may be cleaned using a spray bottle containing a water/soap solution and wiped with a chemical free paper towel.
- Immerse the device in the basin containing the rinse water and gentle agitate. Periodic changing of the water is required. Alternatively, the equipment may be cleaned using a spray bottle and wiped with a chemical free paper towel.

### 3.5.5.4 Decontamination of Large Equipment

If large equipment such as a drilling rig becomes soiled and decontamination is thought necessary, a temporary decontamination pad will be established for decontamination of heavy equipment. This pad may include a membrane-lined and bermed area large enough to drive heavy equipment (e.g., drill rig, backhoe) onto with enough space to spread other equipment and to contain overspray. Usually, a small sump is necessary to collect and contain rinsate (a pump is used to remove these wastes from the sump). A water supply and power source are also necessary to run steam cleaning and/or pressure washing equipment. Decontamination will be accomplished by steam cleaning or high-pressure water wash and manual scrubbing. This may be performed at the decontamination pad or in the vicinity of the drilling location, if the rinsate can be captured and containerized.

### 3.6 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables will be inspected and approved by the on-site project manager or field team leader to ensure that products meet project requirements. Those items not meeting project requirements should be returned immediately for replacement or refund.

### 3.7 Sample Handling Procedures

Many of the chemical constituents and physicochemical parameters that are to be measured or evaluated in the QAPP are volatile or are not chemically stable, and therefore sample preservation is required. For these constituents, samples will be transferred in the field from the sampling equipment directly into the container that has been specifically prepared for that analysis or set of compatible parameters. Samples will be stored at 0 to  $\leq 6$  °C from the time of collection to the time of analysis. Collected samples will be stored together with MS/MSD, blind field duplicate, trip blank, and equipment blank samples collected during that sampling event on ice in a cooler. Samples will be stored together in an area known to be free of contamination.

#### 3.7.1 Sample Containers and Preservatives

The laboratory will be responsible for supplying the proper containers to ensure sample integrity. The laboratory will provide new and/or pre-cleaned containers from an outside supplier. **Table 3** details the bottle type, quantity, preservative and holding time for each parameter analyzed in soil and groundwater. Sample preservation additives will be measured and placed in the appropriate sample containers by the laboratory prior to sampling.

#### 3.7.2 Sample Designation

Each separate sample will be identified using a sample label with a unique sample identifier (ID). The following presents the sample designation for soil and groundwater samples.

### 3.7.2.1 Soil Sample Designation

Soil sample identifier (ID) will use the following nomenclature:

Site Location-Field ID- (Confirmation or Step Out)-Matrix- (Depth From)- (Depth To)

where

Site Location:	SSHS
Field ID:	B## – Subsurface; numbered sequentially
Matrix:	Surface Soil: SS Subsurface Soil: SUB
Depth From:	Upper depth of sample interval in feet (subsurface only)
Depth To:	Lower depth of sample interval in feet (subsurface only)

Optionally, an additional prefix identifying the associated sampling event may be added.

### 3.7.2.2 Groundwater Sample Designation

Groundwater sample IDs will use the following nomenclature:

Site Location-Field ID-Date

where

Site Location:	SSHS
Field ID:	Monitoring Well ID
Date:	mmddyyyy

Optionally, an additional prefix identifying the associated sampling event may be added.

### 3.7.3 Sample Labeling

Each separate sample will be identified using a sample label. The sampler will complete information using waterproof ink with the following information:

- Sample identifier (ID) in accordance with Section 3.7.2;
- job name and identification number;
- date and time of sample collected;

- preservative;
- analytical method requested; and
- name of sampler.

The sample label contains the authoritative information for the sample. A chain-of-custody (COC) should reflect the same information as the label and be kept with the samples.

### **3.7.4 Sample Packaging and Shipment**

When samples have been collected at the end of the day, samples will be retrieved from their storage location and packaged for shipment. The following procedures will be during sample packing.

- Place plastic bubble wrap matting or other suitable packing material over the base of each cooler or shipping container as needed.
- Insert a clean lab provided liner or trash bag into the cooler to serve as a liner.
- Insert a cooler temperature blank supplied by the laboratory into each cooler.
- Place loose ice in even layer on bottom of cooler. Place samples atop ice in sealable or large bags to prohibit ice from contacting. Cover sealed samples in loose ice.
- Check that each sample container is sealed, labeled legibly, and is externally clean. Re-label and/or wipe bottles clean if necessary. If needed, clear tape should be placed over the labels to protect them and keep them from falling off the container. To protect each bottle from breakage during shipment, the glass sample bottles should be wrapped with bubble wrap. Alternate bottle protection procedures such as placing glass jars back in the cardboard shipping box in which they arrived, using cardboard dividers in the cooler, or placing in an appropriate foam holder may also be used. If plastic and glass sample containers are used, alternate the placement of each type of container as possible within the cooler so that glass bottles are not placed side by side.
- Insert a Trip Blank into each cooler containing VOC groundwater samples.
- If space allows, place ice in voids between sample containers. Other packing materials such as bubble wrap, and/or Styrofoam pellet packing material may be used as a substitute to fill voids between sample containers within each cooler to a level that meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling.

- Add additional bubble wrap/Styrofoam pellets or other packing materials to fill the balance of the cooler or container, if necessary.
- Sign and date a custody seal as discussed in Section 3.8.3.
- Complete the COC form as discussed in Section 3.8.1. If shipping the samples involves use of a third-party commercial carrier service, sign the COC record thereby relinquishing custody of the samples. Shippers should not be asked to sign COC records. If a laboratory courier is used, or if samples are transported to the laboratory by field personnel, the receiving party should accept custody and sign the COC records. Keep a copy of the COC for the project file. Place the original in a zipper-lock plastic bag and tape the bag to the inside lid of the cooler or shipping container.
- Close the lid of the cooler or the top of the shipping container.
- Place the custody seal across the cooler or container lid opening and overlap with transparent packaging tape.
- Packaging tape should be placed entirely around the sample shipment containers. A minimum of three full wraps of packaging tape will be placed on at least two places on the cooler/container.
- Place a shipping label on the outside of the shipping container that indicates the point of origin and destination.
- Repeat the above steps for each cooler or shipping container.

Following sample packing, the cooler/container containing the samples will be transported to the laboratory overnight via a package delivery service or laboratory courier under executed chain of custody. The appropriate shipping form or air bill will be filled out and affixed to the cooler/container. Some courier services may use multi-package shipping forms where only one form needs to be filled out for packages going to the same destination. If not, a separate shipping form should be used for each cooler/container. The receipt for package tracking purposes should be kept in the project files, in the event a package becomes lost.

### **3.8 Sample Custody and Documentation**

An overriding consideration for data resulting from laboratory analyses is the ability to demonstrate that the data are legally defensible (i.e., that the samples were obtained from the locations stated and that they reached the laboratory without alteration). To accomplish this, evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal will be documented through the COC record. A sample is considered to be in custody if the following applies to the sample:

- It is in actual possession or in view of the person who collected the samples;
- 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 custody seal, such that the sample cannot be reached without breaking the seal.

If sample preservation requires temperature control, then samples will be stored in iced coolers or a refrigerator in an access-controlled area of the Site. Sample custody will be the responsibility of the field manager or on-site designee from the time of sample collection until the samples are accepted by the courier service for delivery to the laboratory. Thereafter, the laboratory performing the analysis will maintain custody.

### 3.8.1 Chain-of-Custody

COC records will be filled out for samples to establish the documentation necessary to trace sample possession from the time of collection. In addition to providing a custody exchange record for the samples, the COC record serves as a formal request for sample analyses. The COC record lists each sample and the individuals performing the sample collection, shipment, and receipt. The following information will be recorded on the COC record:

- Project name;
- Project location;
- Geosyntec project number;
- Geosyntec project manager;
- Geosyntec project manager contact information;
- Sample numbers;
- Date (of sample collection);
- Time (of sample collection to the nearest minute, military time);
- Sample type (composite or grab);
- Sample description (matrix);
- Number of sample containers;
- Analysis required;
- Project specific QC samples (e.g. MS/MSD)
- Remarks (including special instructions to the laboratory);
- Type of data deliverable;
- Preservative information;
- Date/time (of custody transfer);
- Laboratory name;
- Turnaround time required; and
- Sampler's signature.

The COC records will be completed, signed, and distributed as follows:

- one copy will be retained by the sample coordinator for inclusion in the project files; and
- the original will be sent to the analytical laboratory with the sample shipment as described in Section 3.7.3 of this document.

### **3.8.2 Field Sample Custody**

Necessary sample containers will be shipped by the laboratory. The field personnel and/or Geosyntec QAM will determine the sample containers needed for a specific sampling task, check the integrity of the containers, and assure that the proper containers are assigned to the task to be conducted.

The COC record will be the controlling document to ensure that sample custody is maintained. The COC record will be initiated in the field by sampling personnel when they collect a sample. Each time the sample custody is transferred, the former custodian will sign the COC in the “Relinquished By” line, and the new custodian will sign the COC in the “Received By” line. The date and time will accompany each signature.

Immediately after sample collection, each sample will be handled as described in Section 3.7 of this document.

### **3.8.3 Custody Seals**

Custody seals are used to prevent unauthorized tampering with samples from the time of sample collection through the time of laboratory analysis. The seals will be signed and dated by sampling personnel and then placed on the shipping containers in such a way that they must be broken to open the containers. Seals will be affixed to the sample containers before the samples leave the custody of the sampling personnel. It is recommended that clear packing tape be placed over the custody seal to ensure that it is securely affixed to the shipping container. The laboratory will immediately notify Geosyntec personnel upon receipt in the event that the custody seal indicates that the container has been tampered with.

### **3.8.4 Laboratory Sample Custody and Documentation**

Samples will be delivered to laboratory personnel authorized to receive samples, also referred to as the “sample custodian”. The custodian, upon receipt of a sample, will inspect the condition of the sample (including temperature of the cooler) and the custody seal, reconcile the information on the sample label against that on the COC record, assign a laboratory number, log the sample in the laboratory information management system (LIMS), and store the sample in a secured sample storage area. The custodian will record pertinent observations and measurements on the COC record and sign the COC record.

Upon receiving the samples, the laboratory personnel will note on the original COC record discrepancies in the number of samples, temperature within the cooler or broken samples. The Geosyntec QAM or designated representative will be notified immediately of problems identified with shipped samples. The Geosyntec QAM or designated representative will, in turn, notify the project manager and together they will determine the appropriate course of action.

If the laboratory sample custodian judges sample custody to be invalid (e.g., custody seals have been broken), the Geosyntec QAM or designated representative will be immediately notified. The Geosyntec QAM or designated representative will, in turn, notify the project manager. The project manager will decide as to the fate of the sample in question on a case-by-case basis. The sample will either be processed “as-is” with custody failure noted along with the analytical data, or rejected with resampling scheduled, if necessary. The laboratory will initiate an internal COC that will track the sample within the various areas of the laboratory. Custody of the samples is transferred with the relinquishing signature of the sample custodian and the custody acceptance signature of the laboratory personnel. This procedure is followed each time a sample changes hands. The laboratory will archive the samples and maintain their custody, as required by the contract, or until further notification from the Geosyntec QAM or designated representative, at which time the samples will either be returned to the project for disposal or disposed of by the laboratory.

### **3.8.5 Field Documentation**

Information pertinent to field sampling will be recorded in a permanently bound or electronic field logbook or field forms to maintain the integrity and traceability of samples. Detailed field data will be recorded on activity-specific field forms. Entries will be recorded in indelible ink.

At a minimum, the logbook and/or corresponding field forms will contain the following information as applicable to the sample type collected:

- Project name and location (on the front page of the logbook);
- Signature or initials of field sampler;
- Date and time of collection for each sample;
- Sample identification number;
- Sample location (sampling point);
- Weather (rain, sunny, approximate temperature, etc.);
- Requested analysis;
- If prudent, a drawing of or a copy of a map with the sample locations;



- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments;
- Descriptions of deviations from this QAPP/FSP;
- Problems encountered and corrective action taken;
- Identification of field QC samples; and
- Other events that may affect the samples.

Field documentation will be stored in the project files for future use or reference, if necessary.

### **3.8.6 Document Corrections**

Changes or corrections on project documentation will be made by crossing out the item with a single line. The person performing the correction must initial and date the correction. The original item, although erroneous, must remain legible. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly.

## **4. QUALITY ASSURANCE/QUALITY CONTROL MEASURES**

### **4.1 Field Quality Control**

Field QC samples will be collected and analyzed to assess the precision and accuracy of groundwater and soil sampling activities. Field QC samples for this project will include field duplicates, MS/MSD, equipment rinsates, source blanks when necessary, temperature blanks, and trip blanks. Table 4 describes the field quality control samples per matrix and their frequencies.

#### **4.1.1 Field Duplicates**

Field duplicates are two samples (an original and a duplicate) of the same matrix, collected at the same time and location and using the same sampling techniques, to the extent practicable. Field duplicate samples are used to evaluate the precision of the overall sample collection process. Field duplicates will be collected at a frequency of approximately 1 per 10 regular samples and will be analyzed for the full set of analyses used for the regular samples collected. Field duplicates receive unique sample numbers; therefore, the identities of the duplicate samples are “blind” to the analytical laboratory. Exact locations of duplicate samples and sample identifications will be recorded in the field logbook.

#### **4.1.2 Matrix Spike/Matrix Spike Duplicate**

The laboratory will analyze an MS/MSD for every 20 samples analyzed. Field personnel will collect approximately triple the amount of the volume of the sample matrix for the designated

MS/MSD sample. The MS/MSD sample will be used to determine the precision and accuracy of the sample preparation and analytical methods for a given matrix.

### **4.1.3 Equipment Rinsate Blank**

Equipment rinsate samples will be collected at a frequency of one per day for each matrix that non-disposable or non-dedicated sampling equipment is used. Rinsate samples are laboratory-certified clean water collected from the final rinse of the decontamination process. Rinsate samples will be collected from the sampling equipment, placed in appropriate containers supplied by the analytical laboratory, and analyzed for the full set of analyses used for the samples collected that day. Equipment rinsate samples are used to evaluate the effectiveness of the decontamination procedure and the potential for cross-contamination during sampling events.

If conducting PFAS groundwater sampling, one equipment blank will be collected per day per 20 samples as per NYSDEC PFAS sampling guidelines. The equipment blank will test both new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample will be obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.

### **4.1.4 Trip Blanks**

Trip blanks will be prepared by the laboratory in 40-mL volatile organic analysis (VOA) vials with analyte-free water. The trip blanks will be carried into the field, stored, and shipped to the laboratory along with the water samples. Trip blanks will be shipped with each cooler that contains groundwater samples to be analyzed for VOCs. Trip blanks are evaluated to determine whether VOC cross-contamination between samples has occurred during storage and transportation. Trip blanks apply only to volatile organics in groundwater and must be free of headspace.

### **4.1.5 Temperature Blanks**

Each cooler will be shipped with a temperature blank. A temperature blank is a sample container filled with tap water and stored in the cooler during sample collection and transportation. The laboratory will record the temperature of the temperature blank immediately upon receipt of the samples. If samples are received at the laboratory less than 8 hours after collection, they may not have had sufficient time to cool to the required  $0 \text{ to } \leq 6 \text{ }^{\circ}\text{C}$ .

## **4.2 Laboratory Quality Control/Quality Assurance**

### **4.2.1 Laboratory Qualifications**

The analytical laboratory selected for this project will be Eurofins Laboratories which are certified by New York State through the National Environmental Laboratory Accreditation Program for the analytical methods required for the project.

## 4.2.2 Quality Control Samples

The laboratory has a QC program in place to ensure the reliability and validity of the analysis performed by the laboratory. Analytical procedures are documented in writing as Standard Operating Procedures (SOPs) and each SOP includes a QC section which addresses the minimum QC requirements for the procedures. The internal QC checks differ slightly for each individual procedure but in general the QC requirements include the following:

- Method blanks;
- Reagent/preparation blanks (inorganic parameters);
- Instruments blanks;
- MS/MSDs;
- Surrogate spikes;
- Laboratory duplicates;
- LCSs;
- Internal standards;
- Mass tuning;
- serial dilutions; and
- interference check samples.

## 4.2.3 Calibration

Instruments will be calibrated, and the calibration acceptance criteria met before samples are analyzed. Calibration standards will be prepared with National Institute for Standards and Testing (NIST)-traceable standards and analyzed according to method requirements. Initial calibration acceptance criteria documented in the laboratory SOPs will meet those of applicable guidance documents. The initial calibration will meet one of the following requirements:

- The lowest concentration of the calibration standard is less than or equal to the RL based on the final volume of extract or sample; or
- For each target analyte, at least one of the calibration standards will be at or below the regulatory limit (action level) as defined by the DQOs.

Initial calibration will be verified, before samples are analyzed, with a second source standard prepared at the mid-point of the calibration curve. Initial calibration verification will meet the acceptance criteria that are expressed in the laboratory SOPs.

Daily calibration verification will be conducted at the method-prescribed frequencies and will meet the acceptance criteria of applicable guidance documents. Daily calibration verification will not be used for quantitation of target analytes.

Calibration data (calibration tables, chromatograms, instrument printouts, and laboratory logbooks) will be clearly labeled to identify the source and preparation of the calibration standard, and will therefore be traceable to the standard preparation records.

#### **4.2.4 Preventive Maintenance**

The primary objective of a preventive maintenance program is to help ensure the timely and effective completion of a measurement effort by minimizing the downtime of crucial analytical equipment caused by expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas: maintenance responsibilities, maintenance schedules, and adequate inventory of critical spare parts and equipment.

Maintenance responsibilities for laboratory equipment are assigned to the respective laboratory managers. The laboratory managers then establish maintenance procedures and schedules for each major equipment item. These are contained in the maintenance logbooks assigned to each instrument.

The effectiveness of maintenance programs depends, to a large extent, on adherence to specific routine maintenance for each major equipment item. Other maintenance activities may also be identified as requiring attention on an as-needed basis. The manufacturer's recommendations or sample throughput provide the basis for the established maintenance schedules, and the manufacturers' service contracts provide primary maintenance for many major instruments (e.g., gas chromatography instruments, atomic absorption spectrometers, analytical balances, etc.). Maintenance activities for each instrument are documented in a maintenance log.

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment downtime. This inventory emphasizes those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur.

The laboratory manager is responsible for maintaining an adequate inventory of necessary spare parts. Sufficient equipment will be on hand to continue analyses in the event that an instrument encounters problems. In addition to backup instrumentation, a supply of spare parts, such as fittings, septa, atomic absorption lamps, mirrors, diaphragms, graphite furnace tubes, and other ancillary equipment, will be maintained.

#### **4.2.5 Training**

The laboratory will have an established policy and procedure on training and documenting of the analyst's competency. As described in SW-846 (EPA, 1996), each staff member that performs sample preparation and analysis will demonstrate their proficiency through preparation and analysis of four LCSs. An analyst will be considered proficient if the acceptance criteria for method accuracy and precision are met. The laboratory will maintain training records on file.

#### **4.2.6 Supplies and Consumables**

The laboratory will inspect supplies and consumables before their use in analysis. The materials specifications in the analytical methods will be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents will be monitored by analysis of solvent blanks. An inventory and storage system for materials and supplies will ensure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

### **5. DATA MANAGEMENT, VALIDATION, AND USABILITY**

#### **5.1 Data Management**

Data management operations include data recording, validation, transformation, transmittal, reduction, analysis, tracking, storage and retrieval.

Data will be managed by an EQUIS<sup>®</sup> Database System. Upon receipt from the laboratory, the analytical report and electronic data deliverable (EDD) will be entered into the project's data validation tracking system, which allows the data to be tracked from receipt, through validation, to data loading and storage. The electronic data will be imported into the database system concurrent with the data validation process. The database will be updated with validated data after validation of the laboratory data is complete.

The data will be considered final when data validation is complete and required data qualifiers have been added to the database. Changes made to the database after finalization will be documented, including a description of the change, date of change, person responsible, and reason for change.

Once the data quality checks are performed, the data will be exported to a variety of formats to meet project needs. Cross-tab tables showing concentrations by sample location will be prepared. Data can be accessed by a variety of mapping and visualization tools.

The project database will be maintained on a secure network drive which is backed up regularly. Access to the database will be limited to authorized and trained project personnel.

## 5.2 Data Reduction, Review, Verification, and Validation

This section addresses the stages of data quality assessment by the laboratory, and by Geosyntec after data have been generated and received (i.e., data reduction, review, verification, and validation). It also sets procedures for evaluating the usability of data with respect to the DQOs set forth in Section 2. Data validation pertinent to this Site will be performed in accordance with the following data validation guidance documents, where applicable:

- USEPA, Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, most current version
- USEPA, Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, most current version
- DER-10/Technical Guidance for Site Investigation and Remediation, NYSDEC May 3, 2010

### 5.2.1 Data Reduction

Raw analytical data generated in the laboratory are collected from the instruments and associated data system or are manually recorded into bound notebooks. Analysts review data as they are generated to determine that the instruments are performing within specifications. This review includes calibration checks, surrogate recoveries, blank checks, retention time reproducibility, and other QC checks as specified in the SOPs. If problems are noted during the analytical run, corrective action is taken by the laboratory and documented. Each analytical run is reviewed by the laboratory for completeness prior to interpretation and data reduction.

### 5.2.2 Data Review

Data review is an initial and relatively non-technical step of data assessment that primarily addresses issues of completeness and data handling integrity. In data review, the reviewer will ensure that necessary reporting components have been included in laboratory reports, such as necessary fields (e.g., collection/analysis dates, units, etc.) as well as the presence of (but not implications of) QC data components (e.g., LCS records, surrogate results, etc.).

### 5.2.3 Data Verification

Data verification is a more technical process than data review in that the core technical aspects of data quality (e.g., precision, accuracy, etc.) are evaluated through a review of the results of QA/QC measures, such as LCSs and surrogates.

Following interpretation and data reduction by an analyst, data are transferred to the laboratory sample management system either by direct data upload from the analytical data system or manually. The data are reviewed by the group leader or another analyst and marked on the sample

management system as being verified. The person performing the verification reviews data including QC information prior to verifying the data. If data package deliverables have been requested, the laboratory will complete the appropriate forms summarizing the QC information and transfer copies of raw data (e.g., instrument printouts, spectra, chromatograms, etc.) to the data packages group. This group will combine the information from the various analytical groups and the analytical reports from the laboratory sample management system into one package. This package is reviewed by the laboratory project manager (LPM) for conformance with SOPs and to ensure that project QC goals have been met. Analytical problems are discussed in the case narrative, which is also included with the data package deliverables.

#### **5.2.4 Data Validation and Usability Determination**

Following data verification by the laboratory, data validation will be coordinated and/or conducted by Geosyntec's QAM or designee. Validation documentation will be stored in the project file. Validation will be conducted in accordance with TAGM SW-96-09 on the laboratory data by an entity independent of the laboratory. This validation will be done on the hard copy (or pdf version) data with electronic data screening as a component of the validation.

While data verification is a technical process in which the data's adherence to core PARCCS elements is evaluated, it still does not answer the final question of the usability of the data and the implications of departures from data expectations. The data validation process is designed to answer these questions through: (i) the assignment of data qualifiers based on the data validation results; and (ii) a case-by-case review of data quality issues with respect to project DQOs to render a final assessment of data usability.

#### **5.3 Data Evaluation Roles and Responsibilities**

The following components of data evaluation will be performed by certain entities as noted:

- data reduction will be performed by the analytical laboratory;
- data review will be performed both by the laboratory and by Geosyntec;
- data verification will be performed both by the laboratory and by Geosyntec; and
- data validation and usability determination will be performed by Geosyntec.

#### **5.4 Data Reporting**

The laboratory data package receipt schedules will be based on the laboratory standard turnaround time. The laboratory will provide hard copy data packages that consist of several components, as well as an EDD for each set of samples (i.e., each work order). The data package deliverables from the laboratory will be specific to each type of data collected but will consist of Level 4 data packages (referred as Category B by NYSDEC)The components of a Level 1 through Level 4 data package are as follows:

- Level 1– Signed cover sheet, narrative, data results, and copy of the chain-of-custody;
- Level 2 – Signed cover sheet, narrative, data results, QC sample results, copy of the chain-of-custody;
- Level 3 – Signed cover sheet, narrative, data results, raw data result information, QC sample results, raw data QC information, calibration and continuing calibration information; and
- Level 4, Full, or CLP-like – The levels stated above plus raw data and supporting information for the data results.

The reporting scheme from collection of raw data through document storage is as follows:

- Raw data collected by laboratory technical personnel;
- Data reviewed/checked by laboratory supervisor;
- Data receive QA/QC review by LPM;
- Data deliverable undergoes data validation as per project requirements; validation qualifier codes are applied to the data (as applicable) and incorporated into the EDD (with follow-up QC check). The EDD is checked against the hardcopy results during the validation process. Minor errors are corrected in-house. Resubmittal of the hardcopy or the EDD may be required if major errors are observed; and
- If data are found to be incorrect, then corrective action procedures are implemented, and the data review process is reinitiated.

The validation process for laboratory data will include a review of laboratory QC results and comparison against USEPA validation limits and/or project specific criteria that could affect the quality of sample results. Specific QC components to be evaluated in the review include the following:

- Case narrative;
- Data completeness check;
- Holding times;
- Sample preservation;
- Blank results (instrument blanks, method blanks, field blanks, trip blanks, equipment blanks (as applicable));



- Surrogate recoveries;
- Internal standard recoveries (as applicable);
- Calibrations;
- Initial and Continuing calibration;
- Analytical run sequence;
- Chromatograms;
- Raw data files;
- Internal Standard and Retention Time Summary
- Instrument tune (as applicable);
- Serial dilution;
- Laboratory duplicates (as applicable);
- Matrix spike and matrix spike duplicate results;
- Field duplicates;
- Laboratory control sample results; and
- Other specific information as described in the most current NYSDEC ASP.

Based on validation results, qualifiers will be added to reported analytical results to indicate uncertainty or potential bias or interferences. Specific data qualifiers which will be applied to sample concentration include the following:

- J - The results are considered estimated. The analyte was detected above the MDL, but the associated reported concentration is approximate and is considered estimated because it is below the RL, also referred to as reporting limit) or because there was a QC issue identified and associated with the analytical result.
- R - The reported analyte concentration is rejected due to a serious deficiency with the associated quality control result(s). The presence or absence of the analyte cannot be confirmed.
- U - The analyte was not detected above the MDL or RL as applicable.

UJ - The analyte was not detected above the MDL or RL as applicable. However, due to quality control results that did not meet acceptance criteria, the RL is uncertain and may not accurately represent the actual limit.

## **5.5 Data Usability and Reconciliation with Project Quality**

The following sections describe the performance criteria and data usability for the investigation program. In general, if issues with data quality are found in the various data sets, they will be discussed with the project team including the laboratory and NYSDEC. A NYSDEC Data Usability Summary Report (DUSR) will be prepared to assess the usability of the data when compared to its intended use as established in the DQO statement. Data sets will be assessed with regard to the PARCCS parameters described below.

### **5.5.1 Precision**

Field and laboratory duplicates have been incorporated into the program to assess the precision of the measurement system. If duplicate results indicate matrix heterogeneity greater than anticipated, qualifiers will be added to reported concentrations and a description of validation actions will be included in the DUSR.

### **5.5.2 Accuracy**

Accuracy is a measure of how a concentration is in agreement with a reference concentration. Calibrations, matrix spikes, surrogate spikes, internal standards, and laboratory control sample results will be used to assess accuracy. The DUSR will identify non-compliant results and discuss the impact to reported results. Data qualifiers will be applied to sample concentrations based on a comparison of quality control results to laboratory or method specified performance criteria.

### **5.5.3 Representativeness**

Sample representativeness will be assessed through an analysis of the blank results. The concentrations and frequencies of target analytes detected in blanks will provide an indication of data representativeness. The DUSR will describe issues concerning representativeness based on a review of these data. Qualifiers will be applied to data that do not meet the specified laboratory or method criteria of these measurement parameters.

### **5.5.4 Comparability**

Comparability between data sets will be made qualitatively and quantitatively to determine the extent to which different measurements of the same quantity will yield valid conclusions. Comparability performance will be assessed on the basis of duplicate results from samples of the same media collected from the same location at the same time compared against measurement performance criteria, as discussed in Section 2.

Field parameters can provide another means of assessing the comparability of data points within a data set. Parameters including pH, turbidity, and specific conductivity are generally similar among like samples, within certain limits. Should laboratory data appear anomalous, field parameters will be checked to assess the potential that a sample may not have been representative of general conditions for a particular location at a particular time.

### **5.5.5 Completeness**

A data set for a specific medium will be considered complete if at least 90 percent of the results have associated quality control results and are accepted a valid data to meet the Quality Objectives provided in this QAPP/FSP. The DUSR will include a discussion of the results obtained from the completeness review and recommend corrective action(s) as appropriate.

## **6. REFERENCES**

NYSDEC, 2010. DER-10 Technical Guidance for Site Investigation and Remediation. May 2010.

NYSDEC, 2013. NYSDEC Electronic Data Deliverable Manual. NYSDEC EDD Format v.3. April 2013.

NYSDEC, 2023. Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl Substances. April 2023.

USEPA, 1996. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846. December.

USEPA, 2001. Requirements for Quality Assurance Project Plans. EPA QA/R-5. March.

USEPA, 2020a. Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51. EPA 540-R-20-005. November 2020.

USEPA, 2020b. National Functional Guidelines for Inorganic Superfund Method Data Review. OLEM 9240.1-66. EPA 542-R-20-006. November 2020.

# TABLES

APPENDIX A  
GEOSYNTEC RESUMES

**AREAS OF SPECIALIZATION**

- Site Assessment and Remediation
- Groundwater Assessment and Remediation
- Program Management

**EDUCATION**

M.S., Engineering Geology,  
Drexel University, 1999  
B.S., Geology, Juniata College,  
1993

**PROFESSIONAL REGISTRATIONS/  
CERTIFICATIONS**

Registered Professional  
Geologist, Pennsylvania No.  
PG003751E

Project Management  
Professional, Project  
Management Institute, No.  
133058

40-Hour OSHA Training as per  
CFR 1910.120

8-Hour OSHA Supervisor  
Training as per CFR 1910.120

Loss Prevention System  
Standard & Supervisor  
Training

**SUMMARY OF QUALIFICATIONS**

Ms. Huha is a geologist with 30 years of experience supporting a variety of complex environmental programs under state and federal regulations. She is a skilled project management professional with strong leadership capabilities and is focused on a culture of safety, operational excellence, and financial success for customers. She specializes in managing client programs and liability associated with investigation and remediation of contaminated sites and environmental due diligence. She has managed and performed hydrogeologic investigations, site contamination studies, Phase I and II environmental assessments, remedial feasibility studies, and oversight of remedial system installation and operation and maintenance activities for a variety of clients and facilities. In addition, she has constructed groundwater models of water supply/wellhead protection studies, and constructed fate and transport models for risk-based closure projects. Her experience includes all aspects of project management, client liaison, regulatory interaction, and technical report preparation and review. She is a licensed Professional Geologist in Pennsylvania, and a certified Project Management Professional.

**RELEVANT PROJECT EXPERIENCE**

**Project Director Former Remington Site, Fortune 500 Corporation, Elmira, New York.** Project director for the evaluation of interim measures (IM) and completion of remedial investigation/feasibility studies (RI/FS) of a former typewriter manufacturing facility. The Site has been segregated into multiple operable units (OU) to account for current property use: OU-1 – off-site issues related to past manufacturing activities; OU-2 – former manufacturing activities associated with the portion of the property currently operated as a public high school, and; OU-3 – former manufacturing activities associated with the portion of the property currently operated as multitenant storage, manufacturing and office space.

IM evaluation included a pre-design investigation of potential continuing discharge sources to an adjacent wetland and surface water bodies for compounds of potential concern (COPCs) including cadmium, nickel, zinc and PCBs. RI/FS activities included a sediment, soil, and surface water sampling program intended to delineate the magnitude and extent for COPCs. Anticipated investigation activities include soil, groundwater, surface water, sediment sampling and fish & wildlife evaluation. Implementation of IMs onsite to address TSCA and non-TSCA levels of PCBs in surface, near surface and deeper soils were initiated in 2017 and continue and include activities to accommodate property owner capital improvement projects included completion of pre-design investigation data collection; an Interim Remedial Measures (IRM) Work Plan & Design; contractor bid solicitation and selection; and IRM implementation under significant schedule constraints by the stakeholders involved and affected by the project.

**Project Manager for RCRA manufacturing facility, AstraZeneca, Dighton, Massachusetts.** Managed ecological and human health assessment activities associated with a large former manufacturing facility. The facility is under the RCRA program, requiring significant interaction with EPA and their oversight contractor to reach agreement on the risk assessment phase to guide the project toward media cleanup standards, corrective measures studies and implementation.

**Project Director for COPR Sites, Glen Springs Holdings, Kearny, New Jersey.** Served as project director to guide implement two clean closures, three commercial closures, and interim remedial measures at five COPR sites for client as required by Consent Judgment. Served as Owners representative at one clean closure via excavation and off-site disposal for four months in the field. Developed remedial strategy and lead the design of three commercial closures including excavations, capping, stormwater management, and groundwater treatment.

**Project Manager/Principal Geologist for Crude Oil Spill from Hurricane Dorian, Equinor, Grand Bahama, The Bahamas.** Managed groundwater assessment activities associated with a large environmental response for loss of 55,000 barrels of

crude oil to ground surface due to Hurricane Dorian. The assessment activities included selection and installation of 27 monitoring wells, managing all field and laboratory groundwater data collection, quality assurance/quality control of data, and reporting. Required extensive oversight of a team of 10 environmental professionals, and extensive regulatory interaction with The Ministry of Environment Department of Environmental Health Services and The Attorney General for The Bahamas.

**Project Manager/Principal Geologist for Geohazard Mitigation of Subsidence from Installation of Pipeline, Chester County, Pennsylvania.** Provided third party review as part of a team of geotechnical professionals to guide geohazard mitigation activities associated with subsidence from horizontal directional drilling to install new subsurface pipeline. The activities included review of field work and geophysics reports to assist in selection of grouting remedies, and interface with the regulatory agencies and their consultants to gain approval of remedial actions.

**Project Manager/Principal Geologist for Terminal and Bulk Petroleum Storage Facility, Linden, New Jersey.** Managed and guided remedial investigation reporting activities, installation of offsite monitoring wells to finalize delineation and Classification Exception Area (CEA), and develop site remedial action strategies and work plans for compliance with the New Jersey Department of Environmental Protection (NJDEP).

**Project Manager for Compressor Station Construction, Roseland, New Jersey.** Managed construction quality assurance activities associated with soil compaction and concrete testing for installation of a new pipeline compressor station in New Jersey for a prominent gas pipeline company.

**Program Manager for U.S. Oil & Gas Market Sector.** Defined annual strategy and business plans for top oil & gas clients. Thoroughly understood and led the program and project teams through time & materials, unit price/lump sum, and performance-based contract terms and conditions, client workflow, project delivery and invoicing requirements for the ExxonMobil program. Maintained federal and state regulatory knowledge base to understand how regulations applied to and drove business needs per state. For example, within the State of New Jersey, the ExxonMobil remediation program consisted of \$5M in budget to manage and ensure critical regulatory deadlines were met and spending met established client targets per project. Directed and stewarded company's Loss Prevention System, Inc. behavior-based health and safety program. This included implementation of a root cause analysis approach to investigating loss prevention observations, near losses, and losses to capture and improve job safety analysis tools, best practices, standard operating procedures, and policies.

**Program Management/Assessment & Remediation for Upstream Oil & Gas Exploration & Production, Pennsylvania, Ohio, and West Virginia.** Managed unconventional shale gas programs for numerous clients in the Marcellus and Utica Shale Plays for baseline "pre-drill" groundwater sampling, erosion and sedimentation control inspections, and development and maintenance of environmental data management systems to centrally store, evaluate and report on results.

**Program Manager/Assessment & Remediation for Well Control Incident, Bradford County, Pennsylvania.** Managed a large environmental response for loss of well control during development. Activities included managing and quality assurance/quality control of all field and laboratory data collection, and reporting. Required extensive oversight of a team of 20 environmental professionals, and extensive regulatory interaction with the Pennsylvania Department of Environmental Protection (PADEP) and U.S. EPA Region III, and third parties involved in the incident.

**Catastrophic Gasoline Release Emergency Response Management, Northeastern Pennsylvania.** Served as Project Manager during emergency response activities surrounding approximately 80,000-gallon jet fuel release from a pipeline that traversed a coal mine (subsurface and strip) with mine pool and acid mine drainage. Directed subsurface assessment, product recovery, remediation planning, community well sampling, community vapor monitoring and mitigation, regulatory agency interactions and community relations activities. Ensured safety of near-by residential properties through comprehensive sampling program. Led technical discussions during multiple regulatory agencies and departments as well as public meetings to communicate status of response efforts and planned activities.

**Remedial Investigation/Remedial Action at Bulk Petroleum Storage Facility, Sinking Spring, Pennsylvania.** Conducted site-wide site characterization activities including soil sampling, fracture trace analysis, electromagnetic and microgravity geophysical surveys, well installation, groundwater sampling, slug testing, remedial feasibility testing, and bio-feasibility analysis. Managed and oversaw the investigation activities and continued to develop site remediation strategies.

**Remedial Investigation/Remedial Action at Bulk Petroleum Storage Facility, Edwardsville, Pennsylvania.** Conducted site-wide site characterization activities including soil and groundwater sampling, well installation, slug testing, and remedial feasibility testing for this site where two aquifers have been impacted by petroleum hydrocarbons. Managed and oversaw the investigation activities and continued to develop the remedial action strategy for the site.

**Remedial Investigation at Bulk Petroleum Storage Facility, Williamsport, Pennsylvania.** Conducted site-wide site characterization activities including soil and groundwater sampling, and well installation, where off-site impact by petroleum hydrocarbons is a major concern. Managed and oversaw the investigation activities and continued to develop remediation strategies for the site.

**Emergency Response/Project Management at Petroleum Pipeline and Valve Station Sites, Multiple Locations throughout Pennsylvania.** Conducted site-wide site characterization activities including soil and groundwater sampling, and well installation, where off-site impact by petroleum hydrocarbons is a major concern. Managed and oversaw the investigation activities and continued to develop remediation strategies for the site.

**Remedial Investigation/Risk-Based Closure for Apparatus Service Center, Minneapolis, Minnesota.** Participated in the remedial investigation/feasibility study for soil and groundwater impacted with chlorinated solvents, polychlorinated biphenyls (PCBs), and petroleum hydrocarbons. Project included characterizing the site and developing the fate and transport model to aid in the development of a risk-based closure.

**Remedial Investigation/Fractured Bedrock at Petroleum Pipeline Pump Station and Former Bulk Storage Facility, Quentin, Pennsylvania.** Conducted site-wide site characterization activities where a fractured-rock aquifer has been impacted by petroleum hydrocarbons. Activities included soil and groundwater sampling, well installation, slug testing, remedial feasibility testing, and design review and oversight of the installation of a groundwater, product, and soil vapor extraction system. Managed operating, maintaining, and maximizing recovery of this remediation system to drive the site toward closure under Pennsylvania's Act 2.

**Regulatory Compliance Management at Apparatus Service Center, Philadelphia, Pennsylvania.** Managed the remediation of a PCB groundwater plume using pump and treat technology. Managed regulatory compliance for facility's sanitary sewer discharges.

**Quality Assurance/Quality Control Audits at Defense Distribution Depot, Susquehanna, New Cumberland, Pennsylvania.** Performed quarterly Quality Assurance/Quality Control audits.

**Quality Assurance/Quality Control Audits at Superfund Site, Havertown, Pennsylvania.** Performed quarterly Quality Assurance/Quality Control audits.





**KRISTA BRODERSEN**

**Phase I and II Environmental Site Assessments  
Site Characterization and Remediation  
Brownfields**

## **EDUCATION**

B.S., Environmental Science, Southern Illinois University, 1996

## **REGISTRATIONS AND CERTIFICATIONS**

OSHA 40-Hour HAZWOPER, with annual refresher  
OSHA 8-Hour HAZWOPER Supervisor  
CPR and First Aid Certification

## **CAREER SUMMARY**

Over 25 years' experience in the environmental field that includes the performance, management, and review of due diligence projects, Brownfield projects, remediation system installation and operation, and hazardous materials surveys. Investigations have been conducted under the supervision of multiple regulatory agencies throughout the United States.

### **PHASE I and PHASE II ENVIRONMENTAL SITE ASSESSMENTS (ESAs)**

Performed and reviewed Phase I ESAs on multiple sites throughout the United States under the provisions of ASTM E-1527-05, ASTM E-1527-13, and ASTM E-1527-21. The Phase I ESAs were conducted for various financial institutions, government agencies, land developers, and private buyers. Sites included residential, commercial, and industrial properties. Completed more than 800 Phase I ESAs over 25 years and reviewed over 1,000 Phase I ESAs over three years as a Risk Assessor for a National Bank.

Performed and managed Phase II ESAs for commercial, industrial, agricultural, residential, and government properties throughout California, Illinois, Iowa, Arizona, Kentucky, Missouri, Nevada, North Dakota, Oklahoma, Tennessee, Texas, and Wisconsin. Services were performed for various financial institutions, government agencies, land developers, and private buyers. Sites investigated include industrial/manufacturing facilities, automotive

dealerships/automotive repair facilities, gasoline stations, smelting operations, power transfer stations, dry cleaners, aerospace facilities, a pesticide pit, railroads, future school sites, and Brownfield sites.

Phase II ESAs included very large to small blocks of land that had recognized environmental conditions such as: existing and former underground storage tanks (USTs; some leaking); oil pipelines; oil wells; storage of hazardous materials; former landfills; and dry-cleaning operations. Prepared plans including health and safety plans, investigation work plans, remedial and corrective action plans, and monitoring plans. Performed and managed numerous Phase II ESAs at sites with volatile organic compounds (VOCs), petroleum, solvent, heavy metal, and polychlorinated biphenyl (PCB) contamination. Conducted soil vapor, soil, and groundwater sampling using various technologies including hollow-stem auger, direct-push, air-knife, and hand-auger drilling. Supervised UST and other subsurface structure removals, building demolitions, groundwater remediation projects, aerially deposited lead surveys, groundwater monitoring and sampling, remedial excavations, and remediation system installations.

***Freeway Expansion, Los Angeles, California***

The 405 Freeway was being expanded and the California Department of Transportation requested a Phase I ESA along a 10-mile corridor of the freeway. Ms. Brodersen conducted the site walk, regulatory agency review, interviews, historical research, and completed the Phase I ESA. Multiple recognized environmental conditions were identified and additional assessment was recommended.

***Former Gasoline Station, Cedar Rapids, Iowa***

A Phase I ESA was conducted on a retail building that was a former gasoline station from the 1950s through the 1970s. The former gasoline station was investigated during a Phase II ESA which indicated elevated VOCs in groundwater. Based on the concentrations, a vapor concern was identified. Indoor air and subslab vapor samples were collected and to assess the concern and identified an indoor air issue. A vapor mitigation system was designed and installed at the facility. An environmental covenant was placed on the facility that included the operation of the vapor mitigation system and the use of the City of Cedar Rapids Groundwater Ordinance to address the groundwater impacts. The facility received closure from the Iowa Department of Natural Resources (IDNR).

***Former Industrial Facility, Dubuque, Iowa***

A Phase I ESA was conducted on a 43-acre manufacturing facility with a 715,000 square foot building that was over 100 years old. Multiple concerns were identified during the Phase I ESA and investigated during a Phase II investigation. VOCs, semi-volatile organic compounds (SVOCs), and heavy metals were identified in soil and groundwater. Reports were prepared for submittal to the IDNR and the project is currently in progress. The proposed remedial alternatives included excavation of impacted soil and capping of contaminants.

***Former Manufacturing Facility, East Moline, Illinois.***

Several buildings of a 100-year-old manufacturing facility along the Mississippi River were being sold and multiple Phase I ESAs were conducted for the buildings for multiple clients. Phase II ESA investigations were conducted and identified elevated concentrations of VOCs, SVOCs, and heavy metals in soil, groundwater, and/or vapor. Engineering controls were used to sever the pathway to the contaminants. A Site Investigation Report, Remedial Action Report, Remedial Action Plan, and Remedial Action Completion Report were prepared for and approved by the Illinois Environmental Protection Agency (IEPA) Site Remediation Program (SRP). Closure was obtained from the IEPA.

***Former Warehouse Facility, Dubuque, Iowa***

A Phase I ESA was conducted on a property that had been used by oil companies and a warehouse for almost 100 years. Based on the results of the investigation, petroleum hydrocarbons, volatile organic compounds, and heavy metals were identified above the Iowa State Standards. A Soil and Groundwater Management Plan was prepared prior to redevelopment. The Site Investigation report was submitted to IDNR and a “comfort letter” was obtained. Quarterly groundwater monitoring was required and conducted for one year. The monitoring indicated a decrease in concentration of impacts and a report and request for closure was prepared. The site received closure from the IDNR.

***Former Manufacturing Facility and Gasoline Station, Davenport, Iowa***

A Phase II investigation was conducted to assess a former manufacturing/gasoline station property in Davenport, Iowa. The Phase II included conducting a geophysical survey and collection of soil, groundwater, and soil vapor samples from in and outside of the site buildings. The investigation identified lead and semi-volatile organics in soil and volatile organics in the soil vapor. The overall proposed remedial alternatives included excavation of impacted soil and vapor mitigation at the site buildings.

### **Site Characterization and Remediation**

Performed work under multiple regulatory agency oversight including the IEPA, IDNR, Region 7 of the Environmental Protection Agency (EPA), California Underground Storage Tank (UST) Cleanup Fund, multiple divisions of the California Regional Water Quality Control Board (CRWQCB), California Department of Toxics and Substances Control (DTSC), the California Integrated Waste Management Board (CIWMB), and various voluntary remediation programs and brownfield programs.

#### ***Cement Kiln Dust Monofil, Buffalo, Iowa***

Managed activities related to groundwater impacts at a cement kiln dust (CKD) monofil in Buffalo, Iowa under the supervision of IDNR. Groundwater was impacted by metals from an adjacent underground mine and leachate from the CKD. The project included monthly measurements of depth to groundwater, semi-annual groundwater monitoring, and groundwater modeling. Conducted investigations to identify source of impacts and prepared Groundwater Remedial Action Plan, and Annual Groundwater Quality Reports.

#### ***Former Gasoline Station, Moline, Illinois***

Managed the investigation and remediation of a former gasoline station property in Moline, Illinois. The site was impacted by petroleum hydrocarbons and metals from the former gasoline station and buried garbage found on the site. Excavated and removed approximately 700 tons of impacted soil and buried garbage, sampling of clean import backfill to 25 feet, and soil confirmation sampling. Prepared Site Investigation Report, Remedial Action Report, Remedial Action Plan, and Remedial Action Completion Report that were approved by the IEPA. Obtained site closure from the IEPA.

#### ***Future School Site, Los Angeles, California***

Managed oversight of Remedial Action Plan (RAP) implementation at a six-acre property identified by the Los Angeles Unified School District as a potential future school site. The site was impacted with elevated levels of tetrachloroethene (PCE) in soil vapor. The project consisted of oversight and monitoring of the excavation of approximately 75,000 tons of impacted soil, sampling of excavated material, sampling of clean import backfill to 25 feet, soil and soil vapor confirmation sampling, dust monitoring, risk assessment, installation of sixteen vapor cutoff wells between the school and the upgradient adjacent PCE source, and appropriate waste characterization based on sample results. During RAP implementation, three USTs, two pressure vessels, a buried 55-gallon drum, clarifier, hydraulic hoist, sump,

and soil impacted by organochlorine pesticides were discovered and removed. The property was granted regulatory closure and a school was constructed onsite.

***Former Gasoline Stations, Los Angeles, California***

Oversaw soil sampling, soil vapor sampling, the installation and development of numerous groundwater monitoring wells, conducting quarterly groundwater monitoring, and installation and maintenance of a pump and treat groundwater remediation system for a commercial property formerly occupied by two separate gasoline stations. Ms. Brodersen also managing staff during quarterly monitoring of the property, reviewed quarterly reports, and interacted with the State regulatory agencies. The site was under the oversight of the CRWQCB and was included in the in the California UST Cleanup Fund.

***Debris Removal, Lompoc, California***

Performed and managed trash and debris excavation at 25,000-acre ranch under the oversight of the County of Santa Barbara, CalRecycle, and the CRWQCB. Work was conducted on a remote cattle ranch with many obstacles that included the need to build roads and bring water to the site, and the presence of rattlesnakes, Indian burial grounds, uneven terrain, former mines containing blasting caps, and oil wells. Removed approximately 7,000-tons of debris and contaminated soil, some of which was classified as hazardous waste, from the debris site. Recycled creosote laden utility poles and former oil production pipes. Property was granted a regulatory clean closure.

***Former Automotive Dealership, Cerritos, California***

Successfully supervised the assessment and remediation of an automobile dealership that was vacating a lease. The client was being sued by the property owner. Supervision of the project was taken over from another consultant after they received a cease-and-desist order from the property owner. The project included the removal of leaking USTs, leaking hydraulic lifts, a clarifier, and extensive excavation of contaminated soil (approximately 2,700 tons) resulting from former USTs and hydraulic lifts. A groundwater investigation was also conducted that included installation of groundwater monitoring wells and performance of quarterly monitoring under the oversight of Los Angeles County (LAC) and the CRWQCB. Avoided legal action against client and satisfied the client, property owner, property owner's consultant, property owner's lawyers, LAC, and CRWQCB. Property was granted regulatory closure.

## **BROWNFIELDS**

### ***Dilapidated and Collapsed Buildings, City of Clinton, Iowa***

Prepared a winning Brownfield Cleanup Grant Application for the City of Clinton, Iowa in 2023 for a block of buildings that were dilapidated and were to be torn down. Participated in public outreach and city council meetings in preparation for the grant application. Was awarded the Cleanup contract with the City. After the grant was awarded, two of the buildings collapsed and an emergency demolition on the asbestos impacted buildings were conducted. Oversaw the emergency demolition of the buildings and stockpile of debris. Participated in public outreach and city council meetings in preparation for the Analysis of Brownfields Cleanup Alternatives (ABCA), prepared ABCA, a demolition plan, Health and Safety Plan, Quality Assurance Project Plan, supervised the weekly air monitoring of the asbestos contaminated debris, updated Brownfields Assessment, Cleanup and Redevelopment Exchange System (ACRES), and interacted with Region 7 Project Manager and IDNR.

### ***East Central Intergovernmental Agency, Dubuque, Iowa***

Prepared Sampling and Analysis Plans, Phase I ESAs, Phase II ESAs, and hazard materials assessments under Brownfields Assessment and Multi-purpose Grants in EPA Region 7.

### ***EPA Cleanup Grants West Blum 1 and 2, Dubuque, Iowa***

Worked with the City of Dubuque, Iowa with their Brownfields Investigation, Clean-up, and Multi-purpose grants. One site was a former recycling facility that was impacted with polychlorinated biphenyls (PCBs), volatiles, waste oil, and hazardous levels of arsenic and lead. Prepared quarterly reports for the EPA; coordinated project work with EPA, prepared Sampling and Analysis Plan, Quality Project Plan, and Standards Operating Procedures for EPA approval. Tested and coordinated disposed of soil under Toxic Substances Control Act (TSCA) and Resource Conservation and Recovery Act (RCRA). Site investigation and remediation are ongoing.

## **SUPERFUND**

### ***Pesticide Contaminated Site, Riverside, California***

Assisted with the management of the remediation of a pesticide contaminated Superfund Site in Riverside, California. Duties at the Superfund site included health and safety monitoring, collecting soil samples, preparation of analytical data, coordination of construction workers, client interface, preparation of hazardous waste manifests, coordination of vendors, and preparation of site maps and data tables.

**HAZARDOUS MATERIALS ASSESSMENTS**

Supervised asbestos, lead-based paint, and mold surveys at various properties throughout the United States.

**PROFESSIONAL EXPERIENCE**

Geosyntec Consultants, Minneapolis, Minnesota, February 2024 – Present

Blackstone Environmental, Senior Project Manager, October 2019 – January 2024

Terracon Consultants, Senior Project Manager, 2013 – 2019

Union Bank, Assistant Vice President, 2010 – 2013

Ninyo & Moore, Senior Project Manager, 2003 – 2010

ATC Associates, Senior Staff Scientist, 2001 – January 2003

American Integrated Services, Assistant Project Manager, March 2001 – July 2001

Ceres Associates, Environmental Specialist, 1999 – 2001

**Kristoffer Henderson, ASQ CQT**

**Data Verification and Validation  
Quality Assurance Project Plan  
Laboratory Auditing  
Radiological Data Validation  
HAPSITE Portable GC/MS Analysis  
Groundwater Sampling  
Vapor Intrusion Sampling**

## **EDUCATION**

Masters in Managerial Accounting and Finance, DeVry University, 2008  
B.S., Chemistry, Georgia College and State University, Milledgeville, GA, 1996

## **REGISTRATION AND CERTIFICATIONS**

Certified Quality Technician, American Society for Quality  
ISO/IEC 17025 Lead Assessor Training  
HAPSITE Advanced Operator Training, February 2015  
Environmental Radiochemistry 40-hr Technical Short Course  
40-hr HAZWOPER, January 2012  
8-hr HAZWOPER Supervisor Training, January 2015  
CPR Training March 2017  
RCRA Hazardous Waste Annual Training, January 2015  
Environmental Radiochemistry Course, February 2016  
Confined Space Entry, January 2017  
RAD Worker II, September 2017  
IATA Dangerous Goods, March 2018  
DOT Hazmat Shipping, March 2018  
Respirator Training, March 2018

## **CAREER SUMMARY**

Mr. Henderson is a Quality Assurance Specialist based in Geosyntec's Knoxville office. He specializes in data verification and validation, quality assurance project plans (QAPP) and data usability reports. His experience in data quality includes both organic and inorganic parameters. Mr. Henderson also supports remediation projects in the areas of sample collection, data acquisition, data analysis, and reporting. Mr. Henderson has performed radiochemistry validation using Multi-Agency Radiological Laboratory Protocols and American National Standards Institute standards. He gained knowledge of radiochemistry data through an environmental radiochemistry course provided by Nevada Technical Associates and from visiting a radiochemistry laboratory.



## REPRESENTATIVE EXPERIENCE

### Data Validation and Verification

Mr. Henderson has 10+ years of data validation experience. Mr. Henderson performs data validation for numerous projects and responsible for Stage 2A to Stage 4 data validation of organic and inorganic chemical analyses of tissue, solid, water and air samples. Methods evaluated include both Contract Laboratory Program (CLP) and non-CLP methods.

Mr. Henderson led the validation of radiochemistry data of Berry's Creek Study Area in 2014 and 2015. Additional validation projects include Milwaukee Die Casting, Cascade Corporation, Former Sperry Remington, Milton Dry Cleaners, Moundsville, Aerojet Rocketdyne, and Newhall Ranch Water Reclamation Plant. Validation of data of coal combustion residual sites. Mr. Henderson has also validated radiochemistry data.

Mr. Henderson has performed data validation and data usability summary reports under the supervision of Julia Caprio according to the New York Department of Environmental Conservation (NYSDEC) DER-10 Technical Guidance for Site Investigation and Remediation.

### Quality Assurance Project Plan

Mr. Henderson has contributed to several quality assurance project plans (QAPP), including using the Uniform Federal Policy (UFP) QAPP format. He was involved with the following QAPPs: Nellis Air Force Base, Davis-Monthan Air Force Base, and Bristol Myers Squibb Syracuse Campus.

### Laboratory Auditing

Mr. Henderson attended Environmental Laboratory Assessment training from the National Environmental Laboratory Accreditation Conference (NELAC) and has performed laboratory auditing under the supervision of Julia Caprio.

### Vapor Intrusion

***Velsicol Chemical Corporation, Chattanooga, TN.*** Installed soil sampling probes and collected soil gas samples in Summa canisters for volatile organic compound (VOC) analysis and polyurethane foam cartridges for pesticide analysis.

***Conrail Site Elkhart, Elkhart, IN.*** Performed portable gas chromatograph/mass spectrometer (GC/MS) analysis of a residential sub-slab and indoor air using HAPSITE GC/MS in response to vapor intrusion exceedances of a residence with an installed vapor mitigation system. Summarized data to compare to Summa sampling results.

***Corpus Christi Army Depot, Corpus Christi, TX.*** Performed portable GC/MS analysis of an Army Depot using HAPSITE GC/MS to search for potential pathways to mitigate prior to deploying Summa canisters. Deployed Summa canisters for indoor and sub-slab sampling.

***Texas Instrument, Dallas, TX.*** Performed portable GC/MS analysis on samples collected in tunnels beneath a multi-use building to determine potential exposure of vapor intrusion compounds to building occupants.

***CDG-Cumberland, Knoxville, TN.*** Supervised several smoke tests of vapor mitigation barrier installations for a new construction.

***Paducah Gaseous Diffusion Plant, Paducah, KY.*** Performed indoor, outdoor, and sub-slab sampling using Summa canisters. Monitored weather using a weather station and gathered differential pressure readings using a DG-700 meter. Performed a helium leak test on sub-slab sample ports using a shroud and “shut-in” test. Used a landfill gas meter to determine the equilibrium of sample locations.

***Naval Base Kitsap, Keyport, WA.*** Performed portable GC/MS analysis on several buildings to optimize a sample plan and locate potential pathways and indoor sources. Tested the buildings for methane using landfill gas meter and gathered differential pressure readings between the building and outdoors using a DG-700 meter.

#### **Site Remediation**

***Former Robertshaw Controls Site, Knoxville, TN.*** Performed groundwater sampling and reporting.

***Berry’s Creek Study Area, Bergen County, NJ.*** Performed sediment core sampling and prepared samples for shipment to the laboratory.

#### **Laboratory Experience**

Mr. Henderson’s experience in environmental analytical laboratory includes preparing and analyzing environmental samples for metal and VOC analysis using atomic absorption and analyzing gas chromatography using multiple detectors including mass spectrometry interpretation. He has prepared samples using acid digestion, leachates, and extraction for metals (including mercury) and VOC analysis. His method experience includes the following:

- SW846 8021 Aromatic and Halogenated Volatiles by Gas Chromatography Using Photoionization and/or Electrolytic Conductivity Detectors
- SW846 8260 Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry
- SW846 7000 Flame Atomic Absorption Spectrophotometry
- SW846 7010 Furnace Atomic Absorption Spectrophotometry
- SW846 7470 Mercury in Liquid Waste (Manual Cold-Vapor Technique)
- SW846 7471 Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)
- SW3005 Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by Flame Atomic Absorption (FLAA) or inductively coupled plasma (ICP) Spectroscopy

- SW3010 Acid Digestion of Aqueous for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy
- SW3050 Acid Digestion of Sediments, Sludges, and Soils
- SW1311 Toxicity Characteristic Leaching Procedure
- SW1312 Synthetic Precipitation Leaching Procedure
- SW5030 Purge-and-Trap for Aqueous Samples
- SW5035 Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
- EPA Method 601/602 Purgeable Halocarbons and Aromatics
- EPA 624 Purgeables
- SW846 9040 pH Electrometric Measurement

#### **Nuclear Waste Characterization**

Mr. Henderson's experience in the nuclear waste field has involved venting waste drums and testing headspace for VOCs. As Group Lead, he has worked in radiation areas and used personal protection equipment. Mr. Henderson has performed the following duties:

- Analyzed headspace gas using modified SW8260 method with a drum venting system that allowed for the delivery of headspace to the GC/MS system.
- Performed syringe sampling of waste drums through filter septum for headspace gas analysis.
- Performed headspace sampling of waste drums using Summa canisters for off-site analysis and transported samples with chain of custody, tamper proof devices, and min/max thermometers.
- Determined the drum age requirement based on procedure and the drum profile based on historic data.
- Reported sample data and performed level one review and submittal of data for project-level reviews.
- Served as Group Lead responsible for training, group inventory, subject matter expert, and technical expert for management correspondents.
- Followed Radiological Worker II Training by using proper protective clothing, dosimeters, and respirators.
- Validated standard operating procedures and offered procedure changes to improve process or correct errors.

- Tested software to ensure the expected output for revision change.
- Served as a Technical Expert for hazard analysis of group activity.

Mr. Henderson utilized high-performance liquid chromatography to determine aflatoxin levels in corn and corn products in a manufacturing laboratory.

## **PROFESSIONAL EXPERIENCE**

Tate and Lyle, Loudon, TN, 2012  
Nuclear Filter Technology, Lenoir City, TN, 2004-2012  
ATC Associates, Marietta, GA, 1997-2004

## **AFFILIATIONS**

Associate Member, American Society for Quality, 2012

## **INVITED PRESENTATIONS**

- Christopher Gale, Todd McAlary, Hester Groenevelt, Lisa Smith, Kristoffer Henderson. (2016).  
“Comparison of Field Analytical Instruments for Vapor Intrusion Assessment.” Battelle  
2016 Chlorinated Conference.
- Kristoffer Henderson, Duane Graves, Leroy Leonard, Tyler McNabb, Jessie Fears. (2016, June  
7-9). “Phytoremediation Complements Enhanced In Situ Bioremediation (EISB) for  
Optimized Groundwater Remediation.” 16th Annual Meeting of the American Ecological  
Engineering Society.
- Kristoffer Henderson, Duane Graves, Robbie Ettinger, and Tammy Hebel. (2017, April 20).  
“Using the HAPSITE as a Vapor Intrusion Investigation Tool.” Department of Defense  
Environmental Monitoring Data Quality Workshop.
- Kristoffer Henderson and Teresa Fischer. (2017, May 18). “Vapor Intrusion, What Is It and Why  
It Matters.” Show of the South. May 18, 2017.

**Stephen E. Perdziola, P.G.**

Site investigation and characterization  
Hydrogeologic investigation and analysis  
GIS

## **EDUCATION**

M.S., Geology, Northern Illinois University, DeKalb, Illinois, 2018

B.S., Geology, University of Pittsburgh, Pittsburgh, Pennsylvania, 2016

## **REGISTRATIONS AND CERTIFICATIONS**

Professional Geologist, Pennsylvania (PG005581)

OSHA 40-hour Hazardous Waste Operations and Emergency Response

OSHA 8-hour Supervisor Training (HAZWOPER)

## **CAREER SUMMARY**

Mr. Stephen Perdziola is a certified Professional Geologist in the state of Pennsylvania possessing 5 years' experience performing a variety of environmental, geotechnical and stormwater investigations. His particular expertise is in the technical execution of environmental site investigations and characterization activities to support remediation, transfer, or closure of contaminated former industrial properties. Mr. Perdziola has supported and managed environmental investigation activities, reporting efforts, and field testing for a variety of environmental media including soil, groundwater, surface water, sediment, and soil gas.

### **Geotechnical Investigations**

***Geotechnical Field Investigations, Multiple Projects, Pennsylvania and Ohio.*** Field geologist responsible for overseeing drill rig operations, standard penetration tests, dynamic cone penetration tests, logging soils, water level measurements, undisturbed collection of Shelby tube samples, and split spoon sample collection. Shelby tube and SPT samples were collected and submitted for geotechnical analysis to support construction design projects, fill placement investigations, and slope stability analyses. Also assisted with proposal and report generation for projects involving geotechnical investigations.

***Hard Rock drilling, Multiple Projects, Pennsylvania and Ohio.*** Provided oversight for hard rock coring operations using conventional and wireline equipment, including core sample collection, classification, lithologic descriptions of boreholes, and rock quality designation. Hard rock drilling was performed as part of geotechnical investigations to support construction design projects.

***Inclinometer Installation, Penn Hills, Pennsylvania.*** Task managed geotechnical investigation completed in response to slope failure impacting residential properties. Objective of the investigation was to monitor for additional slope movement, determine depth to bedrock and slip

plane and support development of a slope stabilization design. Responsible for overseeing drilling operations on slip plane and installation of inclinometers to monitor additional slope failure.

***Infiltration Testing, Multiple Projects, Pennsylvania.*** Performed infiltration tests via double-ring infiltrometer in accordance with Pennsylvania Stormwater Best Management Practices in test pits to identify limiting sub-surface features. Infiltration testing informed design of storm water management features and determination of site suitability for stormwater management systems.

### **Environmental Investigation**

***Soil, Water Sampling and Remedial Investigation Oversight, Confidential Client, New York.*** Responsible for on-site management of soil and groundwater collection as part of sitewide Remedial Investigation to delineate heavy metals impacts at former manufacturing facility, currently the location of a high school. Responsibilities included organization of field efforts, subcontractor management, coordinating field team members to ensure adherence to work plan, documenting work plan deviations, coordination with school representatives to minimize impacts to school activities, coordinating with NYSDEC representatives on site, and coordinating with laboratories for sample analysis and quality assurance. Utilized direct push drilling for collection of soil samples at discrete intervals for assessment and delineation of hazardous waste contamination. Oversaw installation of monitoring wells using hollow stem auger and roto sonic drilling methods and development of monitoring wells. Evaluated geologic data to determine monitoring well design and configuration for successful well installation and development at target aquifer intervals. Served as site health and safety officer to ensure adherence to company and client health and safety policies. Lead Health and Safety tailgate meetings and assisted with excavation air monitoring through use of dust monitors and 5-gas meters during remedial activities.

***Remedial Investigation and Interim Remedial Measure Design, Confidential Client, New York.*** Assisted with designs for Remedial Investigation (RI) and Interim Remedial Measure for multi-million project. Primary objective of RI was to define the nature and extent of contamination across the site, including lateral and vertical delineation of contamination in all media to evaluate potential exposure and effective remedial cleanup options. Prepared preliminary design of non-hazardous and hazardous soil excavation utilizing GIS and analytical results from RI activities to achieve cleanup goals in compliance with NYSDEC Technical Guidance for Site Investigation and Remediation. Worked with CADD team to complete overall excavation grading plan.

***Groundwater Sampling, Multiple Clients, Pennsylvania, New York, and New Jersey.*** Field team leader responsible for groundwater quality parameter monitoring and groundwater sample collection from groundwater monitoring well networks at multiple sites with varying contaminants including petroleum, chlorinated solvents, PFAS, and/or heavy metals contamination. Work done in accordance with applicable regulations (PADEP, NYDEC, NJDEP) to support remedial investigation and/or pilot testing objectives. Responsible for post-processing of field data, coordination with laboratory, potentiometric map development, and reporting.

**Groundwater Sampling, Confidential Client, Cleveland, Ohio.** Hydrogeologist responsible for groundwater sample collection and stabilization parameter readings from the groundwater monitoring network at the facility. Assisted with cross section generation, groundwater potentiometric maps, and creation of figures and tables for the RFI Report for the USEPA.

**Stormwater and Surface water Sampling, Petrolia, PA.** Performed stormwater sampling at a former chemical facility in accordance with NDPES permitting. Sampled stormwater outfalls and surface water from stormwater containment areas in accordance with established environmental procedures. Analyzed collected samples at the on-site laboratory for pH, conductivity, color, and odor.

**Sub-slab Soil Vapor Sampling, Confidential Client, Painted Post, PA.** Performed sub-slab soil vapor sampling at active manufacturing plant to investigate extent of chlorinated volatile organic compounds as part of site remedial investigation. Sub-slab vapor samples were collected via 1-L Summa canisters equipped with 200 mL/min flow controllers and analyzed via USEPA Method TO-15 for VOCs. Results utilized to assess potential exposure risk pathways.

**LNAPL Baildown and Slug Testing Norfolk Southern Railway Company, Conway, Pennsylvania.** Performed LNAPL Baildown tests following ASTM E2856-11 at active rail yard to estimate LNAPL transmissivity as part of a LNAPL recovery system evaluation. Prepared data for transmissivity analysis using the American Petroleum Institute's LNAPL Transmissivity Work. Performed single-point rising and falling head hydraulic conductivity tests using manual slugs and pneumatic assemblies.

### **Contractor Oversight**

**Well Installation, Confidential Client, NJ.** Supervised subcontractor installation of monitoring and air injection wells in support of air sparge pilot testing. Logged soils utilizing the unified soil classification system. Analyzed soil cuttings and hydrologic data to design injection wells and monitoring wells to ensure installation of screened intervals in two distinct low-permeability zones. Monitoring and injection wells were installed as part of a pilot-phase remedy for treatment of a mixed chlorinated solvent source area via combined zero-valent ion and enhanced anaerobic bioremediation remedy at a large former manufacturing site with more than 10 areas of concern requiring remediation.

**Construction Oversight, ABEX, Pennsylvania.** Performed construction oversight and quality assurance for repairs to stream bank cap at metals impacted soils and sediments site. Project included installation of geotextile fabric, placement of R-4 and R-6 Rip-Rap armor and regrading of stream to design specifications. Ensured proper erosion and sediment controls for in-channel work, including construction of flow diversion berm and diversion of water via bypass pump and pump discharge energy dissipater.

***Test Pitting and Sewer Evaluation, Confidential Client, New York.*** Responsible for leading subcontractor field team in efforts to delineate extent of stormwater and industrial sewers as assess data gaps as part of sitewide Remedial Investigation efforts at former manufacturing facility, currently a high school. Field team leader responsible for oversight of test pitting operations that included excavation and offsite removal of contaminated soils, utility locations, push camera and robotic camera surveys, sewer and stormwater pipe sediment sampling, and backfilling of test pits via clean fill. Coordinated efforts with subcontractors, NYSDEC onsite representatives, and local school district.

***Tank Car Loading Area Decommissioning, Norfolk Southern Railway Company, Conway, Pennsylvania.*** Supervised subcontractor decommissioning and disposal of two former abatement systems in accordance with scope of work. Abatement systems were previously used for passive collection and treatment of groundwater and recovery and management of subsurface petroleum impacts. Collected representative sample of standing fluids for waste characterization. Documented decommissioning activities, including dismantling of previous systems, pumping of standing fluids and transportation to waste water treatment area, separation and cleaning of scrap metal for recycling, decontamination of the oil water separator, and disposal of debris. Work area was restored to grade via backfill with AASHTO #57 stone. Ensured contractor compliance to all NSRC, federal, state and local regulations, including health and safety procedures.

### **Geographic Information Systems**

***MarkWest, Midstream GIS Operations, Pennsylvania and Ohio.*** Provided support for Midstream natural gas operations via geographic information systems, including creating various maps for land agents to assist in right of way negotiations and expansion of spatial data library.

***Spatial Data Management, various projects.*** Assisted in a variety of geographic information system tasks using ArcGIS 10.9, including data visualization, georeferencing, figure creation, production of potentiometric map, and creation of spatial features. Provides geospatial analysis and data management support for planning, environmental sample collection and results, and reporting.

### **Environmental Compliance**

***Spill Prevention, Control, and Countermeasure (SPCC) Plans, Norfolk Southern Railway Company, Pennsylvania.*** Assisted in preparation of Tier I SPCC Plans in accordance with 40 CFR Section 112 for various NSRC rail yards in Pennsylvania. Utilized information gathered during site reconnaissance to update SPCC Plans, including Material Inventory list, according to regulatory requirements. Created aerial facility maps for SPCC Plans.

***Post Closure/Post Remediation Care Services, Confidential Client, PA.*** Served as project team member providing post-closure/post-remediation care activities for a closed hazardous waste landfill, parking lot, and metals-impacted soils and sediments site. The site was closed under



Pennsylvania's Voluntary Cleanup Program (Act 2) and requires routine maintenance and monitoring of the containment area cap under an environmental covenant. Responsible for site inspections/basic landfill cap maintenance and subsequent reporting.

## **PROFESSIONAL EXPERIENCE**

Geosyntec Consultants, Pittsburgh, Pennsylvania, January 2019 – Present  
Engineering Consulting Services, Pittsburgh, Pennsylvania, June 2018 – December 2018

## **AWARDS AND RECOGNITIONS**

Samuel S. Goldich Fund Recipient – Northern Illinois University, 2018  
GSA Graduate Student Research Grant Recipient – Northern Illinois University, 2017  
Jonathan H. Berg Fellowship – Northern Illinois University, 2017  
Brackenridge Honors College Research Fellowship – University of Pittsburgh, 2016

## **TEACHING EXPERIENCE**

Teaching Assistant, Northern Illinois University, DeKalb, Illinois, 2016-2018

## **AFFILIATIONS**

Pennsylvania Council of Professional Geologists Member – 2020 to Present  
Pittsburgh Geological Society Member – 2020 to Present  
National Groundwater Association Member – 2020 to Present

## **PRESENTATIONS & PUBLICATIONS**

Perdziola, S., Stansell, N., Harvey, W., “Late Holocene Oxygen Isotope Record of Hydroclimate Variability in Nicaragua from Lake Asososca”. Poster Presentation. *GSA Annual Meeting*. (Seattle, WA; October 2017).

Stansell, N., Steinman, B., Lachniet, M., Feller, J., Harvey, W., Fernandez, A., Shea, C., Price, B., Boes, M., and Perdziola, S., 2019. “Lake sediment stable isotope record of middle to late Holocene hydroclimate variability in the western Guatemala highlands”. *Earth and Planetary Science Letters*.

**DAVID TOWSEY, G.I.S.P**

**Information Management Systems  
Data Analysis  
Geographic Information Systems  
Environmental Science**

## **EDUCATION**

California University of Pennsylvania, B.S., Environmental Science, 1997

University of Montana, B.S., Natural Resource Management, 1989

## **PROFESSIONAL REGISTRATION**

Certified GIS Professional No. 00041887

## **CAREER SUMMARY**

Mr. Towsey is an environmental scientist and environmental data manager with over twenty-five years of experience in the environmental consulting field. His expertise is in the designing and development of spatial and environmental information management systems at small to mid-sized engineering consulting firms using methods and technologies such as relational databases, EQuIS, ESRI GIS products, web application development, and program automation. He has worked closely with clients to assess their needs for information management systems and has identified and implemented solutions, whether as a custom developed system tailored to the client's needs, or a best-fit commercial off the shelf option.

Highlights of Mr. Towsey's project experience include:

### **Environmental Data Management Systems**

*Elmira Brownfield Site, Elmira, New York.* Mr. Towsey is the database/ GIS manager for a large Brownfield Site located in southern New York. EQuIS and ArcGIS are used to manage large volumes of soil and groundwater data that is utilized for project deliverables to the state agency. This project also involves the migration of data from a legacy data management system that could not handle the volume of data being generated at the site. A Power BI data dashboard was also developed to provide all stakeholders access to the data.

*Somerville Landfill, Somerville, New Jersey.* Mr. Towsey is the database/ GIS manager for a landfill located in central New Jersey. EQuIS is used to manage groundwater data that is collected at the site to address site wide remediation goals. This project included the development of an EQuIS Enterprise site.

*BROS Superfund Site, Logan Township, New Jersey.* Mr. Towsey was the database/ GIS manager for a large superfund Site located in southern New Jersey. EQuIS and ArcGIS

were used to manage a large volume of groundwater data that was utilized in the development of a site-wide conceptual model to address site wide remediation goals. EQuIS was also utilized to manage data collected from an onsite treatment plant. Custom reporting was developed using SQL Server Report server and ArcGIS online dashboards.

*British Petroleum Refinery, Marcus Hook, Pennsylvania.* Mr. Towsey was the database/ GIS manager for a large active refinery. EQuIS and ArcGIS were used to manage a large volume of environmental data that was utilized in the development of a site-wide conceptual model and risk-based decision-making framework to address site wide remediation goals. Other activities included the development of custom reporting tools and website integration.

*Valero Refinery, Gloucester City, New Jersey.* Mr. Towsey was the database/ GIS manager for a large active refinery in southern New Jersey. EQuIS and ArcGIS were used to manage a large volume of environmental data that was utilized in the development of a site-wide conceptual model to address site wide remediation issues. Other activities included the development of custom reporting tools and website integration.

### **Data Management and Web Mapping Application Development**

*Bucks County Redevelopment Authority, Pennsylvania.* Mr. Towsey designed and developed an ArcGIS web application and backend database that facilitated access to information on Brownfield sites located within Bucks County, Pennsylvania. This application provided users the ability to search for Brownfield sites by Municipality, Tax Parcel ID, Site Name, Zip Code, Acreage, or Assessed Value. Additional information regarding each site such as photos and inventory sheets, were integrated as well.

*Lucent Technologies, New Jersey.* Mr. Towsey designed and developed an ArcGIS Web Mapping application that provided the client the ability to access project documents and query analytical exceedances for a groundwater sampling program. Project included the integration of ARCIMS, EQuIS, and ASP.net technologies. Mr. Towsey was also responsible for managing the EQuIS database and Geographic Information System (GIS) used to develop a site-wide conceptual model.

### **Custom Data Management Tool**

*The ELM Group, Princeton, New Jersey.* Mr. Towsey developed a custom application using PowerApps and PowerAutomate to manage site remediation regulatory time frames under the New Jersey Licensed Site Remediation Program. This application allowed for tracking of the regulatory time frames at a site and automated email notifications when an activity was coming due. This application helped the client to avoid costly fines from the regulatory agency.

**ALEC HAYES, G.I.T.**

**Site Investigation and Characterization  
Environmental Quality Assurance  
Database Management and GIS  
Project Health and Safety Support**

## **EDUCATION**

B.S., Geology, West Virginia University, Morgantown, West Virginia, 2021

## **REGISTRATIONS AND CERTIFICATIONS**

Geologist in Training, Pennsylvania

OSHA 40-hour Hazardous Waste Operations and Emergency Response

Roadway Worker and E-Railsafe Certification

First Aid, CPR, and AED

## **CAREER SUMMARY**

Mr. Alec Hayes is a Senior Staff Professional at Geosyntec, and a certified Geologist in Training in the State of Pennsylvania. He has experience performing a variety of environmental investigations supporting contaminated site assessment and remediation and is experienced in supporting site characterization and remediation projects through data management and geospatial data analysis. Mr. Hayes' project work has recently focused on leading the preparation and execution of field sampling efforts for site characterization, as well as supporting subsequent data management and reporting efforts. Mr. Hayes earned a B.S. in Geology from West Virginia University in 2021.

Mr. Hayes' project experience includes the following:

### **Site Investigation and Characterization**

***Semi-Annual Groundwater Monitoring, Union Tank Car Maintenance Facility, Marion, Ohio.***  
Led the preparation and completion of multiple routine semi-annual groundwater monitoring events as part of a program of routine groundwater sample collection in northern Ohio to evaluate concentrations of VOC, PAH, and 1,4-dioxane in groundwater, as well as the size of multiple LNAPL bodies at an active tank car maintenance facility. Mr. Hayes was also responsible for coordinating with the laboratory to ensure sample quality and serving as the site safety officer to ensure compliance with Geosyntec health and safety policies.

***Site Characterization and Closure, Active metals casting foundry, Lebanon County, Pennsylvania.*** Served as the field team lead in the investigation of an investment casting foundry that has been in operation for over 100 years. The investigation was performed by the owner to seek relief from future liability under Pennsylvania's Voluntary Cleanup Program (Act 2). Mr.

Hayes collected surface and subsurface soil samples were collected from the site to investigate the potential for impacts from historical facility operations. Following review of the soils data, Mr. Hayes oversaw the installation of a bedrock monitoring well to access site groundwater. He collected groundwater samples at the site to rule out the potential for metals migration from soil to the water table. Following analysis of the field data collected, Mr. Hayes assisted with the preparation of the final Act 2 report, which is currently under regulatory review.

***Ongoing Air Quality and Emissions Monitoring, Olympus Energy LLC, Pennsylvania.*** Mr. Hayes has performed air sampling as part of an ongoing routine air sample collection program in southwestern PA to evaluate VOC, methane, and particulate (PM<sub>2.5</sub> and PM<sub>10</sub>) concentrations to maintain compliance with local, state, and federal emissions requirements, and identify potential constituents of concern surrounding unconventional natural gas drilling and well pad operation activities.

***Remedial Investigation and Interim Remedial Measures, Confidential Client, New York.*** Mr. Hayes has served as a field team leader, responsible for leading Remedial Investigation (RI) groundwater and soil sample collection tasks at a former manufacturing facility that are concurrent with several site interim remedial measures (IRM). Mr. Hayes has also lead field efforts conducting site-wide groundwater sampling, well installation, well development, and various instrument deployment. Additional field efforts include subcontractor and field team management, coordination with multiple laboratories for sample analysis and quality assurance, strict adherence to site work plans, coordination with NYSDEC representatives, and serving as the site safety officer to ensure compliance with company health and safety policies.

***LNAPL Remedial Investigation and Groundwater Monitoring, Norfolk Southern Rail Company (NSRC), Conway, Pennsylvania.*** Mr. Hayes has performed and led multiple field investigations to monitor the groundwater and LNAPL bodies at the Conway Rail Yard site in southwest Pennsylvania. He has also performed groundwater sampling, LNAPL baildown testing, and natural source zone depletion (NSZD) sensor maintenance as part of the investigation of remedial measures to be implemented at the site.

***Post Remedial Care Plan Compliance, INDSPEC Chemical Corporation, Petrolia, Pennsylvania.*** Mr. Hayes has performed surface water and groundwater sampling, storm water sampling, surface water inspections, and inspection of engineering controls (asphalt cap and property fence) in accordance with an EPA approved Post Remedial Care Plan (PRCP). Mr. Hayes is responsible for leading and managing PRCP field activities including the timely completion of inspections and sampling, laboratory coordination, equipment procurement and assisting of annual reporting efforts.

***Site Remediation and Regulatory Closure, Vitro Automotive Glass Plant, Meadville, Pennsylvania.*** Oversaw the removal of impacted soil associated with a fuel-oil release from an aboveground storage tank (AST) at the site. Mr. Hayes coordinated work with contractors and

laboratories to ensure removal of impacted soil was targeted using data collected from confirmation sampling. Mr. Hayes assisted project management to document the remedial measures taken at the site and draft the Act 2 report to be submitted to the PADEP.

***Site Instrumental Measurement and Inspection, Pike Island Lock and Dam, Army Corps of Engineers, Wheeling, West Virginia.*** The Pike Island Lock and Dam operated by the Army Corps of Engineers developed a laterally extensive crack through the lock system. A vibrational wireline system was installed by Geosyntec Consultants to monitor crack growth. Mr. Hayes performed weekly site inspections and monitored crack propagation via a standard crack gauge to ground truth the wireline system. Mr. Hayes was responsible for coordinating with onsite contractors and ensured complete and accurate site inspections.

### **Environmental Quality Assurance**

***Third-Party Environmental QA/QC and Workplan Auditing, Confidential Client, OH.*** Performed third-party audits of ongoing air, water, and soil sampling for VOCs conducted at a high-profile environmental remediation site. Perform oversight and coordinate with multiple other environmental consultants to ensure sample integrity and quality of results to maintain conformance with USEPA and Ohio Environmental Protection Agency (OEPA) approved work plans and other quality assurance documents.

### **Data Management and GIS**

***Sample Analytical Data Management, Various Projects.*** Mr. Hayes has supported various projects by managing the uploading and tabulation of sample analytical data to project EQUIS databases. Mr. Hayes has also worked with project managers on various projects to deliver tabulated analytical data from project databases to support project planning and remedial approaches.

***Confidential Client, Rubbertown, KY.*** Mr. Hayes supported the due-diligence review of the former industrial property. Mr. Hayes managed the analysis and visualization of decades of historical groundwater and soil data to generate multiple figures depicting potentially impacted zones of the subject property. Mr. Hayes also oversaw the transcription and digitization of site historical records.

***Spatial Data Management, Various Projects.*** Supported various projects using geographic information system techniques to visualize data, spatial features, create site maps, potentiometric maps, subsurface features and general figure creation using ArcMap and ArcGIS Pro.

### **Project Health and Safety Support**

***Preparation of Site-Specific Health and Safety Plan, Union Tank Car Maintenance Facility, Marion, Ohio.*** Mr. Hayes led the preparation of a site-specific health and safety plan (HASP) for the Union Tank Car maintenance facility in Marion, OH in preparation for upcoming remedial

investigation and design work. This health and safety plan outlined all risks associated with anticipated activities to be performed at the site and provided guidance to staff on how to safety measures to mitigate these anticipated risks.

*Task Hazard Analysis Review, Various Projects.* Supported various projects by providing review of Task Hazard Analysis (THA) documents and other health and safety documents prior to field task mobilization. Provided comments and recommendations for safety procedures and precautions to ensure that all health and safety needs are addressed.

## **PROFESSIONAL EXPERIENCE**

Geosyntec Consultants, Huntington, West Virginia, May 2016 – August 2016

Geosyntec Consultants, Huntington, West Virginia, May 2017 – August 2017

Geosyntec Consultants, Pittsburgh, Pennsylvania, May 2021 – present

APPENDIX B  
NYSDEC SAMPLING, ANALYSIS, AND  
ASSESSMENT OF PER- AND  
POLYFLUOROALKYL SUBSTANCES –  
APRIL 2023





Department of  
Environmental  
Conservation

# SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

April 2023



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## ERRATA SHEET for

**SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES  
(PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020**

<b>Citation and Page Number</b>	<b>Current Text</b>	<b>Corrected Text</b>	<b>Date</b>
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Data Assessment and Application to Site Cleanup Page 3	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	3/28/2023
Water Sample Results Page 3	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below.	NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These guidance values also include criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt). Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.	3/28/2023
Soil Sample Results Page 3	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values:	NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:	3/28/2023
Protection of Groundwater Page 3	PFOA (ppb) 1.1 PFOS (ppb) 3.7	PFOA (ppb) 0.8 PFOS (ppb) 1.0	3/28/2023

Citation and Page Number	Current Text	Corrected Text	Date
Footnote 2 Page 3	The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document ( <a href="http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf">http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf</a> ).	The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 ( <a href="https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf">https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf</a> ). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document ( <a href="http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf">http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf</a> ).	3/28/2023
Testing for Imported Soil Page 4	If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.	If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.	3/28/2023
Routine Analysis, page 9	“However, laboratories analyzing environmental samples...PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101.”	“However, laboratories analyzing environmental samples...PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533.”	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	“In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.”	9/15/2020

<b>Citation and Page Number</b>	<b>Current Text</b>	<b>Corrected Text</b>	<b>Date</b>
<p>Data Assessment and Application to Site Cleanup Page 10</p>	<p>Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.</p>	<p>Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.</p>	<p>9/15/2020</p>
<p>Water Sample Results Page 10</p>	<p>PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (...)  If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.</p>	<p>PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (...)  If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.</p>	<p>9/15/2020</p>

Citation and Page Number	Current Text	Corrected Text	Date
Soil Sample Results, page 10	<p>“The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase.”</p>	<p>“Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. “</p> <p>[Interim SCO Table]</p> <p>“PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.</p> <p>As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference:  <a href="https://www.nj.gov/dep/srp/guidance/rs/daf.pdf">https://www.nj.gov/dep/srp/guidance/rs/daf.pdf</a>. ”</p>	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
<p>Testing for Imported Soil Page 11</p>	<p>Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs.</p> <p>If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State’s Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.</p>	<p>Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.</p> <p>PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.</p>	<p>9/15/2020</p>

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	<p><sup>1</sup> TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.</p> <p><sup>2</sup> The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (<a href="http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsupdoc.pdf">http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsupdoc.pdf</a>).</p>	9/15/2020
Additional Analysis, page 9	In cases... soil parameters, such as Total Organic Carbon (EPA Method 9060), soil...	In cases... soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil...	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	<p>“In addition, further assessment of water may be warranted if either of the following screening levels are met:</p> <p>a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or</p> <p>b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L”</p>	Deleted	6/15/2021



Citation and Page Number	Current Text	Corrected Text	Date
Routine Analysis, Page XX	Currently, New York State Department of Health’s Environmental Laboratory Approval Program (ELAP)... criteria set forth in the DER’s laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids).	Deleted	5/31/2022
Analysis and Reporting, Page XX	As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.	Deleted	5/31/2022
Routine Analysis, Page XX	LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media.	EPA Method 1633 is the procedure to use for environmental samples.	
Soil Sample Results, Page XX	Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6	
Appendix A	“Include in the text... LC-MS/MS for PFAS using methodologies based on EPA Method 537.1”	“Include in the text ....EPA Method 1633”	
Appendix A	“Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101”	Deleted	
Appendix B	“Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1”	“Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633”	

Citation and Page Number	Current Text	Corrected Text	Date
Appendix C	“Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1”	“Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633”	
Appendix D	“Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1”	“Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633”	
Appendix G		Updated to include all forty PFAS analytes in EPA Method 533	
Appendix H		Deleted	
Appendix I	Appendix I	Appendix H	
Appendix H	“These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report.”	“These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER).”	
Appendix H	“The holding time is 14 days...”	“The holding time is 28 days...”	
Appendix H, Initial Calibration	“The initial calibration should contain a minimum of five standards for linear fit...”	“The initial calibration should contain a minimum of six standards for linear fit...”	
Appendix H, Initial Calibration	Linear fit calibration curves should have an R <sup>2</sup> value greater than 0.990.	Deleted	
Appendix H, Initial Calibration Verification	Initial Calibration Verification Section	Deleted	
Appendix H	secondary Ion Monitoring Section	Deleted	
Appendix H	Branched and Linear Isomers Section	Deleted	

# Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

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## Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

## Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

## Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments, or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

## Analysis and Reporting

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third-party data validator. Electronic data submissions should meet the requirements provided at: <https://www.dec.ny.gov/chemical/62440.html>.

DER has developed a *PFAS Analyte List* (Appendix G) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

### Routine Analysis

EPA Method 1633 is the procedure to use for environmental samples. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist. Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

### Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.<sup>1</sup>

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<sup>1</sup> TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA’s Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

## Data Assessment and Application to Site Cleanup

Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

### Water Sample Results

NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These human health criteria should also be applied to surface water that is used as a water supply. This guidance also includes criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt). Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

### Soil Sample Results

NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:

<b>Guidance Values for Anticipated Site Use</b>	<b>PFOA (ppb)</b>	<b>PFOS (ppb)</b>
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater <sup>2</sup>	0.8	1.0

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These

<sup>2</sup> The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 ([https://www.dec.ny.gov/docs/remediation\\_hudson\\_pdf/part375techsupport.pdf](https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf)). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document ([http://www.dec.ny.gov/docs/remediation\\_hudson\\_pdf/techsuppdoc.pdf](http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf)).

additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference:  
<https://www.nj.gov/dep/srp/guidance/rs/daf.pdf>.

## Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

## Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

### General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
  - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an “Analytical Methods/Quality Assurance Summary Table” specifying:
  - Matrix type
  - Number or frequency of samples to be collected per matrix
  - Number of field and trip blanks per matrix
  - Analytical parameters to be measured per matrix
  - Analytical methods to be used per matrix with minimum reporting limits
  - Number and type of matrix spike and matrix spike duplicate samples to be collected
  - Number and type of duplicate samples to be collected
  - Sample preservation to be used per analytical method and sample matrix
  - Sample container volume and type to be used per analytical method and sample matrix
  - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

### Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by EPA Method 1633
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
  - Reporting Limits should be less than or equal to:
    - Aqueous – 2 ng/L (ppt)
    - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
- 
- Include detailed sampling procedures
  - Precautions to be taken
  - Pump and equipment types
  - Decontamination procedures
  - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

## Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

### General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 ([http://www.dec.ny.gov/docs/remediation\\_hudson\\_pdf/sgpsect5.pdf](http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf)), with the following limitations.

### Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

### Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

### Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

### Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.



## Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

## Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at  $4 \pm 2^\circ$  Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

## Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

## Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

## Appendix C - Sampling Protocols for PFAS in Monitoring Wells

### General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 ([http://www.dec.ny.gov/docs/remediation\\_hudson\\_pdf/sgpsect5.pdf](http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf)), with the following limitations.

### Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

### Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

### Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

### Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

## Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

## Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at  $4 \pm 2^\circ$  Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

## Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

## Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

## Appendix D - Sampling Protocols for PFAS in Surface Water

### General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 ([http://www.dec.ny.gov/docs/remediation\\_hudson\\_pdf/sgpsect5.pdf](http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf)), with the following limitations.

### Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

### Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

### Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

### Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

### Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

## Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at  $4 \pm 2^\circ$  Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

## Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

## Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

## Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

### General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 ([http://www.dec.ny.gov/docs/remediation\\_hudson\\_pdf/sgpsect5.pdf](http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf)), with the following limitations.

### Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

### Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

### Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

### Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

### Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

## Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at  $4 \pm 2^\circ$  Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

## Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

## Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

## Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the current SOP developed by the Division of Fish and Wildlife (DFW) entitled “General Fish Handling Procedures for Contaminant Analysis” (Ver. 8). This SOP should be followed when collecting fish for contaminant analysis. Note, however, that the Bureau of Ecosystem Health will not be supplying bags or tags. All supplies are the responsibility of the collector

**Procedure Name:** General Fish Handling Procedures for Contaminant Analysis

**Number:** FW-005

**Purpose:** This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

**Organization:** Environmental Monitoring Section  
Bureau of Ecosystem Health  
Division of Fish and Wildlife (DFW)  
New York State Department of Environmental Conservation (NYSDEC)  
625 Broadway  
Albany, New York 12233-4756

**Version:** 8

**Previous Version Date:** 21 March 2018

**Summary of Changes to this Version:** Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

**Originator or Revised by:** Wayne Richter, Jesse Becker

**Date:** 26 April 2019

**Quality Assurance Officer and Approval Date:** Jesse Becker, 26 April 2019



**NEW YORK STATE  
DEPARTMENT OF ENVIRONMENTAL CONSERVATION**

**GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES**

- A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:
1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).
  2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.
  3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.
- B. The following data are required on each **Fish Collection Record** form:
1. Project and Site Name.
  2. DEC Region.
  3. All personnel (and affiliation) involved in the collection.
  4. Method of collection (gill net, hook and line, etc.)
  5. Preservation Method.
- C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:
1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.
  2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.
  3. Date collected.
  4. Sample location (waterway and nearest prominent identifiable landmark).
  5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.
  2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.
  3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.
  4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate "Age" column.
  5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.
  6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.
  7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.
- E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish's tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **The Bureau of Ecosystem Health will supply the bags.** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with

the same information.

- F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.
- G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.
- H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:
- No materials containing Teflon.
  - No Post-it notes.
  - No ice packs; only water ice or dry ice.
  - Any gloves worn must be powder free nitrile.
  - No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
  - No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
  - Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
  - Wash hands after handling any food containers or packages as these may contain PFCs.
    - Keep pre-wrapped food containers and wrappers isolated from fish handling.
  - Wear clothing washed at least six times since purchase.
  - Wear clothing washed without fabric softener.
  - Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.
- I. All fish must be kept at a temperature  $<45^{\circ}\text{F}$  ( $<8^{\circ}\text{C}$ ) immediately following data processing. As soon as possible, freeze at  $-20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.
- J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.
- K. A recommended equipment list is at the end of this document.

**NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION  
DIVISION OF FISH AND WILDLIFE  
FISH COLLECTION RECORD**

page \_\_\_\_\_ of \_\_\_\_\_

Project and Site Name \_\_\_\_\_ DEC Region \_\_\_\_\_

Collections made by (include all crew) \_\_\_\_\_

Sampling Method:  Electrofishing  Gill netting  Trap netting  Trawling  Seining  Angling  Other \_\_\_\_\_

Preservation Method:  Freezing  Other \_\_\_\_\_ Notes (SWFDB survey number): \_\_\_\_\_

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

**NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION  
CHAIN OF CUSTODY**

I, \_\_\_\_\_, of \_\_\_\_\_ collected the  
(Print Name) (Print Business Address)

following on \_\_\_\_\_, 20\_\_\_\_ from \_\_\_\_\_  
(Date) (Water Body)

in the vicinity of \_\_\_\_\_  
(Landmark, Village, Road, etc.)

Town of \_\_\_\_\_, in \_\_\_\_\_ County.

Item(s) \_\_\_\_\_

\_\_\_\_\_

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_ Signature \_\_\_\_\_ Date

I, \_\_\_\_\_, received the above mentioned sample(s) on the date specified and assigned identification number(s) \_\_\_\_\_ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

\_\_\_\_\_ Signature \_\_\_\_\_ Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

## **NOTICE OF WARRANTY**

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

## **HANDLING INSTRUCTIONS**

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

## EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelopes, approximately 2" x 3.5", if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

## Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluoropentanesulfonic acid	PFPeS	2706-91-4
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorononanesulfonic acid	PFNS	68259-12-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
	Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluoroalkyl carboxylic acids	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	PFUnA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	376-06-7
Per- and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2



Group	Chemical Name	Abbreviation	CAS Number
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

## Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

### General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory’s Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER’s Quality Assurance Officer, Dana Barbarossa, at [dana.barbarossa@dec.ny.gov](mailto:dana.barbarossa@dec.ny.gov).

### Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 28 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6°C upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

\*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

### Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects
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### Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results
---------------------------	----------------

## Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

## Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample
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## Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects
--	--

## Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

## Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

## Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

## Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

## Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

**APPENDIX C**  
**GEOSYNTEC SOIL VAPOR STANDARD**  
**OPERATING PROCEDURES**

**SUGGESTED OPERATING PROCEDURE  
SOIL GAS PROBE INSTALLATION**

**Geosyntec Consultants, Inc.**

**Last revision: Oct 2020**

**1 INTRODUCTION**

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

**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. All 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 any drilling.

**2.2 Soil Coring via GeoProbe<sup>®</sup>**

Soil core will be collected with a GeoProbe<sup>®</sup> direct push system (or equivalent). This method minimizes the disturbance to the geologic materials surrounding a soil gas probe subsequently installed in the core-hole. 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 visually inspected to record details of the color, texture, moisture, density, cohesion, plasticity, staining, and odor. Digital photographs will be taken of each soil core.

**2.4 Soil Gas Probe Installation**

Each soil gas probe will consist of ¼-inch diameter Nylaflo<sup>®</sup> or Teflon<sup>®</sup> 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 or hydrated bentonite chips 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;
- all related information (weather, attendees, equipment problems, any 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 \_\_\_\_\_  
 Installation Date(s) \_\_\_\_\_  
 Drilling Method \_\_\_\_\_  
 Borehole Diameter \_\_\_\_\_

Drilling Contractor \_\_\_\_\_  
 Driller \_\_\_\_\_  
 Temporary Soil Gas Probe  
 Permanent Soil Gas Probe

## Materials Used

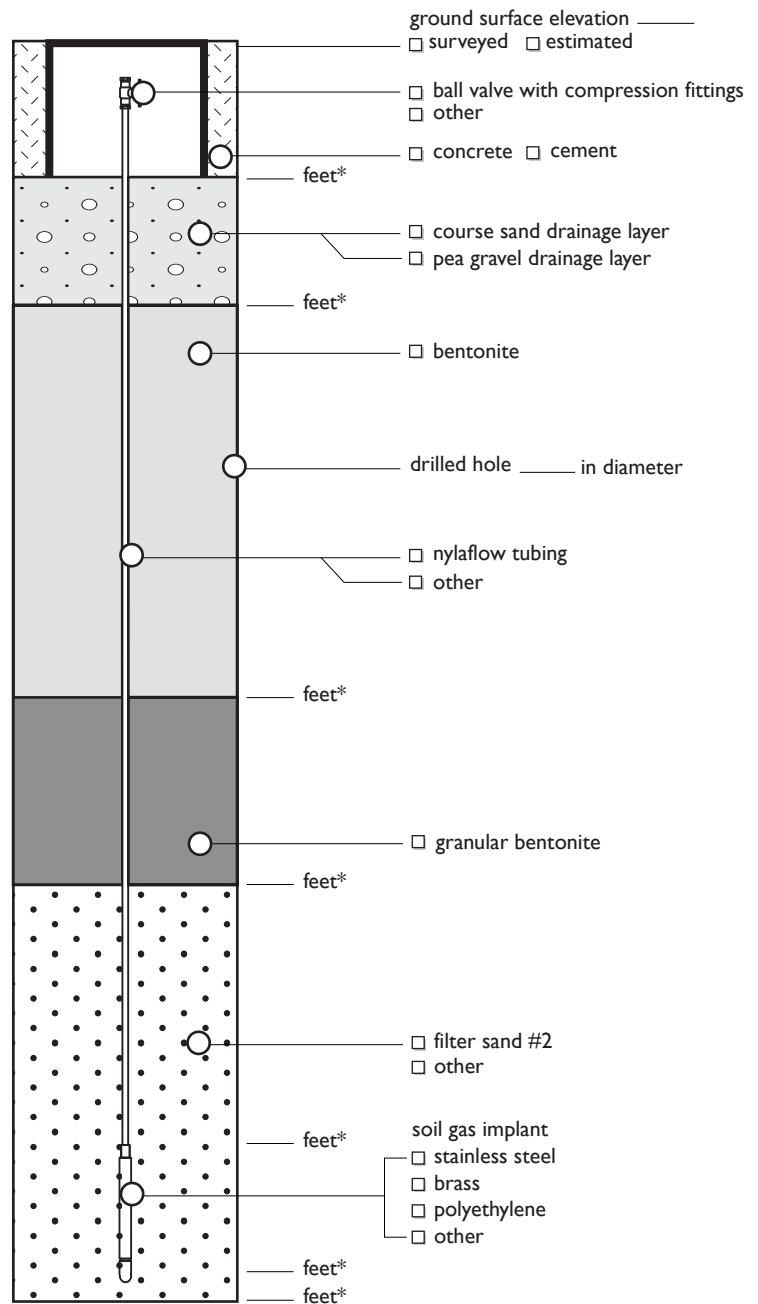
**Pipe/Tubing :** Diameter \_\_\_\_\_ cm/inches  
 Construction \_\_\_\_\_  
 Nylaflo Tubing  
 Other \_\_\_\_\_

**Soil Gas Implant :** Length \_\_\_\_\_ cm/inches  
 Diameter \_\_\_\_\_ cm/inches  
 Construction  
 Stainless Steel  
 Brass  
 Polyethylene  
 Other \_\_\_\_\_

**Surface Fitting:**  Ball valve with compression fittings  
 Other \_\_\_\_\_

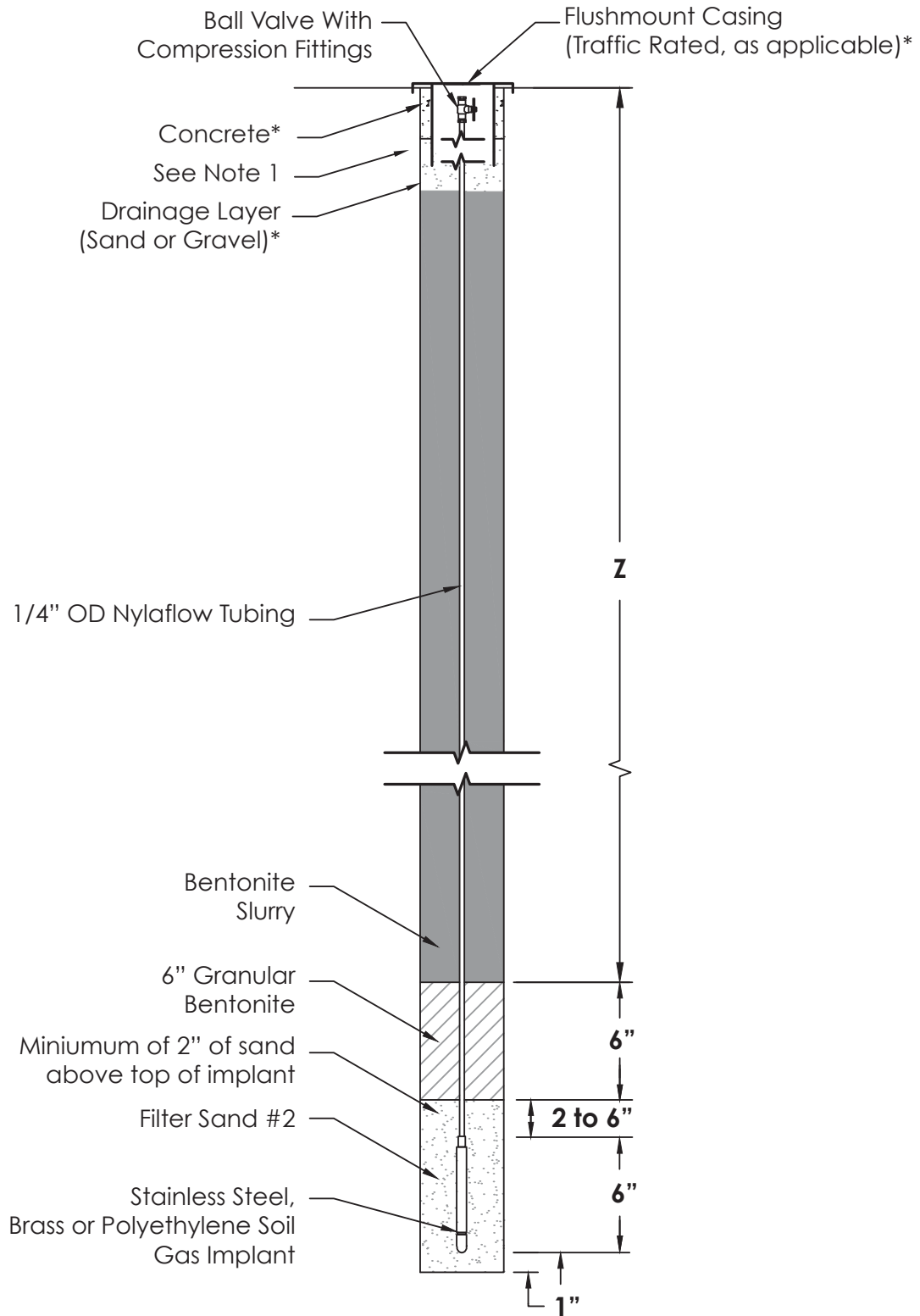
**Protective Casing:**  Flush mount  
 Above grade  
 Length \_\_\_\_\_ cm/inches  
 Stickup \_\_\_\_\_ cm/inches  
 Construction  Cast Aluminum  
 Cast Steel  
 Other \_\_\_\_\_

**Casing Installation:** Depth \_\_\_\_\_ cm/inches  
 Diameter \_\_\_\_\_ cm/inches



\* Depth Below Ground Surface





Temporary Soil Gas Probe Detail, TR0254.ca

**Notes:**  
 1. Nylaflow tubing can be up to 30 centimeters longer at surface in order to facilitate sampling. Tubing must be coiled up and stored in road box sampling events.  
 \* - for permanent soil gas probes only

<b>Soil Gas Probe Detail</b>	
	
Guelph	October 2020

**Figure 1**

## **SUGGESTED OPERATING PROCEDURE**

### **SOIL GAS SAMPLING**

**Geosyntec Consultants, Inc.**

**Last revision: October 2020**

#### **1 INTRODUCTION**

This suggested 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.

#### **2 SUMMA CANISTER CHECK**

Prior to the start of soil gas sampling, connect a vacuum gauge to the summa canister to record the initial vacuum in the canister. Connect the vacuum gauge directly above valve V-3. Open V-3 and record the initial vacuum gauge reading. Close valve V-3 after the reading is recorded. The initial vacuum reading will be used to document that the canister did not leak during shipment from the laboratory. A summa canister should not be used for sample collection if the initial vacuum reading is less than 25 inches of mercury (in-Hg) compared to a standard laboratory provided vacuum of 30 in-Hg.

#### **3 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-H<sub>2</sub>O). 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.

#### **4 PURGING, FIELD SCREENING, AND 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. Valve V-3 will remain closed while the valves under the shroud (V-1 and V-2) 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 valve V-4 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-4 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, photoionization (PID), and landfill gas meter (oxygen, carbon dioxide and methane) in sequence, by opening the Tedlar bag valve, and recording the stabilized readings.

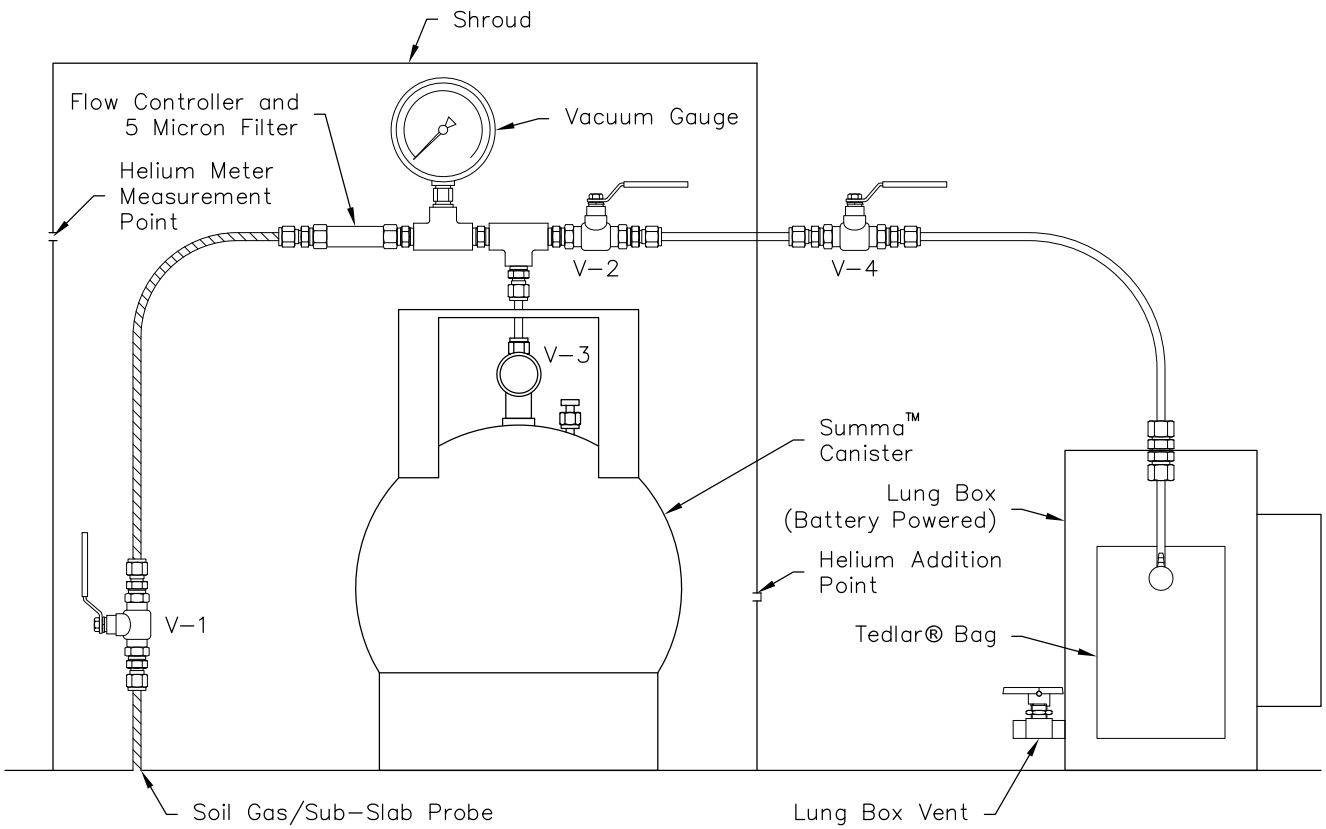
If the concentration of helium in the Tedlar bag is greater than 5% of the concentration in the shroud, the probe seal and fittings should be checked to determine the location of the leak. Once the leak has been fixed, resume purging and field screening. The purging and field screening procedure will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

## **5 SUMMA CANISTER LEAK TEST**

Valves V-1 and V-2 will be closed and then valve V-3 (summa canister valve) will be opened to induce a vacuum on the sample train. Valve V-3 will then be closed to leave a vacuum of about 30 in Hg in 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.

## **6 SUMMA CANISTER SAMPLING**

After the summa canister leak test, valve V-1 will then be opened. Then valve V-3 (summa canister valve) will be opened to begin the sample collection. The sample collection start time should be recorded. The vacuum gauge on the Summa canister should be monitored and valve V-3 should be closed when the residual vacuum in the canister is about 5 in-Hg. The sample collection finish time should be recorded. Following sample collection, connect a vacuum gauge directly above valve V-3, open valve V-3 and record the final vacuum of the summa canister. Close valve V-3 after the vacuum reading is recorded. The final vacuum reading will be included on the chain of custody so that the receiving laboratory can confirm if the summa canister has leaked during transit.



Legend

- New Nylaflow® Tubing
- Non-Dedicated Tubing

**Soil Gas Purging and Sampling Assembly**



Figure

**1**

Guelph

2020