

**APPENDIX E**

**COMMUNITY AIR MONITORING PLAN**

## **Appendix E**

### **New York State Department of Health Generic Community Air Monitoring Plan**

#### Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work zone and when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with the New York State Department of Health (NYSDOH) to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work zone.

#### Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work zone will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate New York State Department of Environmental Conservation (NYSDEC)/NYSDOH staff.

**Continuous monitoring** will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

**Periodic monitoring** for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

#### VOC Monitoring, Response Levels, and Actions

VOCs must be monitored at the downwind perimeter of the immediate work zone (i.e., the exclusion zone) on a **continuous** bases or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If total VOC levels exceed 5 ppm above background for the 15-minute average at the perimeter, work will be temporarily halted and monitoring continued. If levels readily decrease (per instantaneous readings) below 5 ppm above background, work will resume with continued monitoring.
- If total VOC levels at the downwind perimeter of the work zone persist at levels in excess of 5 ppm above background but less than 25 ppm, work will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps work will resume provided that the total organic vapor level 200 feet downwind of the work zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less – but in no case less than 20 feet, is below 5 ppm above background for the 15-minute average.
- If the total VOC level is above 25 ppm at the perimeter of the work zone, work will be shut down.

All 15-minute readings must be recorded and available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

### Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored **continuously** at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM10 particulate level is 100 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work zone, then dust suppression must be employed. Work may continue with dust suppression techniques provided that 15-minute-averages of downwind PM10 particulate levels do not exceed  $150 \mu\text{g}/\text{m}^3$  above the background level and provided that no visible dust is migrating from the work zone.
- If, after implementation of dust suppression techniques, 15-minute average downwind PM10 levels are greater than  $150 \mu\text{g}/\text{m}^3$  above the background level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the 15-minute average downwind PM10 particulate concentration to within  $150 \mu\text{g}/\text{m}^3$  of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.

### Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work zones are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.
- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed  $150 \mu\text{g}/\text{m}^3$ , work activities should be suspended until controls are

implemented and are successful in reducing the total particulate concentration to 150  $\mu\text{g}/\text{m}^3$  or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions should be pre-determined, as necessary, for each site.

#### Special Requirements for Indoor Work with Co-Located Residences or Facilities

Unless a self-contained, negative-pressure enclosure with proper emission controls will encompass the work zone, all individuals not directly involved with the planned work must be absent from the room in which the work will occur. Monitoring requirements shall be as stated above under "Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures" except that in this instance "nearby/occupied structures" would be adjacent occupied rooms. Additionally, the location of all exhaust vents in the room and their discharge points, as well as potential vapor pathways (openings conduits, etc.) relative to adjoining rooms, should be understood and the monitoring locations established accordingly. In these situations, it is strongly recommended that exhaust fans or other engineering controls be used to create negative air pressure within the work zone during remedial activities. Additionally, it is strongly recommended that the planned work be implemented during hours (e.g. weekends or evenings) when building occupancy is at a minimum.

## **APPENDIX F**

### **QUALITY ASSURANCE PROJECT PLAN**

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# QUALITY ASSURANCE PROJECT PLAN

for

**CITY DPW YARD**  
**224 East Main Street**  
**New Rochelle, New York**  
**NYSDEC BCP Site No. C360101**

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## **1.0 PROJECT DESCRIPTION**

### **1.1 INTRODUCTION**

This Quality Assurance Project Plan (QAPP) was completed on behalf of Pratt Landing Partners LLC (the Volunteer), pursuant to the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) No. C360101 for the City Department of Public Works (DPW) Yard site at 224 East Main Street in New Rochelle, New York (the site). The Volunteer intends to remediate the site as part of the remedy. The site is 273,209 square feet ( $\pm$  6.2719 acres) in area. The site is currently occupied by the City of New Rochelle's DPW. The DPW uses the property for: 1) the office/administrative base for its routine operations; 2) a transfer station for recyclables collected from city residents; 3) municipal vehicle and truck storage and repair; and 4) washing street-sweeping vehicles. The DPW's facilities include several interconnected and vacant one-story brick and concrete structures in the northern part of the site, one one-story brick structure in the western part of the site, and one one-story corrugated metal structure in the southern part of the site. The interconnected structure used for offices, the one-story brick structure is used for vehicle storage, and the one-story corrugated metal structure is used for the maintenance and repair of city-owned vehicles. A vehicle fueling island is located in the southern part of the site, outside of the one-story metal building. Municipal sewer and water easements, about 15 to 20 feet in width, are located along the northeastern boundary of the site and extends to the eastern property boundary.

The site is in an urban setting that is characterized by residential, commercial, and light industrial buildings. The site is bound by East Main Street to the northwest; a vacant one-story building to the northeast (214 East Main Street); the surface waters of Echo Bay to the east and southeast, and another BCP site (No. C360201) referred to as the "AMN Site" (260 Main Street) to the west and southwest.

This QAPP specifies analytical methods to be used to ensure that data from the proposed Remedial Action (RA) are precise, accurate, representative, comparable, complete, and meet the sensitivity requirements of the project.

## **1.2 PROJECT OBJECTIVES**

The environmental objective of the Remedial Action Work Plan (RAWP) is to achieve a split Track 1 / Track 4 remedy under the NYSDEC BCP which includes the following:

- Development and implementation of a Construction Health and Safety Plan (CHASP) and Community Air Monitoring Plan (CAMP) for the protection of on-site workers and the community during remediation
- Abatement of hazardous building materials within existing structures prior to demolition and site-wide remediation
- As a pre-requisite to site remediation, removal of the surficial asphalt cover and subsurface obstructions (e.g., remnant foundation elements) by the contractor and management of removed asphalt as construction and demolition (C&D) debris in accordance with Part 360 and 361 regulations. Review and certification of C&D transport and disposal methodologies is not a requirement of the Remedial Engineer (RE). The RE is responsible for documenting that C&D debris is not commingled with contaminated site soil and fill.
- Excavation and off-site disposal of contaminated soil exceeding the Title 6 of the New York Codes, Rules, and Regulations (6 NYCRR) Part 375 Unrestricted Use (UU) Soil Cleanup Objectives (SCO) within the about 183,500-square-foot Track 1 area
- Excavation of an about 88,900 square foot area along the Echo Bay shoreline up to 2 feet bgs to install a composite cover system within the Track 4 area
- Screening of excavated soil for indications of contamination by visual, olfactory, and instrumental methods
- Decommissioning and removal of any encountered underground storage tanks (UST) and aboveground storage tanks (AST) in accordance with 6 NYCRR Part 613 and NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10) Section 5.5
- Handling, transport, and off-site disposal of excavated soil in accordance with federal, state, and local rules and regulations for handling, transport, and disposal
- Installation of support of excavation (SOE) components as needed to facilitate the remedial excavations

- Dewatering as needed to allow for excavation below the groundwater table, and treatment and discharge of dewatering fluids in accordance with applicable regulations
- Collection and analysis of confirmation endpoint soil samples, including quality assurance/quality control (QA/QC) samples, to verify that Track 1 UU SCOs are met at the base of the Track 1 excavation area
- Collection and analysis of documentation soil samples, including QA/QC samples, at the base of the remedial excavation within the Track 4 area to document remaining contamination
- Demarcation of remaining contaminated soil and fill within the Track 4 area by survey and a high-visibility demarcation barrier for visual reference
- Import and placement of fill (e.g., virgin crushed stone or soil) meeting the Part 375 UU SCOs to backfill remedial excavations within the Track 1 area, as needed. Requests for import of fill are subject to NYSDEC review and approval, and will include a Request to Import/Reuse Soil Form.
- Import and placement of fill (e.g., virgin crushed stone, recycled concrete aggregate [RCA], soil) meeting the lower of Part 375 RURR and Protection of Groundwater (PGW) SCOs to backfill remedial excavations within the Track 4 area and facilitate EC installation. Requests for import of fill are subject to NYSDEC review and approval, and will include a Request to Import/Reuse Soil Form.
- Stabilization of the Echo Bay shoreline using a combination of rip rap, living shoreline, and bulkheads, which will prevent erosion of remaining contaminated soil to Echo Bay.
- Installation of a continuous waterproofing/vapor barrier membrane beneath all new concrete building slabs
- Installation of a composite cover system within the Track 4 area, consisting of exterior hardscapes (i.e., asphalt roadways, concrete sidewalks, pavers), landscaped areas with at least 2 feet of fill meeting the lower of Part 375 RURR and PGW SCOs, and a stabilized shoreline along Echo Bay to prevent future exposure to remaining contaminated soil.
- Establishment of use restrictions (i.e., institutional controls [IC]) including prohibitions on the use of groundwater from the site and prohibitions on sensitive site uses, such as farming or vegetable gardening in remaining site soil, to prevent future exposure to remaining contamination within the Track 4 area

- Recording of an Environmental Easement (EE) referencing engineering controls (EC) and ICs to prevent future exposure to remaining contamination within the Track 4 area
- Publication of an SMP for long-term management of remaining contamination as required by the EE within the Track 4 area, including plans for: 1) IC/EC implementation, 2) monitoring, 3) operation and maintenance, and 4) reporting

Remediation will be performed in accordance with this NYSDEC-approved RAWP.

### **1.3 SCOPE OF WORK**

The scope of work is described in detail in the RAWP. Disturbed soil will be sampled for laboratory analysis per disposal facility requirements, and visually examined, screened and characterized for disposal at an approved facility. A dust, odor and organic vapor control and monitoring plan will be implemented during ground intrusive activities.

## 2.0 DATA QUALITY OBJECTIVES AND PROCESS

Data Quality Objectives (DQOs) are qualitative and quantitative statements to help ensure that data of known and appropriate quality are obtained during the project. DQOs for sampling activities are determined by evaluating five factors:

- Data needs and uses: The types of data required and how the data will be used after it is obtained.
- Parameters of Interest: The types of chemical or physical parameters required for the intended use.
- Level of Concern: Levels of constituents, which may require remedial actions or further investigations.
- Required Analytical Level: The level of data quality, data precision, and QA/QC documentation required for chemical analysis.
- Required Detection Limits: The detection limits necessary based on the above information.

The quality assurance and quality control objectives for all measurement data include:

- **Precision** – an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Field sampling precision will be determined by analyzing coded duplicate samples and analytical precision will be determined by analyzing internal QC duplicates and matrix spike duplicates.
- **Accuracy** – a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern. Sampling accuracy will be determined through the assessment of the analytical results of equipment blanks and trip blanks (organic analysis of aqueous matrices only) for each sample set. Analytical accuracy will be assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), internal standards, laboratory method blanks, instrument calibration, and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks.
- **Representativeness** – expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is dependent upon the adequate design of the sampling program and will be satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. Representativeness in the laboratory is ensured by

- compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession. This is accomplished by following all applicable methods, laboratory-issued standard operating procedures (SOPs), the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.
- **Completeness** – the percentage of measurements made which are judged to be valid. Completeness will be assessed through data validation. The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested.
  - **Comparability** – expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured using several procedures, including standard methods for sampling and analysis, instrument calibrations, using standard reporting units and reporting formats, and data validation.
  - **Sensitivity** – the ability of the instrument or method to detect target analytes at the levels of interest. The project manager will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection.

The above objectives are discussed in detail in Section 4.0.

### 3.0 PROJECT ORGANIZATION

Any future remedial activities and investigations will be overseen by Langan or another environmental consultant for the Participant or a future owner. The environmental consultant will also arrange data analysis and reporting tasks. The analytical services will be performed by an Environmental Laboratory Accreditation Program (ELAP)-certified laboratory. Data validation services will be performed by approved data validation contractor(s). Sampling will be conducted by Langan and the analytical services will be performed by Alpha Analytical Laboratories, Inc. of Westborough, Massachusetts (New York State Department of Health [NYSDOH] ELAP certification number 11148). Data validation services will be performed by Joseph Conboy.

Key contacts for this project are summarized below; Langan résumés are included in Attachment A:

Personnel	Investigation Role	Contact Information
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## **4.0 QUALITY ASSURANCE OBJECTIVES FOR COLLECTION OF DATA**

The quality assurance and quality control objectives for all measurement data include precision, accuracy, representativeness, completeness, comparability, and sensitivity. These objectives are defined in following subsections. Variances from the quality assurance objectives at any stage of the investigation will result in the implementation of appropriate corrective measures and an assessment of the impact of corrective measures on the usability of the data.

### **4.1 PRECISION**

Precision is a measure of the degree to which two or more measurements are in agreement. Field precision is assessed through the collection and measurement of field duplicates. Laboratory precision and sample heterogeneity also contribute to the uncertainty of field duplicate measurements. This uncertainty is taken into account during the data assessment process. For field duplicates, results less than 5x the reporting limit (RL) meet the precision criteria if the absolute difference is less than  $\pm 2x$  the RL for soil or  $\pm 1x$  for groundwater. For results greater than 5x the RL, the acceptance criteria is a relative percent difference (RPD) of  $\leq 50\%$  (soil) or  $\leq 30\%$  (groundwater). RLs and method detection limits (MDL) are provided in Attachment B.

### **4.2 ACCURACY**

Accuracy is the measurement of the reproducibility of the sampling and analytical methodology. It should be noted that precise data may not be accurate data. For the purpose of this QAPP, bias is defined as the constant or systematic distortion of a measurement process, which manifests itself as a persistent positive or negative deviation from the known or true value. This may be due to (but not limited to) improper sample collection, sample matrix, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques.

Accuracy in the field is assessed through the use of field blanks and through compliance with all sample handling, preservation, and holding time requirements. All field blanks should be non-detect when analyzed by the laboratory. Any contaminant detected in an associated field blank will be evaluated against laboratory blanks (preparation or method) and evaluated against field samples collected on the same day to determine potential for bias. Trip blanks are not required for non-aqueous matrices, but will be considered for non-aqueous matrices where high concentrations of volatile organic compounds (VOCs) are anticipated based on field screening.

Laboratory accuracy is assessed by evaluating the percent recoveries of matrix spike/matrix spike duplicate (MS/MSD) samples, laboratory control samples (LCS), surrogate compound recoveries, and the results of method preparation blanks. MS/MSD, LCS, and surrogate percent recoveries will be compared to either method-specific control limits or laboratory-derived control limits. Sample volume permitting, samples displaying outliers should be reanalyzed. All associated method blanks should be non-detect when analyzed by the laboratory.

#### **4.4 REPRESENTATIVENESS**

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. Representativeness is dependent upon the adequate design of the sampling program and will be satisfied by ensuring that the scope of work is followed and that specified sampling and analysis techniques are used. This is performed by following applicable SOPs and this QAPP. All field technicians will be given copies of appropriate documents prior to sampling events and are required to read, understand, and follow each document as it pertains to the tasks at hand.

Representativeness in the laboratory is ensured by compliance to nationally-recognized analytical methods, meeting sample holding times, and maintaining sample integrity while the samples are in the laboratory's possession. This is performed by following all applicable analytical methods, laboratory-issued SOPs, the laboratory's Quality Assurance Manual, and this QAPP. The laboratory is required to be properly certified and accredited.

#### **4.5 COMPLETENESS**

Laboratory completeness is the ratio of total number of samples analyzed and verified as acceptable compared to the number of samples submitted to the fixed-base laboratory for analysis, expressed as a percent. Three measures of completeness are defined:

- Sampling completeness, defined as the number of valid samples collected relative to the number of samples planned for collection;
- Analytical completeness, defined as the number of valid sample measurements relative to the number of valid samples collected; and
- Overall completeness, defined as the number of valid sample measurements relative to the number of samples planned for collection.

Soil, groundwater, and soil vapor data will meet a 90% completeness criterion. If the criterion is not met, sample results will be evaluated for trends in rejected and unusable

data. The effect of unusable data required for a determination of compliance will also be evaluated.

#### **4.6 COMPARABILITY**

Comparability expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Requiring traceability of all analytical standards and/or source materials to the U.S. Environmental Protection Agency (USEPA) or National Institute of Standards and Technology (NIST);
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable);
- Using standard reporting units and reporting formats including the reporting of QC data;
- Performing a complete data validation on documentation sampling analytical results, including the use of data qualifiers in all cases where appropriate; and
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose.

These steps will ensure all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

#### **4.7 SENSITIVITY**

Sensitivity is the ability of the instrument or method to detect target analytes at the levels of interest. The project director will select, with input from the laboratory and QA personnel, sampling and analytical procedures that achieve the required levels of detection and QC acceptance limits that meet established performance criteria. Concurrently, the project director will select the level of data assessment to ensure that only data meeting the project DQOs are used in decision-making.

Field equipment will be used that can achieve the required levels of detection for analytical measurements in the field. In addition, the field sampling staff will collect and submit full volumes of samples as required by the laboratory for analysis, whenever possible. Full volume aliquots will help ensure achievement of the required limits of detection and allow for reanalysis if necessary. The concentration of the lowest level check standard in a multi-point calibration curve will represent the reporting limit.

Analytical methods and quality assurance parameters associated with the sampling program are presented in Attachment C. The frequency of associated field blanks and duplicate samples will be based on the recommendations listed in the DER-10, and as described in Section 5.3.

Site-specific MS and MSD samples will be prepared and analyzed by the analytical laboratory by spiking an aliquot of submitted sample volume with analytes of interest. An MS/MSD analysis will be analyzed at a rate of 1 out of every 20 samples, or one per analytical batch.

## **5.0 SAMPLE COLLECTION AND FIELD DATA ACQUISITION PROCEDURES**

Soil sampling will be conducted in accordance with the established NYSDEC protocols contained in DER-10/Technical Guidance for Site Investigation and Remediation (May 2010). Sub-slab vapor and indoor air sampling, if necessary, will be conducted in accordance with the established NYSDOH protocols contained in the Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006). The following sections describe procedures to be followed for specific tasks.

### **5.1 FIELD DOCUMENTATION PROCEDURES**

Field documentation procedures will include summarizing field observations in field books, logging soil borings and monitoring well construction, completing forms for groundwater sampling, and proper sample labeling. These procedures are described in the following sections.

#### *5.1.1 Field Data and Notes*

Field notebooks contain the documentary evidence regarding procedures conducted by field personnel. Hard cover, bound field notebooks will be used because of their compact size, durability, and secure page binding. The pages of the notebook will not be removed.

Entries will be made in waterproof, permanent blue or black ink. No erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark and the change initialed and dated by the team member making the change. Each entry will be dated. Entries will be legible and contain accurate and complete documentation of the individual or sampling team's activities or observations made. The level of detail will be sufficient to explain and reconstruct the activity conducted. Each entry will be signed by the person(s) making the entry.

The following types of information will be provided for each sampling task, as appropriate:

- Project name and number
- Reasons for being on-site or taking the sample(s)
- Date and time of activity
- Sample identification number(s)
- Geographical location of sampling points with references to the Site, other facilities or a map coordinate system; sketches will be made in the field logbook when appropriate
- Physical location of sampling locations such as depth below ground surface

- Description of the method of sampling including procedures followed, equipment used and any departure from the specified procedures
- Description of the sample including physical characteristics, odor, etc.
- Readings obtained from health and safety equipment
- Weather conditions at the time of sampling and previous meteorological events that may affect the representative nature of a sample
- Photographic information including a brief description of what was photographed, the date and time, the compass direction of the picture and the number of the picture on the camera
- Other pertinent observations such as the presence of other persons on the Site, actions by others that may affect performance of site tasks, etc.
- Names of sampling personnel and signature of persons making entries

Field records will also be collected on field data sheets including boring logs, which will be used for geologic and drilling data during soil boring activities. Field data sheets will include the project-specific number and stored in the field project files when not in use. At the completion of the field activities, the field data sheets will be maintained in the central project file.

#### 5.1.2 Sample Labeling

Each sample collected will be assigned a unique identification number and abbreviation in accordance with the sample nomenclature guidance provided in the following table and the Standard Operating Procedure provided in Attachment D.

Sample Nomenclature Summary	
<b>AA</b>	Ambient Air
<b>DUP</b>	Field Duplicate
<b>EA</b>	Effluent Air
<b>FB</b>	Field Blank
<b>IA</b>	Indoor Air
<b>MW</b>	Monitoring Well
<b>SB</b>	Soil Boring
<b>SSV</b>	Sub-slab Vapor
<b>TB</b>	Trip Blank
<b>(#-#)</b>	Depth Interval
<b>MMDDYY</b>	Date of Sampling

Each sample container will have a sample label affixed to the outside with the date and time of sample collection and project name. In addition, the label will contain the sample

identification number, analysis required and chemical preservatives added, if any. All documentation will be completed in waterproof ink.

## **5.2 EQUIPMENT CALIBRATION AND PREVENTATIVE MAINTENANCE**

A photoionization detector (PID) will be used during the sampling activities to evaluate work zone action levels, screen soil samples, and collect monitoring well headspace readings. Field calibration and/or field checking of the PID will be the responsibility of the field team leader and the Site Health & Safety Officer, and will be accomplished by following the procedures outlined in the operating manual for the instrument. At a minimum, field calibration and/or field equipment checking will be performed once daily, prior to use. Field calibration will be documented in the field notebook. Entries made into the logbook regarding the status of field equipment will include the following information:

- Date and time of calibration
- Type of equipment serviced and identification number (such as serial number)
- Reference standard used for calibration
- Calibration and/or maintenance procedure used
- Other pertinent information

Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent utilization. The equipment will be properly tagged to indicate that it is out of calibration. Such equipment will be repaired and recalibrated to the manufacturer's specifications by qualified personnel. Equipment that cannot be repaired will be replaced.

Off-site calibration and maintenance of field instruments will be conducted as appropriate throughout the duration of project activities. All field instrumentation, sampling equipment and accessories will be maintained in accordance with the manufacturer's recommendations and specifications and established field equipment practice. Off-site calibration and maintenance will be performed by qualified personnel. A logbook will be kept to document that established calibration and maintenance procedures have been followed. Documentation will include both scheduled and unscheduled maintenance.

## **5.3 SAMPLE COLLECTION**

### *5.3.1 Soil Samples*

Soil samples will be visually classified and field screened using a PID to assess potential impacts from VOCs and for health and safety monitoring. Soil samples collected for

analysis of VOCs will be collected using either EnCore® or Terra Core® sampling equipment. For analysis of non-volatile parameters, samples will be homogenized and placed into glass jars. After collection, all sample jars will be capped and securely tightened, and placed in iced coolers and maintained at  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$  until they are transferred to the laboratory for analysis, in accordance with the procedures outlined in Section 5.4. Analysis and/or extraction and digestion of collected soil samples will meet the holding times required for each analyte as specified in Attachment C. In addition, analysis of collected soil sample will meet all quality assurance criteria set forth by this QAPP and DER-10.

Imported soil (i.e., clean fill) will meet the lower of RURR and PGW SCOs. Qualified environmental personnel will collect representative samples at a frequency consistent with NYSDEC CP-51. The samples will be analyzed for Part 375 VOCs (USEPA Method 8260), semivolatile organic compounds (SVOC) (USEPA Method 8270), pesticides/PCBs (USEPA Method 8082/8081), metals (USEPA Method 6010), and per- and polyfluoroalkyl substances (PFAS) (USEPA Method 537 or 537.1, or, if after November 1, 2022, Method 1633) by a NYSDOH ELAP-certified laboratory.

### 5.3.2 *Groundwater Samples*

Groundwater sampling will be conducted using low-flow sampling procedures following USEPA guidance ("Low Stress [low flow] Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells", EQASOP-GW 004, January 19, 2017).

During purging, field parameters should be measured, including: water level drawdown, purge rate, pH, specific conductance, temperature, dissolved oxygen, turbidity and oxidation-reduction-potential (ORP), every five minutes using a water quality meter (Horiba U-52 or similar) and a depth-to-water interface probe that should be decontaminated between wells. Samples should generally not be collected until the field parameters have stabilized. Field parameters will be considered stable once three sets of measurements are within  $\pm 0.1$  standard units for pH,  $\pm 3\%$  for conductivity and temperature,  $\pm 10$  millivolts for ORP, and  $\pm 10\%$  for turbidity and dissolved oxygen. Purge rates should be adjusted to keep the drawdown in the well to less than 0.3 feet, as practical. Additionally, an attempt should be made to achieve a stable turbidity reading of less than 10 Nephelometric Turbidity Units (NTU) prior to sampling. If the turbidity reading does not stabilize at reading of less than 10 NTU for a given well, then both filtered and unfiltered samples should be collected from that well. If necessary, field filtration should



be performed using a 0.45 micron disposable in-line filter. Groundwater samples should be collected after parameters have stabilized as noted above or the readings are within the precision of the meter. Deviations from the stabilization and drawdown criteria, if any, should be noted on the sampling logs.

Samples should be collected directly into laboratory-supplied jars. After collection, all sample jars will be capped and securely tightened, and placed in iced coolers and maintained at 4°C ±2°C until they are transferred to the laboratory for analysis, in accordance with the procedures outlined in Section 5.4. Analysis and/or extraction and digestion of collected groundwater samples will meet the holding times required for each analyte as specified in Attachment C. In addition, analysis of collected groundwater sample will meet all quality assurance criteria set forth by this QAPP and DER-10.

#### *5.3.3 Air Samples*

Prior to sample collection, a pre-sampling inspection will be conducted to document chemicals and potential subsurface pathways at the site. The pre-sampling inspection will assess the potential for interference from chemical storage nearby or within the building. Air samples will be collected into laboratory-supplied, batch certified-clean Summa® canisters calibrated for a sampling rate of two hours. The pressure gauges on each calibrated flow controller should be monitored throughout sample collection. Sample collection should be stopped when the pressure reading reaches -4 millimeters of mercury (mmHg).

#### *5.3.4 Sample Field Blanks, Equipment Blanks, and Duplicates*

Field blanks will be collected for quality assurance purposes at a rate of one per 20 soil and groundwater investigation samples per analysis. Field blanks will be obtained by pouring laboratory-demonstrated analyte-free water into a laboratory-provided sample container for analysis. Field blank samples will be analyzed for the complete list of analytes on the day of sampling. Trip blanks will be collected at a rate of one per day if groundwater samples are analyzed for VOCs during that day.

Field duplicate soil and groundwater samples will be collected and analyzed for quality assurance purposes. Field duplicate samples will be collected at a frequency of 1 per 20 investigative soil samples per analysis and will be submitted to the laboratory as “blind” samples. If less than 20 samples are collected, one field duplicate sample will be collected.

#### **5.4 SAMPLE CONTAINERS AND HANDLING**

Certified, commercially clean sample containers will be obtained from the analytical laboratory. The laboratory will also prepare and supply the required trip blanks and field blank sample containers and reagent preservatives. Sample bottle containers, including the field blank containers, will be placed into plastic coolers by the laboratory. These coolers will be received by the field sampling team within 24 hours of their preparation in the laboratory. Prior to the commencement of field work, Langan field personnel will fill the plastic coolers with ice in Ziploc® bags (or equivalent) to maintain a temperature of  $4^{\circ} \pm 2^{\circ} \text{C}$ .

Soil samples collected in the field for laboratory analysis will be placed directly into the laboratory-supplied sample containers. Samples will then be placed and stored on-ice in laboratory provided coolers until shipment to the laboratory. The temperature in the coolers containing samples and associated field blanks will be maintained at a temperature of  $4^{\circ} \pm 2^{\circ} \text{C}$  while on-site and during sample shipment to the analytical laboratory.

Possession of samples collected in the field will be traceable from the time of collection until they are analyzed by the analytical laboratory or are properly disposed. Chain-of-custody procedures, described in Section 5.10, will be followed to maintain and document sample possession. Samples will be packaged and shipped as described in Section 5.7.

#### **5.5 SPECIAL CONSIDERATIONS FOR PFAS SAMPLE COLLECTION**

The following special considerations apply to the collection of soil and groundwater samples for per- and polyfluoroalkyl substances (PFAS) analysis to prevent cross-contamination:

- Field equipment will not contain Teflon®
- All sampling material will be made from stainless steel, high-density polyethylene (HDPE), acetate, silicon, or polypropylene
- No waterproof field books will be used
- No plastic clipboards, binders, or spiral hard cover notebooks will be used
- No adhesives will be used
- No sharpies or permanent markers will be used; ball point pens are acceptable
- Aluminum foil will not be used
- PFAS samples will be kept in a separate cooler from other sampling containers
- Coolers will be filled only with regular ice

DER has developed a PFAS target analyte list. At minimum, the laboratory will report the following PFAS target compounds:

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

The PFAS compound sampling protocol is provided in Attachment E.

## 5.6 SAMPLE PRESERVATION

Sample preservation measures will be used in an attempt to prevent sample decomposition by contamination, degradation, biological transformation, chemical interactions and other factors during the time between sample collection and analysis. Preservation will commence at the time of sample collection and will continue until analyses are performed. Should chemical preservation be required, the analytical

laboratory will add the preservatives to the appropriate sample containers before shipment to the office or field. Samples will be preserved according to the requirements of the specific analytical method selected, as shown in Attachment C.

## **5.7 SAMPLE SHIPMENT**

### *5.7.1 Packaging*

Soil and groundwater (contingency) sample containers will be placed in plastic coolers. Ice in Ziploc® bags (or equivalent) will be placed around sample containers. Cushioning material will be added around the sample containers if necessary. Chains-of-custody and other paperwork will be placed in a Ziploc® bag (or equivalent) and placed inside the cooler. The cooler will be taped closed and custody seals will be affixed to one side of the cooler at a minimum. If the samples are being shipped by an express delivery company (e.g. FedEx) then laboratory address labels will be placed on top of the cooler.

### *5.7.2 Shipping*

Standard procedures to be followed for shipping environmental samples to the analytical laboratory are outlined below.

- All environmental samples will be transported to the laboratory by a laboratory-provided courier under the chain-of-custody protocols described in Section 5.11.
- Prior notice will be provided to the laboratory regarding when to expect shipped samples. If the number, type or date of shipment changes due to site constraints or program changes, the laboratory will be informed.

## **5.8 DECONTAMINATION PROCEDURES**

Decontamination procedures will be used for non-dedicated sampling equipment. Decontamination of field personnel is discussed in the site-specific CHASP included in Appendix D of the RAWP. Field sampling equipment that is to be reused will be decontaminated in the field in accordance with the following procedures:

1. Laboratory-grade glassware detergent and tap water scrub to remove visual contamination
2. Generous tap water rinse
3. Distilled/de-ionized water rinse

Any field sampling equipment that is to be reused for PFAS sampling will be decontaminated in the field in accordance with the following procedures:

1. Alconox detergent and “PFAS-free” water scrub to remove visual contamination
2. Generous PFAS-free” water rinse

## **5.10 RESIDUALS MANAGEMENT**

Debris (e.g., paper, plastic and disposable personal protective equipment [PPE]) will be collected in plastic garbage bags and disposed of as non-hazardous industrial waste. Debris is expected to be transported to a local municipal landfill for disposal. If applicable, residual solids (e.g., leftover soil cuttings) will be placed back in the borehole from which it was sampled. If gross contamination is observed, soil will be collected and stored in Department of Transportation (DOT)-approved 55-gallon drums in a designated storage area at the Site. The residual materials stored in a designated storage area at the site for further characterization, treatment or disposal.

Residual fluids (such as purge water) will be collected and stored in DOT-approved (or equivalent) 55-gallon drums in a designated storage area at the site. The residual fluids will be transported to the on-site wastewater treatment plant or analyzed, characterized and disposed off-site in accordance with applicable federal and state regulations. Residual fluids such as decontamination water may be discharged to the ground surface, however, if gross contamination is observed, the residual fluids will be collected, stored, and transported similar purge water or other residual fluids.

## **5.11 CHAIN OF CUSTODY PROCEDURES**

A chain-of-custody protocol has been established for collected samples that will be followed during sample handling activities in both field and laboratory operations. The primary purpose of the chain-of-custody procedures is to document the possession of the samples from collection through shipping, storage and analysis to data reporting and disposal. Chain-of-custody refers to actual possession of the samples. Samples are considered to be in custody if they are within sight of the individual responsible for their security or locked in a secure location. Each person who takes possession of the samples, except the shipping courier, is responsible for sample integrity and safe keeping. Chain-of-custody procedures are provided below:

- Chain-of-custody will be initiated by the laboratory supplying the pre-cleaned and prepared sample containers. Chain-of-custody forms will accompany the sample containers.
- Following sample collection, the chain-of-custody form will be completed for the sample collected. The sample identification number, date and time of sample

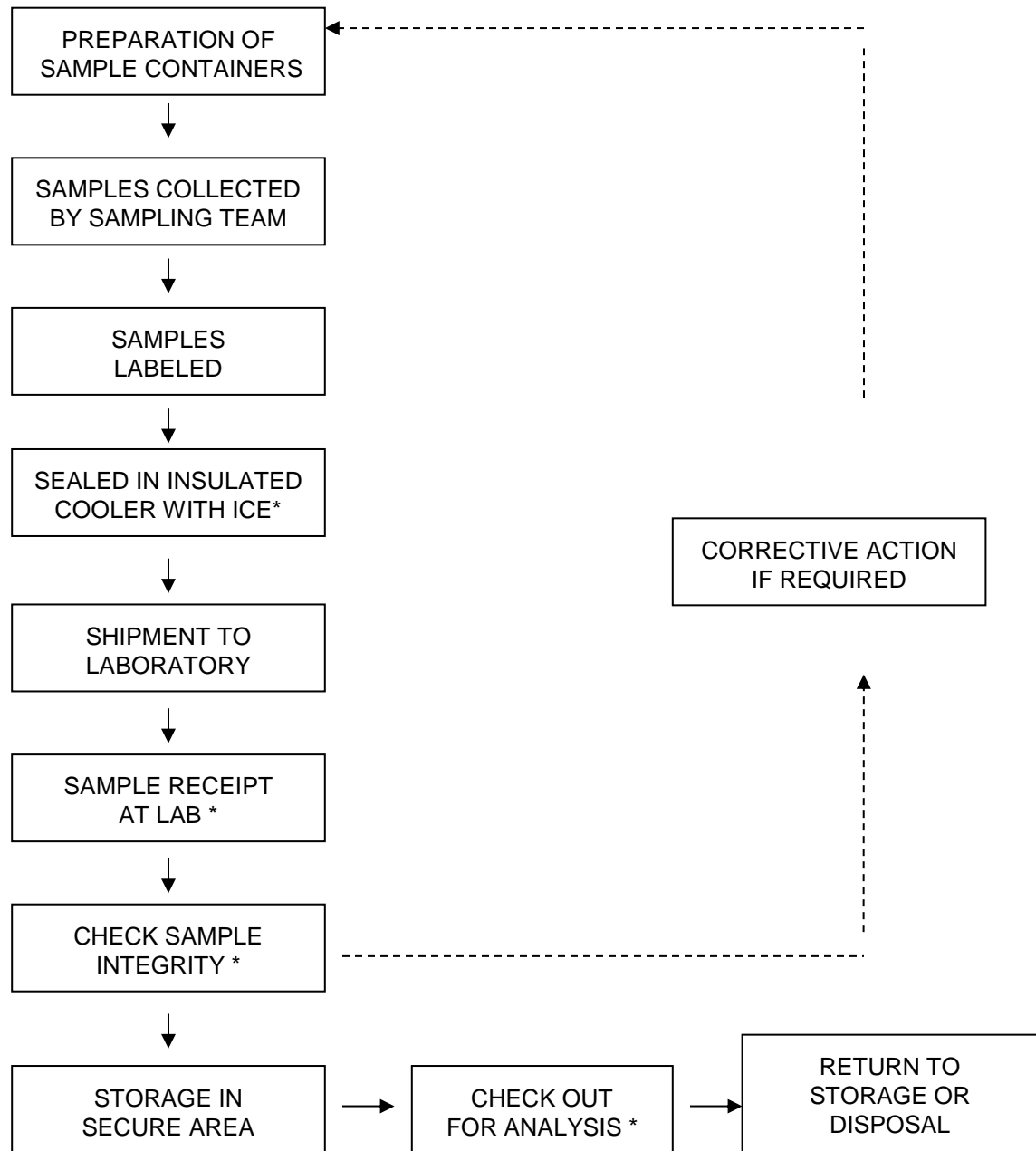
collection, analysis requested and other pertinent information (e.g., preservatives) will be recorded on the form. All entries will be made in waterproof, permanent blue or black ink.

- Langan field personnel will be responsible for the care and custody of the samples collected until the samples are transferred to another party, dispatched to the laboratory, or disposed. The sampling team leader will be responsible for enforcing chain-of-custody procedures during field work.
- When the form is full or when all samples have been collected that will fit in a single cooler, the sampling team leader will check the form for possible errors and sign the chain-of-custody form. Any necessary corrections will be made to the record with a single strike mark, dated, and initialed.

When soil and samples are collected, sample coolers will be accompanied by the chain-of-custody form, sealed in a Ziploc® bag (or equivalent) and placed on top of the samples or taped to the inside of the cooler lid. If applicable, a shipping bill will be completed for each cooler and the shipping bill number recorded on the chain-of-custody form.

Samples will be packaged for shipment to the laboratory with the appropriate chain-of-custody form. A copy of the form will be retained by the sampling team for the project file and the original will be sent to the laboratory with the samples. Bills of lading will also be retained as part of the documentation for the chain-of-custody records, if applicable. When transferring custody of the samples, the individuals relinquishing and receiving custody of the samples will verify sample numbers and condition and will document the sample acquisition and transfer by signing and dating the chain-of-custody form. This process documents sample custody transfer from the sampler to the analytical laboratory. A flow chart showing a sample custody process is included as Figure 5.1, and an example chain-of-custody form for soil and groundwater (contingency) samples is included as Figure 5.2.

Figure 5.1 Sample Custody



\* REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

[illegible]



[illegible]

Laboratory chain-of-custody will be maintained throughout the analytical processes as described in the laboratory's Quality Assurance (QA) Manual. The analytical laboratory will provide a copy of the chain-of-custody in the analytical data deliverable package. The chain-of-custody becomes the permanent record of sample handling and shipment.

## **5.12 LABORATORY SAMPLE STORAGE PROCEDURES**

The subcontracted laboratory will use a laboratory information management system (LIMS) to track and schedule samples upon receipt by the analytical laboratories. Any sample anomalies identified during sample log-in must be evaluated on individual merit for the impact upon the results and the DQOs of the project. When irregularities do exist, the environmental consultant must be notified to discuss recommended courses of action and documentation of the issue must be included in the project file.

For samples requiring thermal preservation, the temperature of each cooler will be immediately recorded. Each sample and container will be assigned a unique laboratory identification number and secured within the custody room walk-in coolers designated for new samples. Samples will be, as soon as practical, disbursed in a manner that is functional for the operational team. The temperature of all coolers and freezers will be monitored and recorded using a certified temperature sensor. Any temperature excursions outside of acceptance criteria (i.e., below 2°C or above 6°C) will initiate an investigation to determine whether any samples may have been affected. Samples for VOCs will be maintained in satellite storage areas within the VOC laboratory. Following analysis, the laboratory's specific procedures for retention and disposal will be followed as specified in the laboratory's SOPs and/or QA manual.

## **6.0 DATA REDUCTION, VALIDATION, AND REPORTING**

### **6.1 INTRODUCTION**

Data collected during the field investigation will be reduced and reviewed by the laboratory QA personnel, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the USEPA SW-846 and subsequent updates. The data package provided by the laboratory will contain all items specified in the analytical methodology (Attachment C) appropriate for the analyses to be performed, and be reported in standard format.

The completed copies of the Chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

### **6.2 DATA REDUCTION**

The Analytical Services Protocol (ASP) Category B data packages and an electronic data deliverable (EDD) will be provided by the laboratory after receipt of a complete sample delivery group. The Project Manager will immediately arrange for archiving the results and preparation of result tables. These tables will form the database for assessment of the site contamination condition.

Each EDD deliverable must be formatted using a Microsoft Windows operating system and the NYSDEC data deliverable format for EQulS™. To avoid transcription errors, data will be loaded directly into the ASCII format from the LIMS. If this cannot be accomplished, the consultant should be notified via letter of transmittal indicating that manual entry of data is required for a particular method of analysis. All EDDs must also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

The Project Manager or Task Manager will maintain close contact with the QA reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review has been completed, the Project Manager may direct the Team Leaders or others to initiate and finalize the analytical data assessment.

### **6.3 DATA VALIDATION**

Data validation will be performed in accordance with the USEPA Region 2 SOPs for data validation and USEPA's National Functional Guidelines for Organic and Inorganic Data Review. Samples collected to characterize material proposed for export and import will not be validated. Tier 1 data validation (the equivalent of USEPA's Stage 2A validation) will be performed to evaluate data quality. Tier 1 data validation is based on completeness and compliance checks of sample-related QC results, including:

- Holding times;
- Sample preservation;
- Blank results (method, trip, and field blanks);
- Surrogate recovery compounds and extracted internal standards (as applicable);
- LCS and Laboratory Control Sample Duplicate (LCSD) recoveries and RPDs;
- MS and MSD recoveries and RPDs;
- Laboratory duplicate RPDs; and
- Field duplicate RPDs

A Data Usability Summary Report (DUSR) will be prepared by the data validator and reviewed by the QAO before issuance. The DUSR will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain-of-custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.

Based on the results of data validation, the validated analytical results reported by the laboratory will be assigned one of the following usability flags:

- "U" - Not detected. The associated number indicates the approximate sample concentration necessary to be detected significantly greater than the level of the highest associated blank;
- "UJ" - Not detected. Quantitation limit may be inaccurate or imprecise;
- "J" - Analyte is present. Reported value may be associated with a higher level of uncertainty than is normally expected with the analytical method
- "R" – Unreliable result; data is rejected or unusable. Analyte may or may not be present in the sample; and
- No Flag - Result accepted without qualification.

#### **6.4 REPORTING**

Upon receipt of validated analytical results, NYSDEC format EDDs, compatible with EQulS™, will be prepared and submitted to the NYSDEC.

## **7.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS**

### **7.1 INTRODUCTION**

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the QAO. These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate quality assurance management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

### **7.2 SYSTEM AUDITS**

System audits may be performed by the QAO or designated auditors, and encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may occur.

### **7.3 PERFORMANCE AUDITS**

The laboratory may be required to conduct an analysis of Performance Evaluation samples or provide proof that Performance Evaluation samples submitted by USEPA or a state agency have been analyzed within the past twelve months.

### **7.4 FORMAL AUDITS**

Formal audits refer to any system or performance audit that is documented and implemented by the QA group. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by auditors who have performed the site audit after gathering and evaluating all data. Items, activities, and documents determined by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Non-compliances will be logged, and documented through audit findings, which are attached to and are a part of the integral audit report. These audit-finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QAO prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

## **8.0 CORRECTIVE ACTION**

### **8.1 INTRODUCTION**

The following procedures have been established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

### **8.2 PROCEDURE DESCRIPTION**

When a significant condition adverse to quality is noted at site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader and involved contractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly traceable;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment;
- As a result of laboratory/field comparison studies; and
- As required by USEPA SW-846, and subsequent updates, or by the NYSDEC ASP.

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the sites, laboratories, or contractor locations. Activities, or documents ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Project Manager.



Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 12.1 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

**FIGURE 8.1**

<b>CORRECTIVE ACTION REQUEST</b>					
Number: _____		Date: _____			
TO: _____ You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _____					
CONDITION:					
REFERENCE DOCUMENTS:					
RECOMMENDED CORRECTIVE ACTIONS:					
_____	_____	_____	_____	_____	_____
Originator	Date	Approval	Date	Approval	Date
RESPONSE					
CAUSE OF CONDITION					
CORRECTIVE ACTION  (A) RESOLUTION  (B) PREVENTION  (C) AFFECTED DOCUMENTS					
C.A. FOLLOWUP:  CORRECTIVE ACTION VERIFIED BY: _____ DATE: _____					

## **9.0 REFERENCES**

1. NYSDEC. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS), dated June 2021.
2. NYSDEC. Division of Environmental Remediation. DER-10/Technical Guidance for Site Investigation and Remediation, dated May 3, 2010.
3. NYSDOH. Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006, updated May 2017.
4. USEPA, 2014. "Test Method for Evaluating Solid Waste," Update V dated July 2014 U.S. Environmental Protection Agency, Washington, D.C..
5. USEPA, 2016. Region II Standard Operating Procedure (SOP) #HW-34, "Trace Volatile Data Validation" (September 2016, Revision 1), USEPA Hazardous Waste Support Section. USEPA Region II.
6. USEPA, 2016. Region II SOP #HW-33A, "Low/Medium Volatile Data Validation" (September 2016, Revision 1), USEPA Hazardous Waste Support Section. USEPA Region II.
7. USEPA, 2016. Region II SOP #HW-35A, "Semivolatile Data Validation" (September 2016, Revision 1), USEPA Hazardous Waste Support Section. USEPA Region II.
8. USEPA, 2016. Region II SOP #HW-36A, "Pesticide Data Validation" (October 2016, Revision 1), USEPA Hazardous Waste Support Section. USEPA Region II.
9. USEPA, 2015. Region II SOP #HW-37A, "PCB Aroclor Data Validation" (June 2015, Revision 0), USEPA Hazardous Waste Support Section. USEPA Region II.
10. USEPA 2015. Region II SOP #HW-3a, "ICP-AES Data Validation" (July 2015, Revision 0), USEPA Hazardous Waste Support Section. USEPA Region II.
11. USEPA, 2016. Region II SOP #HW-3b, "ICP-MS Data Validation" (September 2016, Revision 1), USEPA Hazardous Waste Support Section. USEPA Region II.
12. USEPA, 2016. Region II SOP #HW-3c, "Mercury and Cyanide Data Validation" (September 2016, Revision 1), USEPA Hazardous Waste Support Section. USEPA Region II.
13. USEPA 2017. National Functional Guidelines for Superfund Organic Methods Data Review, Office of Superfund Remediation and Technology Innovation, EPA-540-R-2017-002, January 2017.

14. USEPA 2017b. National Functional Guidelines for Superfund Inorganic Methods Data Review, Office of Superfund Remediation and Technology Innovation, EPA-540-R-201 7-001, January 2017.

**ATTACHMENT A**

**RÉSUMÉS**

# JOSEPH CONBOY

STAFF CHEMIST  
ENVIRONMNETAL

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Mr. Conboy has seven years of environmental chemistry, quality assurance, and environmental database management experience, with a current emphasis on validation of laboratory data for submittal to NJDEP via the New Jersey Data of Known Quality Protocols and to NYSDEC. Previous work experience includes performing validation of data for projects in USEPA Regions 2 and 3 while employing appropriate validation guidelines for each region, managing large data sets, updating appropriate regulatory limits, performing statistical evaluations, and preparing electronic data deliverables and report deliverables using the Earthsoft EQulS database program, and acted as an intermediary between project managers, field staff, and laboratories. Mr. Conboy also has experience in field sampling techniques and maintains current OSHA HAZWOPER certification.



## SELECTED PROJECTS

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- 1400 Ferris, Bronx, NY – Completed validation of soil and groundwater data and prepared the Data Usability Summary Report for submittal to NYSDEC. USEPA Region II guidelines, with aide from National Functional Guidelines, were employed to perform validation of VOCs and SVOCs including 1,4-dioxane, and tangentially used based on professional judgment to perform validation of PFAS data.
- Broome Street Parking Lot, NY - Completed validation of waste characterization data and prepared the Data Usability Summary Report for submittal to NYSDEC. USEPA Region II guidelines, with aide from National Functional Guidelines, were employed to perform validation of VOCs, SVOCs, herbicides, PCBs, pesticides, metals including mercury, ignitability temperature, pH, reactive cyanide, reactive sulfide, cyanide, and hexavalent chromium. Toxicity characteristic leachate procedure extraction data for VOCs, SVOCs, herbicides, pesticides, metals, and mercury were also validated.
- 215 North 10<sup>th</sup> Street, Brooklyn, NY - Completed validation of soil and groundwater data and prepared the Data Usability Summary Report for submittal to NYSDEC. USEPA Region II guidelines, with aide from National Functional Guidelines, were employed to perform validation of VOC, SVOC, SVOC SIM, herbicide, PCB, pesticide, metals, mercury, cyanide, hexavalent chromium, trivalent chromium data.
- 35 Commercial Street, Brooklyn, NY - Completed validation of soil data and prepared the Data Usability Summary Report for submittal to NYSDEC. USEPA Region II guidelines, with aide from National Functional Guidelines, were employed to perform validation of VOC, SVOC, SVOC SIM, herbicide, PCB, pesticide, metals, mercury, cyanide, hexavalent chromium, trivalent chromium data, and tangentially used based on professional judgment to perform validation of PFAS data.
- Suffolk Street, Lower East Side, NY- Completed validation of soil, groundwater, and soil vapor data and prepared the Data Usability Summary Report for submittal to NYSDEC. USEPA Region II

## EDUCATION

B.Sc., Chemistry with a  
minor in Mathematics  
Rowan University

## CERTIFICATIONS & TRAINING

OSHA 40-Hour  
HAZWOPER 29 CFR  
1910.120(e)(4)  
Certification

NJ Analytical Guidance  
and Data Usability  
Training

USEPA Data Validation  
Training

Earthsoft EQulS  
Environmental Database  
Training

## JOSEPH CONBOY

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guidelines, with aide from National Functional Guidelines, were employed to perform validation of VOC, VOCs by USEPA TO-15, SVOC, SVOC SIM, herbicide, PCB, pesticide, metals, mercury, cyanide, hexavalent chromium, trivalent chromium data, and tangentially used based on professional judgment to perform validation of PFAS data.

- Managed a database for a confidential client containing 10+ years of environmental chemical data from multiple laboratories, requiring select data validation in accordance with New Jersey Data of Known Quality Protocols and identifying areas of delineation from historic field information. Once identified, NJDEP designated groundwater, surface water, soil, sediment, soil vapor, and custom screening criteria were researched and applied to each area, requiring individualized flagging for reporting.\*
- Prepared the New Jersey Data of Known Quality Protocol Data Usability Evaluation and managed the database for a confidential client for a data set greater than 20 years old. A DUE or any validation effort was not prepared in the 20 years prior to current. This included data from variations of methods for volatile organic compounds, semivolatile organic compounds, total and dissolved metals, pesticides, herbicides, natural attenuation parameters, and per- and polyfluoroalkyl substances in multiple media.\*
- Performed 200+ Stage 2a validations for a combined 87-acre USEPA designated Corrective Action site under the Resource Conservation and Recovery Act, including a quick-turn USEPA required PCB by soxhlet extraction investigation across multiple plants. Once a former train car painting facility, USEPA required a quick-turn PCB by soxhlet extraction soil investigation.
- Preparation of a quality assurance program for a confidential client in West Virginia. A quick turn QAPP was prepared in a service location new to the consultant, resulting in research into state requirements for data usability and auditing newly employed laboratories. The QAPP was understood to be prepared for groundwater only, but the client did not reveal the need for sediment and soil. Two QAPPs were submitted for review to governing agencies.\*
- Used statistical software to determine a localized background upper confidence limit of chromium for a confidential client's sand and gravel site. Validation was used to confirm laboratory procedures, and data was used in ProUCL calculations to compare to researched background chromium levels for Pennsylvania soils. \*
- Prepared daily perimeter dust and air monitoring summaries and validation of low level mirex data for a confidential client's superfund site. Low level mirex data was generated by university laboratories and subject to validation following national functional guidelines to aide in river clean-up, including sediment, surface water, and treatment system water matrices.\*

*\*Project completed prior to employment at LANGAN.*

# ELIZABETH ADKINS, P.E.

## PROJECT ENGINEER

## ENVIRONMENTAL ENGINEERING

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Ms. Adkins is an environmental engineer with experience in environmental consulting in the New York metropolitan area. Ms. Adkins has a background in conducting and managing environmental site assessments and investigations, remedial oversight and implementation, data management and analysis, and report writing. She is currently managing various environmental projects in the greater New York City area that require air quality screening and collection of soil, groundwater, soil vapor, and indoor air samples.



### SELECTED PROJECTS

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- Silvercup West, Brownfield Redevelopment, Remediation Oversight, Long Island City, NY
- Hudson Yards Culture Shed, Remediation Oversight, New York, NY
- 601 Washington Street, Remediation Oversight, New York, NY
- Dock 72 at Brooklyn Navy Yard, Remediation Oversight, Brooklyn, NY
- 50 Hudson Yards, Remedial Investigation and Waste Characterization Report preparation, New York, NY
- Northern Boulevard and Steinway Street, Subsurface Investigation, Remedial Investigation Report, and Remedial Action Work Plan, Long Island City, NY
- Fort Totten Training Academies, Phase II ESI, Queens, NY
- 535 4<sup>th</sup> Avenue, Quarterly Groundwater Sampling and Reporting, Brooklyn, NY
- 4 Hudson Square, Remedial Investigation and Reporting, Office Support during Waste Characterization, New York, NY
- 190 Riverside Drive, Spill Response, Groundwater Discharge Permitting, Spill Closure, New York, NY
- 730 Fifth Avenue, Phase I ESA report preparation, Waste Characterization implementation and report preparation, New York, NY
- 1185 Broadway, NYCOER VCP Site Investigation Report, Remedial Action Work Plan, VCP Application, Office Support during Remediation Oversight, New York, NY
- 215 North 10<sup>th</sup> Street, Waste characterization implementation and report preparation, NYSDEC BCP Office Support, Brooklyn, NY
- 561 Greenwich Street, NYSDEC BCP Remedial Investigation Report, Remedial Action Work Plan, BCP Application, Office Support, New York, NY
- 92 Avenue of the Americas, Phase I ESA, Phase II ESI Report, NYSDEC BCP Application, Office Support, New York, NY
- The Women's Building- 550 West 20<sup>th</sup> Street, Phase II ESI Work Plan and Report, Office Support, Remediation Cost Estimates, New York, NY
- 551 Greenwich Street, Brownfield Redevelopment, New York, NY
- 111 Leroy Street, Environmental Remediation, New York, NY
- 122 Varick Street, Environmental Assessment, New York, NY
- 46-15 Kissena Boulevard, Brownfield Redevelopment, Flushing, NY

### EDUCATION

B.Sc., Earth and  
Environmental Engineering  
Columbia University

B.A., Environmental  
Science  
Barnard College

### PROFESSIONAL REGISTRATION

Professional Engineer

LEED Green Associate

OSHA 40-Hour HAZWOPER

OSHA 10-Hour Construction

Qualified SWPPP  
Practitioner

Long Island Railroad  
Roadway Worker Protection

AMTRAK Transportation  
Worker Identification  
Credential

### AFFILIATIONS

American Society of Civil  
Engineers - Metropolitan  
Section, Younger  
Members Forum K-12  
Outreach Committee Chair

**LANGAN**



# JASON J. HAYES, PE, LEED AP

## PRINCIPAL/VICE PRESIDENT

### ENVIRONMENTAL ENGINEERING

---

Mr. Hayes has experience in New York, New Jersey, Washington D.C., California, Washington, Oregon, Alaska, and Internationally. His experience includes Environmental Protection Agency (EPA), New York State (NYS) Brownfields applications, investigation, and remediation; New York City Department of Environmental Protection (NYCDEP) and New York City Office of Environmental Remediation (OER) E-designated site applications, investigations, and remediation. His expertise also includes Phase I and II Environmental Site Investigations and Assessments; contaminated building cleanup and demolition; Underground Storage Tank (UST) permitting, removal specifications, and closure reporting; soil vapor intrusion investigation and mitigation system design (depressurization systems, etc.); development of groundwater contaminant plume migration models; environmental analysis; and oversight, design and specification generation for remediation operations with contaminants of concern to include polychlorinated biphenyls (PCBs), solvents, mercury, arsenic, petroleum products, asbestos, mold and lead.

#### SELECTED PROJECTS

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- Confidential Location (Remediation for Mercury-Contaminated Site), New York, NY
- Confidential Location (Phase II ESI and Remedial Design for Mercury Impacted Site), Brooklyn, NY
- NYC School Construction Authority (PCB Remediation), Various Locations, New York, NY
- 28-29 High Line (Phase I ESA, Phase II ESI, and Environmental Remediation), New York, NY
- Georgetown Heating Plant (Phase II ESI and Remedial Design for Mercury Impacted Site), Washington D.C.
- 268 West Street (BCP Application, RI and RIWP), New York, NY
- Confidential Multiple Mixed-Use Tower Location (BCP Application, RI, Phase I ESA, and Phase II ESI), New York, NY
- Dock 72 at Brooklyn Navy Yard, (NYS Voluntary Cleanup Program), Brooklyn, NY
- 27-21 44<sup>th</sup> Drive (BCP Application, Remedial Investigation Phase I ESA, and Phase II ESI), Long Island City, NY
- Purves Street Development, BCP Application, RAWP, and Phase II ESI, Long Island City, NY
- 267-273 West 87<sup>th</sup> Street (BCP Application, Remedial Investigation, RIWP, RAWP), New York, NY
- New York Aquarium, Shark Tank and Animal Care Facility (Environmental Remediation), Coney Island, NY
- International Leadership Charter School (Environmental Remediation), Bronx, NY
- West & Watts (BCP Application), New York, NY
- Hudson Yards Redevelopment (Phase I ESA and Phase II ESI), New York, NY



#### EDUCATION

M.S., Environmental Engineering  
Columbia University

B.S., Chemistry,  
Environmental Toxicology  
Humboldt State University

Business Administration  
(minor) Humboldt State  
University

#### PROFESSIONAL REGISTRATION

Professional Engineer (PE)  
in NY

LEED Accredited  
Professional (LEED AP)

Troxler Certification for  
Nuclear Densometer  
Training

CPR and First Aid  
Certification

OSHA 40-Hour  
HAZWOPER

OSHA HAZWOPER Site  
Supervisor

#### AFFILIATIONS

US Green Building  
Council, NYC Chapter  
(USGBC),  
Communications  
Committee

## LANGAN

## JASON J. HAYES, PE, LEED AP

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- 627 Smith Street (RI and Report), Brooklyn, NY
- Gateway Center II Retail (Phase I ESA and Phase II ESI), Brooklyn, NY
- 261 Hudson Street (Phase I ESA, Phase II ESI, BCP, and RAWP), New York, NY
- Riverside Center, Building 2 (BCP, Phase I ESA and Phase II ESI), New York, NY
- New York Police Academy, (Sub-Slab Depressurization and Vapor Barrier System), College Point, NY
- Bronx Terminal Market (BCP, RIWP, RAWP, Phase I ESA and Phase II ESI), Bronx, NY
- Jacob Javits Convention Center (Phase I ESA and Phase II ESI), New York, NY
- Yankee Stadium Development Waterfront Park (NYSDEC Spill Sites), Bronx, NY
- Bushwick Inlet Park (Phase I ESA, Approvals for NYC E-Designation), Brooklyn, NY
- Silvercup West (BCP, RIWP, RIR, RAWP, and RAA), Long Island City, NY
- 29 Flatbush, Tall Residential Building (Groundwater Studies, RIR and RAWP), Brooklyn, NY
- Gowanus Village I (BCP, RIWP and RIR), Brooklyn, NY
- Sullivan Street Hotel (Site Characterization Study and Owner Representation), New York, NY
- Riker's Island Co-Generation Plant (Soil and Soil Vapor Quality Investigations), Bronx, NY
- The Shops at Atlas Park (Sub-Slab Depressurization and Vapor Barrier Design), Glendale, NY
- Memorial Sloan-Kettering Cancer Center (Subsurface and Soil Vapor Intrusion Investigations), New York, NY
- Element West 59<sup>th</sup> Street (Oversight and Monitoring of Sub-Slab Depressurization and Vapor Barrier Systems), New York, NY
- Teterboro Airport (Delineation and Remedial Oversight of Petroleum-Contaminated Soils), Teterboro, NJ
- Proposed New York JETS Stadium (Phase I ESA), New York, NY
- Former Con Edison Manufactured Gas Plant Sites (Research Reports), New York, NY
- 7 World Trade Center (Endpoint Sampling and Final Closure Report), New York, NY
- Peter Cooper Village, Environmental Subsurface Investigations, New York, NY

Urban Land Institute (ULI), member

Commercial Real Estate Development Associations (NAIOP), member

NYC Brownfield Partnership, member

## SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS

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NYC Mayor's Office of Environmental Remediation – Big Apple Brownfield Workshop – Presented on Soil Vapor Intrusion Remedies (e.g., SSD Systems, Vapor Barriers, Modified HVAC)

New York City Brownfield Partnership – Presented on environmental considerations and complications of the Hudson Yards Development

**JASON J. HAYES, PE, LEED AP**

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Waterfront Development Technical Course – Presented on Impacted  
Waterfront Planning Considerations

***Site Investigation/Remediation/Compliance***

- Arizona Electric Power Cooperative (AEPCO) Apache Generating Station Arizona Protection Permit (APP), Wilcox, AZ
- Arizona Department of Environmental Quality (ADEQ) Water Quality Assurance Revolving Fund (WQARF) Projects, Phoenix and Gilbert, AZ
- Long-Term Monitoring Program and 5-Year CERCLA Review, Luke Air Force Base (AFB), Glendale, AZ\*
- Development of Stormwater Prevention Pollution Plan (SWPPP) and Stormwater Flow Modeling, Luke AFB, Glendale, AZ\*
- Site Investigation and Clean Closure for Confidential Industrial Client, Tempe, AZ\*
- RCRA Facility Investigation/Corrective Measures Assessment, San Jose, CA\*
- Technical Resource for X-Ray Fluorescence (XRF) Field Screening Program for Former Small Arms Firing Range, Nogales, AZ\*
- Designed and Implemented Sampling Procedures for Volatile Emissions from Tailings Impoundment Using Flux Chambers, Henderson, CO\*
- Conceptual Site Model and Statistical Evaluation for Water Treatment Plant, Denver, CO\*

***Mining Project***

- Third-Party Construction Quality Assurance (CQA) for Geotextile-Lined Tailings Repository, Casa Grande, AZ\*
- CQA For Reclamation at Smelter, Miami, AZ\*
- XRF Field Screening for Excavation at Former Smelter Site, El Paso, TX\*
- CQA for Reclamation Projects at Active Smelter, Miami, AZ

# GERALD F. NICHOLLS, PE, CHMM

## ASSOCIATE

### ENVIRONMENTAL ENGINEERING & HAZARDOUS MATERIALS MANAGEMENT

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Mr. Nicholls' 19 years of expertise includes management of remediation and site investigations, litigation support, brownfield cleanups, remedial design, industrial hygiene, air monitoring and environmental health and safety projects including data collection, inspection and reporting for projects throughout New York and New Jersey. He works closely with various private, state, commercial, industrial, and municipal clients, acting as a liaison between the client and project team.

In 2019, Real Estate Weekly named Mr. Nicholls one of the Rising Stars of Real Estate.



#### SELECTED PROJECTS

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- 491 Wortman Ave, Air Sparge/Soil Vapor Extraction Design and Implementation, Brownfield Cleanup Program, Bid Documents, Construction Administration, Brooklyn, NY
- Whitehead Realty, Acme Sites, DNAPL Delineation, Site Characterization, Remedial Investigation and Reporting, Brooklyn, NY
- West 17th Street Development, DNAPL Assessment, DNAPL Recovery, Remedial Design, Closure through Brownfield Cleanup Program, Remediation Oversight, Bid Documents, ISS and Containment Wall Design, Construction Administration, New York, NY
- 2 Ingraham Street, Brooklyn, NY
- New York City School Construction Authority On-Call Contract for Hazmat Consulting Services, Various Locations, Five Boroughs of New York, NY
- G4 Capital third party due diligence reviews and environmental risk evaluations, Various Locations, New York, NY
- 140 6th Avenue, Sub-Membrane Depressurization System Design, Spill Remediation, Subslab Remediation and Monitoring Well Piping Design, Remediation Oversight, and Construction Administration, New York, NY
- Gowanus Canal Northside, Demolition and Decommissioning of MOSF, Remediation Investigation, Brownfield Cleanup Program, Brooklyn, NY
- 23-01 42nd Road, Phase I, Phase II Remedial Investigation, Remedial Action Work Plan, Sub-Membrane Depressurization System Design, Underground Storage Tank Closure and Remediation, Brownfield Cleanup Program, Remediation Oversight, Construction Administration, Long Island City, NY
- 23-10 Queens Plaza South, Phase I, Phase II Remedial Investigation, Remedial Action Work Plan, Sub-Membrane Depressurization System Design, Underground Storage Tank Closure and Remediation, Brownfield Cleanup Program, Remediation Oversight, Construction Administration, Long Island City, NY

#### EDUCATION

M.S., Environmental Engineering  
New Jersey Institute of Technology

B.S., Chemistry and Environmental Studies  
(Double Major)  
Ursinus College

#### PROFESSIONAL REGISTRATION

Professional Engineer (PE)  
in NY

Certified Hazardous Materials Manager  
(CHMM)

#### AFFILIATIONS

Real Estate Board New York

City of Jersey City  
Environmental Commission, Former Commissioner, Vice Chair and Chair

Alliance of Hazardous Materials Professionals

American Chemical Society

New York League of Conservation Voters

New York City Brownfield Partnership

**LANGAN**

## GERALD F. NICHOLLS, PE, CHMM

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- 163 6<sup>th</sup> Street, Phase I and Phase II Due Diligence, Spill Response, Remedial Action Work Plan, Brooklyn, NY
- 170 Amsterdam Avenue, Remedial Action Work Plan, Voluntary Cleanup Program, Remediation Oversight, Construction Administration, New York, NY
- Urban Health Plan, Medical Building, DNAPL Delineation, Remedial Action Work Plan, Hazardous Waste Management and Minimization, Brownfield Cleanup Program, Bronx, NY
- Second Avenue Subway, Air Monitoring and Ventilated Air Treatment Program, New York, NY
- New York University Spill Sites, 4 Washington Square Village, 7-13, Washington Square North, and 251 Mercer Street, Fuel Oil Spill Cleanup and Closure, New York, NY
- Dormitory Authority of New York (DASNY), City College of New York, Fuel Protection and Leak Detection System Repair and Upgrades, New York, NY
- 45 Broad Street, Waste Characterization, Construction Documents, New York, NY
- 241 West 28<sup>th</sup> Street, New York, NY
- Surfactant Remediation Project, In-Situ Chemical Oxidation Design and Implementation and Site Closure, Margate City, NJ
- Koppers Site, Trans-Hudson Express Project, Kearny, NJ
- Former Cornell Manufacturing Site, Orangeburg, NY
- Horse Pasture Site, Robins Air Force Base, GA
- Williams Air Force Base, Thermal Enhanced Extraction, Mesa, AZ
- New Jersey Transit, 32<sup>nd</sup> Street Station Stop (former Hicor Site), Bayonne, NJ
- Nikolski Radio Relay Station, Umnak Island, AK
- Middletown Post Office, Due Diligence, Middletown, NY
- Lower Manhattan Construction Command Center, Environmental Services Contract, New York, NY
- Da Nang International Airport, Da Nang, Vietnam
- 22<sup>nd</sup> to 8<sup>th</sup> Street Station Light Rail Extension, Bayonne, NJ
- 69<sup>th</sup> Street Grade Separation Project, North Bergen, NJ
- Dukes Parkway Landfill, Hillsboro/Manville, NJ
- NYU Langone Medical Center, New Science Building, Remediation Oversight and Construction Administration, Voluntary Cleanup Program, New York, NY
- 86 Warren Street, Waste Characterization and Construction Documents, New York, NY
- 459 Smith Street, Due Diligence and Cost Estimating, Brooklyn, NY
- 111 Leroy Street, New York, NY
- 411 Broadway, Phase I, Remedial Investigation, Air/Noise Coordination for E-Designation, New York, NY
- Modera on the Hudson, Remediation Oversight, Remedial Action Work Plan, Submembrane Depressurization System Design, Yonkers, NY
- Honeywell Quanta, Remedial Design Peer Review, Edgewater, NJ
- New York University Tandon School of Engineering (Spill 1009933), Remediation, Laser-Induced Fluorescence Investigation, Remedial System Optimization, Product Recovery, Spill Cleanup, Brooklyn, NY
- 237-261 North 9<sup>th</sup> Street, Peer Review and Due Diligence, Brooklyn, NY

**SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS**

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Burke, M., Ciambuschini, S., Nicholls, G., Tashji, A., Vaidya, S.,  
"Redeveloping a Remediated MGP Site", MGP Symposium 2019, Atlantic  
City, NJ.

"Biodegradation Pathways and End Products of Sodium Dioctyl  
Sulfosuccinate/Sodium Hexadecyl Diphenyl Oxide Disulfonate Surfactant  
Solution." Florida Remediation Conference, Orlando, Florida, November  
2005.

# MIMI RAYGORODETSKY

## PRINCIPAL/VICE PRESIDENT ENVIRONMENTAL ENGINEERING

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Ms. Raygorodetsky sources and directs large, complex environmental remediation and redevelopment projects from the earliest stages of pre-development diligence, through the remediation/construction phase, to long-term operation and monitoring of remedial systems and engineering controls. She has a comprehensive understanding of federal, state and local regulatory programs and she uses this expertise to guide her clients through a preliminary cost benefit analysis to select the right program(s) given the clients' legal obligations, development desires and risk tolerance. She is particularly strong at integrating the requirements of selected programs and client development needs to develop and design targeted and streamlined diligence programs and remediation strategies. Ms. Raygorodetsky is also highly skilled in integrating remediation with construction on large urban waterfront projects, which tend to more complex than landside projects.

### SELECTED PROJECTS

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- 25 Kent Avenue, Due Diligence for Purchase of a Brownfields Location, Brooklyn, NY
- Ferry Point Waterfront Park, Redevelopment of a Former Landfill into a Park, Bronx, NY
- Battery Maritime Building (10 South Street), Phase I ESA, New York, NY
- Residential Development at 351-357 Broadway, Phase 1 ESA, New York, NY
- 450 Union Street, Phase I and Phase II Remediation (NYS DEC Brownfield Cleanup Program), New York, NY
- Echo Bay Center, NYS DEC Brownfield Cleanup Program, New York, NY
- 420 Kent Avenue, NYS DEC Brownfield Cleanup Program, Brooklyn, NY
- 416 Kent Avenue, NYS DEC Brownfield Cleanup Program, Brooklyn, NY
- 264 Fifth Avenue, Phase I ESA, New York, NY
- 262 Fifth Avenue, Phase I ESA, New York, NY
- ABC Blocks 25-27 (Mixed-Use Properties), Brownfield Cleanup Program, Long Island City, NY
- Residences at 100 Barrow Street, Phase I ESA, New York, NY
- Residences at 22-12 Jackson Avenue, Due Diligence for Building Sale, Long Island City, NY
- Residences at 2253-2255 Broadway, Phase I and Phase II Services, New York, NY
- Prince Point, Phase I ESA, Staten Island, NY
- 787 Eleventh Avenue (Office Building Renovation), Phase I UST Closure, New York, NY
- 218 Front Street/98 Gold Street, Planning and Brownfield Consulting, Brooklyn, NY
- Mark JCH of Bensonhurst, Phase I and HazMat Renovation, Brooklyn, NY
- 39 West 23<sup>rd</sup> Street, E-Designation Brownfield, New York, NY



### EDUCATION

B.A., Biology and Spanish  
Literature  
Colby College

### AFFILIATIONS

New York Women  
Executives in Real Estate  
(WX) - Board Member;  
Networking and Special  
Events Committee Co-Chair

New York Building  
Congress, Council of  
Industry Women -  
Committee Member

New York City Brownfield  
Partnership - Founding  
Member and President

NYC Office of Environmental  
Remediation Technical Task  
Force - Committee Member



## MIMI RAYGORODETSKY

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- 250 Water Street, Phase I and Phase II Property Transaction, New York, NY
- 27-19 44<sup>th</sup> Drive, Residential Redevelopment, Long Island City, NY
- 515 West 42<sup>nd</sup> Street, E-Designation, New York, NY
- 310 Meserole Street, Due Diligence Property Purchase, Brooklyn, NY
- Former Georgetown Heating Plant, HazMat and Phase I ESA, Washington D.C.
- 80-110 Flatbush Avenue, Brooklyn, NY
- 132 East 23<sup>rd</sup> Street, New York, NY
- 846 Sixth Avenue, New York, NY
- Greenpoint Landing, Remediation/Redevelopment, Brooklyn, NY
- 711 Eleventh Avenue, Due Diligence/Owner's Representative, New York, NY
- Brooklyn Bridge Park, Pier 1, Waste Characterization and Remediation, Brooklyn, NY
- Post-Hurricane Sandy Mold Remediation, Various Private Homes, Far Rockaway, NY
- Brooklyn Bridge Park, One John Street Development, Pre-Construction Due Diligence and Construction Administration, Brooklyn, NY
- 7 West 21<sup>st</sup> Street, Brownfields Remediation, New York, NY
- 546 West 44<sup>th</sup> Street, Brownfields Remediation, New York, NY
- Post-Hurricane Sandy Mold Remediation, Various Private Homes, Nassau and Suffolk Counties, Long Island, NY
- 55 West 17<sup>th</sup> Street, Brownfield Site Support, New York, NY
- Pratt Institute, 550 Myrtle Avenue Renovations, Environmental Remediation, Brooklyn, NY
- 42-02 Crescent Street Redevelopment, Phase I and II Environmental, Long Island City, NY
- IAC Building (555 West 18<sup>th</sup> Street), New York, NY
- Retirement Communities on 100-acre Parcels in ME, NJ, MA, CT, and NJ
- 363-365 Bond Street/400 Carroll Street, Brooklyn, NY
- 160 East 22<sup>nd</sup> Street, New York, NY
- 110 Third Avenue, New York, NY
- Lycee Francais (East 76<sup>th</sup> Street & York Avenue), New York, NY
- Winchester Arms Munitions Factory, New Haven, CT

## SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS

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Raygorodetsky, M., "The Perils and Pleasures of Urban Waterfront Development", Environmental Law In New York, February 3, 2020.

## **ATTACHMENT B**

### **LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS**

## ATTACHMENT B

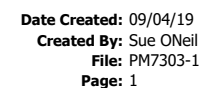
AIR SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	RL	MDL	Units	RL	MDL	Units
Volatile Organic Compounds								
EPA TO-15	Air	1,1,1,2-Tetrachloroethane	1.37	0.38	ug/m <sup>3</sup>	0.2	0.0547	ppbV
EPA TO-15	Air	1,1,1-Trichloroethane	1.09	0.31	ug/m <sup>3</sup>	0.2	0.057	ppbV
EPA TO-15	Air	1,1,2,2-Tetrachloroethane	1.37	0.38	ug/m <sup>3</sup>	0.2	0.0548	ppbV
EPA TO-15	Air	1,1,2-Trichloro-1,2,2-Trifluoroethane	1.53	0.39	ug/m <sup>3</sup>	0.2	0.0511	ppbV
EPA TO-15	Air	1,1,2-Trichloroethane	1.09	0.36	ug/m <sup>3</sup>	0.2	0.0667	ppbV
EPA TO-15	Air	1,1-Dichloroethane	0.81	0.31	ug/m <sup>3</sup>	0.2	0.0771	ppbV
EPA TO-15	Air	1,1-Dichloroethene	0.79	0.22	ug/m <sup>3</sup>	0.2	0.0566	ppbV
EPA TO-15	Air	1,1-Dichloropropene	0.91	0.32	ug/m <sup>3</sup>	0.2	0.0715	ppbV
EPA TO-15	Air	1,2,3-Trichlorobenzene	1.48	0.32	ug/m <sup>3</sup>	0.2	0.0436	ppbV
EPA TO-15	Air	1,2,3-Trichloropropane	1.21	0.46	ug/m <sup>3</sup>	0.2	0.0767	ppbV
EPA TO-15	Air	1,2,3-Trimethylbenzene	0.98	0.37	ug/m <sup>3</sup>	0.2	0.0751	ppbV
EPA TO-15	Air	1,2,4,5-Tetramethylbenzene	1.1	0.44	ug/m <sup>3</sup>	0.2	0.0795	ppbV
EPA TO-15	Air	1,2,4-Trichlorobenzene	1.48	0.45	ug/m <sup>3</sup>	0.2	0.0611	ppbV
EPA TO-15	Air	1,2,4-Trimethylbenzene	0.98	0.34	ug/m <sup>3</sup>	0.2	0.0694	ppbV
EPA TO-15	Air	1,2-Dibromo-3-chloropropane	1.93	0.72	ug/m <sup>3</sup>	0.2	0.0744	ppbV
EPA TO-15	Air	1,2-Dibromoethane	1.54	0.6	ug/m <sup>3</sup>	0.2	0.0779	ppbV
EPA TO-15	Air	1,2-Dichloro-1,1,2,2-tetrafluoroethane	1.4	0.29	ug/m <sup>3</sup>	0.2	0.0419	ppbV
EPA TO-15	Air	1,2-Dichlorobenzene	1.2	0.37	ug/m <sup>3</sup>	0.2	0.0614	ppbV
EPA TO-15	Air	1,2-Dichloroethane	0.81	0.22	ug/m <sup>3</sup>	0.2	0.0552	ppbV
EPA TO-15	Air	1,2-Dichloroethene (total)	0.79	0.23	ug/m <sup>3</sup>	0.2	0.0587	ppbV
EPA TO-15	Air	1,2-Dichloropropane	0.92	0.32	ug/m <sup>3</sup>	0.2	0.0697	ppbV
EPA TO-15	Air	1,3,5-Trimethylbenzene	0.98	0.29	ug/m <sup>3</sup>	0.2	0.0584	ppbV
EPA TO-15	Air	1,3-Butadiene	0.44	0.18	ug/m <sup>3</sup>	0.2	0.0799	ppbV
EPA TO-15	Air	1,3-Dichlorobenzene	1.2	0.38	ug/m <sup>3</sup>	0.2	0.0637	ppbV
EPA TO-15	Air	1,3-Dichloropropane	0.92	0.36	ug/m <sup>3</sup>	0.2	0.0776	ppbV
EPA TO-15	Air	1,3-Dichloropropene, Total	0.91	0.31	ug/m <sup>3</sup>	0.2	0.0693	ppbV
EPA TO-15	Air	1,4-Dichlorobenzene	1.2	0.25	ug/m <sup>3</sup>	0.2	0.0418	ppbV
EPA TO-15	Air	1,4-Dioxane	0.72	0.28	ug/m <sup>3</sup>	0.2	0.078	ppbV
EPA TO-15	Air	1-Methylnaphthalene	5.82	1.66	ug/m <sup>3</sup>	1	0.286	ppbV
EPA TO-15	Air	2,2,4-Trimethylpentane	0.93	0.31	ug/m <sup>3</sup>	0.2	0.0659	ppbV
EPA TO-15	Air	2,2-Dichloropropane	0.92	0.27	ug/m <sup>3</sup>	0.2	0.0581	ppbV
EPA TO-15	Air	2-Butanone	1.47	0.15	ug/m <sup>3</sup>	0.5	0.0522	ppbV
EPA TO-15	Air	2-Ethylthiophene	0.92	0.26	ug/m <sup>3</sup>	0.2	0.0571	ppbV
EPA TO-15	Air	2-Hexanone	0.82	0.25	ug/m <sup>3</sup>	0.2	0.0604	ppbV
EPA TO-15	Air	2-Methylnaphthalene	5.82	0.16	ug/m <sup>3</sup>	1	0.0273	ppbV
EPA TO-15	Air	2-Methylthiophene	0.8	0.32	ug/m <sup>3</sup>	0.2	0.0789	ppbV
EPA TO-15	Air	3-Chloropropene	0.63	0.25	ug/m <sup>3</sup>	0.2	0.0812	ppbV
EPA TO-15	Air	3-Methylthiophene	0.8	0.27	ug/m <sup>3</sup>	0.2	0.0669	ppbV
EPA TO-15	Air	4-Ethyltoluene	0.98	0.38	ug/m <sup>3</sup>	0.2	0.0776	ppbV
EPA TO-15	Air	4-Methyl-2-pentanone	2.05	0.25	ug/m <sup>3</sup>	0.5	0.0607	ppbV
EPA TO-15	Air	Acetaldehyde	4.5	0.99	ug/m <sup>3</sup>	2.5	0.547	ppbV
EPA TO-15	Air	Acetone	2.38	0.64	ug/m <sup>3</sup>	1	0.269	ppbV
EPA TO-15	Air	Acetonitrile	0.34	0.13	ug/m <sup>3</sup>	0.2	0.0761	ppbV
EPA TO-15	Air	Acrolein	1.15	0.26	ug/m <sup>3</sup>	0.5	0.114	ppbV
EPA TO-15	Air	Acrylonitrile	1.09	0.17	ug/m <sup>3</sup>	0.5	0.079	ppbV
EPA TO-15	Air	Benzene	0.64	0.17	ug/m <sup>3</sup>	0.2	0.0537	ppbV
EPA TO-15	Air	Benzothiophene	2.74	0.26	ug/m <sup>3</sup>	0.5	0.0468	ppbV
EPA TO-15	Air	Benzyl chloride	1.04	0.33	ug/m <sup>3</sup>	0.2	0.0645	ppbV
EPA TO-15	Air	Bromobenzene	0.79	0.31	ug/m <sup>3</sup>	0.2	0.079	ppbV
EPA TO-15	Air	Bromodichloromethane	1.34	0.44	ug/m <sup>3</sup>	0.2	0.0656	ppbV
EPA TO-15	Air	Bromoform	2.07	0.54	ug/m <sup>3</sup>	0.2	0.0523	ppbV
EPA TO-15	Air	Bromomethane	0.78	0.27	ug/m <sup>3</sup>	0.2	0.0696	ppbV
EPA TO-15	Air	Butane	0.48	0.11	ug/m <sup>3</sup>	0.2	0.0442	ppbV
EPA TO-15	Air	Butyl Acetate	2.38	0.54	ug/m <sup>3</sup>	0.5	0.114	ppbV
EPA TO-15	Air	Carbon disulfide	0.62	0.11	ug/m <sup>3</sup>	0.2	0.0345	ppbV
EPA TO-15	Air	Carbon tetrachloride	1.26	0.3	ug/m <sup>3</sup>	0.2	0.0471	ppbV
EPA TO-15	Air	Chlorobenzene	0.92	0.36	ug/m <sup>3</sup>	0.2	0.0789	ppbV
EPA TO-15	Air	Chlorodifluoromethane	0.71	0.22	ug/m <sup>3</sup>	0.2	0.0626	ppbV

## ATTACHMENT B

AIR SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	RL	MDL	Units	RL	MDL	Units
EPA TO-15	Air	Chloroethane	0.53	0.2	ug/m <sup>3</sup>	0.2	0.0767	ppbV
EPA TO-15	Air	Chloroform	0.98	0.22	ug/m <sup>3</sup>	0.2	0.0452	ppbV
EPA TO-15	Air	Chloromethane	0.41	0.2	ug/m <sup>3</sup>	0.2	0.0958	ppbV
EPA TO-15	Air	cis-1,2-Dichloroethene	0.79	0.23	ug/m <sup>3</sup>	0.2	0.0587	ppbV
EPA TO-15	Air	cis-1,3-Dichloropropene	0.91	0.34	ug/m <sup>3</sup>	0.2	0.0745	ppbV
EPA TO-15	Air	Cyclohexane	0.69	0.23	ug/m <sup>3</sup>	0.2	0.0656	ppbV
EPA TO-15	Air	Decane (C10)	1.16	0.28	ug/m <sup>3</sup>	0.2	0.0484	ppbV
EPA TO-15	Air	Dibromochloromethane	1.7	0.64	ug/m <sup>3</sup>	0.2	0.0747	ppbV
EPA TO-15	Air	Dibromomethane	1.42	0.34	ug/m <sup>3</sup>	0.2	0.0476	ppbV
EPA TO-15	Air	Dichlorodifluoromethane	0.99	0.23	ug/m <sup>3</sup>	0.2	0.0466	ppbV
EPA TO-15	Air	Dichlorofluoromethane	0.84	0.24	ug/m <sup>3</sup>	0.2	0.0572	ppbV
EPA TO-15	Air	Dodecane (C12)	1.39	0.39	ug/m <sup>3</sup>	0.2	0.0564	ppbV
EPA TO-15	Air	Ethyl Acetate	1.8	0.47	ug/m <sup>3</sup>	0.5	0.131	ppbV
EPA TO-15	Air	Ethyl Alcohol	4.71	1.02	ug/m <sup>3</sup>	2.5	0.542	ppbV
EPA TO-15	Air	Ethyl ether	0.61	0.18	ug/m <sup>3</sup>	0.2	0.0591	ppbV
EPA TO-15	Air	Ethylbenzene	0.87	0.24	ug/m <sup>3</sup>	0.2	0.0555	ppbV
EPA TO-15	Air	Ethyl-Tert-Butyl-Ether	0.84	0.22	ug/m <sup>3</sup>	0.2	0.0515	ppbV
EPA TO-15	Air	Heptane	0.82	0.23	ug/m <sup>3</sup>	0.2	0.0553	ppbV
EPA TO-15	Air	Hexachlorobutadiene	2.13	0.78	ug/m <sup>3</sup>	0.2	0.0732	ppbV
EPA TO-15	Air	Indane	0.97	0.38	ug/m <sup>3</sup>	0.2	0.0795	ppbV
EPA TO-15	Air	Indene	0.95	0.29	ug/m <sup>3</sup>	0.2	0.0608	ppbV
EPA TO-16	Air	iso-Propyl Alcohol	1.23	0.28	ug/m <sup>3</sup>	0.5	0.114	ppbV
EPA TO-17	Air	Isopropyl Ether	0.84	0.27	ug/m <sup>3</sup>	0.2	0.0656	ppbV
EPA TO-18	Air	Isopropylbenzene	0.98	0.21	ug/m <sup>3</sup>	0.2	0.043	ppbV
EPA TO-19	Air	Methanol	6.55	0.96	ug/m <sup>3</sup>	5	0.736	ppbV
EPA TO-20	Air	Methyl Methacrylate	2.05	0.61	ug/m <sup>3</sup>	0.5	0.148	ppbV
EPA TO-21	Air	Methyl tert butyl ether	0.72	0.16	ug/m <sup>3</sup>	0.2	0.0452	ppbV
EPA TO-22	Air	Methylene chloride	1.74	0.65	ug/m <sup>3</sup>	0.5	0.188	ppbV
EPA TO-23	Air	Naphthalene	1.05	0.23	ug/m <sup>3</sup>	0.2	0.0432	ppbV
EPA TO-24	Air	n-Butylbenzene	1.1	0.35	ug/m <sup>3</sup>	0.2	0.0639	ppbV
EPA TO-25	Air	n-Heptane	0.82	0.23	ug/m <sup>3</sup>	0.2	0.0553	ppbV
EPA TO-26	Air	n-Hexane	0.7	0.18	ug/m <sup>3</sup>	0.2	0.0518	ppbV
EPA TO-27	Air	Nonane (C9)	1.05	0.34	ug/m <sup>3</sup>	0.2	0.0644	ppbV
EPA TO-28	Air	n-Propylbenzene	0.98	0.27	ug/m <sup>3</sup>	0.2	0.0559	ppbV
EPA TO-29	Air	o-Chlorotoluene	1.04	0.25	ug/m <sup>3</sup>	0.2	0.0487	ppbV
EPA TO-30	Air	Octane	0.93	0.2	ug/m <sup>3</sup>	0.2	0.0421	ppbV
EPA TO-31	Air	o-Xylene	0.87	0.27	ug/m <sup>3</sup>	0.2	0.0631	ppbV
EPA TO-32	Air	p/m-Xylene	1.74	0.6	ug/m <sup>3</sup>	0.4	0.139	ppbV
EPA TO-33	Air	p-Chlorotoluene	1.04	0.4	ug/m <sup>3</sup>	0.2	0.0764	ppbV
EPA TO-34	Air	Pentane	0.59	0.14	ug/m <sup>3</sup>	0.2	0.0475	ppbV
EPA TO-35	Air	p-Isopropyltoluene	1.1	0.33	ug/m <sup>3</sup>	0.2	0.0608	ppbV
EPA TO-36	Air	Propane	0.9	0.21	ug/m <sup>3</sup>	0.5	0.114	ppbV
EPA TO-37	Air	Propylene	0.86	0.16	ug/m <sup>3</sup>	0.5	0.0929	ppbV
EPA TO-38	Air	sec-Butylbenzene	1.1	0.4	ug/m <sup>3</sup>	0.2	0.0731	ppbV
EPA TO-39	Air	Styrene	0.85	0.34	ug/m <sup>3</sup>	0.2	0.0799	ppbV
EPA TO-40	Air	tert-Butyl Alcohol	1.52	0.18	ug/m <sup>3</sup>	0.5	0.0599	ppbV
EPA TO-41	Air	tert-Butylbenzene	1.1	0.22	ug/m <sup>3</sup>	0.2	0.0402	ppbV
EPA TO-42	Air	Tertiary-Amyl Methyl Ether	0.84	0.33	ug/m <sup>3</sup>	0.2	0.0795	ppbV
EPA TO-43	Air	Tetrachloroethene	1.36	0.51	ug/m <sup>3</sup>	0.2	0.0758	ppbV
EPA TO-44	Air	Tetrahydrofuran	1.47	0.18	ug/m <sup>3</sup>	0.5	0.0622	ppbV
EPA TO-45	Air	Thiophene	0.69	0.18	ug/m <sup>3</sup>	0.2	0.0528	ppbV
EPA TO-46	Air	Toluene	0.75	0.24	ug/m <sup>3</sup>	0.2	0.0628	ppbV
EPA TO-47	Air	Total HC As Hexane	39.34	0.2	ug/m <sup>3</sup>	10	0.0518	ppbV
EPA TO-48	Air	Total VOCs As Toluene	37.69	0.24	ug/m <sup>3</sup>	10	0.0628	ppbV
EPA TO-49	Air	trans-1,2-Dichloroethene	0.79	0.29	ug/m <sup>3</sup>	0.2	0.074	ppbV
EPA TO-50	Air	trans-1,3-Dichloropropene	0.91	0.31	ug/m <sup>3</sup>	0.2	0.0693	ppbV
EPA TO-51	Air	Trichloroethene	1.07	0.38	ug/m <sup>3</sup>	0.2	0.071	ppbV
EPA TO-52	Air	Trichlorofluoromethane	1.12	0.23	ug/m <sup>3</sup>	0.2	0.0416	ppbV
EPA TO-53	Air	Undecane	1.28	0.34	ug/m <sup>3</sup>	0.2	0.0528	ppbV
EPA TO-54	Air	Vinyl acetate	3.52	0.2	ug/m <sup>3</sup>	1	0.0567	ppbV
EPA TO-55	Air	Vinyl bromide	0.87	0.31	ug/m <sup>3</sup>	0.2	0.0699	ppbV
EPA TO-56	Air	Vinyl chloride	0.51	0.14	ug/m <sup>3</sup>	0.2	0.0533	ppbV
EPA TO-57	Air	Xylene (Total)	0.87	0.27	ug/m <sup>3</sup>	0.2	0.0631	ppbV

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## ATTACHMENT B

GROUNDWATER SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	RL	MDL	Units
Volatile Organic Compounds					
EPA 8260C	Groundwater	1,1,1,2-Tetrachloroethane	0.5	0.164	ug/L
EPA 8260C	Groundwater	1,1,1-Trichloroethane	0.5	0.158	ug/L
EPA 8260C	Groundwater	1,1,2,2-Tetrachloroethane	0.5	0.144	ug/L
EPA 8260C	Groundwater	1,1,2-Trichloro-1,2,2-Trifluoroethane	10	0.148	ug/L
EPA 8260C	Groundwater	1,1,2-Trichloroethane	0.75	0.144	ug/L
EPA 8260C	Groundwater	1,1-Dichloroethane	0.75	0.21	ug/L
EPA 8260C	Groundwater	1,1-Dichloroethene	0.5	0.142	ug/L
EPA 8260C	Groundwater	1,1-Dichloropropene	2.5	0.173	ug/L
EPA 8260C	Groundwater	1,2,3-Trichlorobenzene	2.5	0.234	ug/L
EPA 8260C	Groundwater	1,2,3-Trichloropropane	5	0.176	ug/L
EPA 8260C	Groundwater	1,2,4,5-Tetramethylbenzene	2	0.542	ug/L
EPA 8260C	Groundwater	1,2,4-Trichlorobenzene	2.5	0.22	ug/L
EPA 8260C	Groundwater	1,2,4-Trimethylbenzene	2.5	0.191	ug/L
EPA 8260C	Groundwater	1,2-Dibromo-3-chloropropane	2.5	0.327	ug/L
EPA 8260C	Groundwater	1,2-Dibromoethane	2	0.193	ug/L
EPA 8260C	Groundwater	1,2-Dichlorobenzene	2.5	0.184	ug/L
EPA 8260C	Groundwater	1,2-Dichloroethane	0.5	0.132	ug/L
EPA 8260C	Groundwater	1,2-Dichloropropane	1.75	0.133	ug/L
EPA 8260C	Groundwater	1,3,5-Trimethylbenzene	2.5	0.174	ug/L
EPA 8260C	Groundwater	1,3-Dichlorobenzene	2.5	0.186	ug/L
EPA 8260C	Groundwater	1,3-Dichloropropane	2.5	0.212	ug/L
EPA 8260C	Groundwater	1,4-Dichlorobenzene	2.5	0.187	ug/L
EPA 8260C	Groundwater	1,4-Diethylbenzene	2	0.392	ug/L
EPA 8270 SIM Isotope Dilution	Groundwater	1,4-Dioxane	0.15	0.075	ug/L
EPA 8260C	Groundwater	2,2-Dichloropropane	2.5	0.204	ug/L
EPA 8260C	Groundwater	2-Butanone	5	1.94	ug/L
EPA 8260C	Groundwater	2-Hexanone	5	0.515	ug/L
EPA 8260C	Groundwater	4-Ethyltoluene	2	0.34	ug/L
EPA 8260C	Groundwater	4-Methyl-2-pentanone	5	0.416	ug/L
EPA 8260C	Groundwater	Acetone	5	1.46	ug/L
EPA 8260C	Groundwater	Acrolein	5	0.633	ug/L
EPA 8260C	Groundwater	Acrylonitrile	5	0.43	ug/L
EPA 8260C	Groundwater	Benzene	0.5	0.159	ug/L
EPA 8260C	Groundwater	Bromobenzene	2.5	0.152	ug/L
EPA 8260C	Groundwater	Bromochloromethane	2.5	0.138	ug/L
EPA 8260C	Groundwater	Bromodichloromethane	0.5	0.192	ug/L
EPA 8260C	Groundwater	Bromoform	2	0.248	ug/L
EPA 8260C	Groundwater	Bromomethane	1	0.256	ug/L
EPA 8260C	Groundwater	Carbon disulfide	5	0.299	ug/L
EPA 8260C	Groundwater	Carbon tetrachloride	0.5	0.134	ug/L
EPA 8260C	Groundwater	Chlorobenzene	0.5	0.178	ug/L
EPA 8260C	Groundwater	Chloroethane	1	0.134	ug/L
EPA 8260C	Groundwater	Chloroform	0.75	0.162	ug/L
EPA 8260C	Groundwater	Chloromethane	2.5	0.176	ug/L
EPA 8260C	Groundwater	cis-1,2-Dichloroethene	0.5	0.187	ug/L
EPA 8260C	Groundwater	cis-1,3-Dichloropropene	0.5	0.144	ug/L
EPA 8260C	Groundwater	Cyclohexane	10	0.271	ug/L
EPA 8260C	Groundwater	Dibromochloromethane	0.5	0.149	ug/L
EPA 8260C	Groundwater	Dibromomethane	5	0.363	ug/L
EPA 8260C	Groundwater	Dichlorodifluoromethane	5	0.245	ug/L
EPA 8260C	Groundwater	Ethyl ether	2.5	0.15	ug/L
EPA 8260C	Groundwater	Ethylbenzene	0.5	0.168	ug/L
EPA 8260C	Groundwater	Hexachlorobutadiene	0.5	0.217	ug/L
EPA 8260C	Groundwater	Isopropylbenzene	0.5	0.187	ug/L
EPA 8260C	Groundwater	Methyl Acetate	10	0.234	ug/L
EPA 8260C	Groundwater	Methyl cyclohexane	10	0.396	ug/L
EPA 8260C	Groundwater	Methyl tert butyl ether	1	0.16	ug/L
EPA 8260C	Groundwater	Methylene chloride	3	0.289	ug/L
EPA 8260C	Groundwater	Naphthalene	2.5	0.216	ug/L
EPA 8260C	Groundwater	n-Butylbenzene	0.5	0.192	ug/L
EPA 8260C	Groundwater	n-Propylbenzene	0.5	0.173	ug/L
EPA 8260C	Groundwater	o-Chlorotoluene	2.5	0.17	ug/L
EPA 8260C	Groundwater	o-Xylene	1	0.33	ug/L
EPA 8260C	Groundwater	p/m-Xylene	1	0.332	ug/L
EPA 8260C	Groundwater	p-Chlorotoluene	2.5	0.185	ug/L
EPA 8260C	Groundwater	p-Isopropyltoluene	0.5	0.188	ug/L
EPA 8260C	Groundwater	sec-Butylbenzene	0.5	0.181	ug/L
EPA 8260C	Groundwater	Styrene	1	0.359	ug/L
EPA 8260C	Groundwater	tert-Butyl Alcohol	10	0.899	ug/L
EPA 8260C	Groundwater	tert-Butylbenzene	2.5	0.185	ug/L
EPA 8260C	Groundwater	Tetrachloroethene	0.5	0.181	ug/L
EPA 8260C	Groundwater	Toluene	0.75	0.161	ug/L
EPA 8260C	Groundwater	trans-1,2-Dichloroethene	0.75	0.163	ug/L
EPA 8260C	Groundwater	trans-1,3-Dichloropropene	0.5	0.164	ug/L
EPA 8260C	Groundwater	trans-1,4-Dichloro-2-butene	2.5	0.173	ug/L
EPA 8260C	Groundwater	Trichloroethene	0.5	0.175	ug/L
EPA 8260C	Groundwater	Trichlorofluoromethane	2.5	0.161	ug/L
EPA 8260C	Groundwater	Vinyl acetate	5	0.311	ug/L
EPA 8260C	Groundwater	Vinyl chloride	1	0.0699	ug/L
EPA 8260C	Groundwater	Xylenes, Total	1	0.33	ug/L

## ATTACHMENT B

GROUNDWATER SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

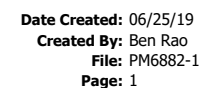
Method	Matrix	Analyte	RL	MDL	Units
		<b>Semivolatile Organic Compounds</b>			
EPA 8270D	Groundwater	1,2,4,5-Tetrachlorobenzene	10	0.357	ug/L
EPA 8270D	Groundwater	1,2,4-Trichlorobenzene	5	0.21	ug/L
EPA 8270D	Groundwater	1,2-Dichlorobenzene	2	0.302	ug/L
EPA 8270D	Groundwater	1,3-Dichlorobenzene	2	0.35	ug/L
EPA 8270D	Groundwater	1,4-Dichlorobenzene	2	0.323	ug/L
EPA 8270D	Groundwater	2,3,4,6-Tetrachlorophenol	5	0.59	ug/L
EPA 8270D	Groundwater	2,4,5-Trichlorophenol	5	0.748	ug/L
EPA 8270D	Groundwater	2,4,6-Trichlorophenol	5	0.775	ug/L
EPA 8270D	Groundwater	2,4-Dichlorophenol	5	0.564	ug/L
EPA 8270D	Groundwater	2,4-Dimethylphenol	5	0.578	ug/L
EPA 8270D	Groundwater	2,4-Dinitrophenol	20	1.4081	ug/L
EPA 8270D	Groundwater	2,4-Dinitrotoluene	5	1.05	ug/L
EPA 8270D	Groundwater	2,6-Dinitrotoluene	5	0.89	ug/L
EPA 8270D	Groundwater	2-Chloronaphthalene	2	0.455	ug/L
EPA 8270D	Groundwater	2-Chlorophenol	2	0.58	ug/L
EPA 8270D	Groundwater	2-Methylnaphthalene	2	0.355	ug/L
EPA 8270D	Groundwater	2-Methylphenol	5	0.703	ug/L
EPA 8270D	Groundwater	2-Nitroaniline	5	0.956	ug/L
EPA 8270D	Groundwater	2-Nitrophenol	10	1.05	ug/L
EPA 8270D	Groundwater	3,3'-Dichlorobenzidine	5	0.478	ug/L
EPA 8270D	Groundwater	3-Methylphenol/4-Methylphenol	5	0.72	ug/L
EPA 8270D	Groundwater	3-Nitroaniline	5	0.668	ug/L
EPA 8270D	Groundwater	4,6-Dinitro-o-cresol	10	1.36	ug/L
EPA 8270D	Groundwater	4-Bromophenyl phenyl ether	2	0.428	ug/L
EPA 8270D	Groundwater	4-Chloroaniline	5	0.835	ug/L
EPA 8270D	Groundwater	4-Chlorophenyl phenyl ether	2	0.355	ug/L
EPA 8270D	Groundwater	4-Nitroaniline	5	0.83	ug/L
EPA 8270D	Groundwater	4-Nitrophenol	10	1.09	ug/L
EPA 8270D	Groundwater	Acenaphthene	2	0.284	ug/L
EPA 8270D	Groundwater	Acenaphthylene	2	0.372	ug/L
EPA 8270D	Groundwater	Acetophenone	5	0.428	ug/L
EPA 8270D	Groundwater	Anthracene	2	0.2	ug/L
EPA 8270D	Groundwater	Atrazine	10	0.794	ug/L
EPA 8270D	Groundwater	Azobenzene	2	0.537	ug/L
EPA 8270D	Groundwater	Benzaldehyde	5	0.986	ug/L
EPA 8270D	Groundwater	Benzidine	20	5.24	ug/L
EPA 8270D	Groundwater	Benzo(a)anthracene	2	0.323	ug/L
EPA 8270D	Groundwater	Benzo(a)pyrene	2	0.658	ug/L
EPA 8270D	Groundwater	Benzo(b)fluoranthene	2	0.371	ug/L
EPA 8270D	Groundwater	Benzo(g)hpileylene	2	0.574	ug/L
EPA 8270D	Groundwater	Benzo(k)fluoranthene	2	0.3	ug/L
EPA 8270D	Groundwater	Benzoic Acid	50	1.0104	ug/L
EPA 8270D	Groundwater	Benzyl Alcohol	2	0.677	ug/L
EPA 8270D	Groundwater	Biphenyl	2	0.237	ug/L
EPA 8270D	Groundwater	Bis(2-chloroethoxy)methane	5	0.596	ug/L
EPA 8270D	Groundwater	Bis(2-chloroethyl)ether	2	0.409	ug/L
EPA 8270D	Groundwater	Bis(2-chloroisopropyl)ether	2	0.597	ug/L
EPA 8270D	Groundwater	Bis(2-Ethylhexyl)phthalate	3	0.928	ug/L
EPA 8270D	Groundwater	Butyl benzyl phthalate	5	1.13	ug/L
EPA 8270D	Groundwater	Caprolactam	10	0.3895	ug/L
EPA 8270D	Groundwater	Carbazole	2	0.374	ug/L
EPA 8270D	Groundwater	Chrysene	2	0.304	ug/L
EPA 8270D	Groundwater	Dibenz(a,h)anthracene	2	0.438	ug/L
EPA 8270D	Groundwater	Dibenzofuran	2	0.218	ug/L
EPA 8270D	Groundwater	Diethyl phthalate	5	0.393	ug/L
EPA 8270D	Groundwater	Dimethyl phthalate	5	0.333	ug/L
EPA 8270D	Groundwater	Di-n-butylphthalate	5	0.768	ug/L
EPA 8270D	Groundwater	Di-n-octylphthalate	5	1.2	ug/L
EPA 8270D	Groundwater	Fluoranthene	2	0.401	ug/L
EPA 8270D	Groundwater	Fluorene	2	0.32	ug/L
EPA 8270D	Groundwater	Hexachlorobenzene	2	0.396	ug/L
EPA 8270D	Groundwater	Hexachlorobutadiene	2	0.417	ug/L
EPA 8270D	Groundwater	Hexachlorocyclopentadiene	20	0.585	ug/L
EPA 8270D	Groundwater	Hexachloroethane	2	0.298	ug/L
EPA 8270D	Groundwater	Indeno(1,2,3-cd)Pyrene	2	0.433	ug/L
EPA 8270D	Groundwater	Isophorone	5	0.787	ug/L
EPA 8270D	Groundwater	Naphthalene	2	0.332	ug/L
EPA 8270D	Groundwater	Nitrobenzene	2	0.401	ug/L
EPA 8270D	Groundwater	NitrosoDiPhenylAmine (NDPA)/DPA	2	0.34	ug/L
EPA 8270D	Groundwater	n-Nitrosodimethylamine	2	0.498	ug/L
EPA 8270D	Groundwater	n-Nitrosodi-n-propylamine	5	0.645	ug/L
EPA 8270D	Groundwater	P-Chloro-M-Cresol	2	0.543	ug/L
EPA 8270D	Groundwater	Pentachlorophenol	10	3.22	ug/L
EPA 8270D	Groundwater	Phenanthrene	2	0.23	ug/L
EPA 8270D	Groundwater	Phenol	5	0.27	ug/L
EPA 8270D	Groundwater	Pyrene	2	0.524	ug/L
EPA 8270D-SIM	Groundwater	2-Chloronaphthalene	0.2	0.035	ug/L
EPA 8270D-SIM	Groundwater	2-Methylnaphthalene	0.2	0.045	ug/L
EPA 8270D-SIM	Groundwater	Acenaphthene	0.2	0.035	ug/L
EPA 8270D-SIM	Groundwater	Acenaphthylene	0.2	0.035	ug/L
EPA 8270D-SIM	Groundwater	Anthracene	0.2	0.035	ug/L
EPA 8270D-SIM	Groundwater	Benzo(a)anthracene	0.2	0.016	ug/L
EPA 8270D-SIM	Groundwater	Benzo(a)pyrene	0.2	0.039	ug/L
EPA 8270D-SIM	Groundwater	Benzo(b)fluoranthene	0.2	0.016	ug/L
EPA 8270D-SIM	Groundwater	Benzo(g)hpileylene	0.2	0.042	ug/L
EPA 8270D-SIM	Groundwater	Benzo(k)fluoranthene	0.2	0.042	ug/L
EPA 8270D-SIM	Groundwater	Chrysene	0.2	0.038	ug/L
EPA 8270D-SIM	Groundwater	Dibenz(a,h)anthracene	0.2	0.039	ug/L
EPA 8270D-SIM	Groundwater	Fluoranthene	0.2	0.038	ug/L
EPA 8270D-SIM	Groundwater	Fluorene	0.2	0.037	ug/L
EPA 8270D-SIM	Groundwater	Hexachlorobenzene	0.8	0.032	ug/L
EPA 8270D-SIM	Groundwater	Hexachlorobutadiene	0.5	0.036	ug/L
EPA 8270D-SIM	Groundwater	Hexachloroethane	0.8	0.03	ug/L
EPA 8270D-SIM	Groundwater	Indeno(1,2,3-cd)Pyrene	0.2	0.04	ug/L
EPA 8270D-SIM	Groundwater	Naphthalene	0.2	0.043	ug/L
EPA 8270D-SIM	Groundwater	Pentachlorophenol	0.8	0.22	ug/L
EPA 8270D-SIM	Groundwater	Phenanthrene	0.2	0.015	ug/L
EPA 8270D-SIM	Groundwater	Pyrene	0.2	0.04	ug/L

## ATTACHMENT B

GROUNDWATER SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	RL	MDL	Units
<b>Pesticides</b>					
EPA 8081B	Groundwater	4,4'-DDD	0.04	0.00464	ug/L
EPA 8081B	Groundwater	4,4'-DDE	0.04	0.00381	ug/L
EPA 8081B	Groundwater	4,4'-DDT	0.04	0.00432	ug/L
EPA 8081B	Groundwater	Aldrin	0.02	0.00216	ug/L
EPA 8081B	Groundwater	Alpha-BHC	0.02	0.00439	ug/L
EPA 8081B	Groundwater	Beta-BHC	0.02	0.0056	ug/L
EPA 8081B	Groundwater	Chlordane	0.2	0.0463	ug/L
EPA 8081B	Groundwater	cis-Chlordane	0.02	0.00666	ug/L
EPA 8081B	Groundwater	Delta-BHC	0.02	0.00467	ug/L
EPA 8081B	Groundwater	Dieldrin	0.04	0.00429	ug/L
EPA 8081B	Groundwater	Endosulfan I	0.02	0.00345	ug/L
EPA 8081B	Groundwater	Endosulfan II	0.04	0.00519	ug/L
EPA 8081B	Groundwater	Endosulfan sulfate	0.04	0.00481	ug/L
EPA 8081B	Groundwater	Endrin	0.04	0.00429	ug/L
EPA 8081B	Groundwater	Endrin aldehyde	0.04	0.0081	ug/L
EPA 8081B	Groundwater	Endrin ketone	0.04	0.00477	ug/L
EPA 8081B	Groundwater	Heptachlor	0.02	0.0031	ug/L
EPA 8081B	Groundwater	Heptachlor epoxide	0.02	0.00415	ug/L
EPA 8081B	Groundwater	Lindane	0.02	0.00434	ug/L
EPA 8081B	Groundwater	Methoxychlor	0.2	0.00684	ug/L
EPA 8081B	Groundwater	Toxaphene	0.2	0.0627	ug/L
EPA 8081B	Groundwater	trans-Chlordane	0.02	0.00627	ug/L
<b>Polychlorinated Biphenyls</b>					
EPA 8082A	Groundwater	Aroclor 1016	0.083	0.05478	ug/L
EPA 8082A	Groundwater	Aroclor 1221	0.083	0.05312	ug/L
EPA 8082A	Groundwater	Aroclor 1232	0.083	0.03071	ug/L
EPA 8082A	Groundwater	Aroclor 1242	0.083	0.05976	ug/L
EPA 8082A	Groundwater	Aroclor 1248	0.083	0.05063	ug/L
EPA 8082A	Groundwater	Aroclor 1254	0.083	0.03403	ug/L
EPA 8082A	Groundwater	Aroclor 1260	0.083	0.03154	ug/L
EPA 8082A	Groundwater	Aroclor 1262	0.083	0.02905	ug/L
EPA 8082A	Groundwater	Aroclor 1268	0.083	0.03735	ug/L
EPA 8082A	Groundwater	PCBs, Total	0.083	0.02905	ug/L
<b>Herbicides</b>					
EPA 8151A	Groundwater	2,4,5-T	2	0.531	ug/L
EPA 8151A	Groundwater	2,4,5-TP (Silvex)	2	0.539	ug/L
EPA 8151A	Groundwater	2,4-D	10	0.498	ug/L
<b>Metals</b>					
EPA 6010A	Groundwater	Aluminum, Dissolved	0.01	0.00169	mg/L
EPA 6010A	Groundwater	Aluminum, Total	0.01	0.00169	mg/L
EPA 6010A	Groundwater	Antimony, Dissolved	0.0005	0.0000699	mg/L
EPA 6010A	Groundwater	Antimony, Total	0.0005	0.0000699	mg/L
EPA 6010A	Groundwater	Arsenic, Dissolved	0.0005	0.000123	mg/L
EPA 6010A	Groundwater	Arsenic, Total	0.0005	0.000123	mg/L
EPA 6010A	Groundwater	Barium, Dissolved	0.0005	0.0000625	mg/L
EPA 6010A	Groundwater	Barium, Total	0.0005	0.0000625	mg/L
EPA 6010A	Groundwater	Beryllium, Dissolved	0.0005	0.00015	mg/L
EPA 6010A	Groundwater	Beryllium, Total	0.0005	0.00015	mg/L
EPA 6010A	Groundwater	Cadmium, Dissolved	0.0002	0.00005	mg/L
EPA 6010A	Groundwater	Cadmium, Total	0.0002	0.00005	mg/L
EPA 6010A	Groundwater	Calcium, Dissolved	0.1	0.032	mg/L
EPA 6010A	Groundwater	Calcium, Total	0.1	0.032	mg/L
EPA 6010A	Groundwater	Chromium, Dissolved	0.001	0.000253	mg/L
EPA 6010A	Groundwater	Chromium, Total	0.001	0.000253	mg/L
EPA 7196A	Groundwater	Chromium, Hexavalent, Dissolved	0.01	0.003	mg/L
EPA 7196A	Groundwater	Chromium, Hexavalent, Total	0.01	0.003	mg/L
EPA 6010A	Groundwater	Cobalt, Dissolved	0.0002	0.0000621	mg/L
EPA 6010A	Groundwater	Cobalt, Total	0.0002	0.0000621	mg/L
EPA 6010A	Groundwater	Copper, Dissolved	0.001	0.000262	mg/L
EPA 6010A	Groundwater	Copper, Total	0.001	0.000262	mg/L
EPA 6010A	Groundwater	Iron, Dissolved	0.05	0.012	mg/L
EPA 6010A	Groundwater	Iron, Total	0.05	0.012	mg/L
EPA 6010A	Groundwater	Lead, Dissolved	0.001	0.000129	mg/L
EPA 6010A	Groundwater	Lead, Total	0.001	0.000129	mg/L
EPA 6010A	Groundwater	Magnesium, Dissolved	0.07	0.0223	mg/L
EPA 6010A	Groundwater	Magnesium, Total	0.07	0.0223	mg/L
EPA 6010A	Groundwater	Manganese, Dissolved	0.001	0.000302	mg/L
EPA 6010A	Groundwater	Manganese, Total	0.001	0.000302	mg/L
EPA 7470A	Groundwater	Mercury, Dissolved	0.0002	0.000066	mg/L
EPA 7470A	Groundwater	Mercury, Total	0.0002	0.000066	mg/L
EPA 6010A	Groundwater	Nickel, Dissolved	0.0005	0.0000865	mg/L
EPA 6010A	Groundwater	Nickel, Total	0.0005	0.0000865	mg/L
EPA 6010A	Groundwater	Potassium, Dissolved	0.1	0.0193	mg/L
EPA 6010A	Groundwater	Potassium, Total	0.1	0.0193	mg/L
EPA 6010A	Groundwater	Selenium, Dissolved	0.005	0.001	mg/L
EPA 6010A	Groundwater	Selenium, Total	0.005	0.001	mg/L
EPA 6010A	Groundwater	Silver, Dissolved	0.00025	0.0000779	mg/L
EPA 6010A	Groundwater	Silver, Total	0.00025	0.0000779	mg/L
EPA 6010A	Groundwater	Sodium, Dissolved	0.1	0.0161	mg/L
EPA 6010A	Groundwater	Sodium, Total	0.1	0.0161	mg/L
EPA 6010A	Groundwater	Thallium, Dissolved	0.0002	0.0000566	mg/L
EPA 6010A	Groundwater	Thallium, Total	0.0002	0.0000566	mg/L
EPA 6010A	Groundwater	Vanadium, Dissolved	0.005	0.000551	mg/L
EPA 6010A	Groundwater	Vanadium, Total	0.005	0.000551	mg/L
EPA 6010A	Groundwater	Zinc, Dissolved	0.01	0.00256	mg/L
EPA 6010A	Groundwater	Zinc, Total	0.01	0.00256	mg/L
<b>Other</b>					
SM21 5210B	Groundwater	Biological Oxygen Demand	2	1.1	mg/L
SM21 5220C	Groundwater	Chemical Oxygen Demand	20	5.7	mg/L
SM21 5310B, SW8469060	Groundwater	Total Organic Carbon	1	0.35	mg/L
ASTM516-90.02	Groundwater	Sulfate	5	1.1	mg/L
SM21 4500 S F	Groundwater	Sulfide	2	0.94	mg/L
EPA 353.2	Groundwater	Nitrate	0.1	0.018	mg/L
SM 21 4500 NO2 B	Groundwater	Nitrite	0.1	0.001	mg/L
EPA 365.4/4500PE	Groundwater	Total Phosphorous	0.1	0.04	mg/L
SM18 4500 NH3F	Groundwater	Ammonia	0.1	0.034	mg/L
N/A	Groundwater	Naphthalene Dioxygenase (NAH)	100	5000	cells/mL
N/A	Groundwater	Naphthalene Inducible Dioxygenase (NIDA)	100	5000	cells/mL
N/A	Groundwater	Phenol Hydroxylase (PHE)	100	5000	cells/mL
N/A	Groundwater	Naphthyl-2-methyl-succinate synthase (NMS)	100	5000	cells/mL
N/A	Groundwater	Naphthalene Carboxylase (ANC)	100	5000	cells/mL





**1,4 Dioxane via EPA 8270D-SIM (WATER)**

**Container/Sample Preservation:** 2 - Amber 250ml unpreserved

[illegible]

Please Note that the RL information provided in this table is calculated using a 100% Solids factor (Soil/Solids only)  
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Langan Engineering & Environmental

NY PFAAs via EPA 537(M)-Isotope Dilution (WATER)

Holding Time: 14 days  
Container/Sample Preservation: 1 - 2 Plastic/1 Plastic/1 H2O Plastic

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluorobutanoic Acid (PFBA)	375-22-4	2	0.408	ng/l	67-148	30	67-148	30	30			
Perfluoropentanoic Acid (PFPeA)	2706-90-3	2	0.396	ng/l	63-161	30	63-161	30	30			
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	2	0.238	ng/l	65-157	30	65-157	30	30			
Perfluorohexanoic Acid (PFHxA)	307-24-4	2	0.328	ng/l	69-168	30	69-168	30	30			
Perfluoroheptanoic Acid (PFHpA)	375-85-9	2	0.2252	ng/l	58-159	30	58-159	30	30			
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	2	0.376	ng/l	69-177	30	69-177	30	30			
Perfluorooctanoic Acid (PFOA)	335-67-1	2	0.236	ng/l	63-159	30	63-159	30	30			
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	2	1.332	ng/l	49-187	30	49-187	30	30			
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	2	0.688	ng/l	61-179	30	61-179	30	30			
Perfluorononanoic Acid (PFNA)	375-95-1	2	0.312	ng/l	68-171	30	68-171	30	30			
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	2	0.504	ng/l	52-151	30	52-151	30	30			
Perfluorodecanoic Acid (PFDA)	335-76-2	2	0.304	ng/l	63-171	30	63-171	30	30			
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	2	1.212	ng/l	56-173	30	56-173	30	30			
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSA)	2355-31-9	2	0.648	ng/l	60-166	30	60-166	30	30			
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	2	0.26	ng/l	60-153	30	60-153	30	30			
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	2	0.98	ng/l	38-156	30	38-156	30	30			
Perfluorooctanesulfonamide (FOSA)	754-91-6	2	0.58	ng/l	46-170	30	46-170	30	30			
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	2	0.804	ng/l	45-170	30	45-170	30	30			
Perfluorododecanoic Acid (PFDoA)	307-55-1	2	0.372	ng/l	67-153	30	67-153	30	30			
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	2	0.3272	ng/l	48-158	30	48-158	30	30			
Perfluorotetradecanoic Acid (PFTA)	376-06-7	2	0.248	ng/l	59-182	30	59-182	30	30			
PFOA/PFOS, Total		2	0.236	ng/l				30	30			
Perfluoro[13C4]Butanoic Acid (MPFBA)	NONE										2-156	
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	NONE										16-173	
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	NONE										31-159	
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	NONE										21-145	
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	NONE										30-139	
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	NONE										47-153	
Perfluoro[13C8]Octanoic Acid (M8PFOA)	NONE										36-149	
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-)	NONE										1-244	
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	NONE										34-146	
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	NONE										42-146	
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	NONE										38-144	
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-)	NONE										7-170	
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid	NONE										1-181	
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	NONE										40-144	
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	NONE										1-87	
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (	NONE										23-146	
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	NONE										24-161	
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	NONE										33-143	

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## ATTACHMENT B

SOIL SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	RL	MDL	Units
Volatile Organic Compounds					
EPA 8260C/5035	Soil	1,1,1,2-Tetrachloroethane	0.001	0.000318	mg/kg
EPA 8260C/5035	Soil	1,1,1-Trichloroethane	0.001	0.0001108	mg/kg
EPA 8260C/5035	Soil	1,1,2,2-Tetrachloroethane	0.001	0.0001008	mg/kg
EPA 8260C/5035	Soil	1,1,2-Trichloro-1,2,2-Trifluoroethane	0.02	0.000274	mg/kg
EPA 8260C/5035	Soil	1,1,2-Trichloroethane	0.0015	0.000304	mg/kg
EPA 8260C/5035	Soil	1,1-Dichloroethane	0.0015	0.0000856	mg/kg
EPA 8260C/5035	Soil	1,1-Dichloroethene	0.001	0.000262	mg/kg
EPA 8260C/5035	Soil	1,1-Dichloropropene	0.005	0.0001414	mg/kg
EPA 8260C/5035	Soil	1,2,3-Trichlorobenzene	0.005	0.0001476	mg/kg
EPA 8260C/5035	Soil	1,2,3-Trichloropropane	0.01	0.0001626	mg/kg
EPA 8260C/5035	Soil	1,2,4,5-Tetramethylbenzene	0.004	0.0001302	mg/kg
EPA 8260C/5035	Soil	1,2,4-Trichlorobenzene	0.005	0.0001818	mg/kg
EPA 8260C/5035	Soil	1,2,4-Trimethylbenzene	0.005	0.0001414	mg/kg
EPA 8260C/5035	Soil	1,2-Dibromo-3-chloropropane	0.005	0.000396	mg/kg
EPA 8260C/5035	Soil	1,2-Dibromoethane	0.004	0.0001744	mg/kg
EPA 8260C/5035	Soil	1,2-Dichlorobenzene	0.005	0.0001532	mg/kg
EPA 8260C/5035	Soil	1,2-Dichloroethane	0.001	0.0001134	mg/kg
EPA 8260C/5035	Soil	1,2-Dichloropropane	0.0035	0.000228	mg/kg
EPA 8260C/5035	Soil	1,3,5-Trimethylbenzene	0.005	0.0001434	mg/kg
EPA 8260C/5035	Soil	1,3-Dichlorobenzene	0.005	0.000135	mg/kg
EPA 8260C/5035	Soil	1,3-Dichloropropane	0.005	0.0001452	mg/kg
EPA 8260C/5035	Soil	1,4-Dichlorobenzene	0.005	0.0001384	mg/kg
EPA 8260C/5035	Soil	1,4-Diethylbenzene	0.004	0.0001598	mg/kg
EPA 8260C/5035	Soil	1,4-Dioxane	0.1	0.01442	mg/kg
EPA 8260C/5035	Soil	2,2-Dichloropropane	0.005	0.000226	mg/kg
EPA 8260C/5035	Soil	2-Butanone	0.01	0.000272	mg/kg
EPA 8260C/5035	Soil	2-Hexanone	0.01	0.000666	mg/kg
EPA 8260C/5035	Soil	4-Ethyltoluene	0.004	0.000124	mg/kg
EPA 8260C/5035	Soil	4-Methyl-2-pentanone	0.01	0.000244	mg/kg
EPA 8260C/5035	Soil	Acetone	0.01	0.001036	mg/kg
EPA 8260C/5035	Soil	Acrolein	0.025	0.00806	mg/kg
EPA 8260C/5035	Soil	Acrylonitrile	0.01	0.000514	mg/kg
EPA 8260C/5035	Soil	Benzene	0.001	0.000118	mg/kg
EPA 8260C/5035	Soil	Bromobenzene	0.005	0.000208	mg/kg
EPA 8260C/5035	Soil	Bromochloromethane	0.005	0.000276	mg/kg
EPA 8260C/5035	Soil	Bromodichloromethane	0.001	0.0001732	mg/kg
EPA 8260C/5035	Soil	Bromoform	0.004	0.000236	mg/kg
EPA 8260C/5035	Soil	Bromomethane	0.002	0.000338	mg/kg
EPA 8260C/5035	Soil	Carbon disulfide	0.01	0.001102	mg/kg
EPA 8260C/5035	Soil	Carbon tetrachloride	0.001	0.00021	mg/kg
EPA 8260C/5035	Soil	Chlorobenzene	0.001	0.000348	mg/kg
EPA 8260C/5035	Soil	Chloroethane	0.002	0.000316	mg/kg
EPA 8260C/5035	Soil	Chloroform	0.0015	0.00037	mg/kg
EPA 8260C/5035	Soil	Chloromethane	0.005	0.000294	mg/kg
EPA 8260C/5035	Soil	cis-1,2-Dichloroethene	0.001	0.0001428	mg/kg
EPA 8260C/5035	Soil	cis-1,3-Dichloropropene	0.001	0.0001176	mg/kg
EPA 8260C/5035	Soil	Cyclohexane	0.02	0.000146	mg/kg
EPA 8260C/5035	Soil	Dibromochloromethane	0.001	0.0001536	mg/kg
EPA 8260C/5035	Soil	Dibromomethane	0.01	0.0001636	mg/kg
EPA 8260C/5035	Soil	Dichlorodifluoromethane	0.01	0.0001908	mg/kg
EPA 8260C/5035	Soil	Ethyl ether	0.005	0.00026	mg/kg
EPA 8260C/5035	Soil	Ethylbenzene	0.001	0.0001274	mg/kg
EPA 8260C/5035	Soil	Hexachlorobutadiene	0.005	0.000228	mg/kg
EPA 8260C/5035	Soil	Isopropylbenzene	0.001	0.0001038	mg/kg
EPA 8260C/5035	Soil	Methyl Acetate	0.02	0.00027	mg/kg
EPA 8260C/5035	Soil	Methyl cyclohexane	0.004	0.0001546	mg/kg
EPA 8260C/5035	Soil	Methyl tert butyl ether	0.002	0.0000844	mg/kg
EPA 8260C/5035	Soil	Methylene chloride	0.01	0.001104	mg/kg
EPA 8260C/5035	Soil	Naphthalene	0.005	0.0001384	mg/kg
EPA 8260C/5035	Soil	n-Butylbenzene	0.001	0.0001148	mg/kg
EPA 8260C/5035	Soil	n-Propylbenzene	0.001	0.0001092	mg/kg
EPA 8260C/5035	Soil	o-Chlorotoluene	0.005	0.0001598	mg/kg
EPA 8260C/5035	Soil	o-Xylene	0.002	0.0001718	mg/kg
EPA 8260C/5035	Soil	p/m-Xylene	0.002	0.0001978	mg/kg
EPA 8260C/5035	Soil	p-Chlorotoluene	0.005	0.0001328	mg/kg
EPA 8260C/5035	Soil	p-Isopropyltoluene	0.001	0.000125	mg/kg
EPA 8260C/5035	Soil	sec-Butylbenzene	0.001	0.000122	mg/kg
EPA 8260C/5035	Soil	Styrene	0.002	0.000402	mg/kg
EPA 8260C/5035	Soil	tert-Butyl Alcohol	0.06	0.00292	mg/kg
EPA 8260C/5035	Soil	tert-Butylbenzene	0.005	0.0001354	mg/kg
EPA 8260C/5035	Soil	Tetrachloroethene	0.001	0.0001402	mg/kg
EPA 8260C/5035	Soil	Toluene	0.0015	0.0001948	mg/kg
EPA 8260C/5035	Soil	trans-1,2-Dichloroethene	0.0015	0.000212	mg/kg
EPA 8260C/5035	Soil	trans-1,3-Dichloropropene	0.001	0.0001208	mg/kg
EPA 8260C/5035	Soil	trans-1,4-Dichloro-2-butene	0.005	0.000392	mg/kg
EPA 8260C/5035	Soil	Trichloroethene	0.001	0.000125	mg/kg
EPA 8260C/5035	Soil	Trichlorofluoromethane	0.005	0.000388	mg/kg
EPA 8260C/5035	Soil	Vinyl acetate	0.01	0.0001322	mg/kg
EPA 8260C/5035	Soil	Vinyl chloride	0.002	0.0001174	mg/kg
EPA 8260C/5035	Soil	Xylenes, Total	0.002	0.0001978	mg/kg

## ATTACHMENT B

SOIL SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS

Method	Matrix	Analyte	RL	MDL	Units
Semivolatile Organic Compounds					
EPA 8270D	Soil	1,2,4,5-Tetrachlorobenzene	0.1665	0.0515817	mg/kg
EPA 8270D	Soil	1,2,4-Trichlorobenzene	0.1665	0.0545787	mg/kg
EPA 8270D	Soil	1,2-Dichlorobenzene	0.1665	0.0546453	mg/kg
EPA 8270D	Soil	1,3-Dichlorobenzene	0.1665	0.0524808	mg/kg
EPA 8270D	Soil	1,4-Dichlorobenzene	0.1665	0.050616	mg/kg
EPA 8270D	Soil	2,3,4,6-Tetrachlorophenol	0.1665	0.028305	mg/kg
EPA 8270D	Soil	2,4,5-Trichlorophenol	0.1665	0.053946	mg/kg
EPA 8270D	Soil	2,4,6-Trichlorophenol	0.0999	0.0314019	mg/kg
EPA 8270D	Soil	2,4-Dichlorophenol	0.14985	0.053946	mg/kg
EPA 8270D	Soil	2,4-Dimethylphenol	0.1665	0.049617	mg/kg
EPA 8270D	Soil	2,4-Dinitrophenol	0.7992	0.227772	mg/kg
EPA 8270D	Soil	2,4-Dinitrotoluene	0.1665	0.0359307	mg/kg
EPA 8270D	Soil	2,6-Dinitrotoluene	0.1665	0.042624	mg/kg
EPA 8270D	Soil	2-Chloronaphthalene	0.1665	0.054279	mg/kg
EPA 8270D	Soil	2-Chlorophenol	0.1665	0.050283	mg/kg
EPA 8270D	Soil	2-Methylnaphthalene	0.1998	0.0531801	mg/kg
EPA 8270D	Soil	2-Methylphenol	0.1665	0.053613	mg/kg
EPA 8270D	Soil	2-Nitroaniline	0.1665	0.046953	mg/kg
EPA 8270D	Soil	2-Nitrophenol	0.35964	0.051948	mg/kg
EPA 8270D	Soil	3,3'-Dichlorobenzidine	0.1665	0.044289	mg/kg
EPA 8270D	Soil	3-Methylphenol/4-Methylphenol	0.23976	0.054612	mg/kg
EPA 8270D	Soil	3-Nitroaniline	0.1665	0.045954	mg/kg
EPA 8270D	Soil	4,6-Dinitro-o-cresol	0.4329	0.060939	mg/kg
EPA 8270D	Soil	4-Bromophenyl phenyl ether	0.1665	0.038295	mg/kg
EPA 8270D	Soil	4-Chloroaniline	0.1665	0.043956	mg/kg
EPA 8270D	Soil	4-Chlorophenyl phenyl ether	0.1665	0.0506493	mg/kg
EPA 8270D	Soil	4-Nitroaniline	0.1665	0.044955	mg/kg
EPA 8270D	Soil	4-Nitrophenol	0.2331	0.053946	mg/kg
EPA 8270D	Soil	Acenaphthene	0.1332	0.034299	mg/kg
EPA 8270D	Soil	Acenaphthylene	0.1332	0.0311355	mg/kg
EPA 8270D	Soil	Acetophenone	0.1665	0.051615	mg/kg
EPA 8270D	Soil	Anthracene	0.0999	0.0277056	mg/kg
EPA 8270D	Soil	Atrazine	0.1332	0.0377289	mg/kg
EPA 8270D	Soil	Azobenzene	0.1665	0.044622	mg/kg
EPA 8270D	Soil	Benzaldehyde	0.21978	0.067266	mg/kg
EPA 8270D	Soil	Benzidine	0.54945	0.130203	mg/kg
EPA 8270D	Soil	Benzo(a)anthracene	0.0999	0.0326007	mg/kg
EPA 8270D	Soil	Benzo(a)pyrene	0.1332	0.0407259	mg/kg
EPA 8270D	Soil	Benzo(b)fluoranthene	0.0999	0.033633	mg/kg
EPA 8270D	Soil	Benzo(ghi)perylene	0.1332	0.034632	mg/kg
EPA 8270D	Soil	Benzo(k)fluoranthene	0.0999	0.0317682	mg/kg
EPA 8270D	Soil	Benzoic Acid	0.53946	0.168498	mg/kg
EPA 8270D	Soil	Benzyl Alcohol	0.1665	0.051282	mg/kg
EPA 8270D	Soil	Biphenyl	0.37962	0.0549117	mg/kg
EPA 8270D	Soil	Bis(2-chloroethoxy)methane	0.17982	0.0504162	mg/kg
EPA 8270D	Soil	Bis(2-chloroethyl)ether	0.14985	0.0466866	mg/kg
EPA 8270D	Soil	Bis(2-chloroisopropyl)ether	0.1998	0.058608	mg/kg
EPA 8270D	Soil	Bis(2-Ethylhexyl)phthalate	0.1665	0.043623	mg/kg
EPA 8270D	Soil	Butyl benzyl phthalate	0.1665	0.0325341	mg/kg
EPA 8270D	Soil	Caprolactam	0.1665	0.045954	mg/kg
EPA 8270D	Soil	Carbazole	0.1665	0.0357975	mg/kg
EPA 8270D	Soil	Chrysene	0.0999	0.0327006	mg/kg
EPA 8270D	Soil	Dibenzo(a,h)anthracene	0.0999	0.0322344	mg/kg
EPA 8270D	Soil	Dibenzofuran	0.1665	0.0555777	mg/kg
EPA 8270D	Soil	Diethyl phthalate	0.1665	0.0351981	mg/kg
EPA 8270D	Soil	Dimethyl phthalate	0.1665	0.042291	mg/kg
EPA 8270D	Soil	Di-n-butylphthalate	0.1665	0.0321345	mg/kg
EPA 8270D	Soil	Di-n-octylphthalate	0.1665	0.040959	mg/kg
EPA 8270D	Soil	Fluoranthene	0.0999	0.0305694	mg/kg
EPA 8270D	Soil	Fluorene	0.1665	0.0477189	mg/kg
EPA 8270D	Soil	Hexachlorobenzene	0.0999	0.0310356	mg/kg
EPA 8270D	Soil	Hexachlorobutadiene	0.1665	0.046953	mg/kg
EPA 8270D	Soil	Hexachlorocyclopentadiene	0.47619	0.106893	mg/kg
EPA 8270D	Soil	Hexachloroethane	0.1332	0.0302697	mg/kg
EPA 8270D	Soil	Indeno(1,2,3-cd)Pyrene	0.1332	0.036963	mg/kg
EPA 8270D	Soil	Isophorone	0.14985	0.044289	mg/kg
EPA 8270D	Soil	Naphthalene	0.1665	0.055278	mg/kg
EPA 8270D	Soil	Nitrobenzene	0.14985	0.039627	mg/kg
EPA 8270D	Soil	NitrosoDiPhenylAmine(NDPA)/DPA	0.1332	0.034965	mg/kg
EPA 8270D	Soil	n-Nitrosodimethylamine	0.333	0.0539127	mg/kg
EPA 8270D	Soil	n-Nitrosodi-n-propylamine	0.1665	0.049617	mg/kg
EPA 8270D	Soil	p-Chloro-M-Cresol	0.1665	0.048285	mg/kg
EPA 8270D	Soil	Pentachlorophenol	0.1332	0.035631	mg/kg
EPA 8270D	Soil	Phenanthrene	0.0999	0.0325674	mg/kg
EPA 8270D	Soil	Phenol	0.1665	0.049284	mg/kg
EPA 8270D	Soil	Pyrene	0.0999	0.0323676	mg/kg

**ATTACHMENT B**

**SOIL SAMPLES  
LABORATORY REPORTING LIMITS AND METHOD DETECTION LIMITS**

Method	Matrix	Analyte	RL	MDL	Units
<b>Pesticides</b>					
EPA 8081B	Soil	4,4'-DDD	0.007992	0.00285048	mg/kg
EPA 8081B	Soil	4,4'-DDE	0.007992	0.00184815	mg/kg
EPA 8081B	Soil	4,4'-DDT	0.014985	0.0064269	mg/kg
EPA 8081B	Soil	Aldrin	0.007992	0.00281385	mg/kg
EPA 8081B	Soil	Alpha-BHC	0.00333	0.00094572	mg/kg
EPA 8081B	Soil	Beta-BHC	0.007992	0.0030303	mg/kg
EPA 8081B	Soil	Chlordane	0.064935	0.0264735	mg/kg
EPA 8081B	Soil	cis-Chlordane	0.00999	0.00278388	mg/kg
EPA 8081B	Soil	Delta-BHC	0.007992	0.0015651	mg/kg
EPA 8081B	Soil	Dieldrin	0.004995	0.0024975	mg/kg
EPA 8081B	Soil	Endosulfan I	0.007992	0.00188811	mg/kg
EPA 8081B	Soil	Endosulfan II	0.007992	0.00267066	mg/kg
EPA 8081B	Soil	Endosulfan sulfate	0.00333	0.00158508	mg/kg
EPA 8081B	Soil	Endrin	0.00333	0.0013653	mg/kg
EPA 8081B	Soil	Endrin aldehyde	0.00999	0.0034965	mg/kg
EPA 8081B	Soil	Endrin ketone	0.007992	0.00205794	mg/kg
EPA 8081B	Soil	Heptachlor	0.003996	0.00179154	mg/kg
EPA 8081B	Soil	Heptachlor epoxide	0.014985	0.0044955	mg/kg
EPA 8081B	Soil	Lindane	0.00333	0.00148851	mg/kg
EPA 8081B	Soil	Methoxychlor	0.014985	0.004662	mg/kg
EPA 8081B	Soil	Toxaphene	0.14985	0.041958	mg/kg
EPA 8081B	Soil	trans-Chlordane	0.00999	0.00263736	mg/kg
<b>Polychlorinated Biphenyls</b>					
EPA 8082A	Soil	Aroclor 1016	0.0335	0.0026465	mg/kg
EPA 8082A	Soil	Aroclor 1221	0.0335	0.0030887	mg/kg
EPA 8082A	Soil	Aroclor 1232	0.0335	0.0039262	mg/kg
EPA 8082A	Soil	Aroclor 1242	0.0335	0.0041004	mg/kg
EPA 8082A	Soil	Aroclor 1248	0.0335	0.0028274	mg/kg
EPA 8082A	Soil	Aroclor 1254	0.0335	0.0027537	mg/kg
EPA 8082A	Soil	Aroclor 1260	0.0335	0.0025527	mg/kg
EPA 8082A	Soil	Aroclor 1262	0.0335	0.0016616	mg/kg
EPA 8082A	Soil	Aroclor 1268	0.0335	0.0048575	mg/kg
EPA 8082A	Soil	Total PCBs	0.0335	0.0016616	mg/kg
<b>Herbicides</b>					
EPA 8151A	Soil	2,4-D	0.1665	0.0051615	mg/kg
EPA 8151A	Soil	2,4,5-TP (Silvex)	0.1665	0.0044289	mg/kg
EPA 8151A	Soil	2,4,5-T	0.1665	0.0104895	mg/kg
<b>Metals</b>					
EPA 6010C	Soil	Aluminum	4	0.8	mg/kg
EPA 6010C	Soil	Antimony	2	0.32	mg/kg
EPA 6010C	Soil	Arsenic	0.4	0.08	mg/kg
EPA 6010C	Soil	Barium	0.4	0.12	mg/kg
EPA 6010C	Soil	Beryllium	0.2	0.04	mg/kg
EPA 6010C	Soil	Cadmium	0.4	0.028	mg/kg
EPA 6010C	Soil	Calcium	4	1.2	mg/kg
EPA 6010C	Soil	Chromium	0.4	0.08	mg/kg
EPA 7196A	Soil	Hexavalent Chromium	0.8	0.16	mg/kg
EPA 6010C	Soil	Cobalt	0.8	0.2	mg/kg
EPA 6010C	Soil	Copper	0.4	0.08	mg/kg
EPA 6010C	Soil	Iron	2	0.8	mg/kg
EPA 6010C	Soil	Lead	2	0.08	mg/kg
EPA 6010C	Soil	Magnesium	4	0.4	mg/kg
EPA 6010C	Soil	Manganese	0.4	0.08	mg/kg
EPA 7473	Soil	Mercury	0.08	0.016896	mg/kg
EPA 6010C	Soil	Nickel	1	0.16	mg/kg
EPA 6010C	Soil	Potassium	100	16	mg/kg
EPA 6010C	Soil	Selenium	0.8	0.12	mg/kg
EPA 6010C	Soil	Silver	0.4	0.08	mg/kg
EPA 6010C	Soil	Sodium	80	12	mg/kg
EPA 6010C	Soil	Thallium	0.8	0.16	mg/kg
EPA 6010C	Soil	Vanadium	0.4	0.04	mg/kg
EPA 6010C	Soil	Zinc	2	0.28	mg/kg
<b>Other</b>					
ASTM D422-63	Soil	Grain Size	N/A	N/A	N/A
SM21 5210B	Soil	Biological Oxygen Demand (BOD)	N/A	N/A	N/A
SM21 5220C	Soil	Chemical Oxygen Demand (COD)	100	28	mg/kg
EPA 9040C	Soil	pH	N/A	N/A	N/A
SM21 5310B, SW8469060	Soil	Total Organic Carbon (TOC)	1000	160	mg/kg
ASTM516-90,02	Soil	Sulfate	50	7	mg/kg
SM21 4500 S F	Soil	Sulfide	4	1.5	mg/kg
EPA 351.2	Soil	Total Kjeldahl Nitrogen (TKN)	5	1.2	mg/kg
EPA 365.4/4500PE	Soil	Total Phosphorous	10	0.24	mg/kg
SM18 4500 NH3F	Soil	Ammonia	5	1.8	mg/kg



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**Langan Engineering & Environmental**

### 1,4 Dioxane via EPA 8270D-SIM (SOIL)

**Holding Time:** 14 days

**Container/Sample Preservation:** 1 - Glass 250ml/8oz unpreserved

[illegible]

Please Note that the RL information provided in this table is calculated using a 100% Solids factor (Soil/Solids only)  
Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.



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Langan Engineering & Environmental

NY PFAAs via EPA 537(M)-Isotope Dilution (SOIL)

Holding Time: 28 days  
Container/Sample Preservation: 1 - Plastic 8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluorobutanoic Acid (PFBA)	375-22-4	1	0.0227	ug/kg	71-135	30	71-135	30	30			
Perfluoropentanoic Acid (PFPeA)	2706-90-3	1	0.046	ug/kg	69-132	30	69-132	30	30			
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	1	0.039	ug/kg	72-128	30	72-128	30	30			
Perfluorohexanoic Acid (PFHxA)	307-24-4	1	0.0525	ug/kg	70-132	30	70-132	30	30			
Perfluoroheptanoic Acid (PFHpA)	375-85-9	1	0.0451	ug/kg	71-131	30	71-131	30	30			
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	1	0.0605	ug/kg	67-130	30	67-130	30	30			
Perfluorooctanoic Acid (PFOA)	335-67-1	1	0.0419	ug/kg	69-133	30	69-133	30	30			
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	1	0.1795	ug/kg	64-140	30	64-140	30	30			
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	1	0.1365	ug/kg	70-132	30	70-132	30	30			
Perfluorononanoic Acid (PFNA)	375-95-1	1	0.075	ug/kg	72-129	30	72-129	30	30			
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	1	0.13	ug/kg	68-136	30	68-136	30	30			
Perfluorodecanoic Acid (PFDA)	335-76-2	1	0.067	ug/kg	69-133	30	69-133	30	30			
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	1	0.287	ug/kg	65-137	30	65-137	30	30			
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSA)	2355-31-9	1	0.2015	ug/kg	63-144	30	63-144	30	30			
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	1	0.0468	ug/kg	64-136	30	64-136	30	30			
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	1	0.153	ug/kg	59-134	30	59-134	30	30			
Perfluorooctanesulfonamide (FOSA)	754-91-6	1	0.098	ug/kg	67-137	30	67-137	30	30			
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	1	0.0845	ug/kg	61-139	30	61-139	30	30			
Perfluorododecanoic Acid (PFDoA)	307-55-1	1	0.07	ug/kg	69-135	30	69-135	30	30			
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	1	0.2045	ug/kg	66-139	30	66-139	30	30			
Perfluorotetradecanoic Acid (PFTA)	376-06-7	1	0.054	ug/kg	69-133	30	69-133	30	30			
PFOA/PFOS, Total		1	0.0419	ug/kg				30	30			
Perfluoro[13C4]Butanoic Acid (MPFBA)	NONE										60-153	
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	NONE										65-182	
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	NONE										70-151	
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	NONE										61-147	
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	NONE										62-149	
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	NONE										63-166	
Perfluoro[13C8]Octanoic Acid (M8PFOA)	NONE										62-152	
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-)	NONE										32-182	
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	NONE										61-154	
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	NONE										65-151	
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	NONE										65-150	
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-)	NONE										25-186	
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid	NONE										45-137	
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	NONE										64-158	
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	NONE										1-125	
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (	NONE										42-136	
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFD OA)	NONE										56-148	
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	NONE										26-160	

Please Note that the RL information provided in this table is calculated using a 100% Solids factor (Soil/Solids only)  
Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.



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## PFAS Compound Analyte List for Soil And Groundwater Samples

Compound Name	Analytical Method
Perfluorohexanoic acid (PFHxA)	USEPA Method 537 Modified
Perfluoroheptanoic acid (PFHpA)	
Perfluorooctanoic acid (PFOA)	
Perfluorobutanoic acid (PFBA)	
Perfluoropentanoic acid (PFPeA)	
Perfluorononanoic acid (PFNA)	
Perfluorodecanoic acid (PFDA)	
Perfluoroundecanoic acid (PFUA/PFUdA)	
Perfluorododecanoic acid (PFDoA)	
Perfluorotridecanoic acid (PFTriA/PFTrDA)	
Perfluorotetradecanoic acid (PFTA/PFTeDA)	
Perfluorobutanesulfonic acid (PFBS)	
Perfluorohexanesulfonic acid (PFHxS)	
Perfluoroheptanesulfonic acid (PFHpS)	
Perfluorodecanesulfonic acid (PFDS)	
Perfluorooctanesulfonic acid (PFOS)	
N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	
N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	
6:2 Fluorotelomer sulfonate (6:2 FTS)	
8:2 Fluorotelomer sulfonate (8:2 FTS)	
Perfluorooctanesulfonamide (FOSA)	

Notes:

1. PFAS - per- and polyfluoroalkyl substances





# Hg Selective Sequential Extractions (SSE):

## General Method Description:

The following describes the method developed by Eurofins Frontier Global Sciences that uses a selective sequential extraction technique to accurately assess the type and concentration of mercury compounds typically found in contaminated geological sites. This method provides specific information about the expected mobility and bioaccessability of various compounds which offers a behavioural profile of the contaminant and data that can be used to assess its potential effect.

Step	Extractant	Description	Typical Compounds
F0	headspace gas	vapor equilibrium	Hg <sup>0</sup>
F1	deionized water	water	HgCl <sub>2</sub> , HgSO <sub>4</sub>
F2	pH 2 HCl/HO Ac	"stomach acid"	HgO
F3	1N KOH	organo-complexed	Hg-humics, Hg <sub>2</sub> Cl <sub>2</sub>
F4	12NHNO <sub>3</sub>	strong-complexed	mineral lattice, Hg <sub>2</sub> , Hg <sup>0</sup>
F5	aqua regia	cinnabar	HgS, m-HgS, HgSe, HgAu
F6	HNO <sub>3</sub> /HCl/HF	mineral-bound	Hg in crystal lattice
FS	-	sum	total Hg

## Scope:

This method is for the selective extraction of geological samples (soils, sediments, ores, mine tailings, etc.), with the goal of determining the biogeochemically relevant associations of inorganic Hg within, and leachability of inorganic Hg from, the solid phase.

When applied exactly as written, this method defines the following extraction fractions (F-0 through F-5, and F-S). The representativeness of each fraction varies from sample to sample, depending upon ancillary parameters such as TOC, soil pH, co-leached substances (i.e., Cl<sup>-</sup>, SO<sub>4</sub><sup>=</sup>, etc.) and actual solid phase speciation of the analyte. Additional ancillary chemistry measurements or kinetic studies may be required to fully interpret the extraction pattern for each sample.

## Basic Principles:

Prior to digestion, the sample should be sieved through a 2-mm plastic mesh screen to remove large chunks, and as an aid in homogenization. Inherently fine-grained samples do not need to be sieved prior to extraction.

Fresh samples should be extracted in a form as close to their natural state as possible. Under no circumstances should samples be dried or pulverized prior to extraction, as this may lead to dramatic changes in leachability.

This method involves the sequential extraction of the **same sample aliquot** through a sequence of different extractants of increasing chemical strength. Recovery in a wide range of geological materials, as the sum of the selective extraction fractions was found to typically be 100 ± 15% (Table 2).

### Summary Table of Eurofins Frontier Global Sciences' Mercury Selective Extraction Procedure

Fraction	Extraction Conditions	Expected Species	Expected Mobility	Expected water solubility range (20° Celsius, 1 atm)
F-0	Ambient temperature gaseous purging	Free elemental Hg	Relatively low mobility	Saturates at a concentration between 25-50 µg/L
F-1	Reagent water	Water soluble Hg salts such as HgCl <sub>2</sub> , Hg(NO <sub>3</sub> ) <sub>2</sub>	Highly mobile	Soluble (1 to 10 g/100 mL, HgCl <sub>2</sub> 6.57 g/100 mL)
F-2	Hydrochloric acid at a pH less than 2	Low pH soluble salts of mercury	Relatively low mobility	Slightly soluble (0.1 to 1 g/100 mL)
F-3	1 N potassium hydroxide	Organic bound mercury compounds (Hg(II) bound to sludge or humic matter)	Mobility strongly dependant on various factors	Solubility is strongly dependant on several factors including redox conditions and presence of competing complexing agents)
F-4	12 N nitric acid	All other non sulfide or silicate bound mercury compounds (can include amalgamated elemental mercury)	Low mobility	Insoluble less than 0.1 g/100 mL. Redox conditions can strongly affect the species and subsequent solubility.
F-5	Aqua regia	Sulfide bound mercury compounds only	Relatively immobile	Insoluble (HgS solubility is 2.943E-25 g/100 mL)
F-6	Combination of aqua regia and hydrofluoric acid	Silicate or aluminosilicate bound mercury compounds	Relatively immobile	Insoluble (solubility lower than HgS)

### Detailed Description Of Each Step:

**Volatile Elemental Mercury (Hg<sup>0</sup>)** This test is performed by placing a measured mass of the soil sample in a trace clean, teflon bomb vessel with an inlet and outlet and allowing and scrubbed, Hg free nitrogen to pass over and purge the samples of free gaseous elemental Hg which in turn is captured at the outlet of the vessel using an EPA I-05/EPA 30B Hg sorbent trap. The trap is then digested using EFGS-009 and analyzed for Total Hg which represents free elemental gaseous Hg that came off the sample and reported in ng Hg (gaseous elemental Hg / gram of soil sample).

**F-1 Water Soluble Mercury.** Mercury extracted in this test is useful in assessing the potential leaching of soils by rain or groundwater, and is a reasonably good (±50%) predictor of the performance of the sample on an official TCLP or EP-toxicity leaching test. At high solid phase concentrations, the water soluble salts such as HgCl<sub>2</sub>, Hg(NO<sub>3</sub>)<sub>2</sub>, etc., will appear largely in this fraction, but as total Hg concentrations decrease, the percentage found in this fraction decreases dramatically, due to adsorption of the free Hg on the soil particles. This fraction is extremely dependent upon the co-leached soil components such as Cl<sup>-</sup>, I<sup>-</sup>, DOC, and pH. Increases in any of these co-leached Hg complexing agents will generally greatly increase the solubility of water-soluble mercury compounds.

**F-2 pH 2 Soluble Mercury.** Mercury extracted in this fraction is a surrogate for what might be extracted by the human stomach upon ingestion, or of leachability under the conditions of acid mine drainage or other industrial process. In cases where the sample contains high TOC, this fraction is usually the lowest in Hg, because of readsorption of Hg(II) by coagulated humic matter at this pH. High concentrations of pH 2 leachable Hg might warrant additional testing that more accurately models the human digestive tract in terms of pH regime and contact time, or acid mine drainage conditions present at the contaminated site.

**F-3 1N KOH Extractable Mercury.** Under the conditions of this extraction, most of the Hg associated with humic organic matter appears to be solubilized, while none of the HgS is co-solubilized. 1N KOH soluble Hg dominates marine and freshwater sediments, as well as the soil humus layer. Not only does most of the CH<sub>3</sub>Hg in the sample also leach out in this fraction, but also this fraction has been found to strongly correlate with *in situ* CH<sub>3</sub>Hg concentrations, and the potential methylatability of the sample. The contribution of the CH<sub>3</sub>Hg content to the total Hg extracted is usually small, but if high concentrations of methyl Hg (greater than 1% of total) are measured in the samples (FGS-045), a correction might be appropriate. The most appropriate way to correct this data is to also measure CH<sub>3</sub>Hg directly on the 1N KOH extract, and subtract it from the measured total Hg value on the same extract.

**F-4 12N HNO<sub>3</sub> Soluble Mercury.** This fraction serves largely to separate out all remaining non-HgS, so that the final measured fraction may safely be taken to represent the HgS content of the sample. In cases where F-0 detected a saturation level of Hg<sup>0</sup>, and the fractions F-1 through F-3 are small by comparison to F-4, the latter fraction may be interpreted as representing essentially the total Hg<sup>0</sup> content of the sample. At lower Hg concentrations in natural samples, much of the non-humic bound Hg(II) is found in this fraction, because it is strongly adsorbed to the particle surfaces, and so not leachable by the weak extractants F-1 and F-2.

**F-5 Aqua Regia Soluble Mercury (Residue).** If the previous steps of the extraction scheme have been carried out accurately, this fraction consists of the cinnabar and meta-cinnabar (HgS) content of the samples. Also included in this fraction, if present in the sample) would be HgSe, and amalgams of Hg with noble metals such as gold and platinum. Hg is leached from the surface of these amalgams, but the bulk concentrations require the dissolution of the noble metal particles, which is accomplished readily by aqua regia.

**F-6 Mineral-Bound Mercury.** For hard mineral samples, such as bauxite, the F5 (aqua regia) step is not vigorous enough to release all mercury from the crystal lattice. In samples of this type, an aggressive HF Bomb digest is necessary to recover all the mercury in the sample ( SOP FGS-111).

**F-S Total Mercury by the Sum of Species.** The sum of all of the fractions, F-0 through F-6 is the total Hg in the sample. It is *inadvisable* to try to measure total Hg (FGS-137) on a separate aliquot of the sample, unless this is being done only for the purpose of assessing sample homogeneity. For real-world samples, heterogeneity is often so great that direct comparison of selective extraction on one aliquot and total Hg on a separate aliquot will produce misleading conclusions (such as that there is a “missing” Hg species, in cases where the total is much greater than the sum of species). For very fine, homogeneous samples such as CRMs, F-S should compare to the independently measured total to within ± 20%.

This leaching is optimized for and only applicable to Hg analysis. Other leaching procedures are necessary to obtain reliable and biogeochemically meaningful results for other trace metals.

This method is a protocol for the extraction only. All recovered aqueous fractions are then analyzed by an appropriate Hg quantification technique. Because of its low detection limits and high tolerance for complex matrices, EPA Method 1631 (ref 10.2), with preparation described in Frontier SOP FGS-012 (Total Hg in aqueous media) and analysis in EFGS-137 (Total Hg analysis) are recommended, as indicated in the text below.

#### **Typical Minimum Detection Limits/Minimum Reporting Limits For Each Fraction:**

Soil/Sediment								
Analyte	MDL	MRL	Units	Duplicate RPD	Matrix Spike %Recovery	RPD	Blank Spike/LCS %Recovery	RPD
Elemental Hg in soil/sediment by CV-AFS (EPA 1631 Mod)								
Mercury (0)	0.344	2.00	ng/g	24	71 - 125	25	80 - 120	24
SSE of Hg in solids (F1) (FGS-069)								
Mercury F-1	1.00	3.12	ng/g	25	75 - 125	25	0 - 125	25
SSE of Hg in solids (F2) (FGS-069)								
Mercury F-2	1.00	3.12	ng/g	25	75 - 125	25	0 - 125	25
SSE of Hg in solids (F3) (FGS-069)								
Mercury F-3	2.00	6.25	ng/g	25	75 - 125	25	0 - 125	25
SSE of Hg in solids (F4) (FGS-069)								
Mercury F-4	5.00	15.6	ng/g	25	75 - 125	25	0 - 125	25
SSE of Hg in solids (F5) (FGS-069)								
Mercury F-5	0.110	1.00	ng/g	25	75 - 125	25	0 - 125	25

## **ATTACHMENT C**

### **ANALYTICAL METHODS/QUALITY ASSURANCE SUMMARY TABLE**

**ATTACHMENT C**  
**ANALYTICAL METHODS/QUALITY ASSURANCE SUMMARY TABLE**

Matrix Type	Field Parameters	Laboratory Parameters	Analytical Methods	Sample Preservation	Sample Container Volume and Type	Sample Hold Time	Field Duplicate Samples	Field Blank Samples	Media Blank Samples	Equipment Blank Samples	Trip Blank Samples	Ambient Air Samples	MS/MSD Samples
<b>Soil</b>	Total VOCs via PID	Part 375 + TCL VOCs	EPA 8260C	Cool to 4°C	Two 40-ml VOC vials with 5ml H <sub>2</sub> O, one with MeOH or 3 En Core Samplers (separate container for % solids)	14 days	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	NA	NA	NA	NA	1 per 20 samples
		Part 375 + TCL SVOCs	EPA 8270D	Cool to 4°C	4 oz. amber glass jar	14 days extract, 40 days after extraction to analysis							
		Part 375 + TAL Metals + Cyanide	EPA 6010C, EPA 7470A, EPA 7196A, EPA 9014/9010C	Cool to 4°C	2 oz. amber glass jar	6 months, except mercury 28 days							
		Part 375 + TCL Pesticides	EPA 8081B	Cool to 4°C	4 oz. amber glass jar	14 days extract, 40 days after extraction to analysis							
		Part 375 + TCL PCBs	EPA 8082A	Cool to 4°C	4 oz. amber glass jar	14 days extract, 40 days after extraction to analysis							
		NYSDEC List PFAS	EPA 537 Modified	Cool to 4°C	8 oz. HDPE jar	14 days to extract, 28 days after extraction to analysis							
		1,4-Dioxane	8270 SIM	Cool to 4°C	4 oz. amber glass jar	14 days extract, 40 days after extraction to analysis							
<b>Groundwater</b>	Temperature, Turbidity, pH, ORP, Conductivity, DO	Part 375 + TCL VOCs	EPA 8260C	Cool to 4°C; HCl to pH <2; no headspace	Three 40-mL VOC vials with Teflon®-lined cap	Analyze within 14 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	NA	NA	1 per shipment of VOC samples	NA	1 per 20 samples
		Part 375 + TCL SVOCs	EPA 8270D	Cool to 4°C	Two 1-Liter amber glass	7 days to extract, 40 days after extraction to analysis							
		Part 375 + TAL Metals	EPA 6010C, EPA 7470A	HNO <sub>3</sub>	250 ml plastic	6 months, except Mercury 28 days							
		Hexavalent Chromium	EPA 7196A	Cool to 4°C	250 ml plastic	24 hours							
		Cyanide	SM 4500 C/E	NaOH plus 0.6g ascorbic acid	250 ml plastic	14 days							
		Part 375 + TCL Pesticides	EPA 8081B	Cool to 4°C	Two 1-Liter Amber Glass for Pesticides/PCB	7 days to extract, 40 days after extraction to analysis							
		PCBs	EPA 8082A	Cool to 4°C		7 days to extract, 40 days after extraction to analysis							
		PFAS	EPA 537 Modified	Cool to 4°C	Two 250 mL HDPE	14 days to extract, 28 days after extraction to analysis							
		1,4-dioxane	8270 SIM	Cool to 4°C	One 1 -Liter Amber Glass	7 days to extract, 40 days after extraction to analysis							
<b>Soil Vapor</b>	Total VOCs, Oxygen, LEL, CO, and H <sub>2</sub> S, with MultiGas Meter	TO-15 Listed VOCs	TO-15	Ambient Temperature	2.7-Liter Summa Canister	Analyze within 30 days of collection	1 per 20 samples (minimum 1)	NA	NA	NA	NA	1 per 20 samples (minimum 1)	NA
<b>Ambient/Indoor Air</b>	Total VOCs via PID				6-Liter Summa Canister		NA	NA	NA	NA			
<b>Soil Vapor</b>	Mercury Vapor via Jerome J405	Mercury Vapor	EPA 6009	Ambient Temperature	Glass Sorbent Tube containing one section of 200 mg Hopcalite	Analyze within 30 days of collection	1 per 20 samples (minimum 1)	NA	3 per set	NA	NA	1 per 20 samples (minimum 1)	NA

**Notes:**  
1. PID - Photoionization Detector  
2. VOC - Volatile organic compound  
3. EPA - Environmental Protection Agency  
4. TCL - Target compound list  
5. TAL - Target analyte list  
6. ORP - Oxidation reduction potential  
7. DO - Dissolved oxygen  
8. LEL - Lower explosive limit  
9. CO -Carbon monoxide  
10. H<sub>2</sub>S - Hydrogen sulfide  
11. PFAS - Per-fluoroalkyl substances  
12. HDPE - High-Density Polyethylene

## **ATTACHMENT D**

### **SAMPLE NOMENCLATURE STANDARD OPERATING PROCEDURE**

## SAMPLE NOMENCLATURE

The sample nomenclature outlined below provides consistency between sample events and projects but, most importantly, establish unique sample IDs that will avoid confusion months or years after the sample has been collected. Furthermore, unique sample IDs are required for any data submitted to the NYSDEC in EDD format or being uploaded to an EQulS database.

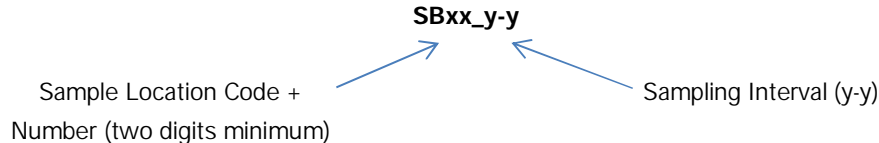
### 1.0 INVESTIGATION LOCATION CODES

SB	Soil Boring	SV	Soil Vapor Point
WC	Waste Characterization Boring	IA	Indoor Air
TP	Test Pit	AA	Ambient Air
EPSW	Endpoint Location (Sidewall)	SVE	Vapor Extraction Well
EPB	Endpoint Location (Bottom)	DS	Drum
MW	Monitoring Well	IDW	Investigation Derived Waste
TMW	Temporary Monitoring Well	SL	Sludge
SW	Surface Water	FP	Free Product

### 2.0 SAMPLE NOMENCLATURE

Each sample at a site must have a unique value.

- Soil/Sediment Samples:

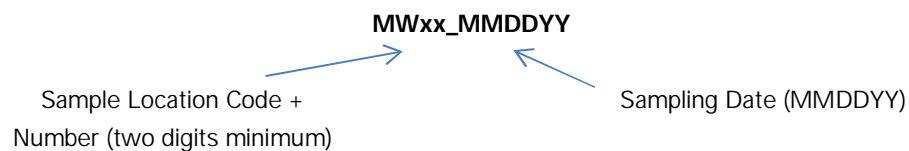


Sample Type	Sample Location Code	Sampling Depth or Interval (feet bgs or approx. elevation)	Sample Name
<b>Phase II/Remedial Investigation</b>			
<b>Grab</b> Soil Sample	SB01	2 to 4	SB01_2-4
	SB02	4	SB02_4
<b>Waste Characterization</b>			
<b>Grab</b> Soil Sample	WC01	2 to 4	WC01_2-4
	WC02	4	WC02_4
<b>Composite</b> Soil Sample from one or more locations	COMP01 or COMP02 + COMP03	0 to 10 (Fill)	COMP01_0-10

# LANGAN

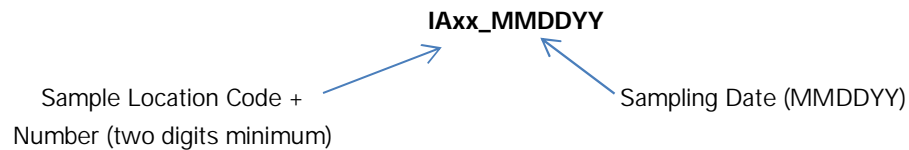
Sample Type	Sample Location Code	Sampling Depth or Interval (feet bgs or approx. elevation)	Sample Name
<b>Endpoint Sampling</b>			
<b>Grab</b> Soil Sample	EPSW01_N	5	EPSW01_N_5
	EPSW01_S	5	EPSW01_S_5
	EPSW01_E	5	EPSW01_E_5
	EPSW01_W	5	EPSW01_W_5
	EPB01	6	EPB01_6

- Groundwater/Surface Water Samples:**



Sample Type	Sample Location Code	Sampling Date	Sample Name
Groundwater Sample	MW01	02/21/2013	MW01_022113

- Air/Soil Vapor Samples:**



Sample Type	Sample Location Code	Date	Sample Name
Air Sample	IA01	02/21/2013	IA01_022113
Soil Vapor Sample	SV01	02/21/2013	SV01_022113
Vapor Extraction Well Sample	SVE01 (INLET/MIDPOINT/OUTLET)	02/21/2013	SVE01_IN_022113 SVE01_MID_022113 SVE01_OUT_022113

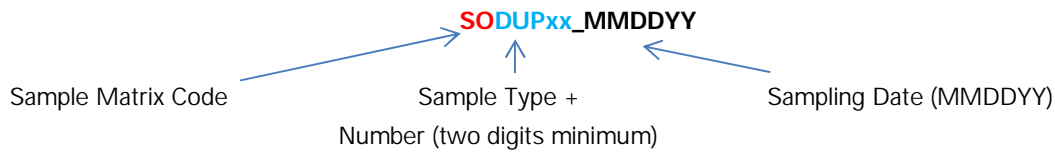
- QA/QC Samples:**

## Sample Matrix Codes

SO	Soil	AS	Air
SE	Sediment	SV	Soil Vapor
GW	Groundwater	SL	Sludge
SW	Surface Water	FP	Free Product

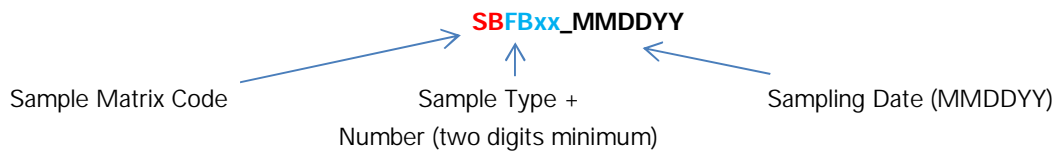


## ○ Duplicates Samples



Sample Type	Parent Sample Code	Date	Sample Name
Groundwater Duplicate Sample (DUP)	MW01_022113	02/21/2013	GWDUP01_022113
Soil boring Duplicate Sample (DUP)	SBP01_022113	02/21/2013	SODUP01_022113
Grab Waste Characterization	WC01	02/21/2013	WCDUP01_022113
Composite Waste Characterization	COMP01	02/21/2013	COMPDUP01_022113

## ○ Field Blanks and Trip Blanks



Sample Type	Date	Sample Name
Groundwater Field Blank (FB)	02/21/2013	GWFB01_022113
Groundwater Trip Blank (TB)	02/21/2013	GWTB01_022113
Soil Field Blank	02/21/2013	SOFB01_022113
Soil Trip Blank	02/21/2013	SOTB01_022113

## ○ Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Parent Sample Name\_MS or MSD

Sample Type	Sample Location	Parent Sample Name	Sample Name
Matrix Spike Soil (MS)	SB01	SB01_2-4	SB01_2-4_MS
Matrix Spike Soil Duplicate (MSD)	SB01	SB01_2-4	SB01_2-4_MSD
Matrix Spike GW (MS)	MW01	MW01	MW01_MS
Matrix Spike GW Duplicate (MSD)	MW01	MW01	MW01_MSD

### 3.0 NOTES

1. The sample location code should not exceed 20 characters and the sample name should not exceed 40 characters.
2. Sample location code (**SB01, MW01, etc.**) is a sequential number (starting with 01) and should be a minimum of two digits.
3. Sample Interval (**SB01\_0-5**) is separated from the sample location code with an underscore, and the top and bottom interval with a dash. Soil and sediment sample intervals should always be in

- feet. Soil and sediment sample intervals should contain no "/" or "()" or unit.
4. Sample date (MW01\_022113) is separated from the sample location code with an underscore and should be provided in MMDDYY format [the date should contain no "/" or "-"].
  5. If groundwater samples are collected from multiple intervals within one well, you may assign a letter designation (in lower case) to the well ID to differentiate between intervals (i.e., MW01a\_022113, MW01b\_022113, and MW01c\_022113). The letter "a" would indicate the shallowest interval and "c" the deepest. The actual depth intervals should be documented in the project field book or field sheets and the letter designations should be used consistently between sampling events.
  6. According to USEPA's Contract Laboratory Program (CLP) Guidance for Field Samplers (January 2011), field duplicate samples should remain "blind" to the laboratory (i.e., they should have separate CLP Sample numbers). Assign two separate (unique) CLP sample numbers (i.e., one number to the field sample and one to the duplicate). Submit blind to the laboratory. (<http://www.epa.gov/superfund/programs/clp/download/sampler/CLPSamp-01-2011.pdf>)

## **ATTACHMENT E**

### **PER- AND POLYFLUOROALKYL SUBSTANCES SAMPLING PROTOCOL**

# Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol

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

**The sampling procedure used must be consistent with the NYSDEC March 1991 SAMPLING GUIDELINES AND PROTOCOLS**

<http://www.dec.ny.gov/regulations/2636.html> with the following materials limitations.

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

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

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

1. Fill two pre-cleaned 500 mL HDPE or polypropylene bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at  $4 \pm 2^{\circ}$  Celsius.

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

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

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

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

## Determination of Selected Perfluorinated Alkyl Substances by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry Isotope Dilution (LC/MS/MS)

**Reference:** EPA Method 537, Version 1.1, September 2009, EPA Document #: EPA/600/R-08/09

EPA Method 537.1, Version 1, November 2018, EPA Document #: EPA/600/R-18/352

Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 5.2, .2019

### 1. Scope and Application

**Matrices:** Drinking water, Non-potable Water, and Soil Matrices

**Definitions:** Refer to Alpha Analytical Quality Manual.

- 1.1 This is a liquid chromatography/tandem mass spectrometry (LC/MS/MS) method for the determination of selected perfluorinated alkyl substances (PFAS) in Non-Drinking Water and soil Matrices. Accuracy and precision data have been generated in reagent water, and finished ground and surface waters for the compounds listed in Table 1.
- 1.2 The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.
- 1.3 This method is restricted to use by or under the supervision of analysts experienced in the operation of the LC/MS/MS and in the interpretation of LC/MS/MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability.

### 2. Summary of Method

- 2.1 A 250-mL water sample is fortified with extracted internal standards (EIS) and passed through a solid phase extraction (WAX) cartridge containing a mixed mode, Weak Anion Exchange, reversed phase, water-wettable polymer to extract the method analytes and isotopically-labeled compounds. The compounds are eluted from the solid phase in two fractions with methanol followed by a small amount of 2% ammonium hydroxide in methanol solution. The extract is concentrated with nitrogen in a heated water bath, and then adjusted to a 1-mL volume with 80:20% (vol/vol) methanol:water. A 3 µl injection is made into an LC equipped with a C18 column that is interfaced to an MS/MS. The analytes are separated and identified by comparing the acquired mass spectra and retention times to reference spectra and retention times for calibration standards acquired under identical LC/MS/MS conditions. The concentration of each analyte is determined by using the isotope dilution technique. Extracted Internal Standards (EIS) analytes are used to monitor the extraction efficiency of the method analytes.

## 2.2 Method Modifications from Reference

None.

Table 1

Parameter	Acronym	CAS
<b>PERFLUOROALKYL ETHER CARBOXYLIC ACIDS (PFECAs)</b>		
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid	HFPO-DA	62037-80-3
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
<b>PERFLUOROALKYLCARBOXYLIC ACIDS (PFCAs)</b>		
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	PFTA *	376-06-7
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
<b>PERFLUOROALKYLSULFONATES (PFASs)</b>		
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

\* also reportable via the standard 537 method

Table 1 Cont.

Parameter	Acronym	CAS
<b>CHLORO-PERFLUOROALKYLSULFONATE</b>		
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
<b>PERFLUOROOCETANESULFONAMIDES (FOSAs)</b>		
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methylperfluoro-1-octanesulfonamide	NMeFOSA	31506-32-8
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA	4151-50-2
<b>TELOMER SULFONATES</b>		
1H,1H,2H,2H-perfluorohexane sulfonate (4:2)	4:2FTS	27619-93-8
1H,1H,2H,2H-perfluorooctane sulfonate (6:2)	6:2FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonate (8:2)	8:2FTS	39108-34-4
1H,1H,2H,2H-perfluorododecane sulfonate (10:2)	10:2FTS	120226-60-0
<b>PERFLUOROOCETANESULFONAMIDOACETIC ACIDS</b>		
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA *	2355-31-9
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA *	2991-50-6
<b>NATIVE PERFLUOROOCETANESULFONAMIDOETHANOLS (FOSEs)</b>		
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	NMeFOSE	24448-09-7
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	NEtFOSE	1691-99-2

\* also reportable via the standard 537 method

### 3. Reporting Limits

The reporting limit for PFAS's is 2 ng/L for aqueous samples (20 ng/L for HFPO-DA) and 1 ng/g (10 ng/g for HFPO-DA) for soil samples.

### 4. Interferences

- 4.1 PFAS standards, extracts and samples should not come in contact with any glass containers or pipettes as these analytes can potentially adsorb to glass surfaces. PFAS analyte and EIS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers.
- 4.2 Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The method analytes in this method can also be found in many common laboratory supplies and equipment, such

as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc. All items such as these must be routinely demonstrated to be free from interferences (less than 1/3 the RL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks as described in Section 9.2. **Subtracting blank values from sample results is not permitted.**

- 4.3** Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of humic content of the sample.
- 4.4** SPE cartridges can be a source of interferences. The analysis of field and laboratory reagent blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

## **5. Health and Safety**

- 5.1** The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.
- 5.2** All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.
- 5.3** PFOA has been described as "likely to be carcinogenic to humans." Pure standard materials and stock standard solutions of these method analytes should be handled with suitable protection to skin and eyes, and care should be taken not to breathe the vapors or ingest the materials.

## **6. Sample Collection, Preservation, Shipping and Handling**

### **6.1 Sample Collection for Aqueous Samples**

- 6.1.1** Samples must be collected in two (2) 250-mL high density polyethylene (HDPE) container with an unlined plastic screw cap.
- 6.1.2** The sample handler must wash their hands before sampling and wear nitrile gloves while filling and sealing the sample bottles. PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.
- 6.1.3** Open the tap and allow the system to flush until the water temperature has stabilized (approximately 3 to 5 min). Collect samples from the flowing system.



6.1.4 Fill sample bottles. Samples do not need to be collected headspace free.

6.1.5 After collecting the sample and cap the bottle. Keep the sample sealed from time of collection until extraction.

6.1.6 Field Reagent Blank (FRB)

6.1.6.1 A FRB must be handled along with each sample set. The sample set is composed of samples collected from the same sample site and at the same time. At the laboratory, fill the field blank sample bottle with reagent water and preservatives, seal, and ship to the sampling site along with the sample bottles. For each FRB shipped, an empty sample bottle (no preservatives) must also be shipped. At the sampling site, the sampler must open the shipped FRB and pour the reagent water into the empty shipped sample bottle, seal and label this bottle as the FRB. The FRB is shipped back to the laboratory along with the samples and analyzed to ensure that PFAS's were not introduced into the sample during sample collection/handling.

The reagent water used for the FRBs must be initially analyzed for method analytes as a MB and must meet the MB criteria in Section 9.2.1 prior to use. This requirement will ensure samples are not being discarded due to contaminated reagent water rather than contamination during sampling.

## 6.2 Sample Collection for Soil and Sediment samples.

Grab samples are collected in polypropylene containers. Sample containers and contact surfaces containing PTFE shall be avoided.

## 6.3 Sample Preservation

Not applicable.

## 6.4 Sample Shipping

Samples must be chilled during shipment and must not exceed 10 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction, but should not be frozen.

**NOTE:** Samples that are significantly above 10° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

## 6.5 Sample Handling

6.5.1 Holding Times

6.5.1.1 Water samples should be extracted as soon as possible but must be extracted within 14 days. Soil samples should be extracted within 28 days. Extracts are stored at < 10 ° C and analyzed within 28 days after extraction.

# 7. Equipment and Supplies

- 7.1 SAMPLE CONTAINERS – 250-mL high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.
- 7.2 POLYPROPYLENE BOTTLES – 4-mL narrow-mouth polypropylene bottles.
- 7.3 CENTRIFUGE TUBES – 50-mL conical polypropylene tubes with polypropylene screw caps for storing standard solutions and for collection of the extracts.
- 7.4 AUTOSAMPLER VIALS – Polypropylene 0.7-mL autosampler vials with polypropylene caps.
  - 7.4.1 NOTE: Polypropylene vials and caps are necessary to prevent contamination of the sample from PTFE coated septa. However, polypropylene caps do not reseal, so evaporation occurs after injection. Thus, multiple injections from the same vial are not possible.
- 7.5 POLYPROPYLENE GRADUATED CYLINDERS – Suggested sizes include 25, 50, 100 and 1000-mL cylinders.
- 7.6 Auto Pipets – Suggested sizes include 5, 10, 25, 50, 100, 250, 500, 1000, 5000 and 10,000- $\mu$ ls.
- 7.7 PLASTIC PIPETS – Polypropylene or polyethylene disposable pipets.
- 7.8 ANALYTICAL BALANCE – Capable of weighing to the nearest 0.0001 g.
- 7.9 SOLID PHASE EXTRACTION (SPE) APPARATUS FOR USING CARTRIDGES
  - 7.9.1 SPE CARTRIDGES – 0.5 g SPE cartridges containing a reverse phase copolymer characterized by a weak anion exchanger (WAX) sorbent phase.
  - 7.9.2 VACUUM EXTRACTION MANIFOLD – A manual vacuum manifold with large volume sampler for cartridge extractions, or an automatic/robotic sample preparation system designed for use with SPE cartridges, may be used if all QC requirements discussed in Section 9 are met. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. Care must be taken with automated SPE systems to ensure the PTFE commonly used in these systems does not contribute to unacceptable analyte concentrations in the MB (Sect. 9.2.1).
  - 7.9.3 SAMPLE DELIVERY SYSTEM – Use of a polypropylene transfer tube system, which transfers the sample directly from the sample container to the SPE cartridge, is recommended, but not mandatory. Standard extraction manifolds come equipped with PTFE transfer tube systems. These can be replaced with 1/8" O.D. x 1/16" I.D. polypropylene or polyethylene tubing cut to an appropriate length to ensure no sample contamination from the sample transfer lines. Other types of non-PTFE tubing may be used provided it meets the MB (Sect. 9.2.1) and LCS (Sect. 9.3) QC requirements. The PTFE transfer tubes may be used, but an MB must be run on each PTFE transfer tube and the QC requirements in Section 13.2.2 must be met. In the case of automated SPE, the removal of PTFE lines may not be feasible; therefore, MBs will need to be rotated among the ports and must meet the QC requirements of Sections 13.2.2 and 9.2.1.
- 7.10 Extract Clean-up Cartridge – 250 mg 6ml SPE Cartridge containing graphitized polymer carbon

**7.11 EXTRACT CONCENTRATION SYSTEM** – Extracts are concentrated by evaporation with nitrogen using a water bath set no higher than 65 °C.

**7.12 LABORATORY OR ASPIRATOR VACUUM SYSTEM** – Sufficient capacity to maintain a vacuum of approximately 10 to 15 inches of mercury for extraction cartridges.

**7.13 LIQUID CHROMATOGRAPHY (LC)/TANDEM MASS SPECTROMETER (MS/MS) WITH DATA SYSTEM**

**7.13.1 LC SYSTEM** – Instrument capable of reproducibly injecting up to 10- $\mu$ L aliquots, and performing binary linear gradients at a constant flow rate near the flow rate used for development of this method (0.4 mL/min). The LC must be capable of pumping the water/methanol mobile phase without the use of a degasser which pulls vacuum on the mobile phase bottle (other types of degassers are acceptable). Degassers which pull vacuum on the mobile phase bottle will volatilize the ammonium acetate mobile phase causing the analyte peaks to shift to earlier retention times over the course of the analysis batch. The usage of a column heater is optional.

NOTE: During the course of method development, it was discovered that while idle for more than one day, PFAS's built up in the PTFE solvent transfer lines. To prevent long delays in purging high levels of PFAS's from the LC solvent lines, they were replaced with PEEK tubing and the PTFE solvent frits were replaced with stainless steel frits. It is not possible to remove all PFAS background contamination, but these measures help to minimize their background levels.

**7.13.2 LC/TANDEM MASS SPECTROMETER** – The LC/MS/MS must be capable of negative ion electrospray ionization (ESI) near the suggested LC flow rate of 0.4 mL/min. The system must be capable of performing MS/MS to produce unique product ions for the method analytes within specified retention time segments. A minimum of 10 scans across the chromatographic peak is required to ensure adequate precision.

**7.13.3 DATA SYSTEM** – An interfaced data system is required to acquire, store, reduce, and output mass spectral data. The computer software should have the capability of processing stored LC/MS/MS data by recognizing an LC peak within any given retention time window. The software must allow integration of the ion abundance of any specific ion within specified time or scan number limits. The software must be able to calculate relative response factors, construct linear regressions or quadratic calibration curves, and calculate analyte concentrations.

**7.13.4 ANALYTICAL COLUMN** – An LC BEH C<sub>18</sub> column (2.1 x 50 mm) packed with 1.7  $\mu$ m d<sub>p</sub> C<sub>18</sub> solid phase particles was used. Any column that provides adequate resolution, peak shape, capacity, accuracy, and precision (Sect. 9) may be used.

## 8. Reagents and Standards

**8.1 GASES, REAGENTS, AND SOLVENTS** – Reagent grade or better chemicals should be used.

**8.1.1 REAGENT WATER** – Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/3 the RL for each method analyte of interest. Prior to daily use, at least 3 L of reagent water should be flushed from the purification system to rinse out any build-up of analytes in the system's tubing.

- 8.1.2 METHANOL ( $\text{CH}_3\text{OH}$ , CAS#: 67-56-1) – High purity, demonstrated to be free of analytes and interferences.
  - 8.1.3 AMMONIUM ACETATE ( $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , CAS#: 631-61-8) – High purity, demonstrated to be free of analytes and interferences.
  - 8.1.4 ACETIC ACID ( $\text{H}_3\text{CCOOH}$ , CAS#: 64-19-7) - High purity, demonstrated to be free of analytes and interferences.
  - 8.1.5 1M AMMONIUM ACETATE/REAGENT WATER – High purity, demonstrated to be free of analytes and interferences.
  - 8.1.6 2mM AMMONIUM ACETATE/METHANOL:WATER (5:95) – To prepare, mix 2 ml of 1M AMMONIUM ACETATE, 1 ml ACETIC ACID and 50 ml METHANOL into 1 Liter of REAGENT WATER.
  - 8.1.7 Methanol/Water (80:20) – To prepare a 1 Liter bottle, mix 200 ml of REAGENT WATER with 800 ml of METHANOL.
  - 8.1.8 AMMONIUM HYDROXIDE ( $\text{NH}_3$ , CAS#: 1336-21-6) – High purity, demonstrated to be free of analytes and interferences.
  - 8.1.9 Sodium Acetate ( $\text{NaOOCCH}_3$ , CAS#: 127-09-3) – High purity, demonstrated to be free of analytes and interferences.
  - 8.1.10 25 mM Sodium Acetate Buffer – To prepare 250mls, dissolve .625 grams of sodium acetate into 100 mls of reagent water. Add 4 mls Acetic Acid and adjust the final volume to 250 mls with reagent water.
  - 8.1.11 NITROGEN – Used for the following purposes: Nitrogen aids in aerosol generation of the ESI liquid spray and is used as collision gas in some MS/MS instruments. The nitrogen used should meet or exceed instrument manufacturer's specifications. In addition, Nitrogen is used to concentrate sample extracts (Ultra High Purity or equivalent).
  - 8.1.12 ARGON – Used as collision gas in MS/MS instruments. Argon should meet or exceed instrument manufacturer's specifications. Nitrogen gas may be used as the collision gas provided sufficient sensitivity (product ion formation) is achieved.
- 8.2 STANDARD SOLUTIONS – When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. PFAS analyte and IS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples.

**NOTE:** Stock standards and diluted stock standards are stored at  $\leq 4^\circ\text{C}$ .

**8.2.1** ISOTOPE DILUTION Extracted Internal Standard (ID EIS) STOCK SOLUTIONS  
 - ID EIS stock standard solutions are stable for at least 6 months when stored at 4 °C. The stock solution is purchased at a concentration of 1000 ng/mL.

**8.2.2** ISOTOPE DILUTION Extracted Internal Standard PRIMARY DILUTION STANDARD (ID EIS PDS) – Prepare the ID EIS PDS at a concentration of 500 ng/mL. The ID PDS is prepared in 80:20% (vol/vol) methanol:water. The ID PDS is stable for 6 months when stored at ≤4 °C.

**Table 2**

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Vol. of EIS Stock (mL)	Final Vol. of EIS PDS (mL)	Final Conc. of EIS PDS (ng/mL)
M4PFBA	1000	1.0	2.0	500
M5PFPeA	1000	1.0	2.0	500
M5PFHxA	1000	1.0	2.0	500
M4PFHpA	1000	1.0	2.0	500
M8PFOA	1000	1.0	2.0	500
M9PFNA	1000	1.0	2.0	500
M6PFDA	1000	1.0	2.0	500
M7PFUdA	1000	1.0	2.0	500
MPFDoA	1000	1.0	2.0	500
M2PFTeDA	1000	1.0	2.0	500
M2PFHxDA	50,000	.02	2.0	500
d3-N-MeFOSA	50,000	.02	2.0	500
d5-N-EtFOSA	50,000	.02	2.0	500
d7-N-MeFOSE	50,000	.02	2.0	500
d9-N-EtFOSE	50,000	.02	2.0	500
M8FOSA	1000	1.0	2.0	500
d3-N-MeFOSAA	1000	1.0	2.0	500
d5-N-EtFOSAA	1000	1.0	2.0	500
M3PFBS	929	1.0	2.0	464.5
M3PFHxS	946	1.0	2.0	473
M8PFOS	957	1.0	2.0	478.5
M2-4:2FTS	935	1.0	2.0	467.5
M2-6:2FTS	949	1.0	2.0	474.5
M2-8:2FTS	958	1.0	2.0	479
M3HFPO-DA	50,000	.4	2.0	10,000

**8.2.3** ANALYTE STOCK STANDARD SOLUTION – Analyte stock standards are stable for at least 6 months when stored at 4 °C. When using these stock standards to prepare a PDS, care must be taken to ensure that these standards are at room temperature and adequately vortexed.

**8.2.4** Analyte Secondary Spiking Standard Prepare the spiking solution of additional add on components for project specific requirements only. ANALYTE PRIMARY SPIKING STANDARD – Prepare the spiking standard at a concentration of 500 ng/mL in methanol. The spiking standard is stable for at least two months when stored in polypropylene centrifuge tubes at room temperature.

Table 3

Analyte	Conc. of IS Stock (ng/mL)	Vol. of IS Stock (mL)	Final Vol. of IS PDS (mL)	Final Conc. of IS PDS (ng/mL)
PFBA	2000	1	4	500
PFPeA	2000	1	4	500
PFHxA	2000	1	4	500
PFHpA	2000	1	4	500
PFOA	2000	1	4	500
PFNA	2000	1	4	500
PFDA	2000	1	4	500
PFUdA	2000	1	4	500
PFDaA	2000	1	4	500
PFTTrDA	2000	1	4	500
PFTeDA	2000	1	4	500
FOSA	2000	1	4	500
N-MeFOSAA	2000	1	4	500
N-EtFOSAA	2000	1	4	500
L-PFBS	1770	1	4	442.5
L-PFPeS	1880	1	4	470
L-PFHxSK	1480	1	4	370
Br-PFHxSK	344	1	4	86
L-PFHpS	1900	1	4	475
L-PFOSK	1460	1	4	365
Br-PFOSK	391	1	4	97.75
L-PFNS	1920	1	4	480
L-PFDS	1930	1	4	482.5
4:2FTS	1870	1	4	467.5
6:2FTS	1900	1	4	475
8:2FTS	1920	1	4	480

**8.2.5** Analyte Secondary Spiking Standard Prepare the spiking solution of additional add on components for project specific requirements only.

Table 4

Analyte	Conc. of IS Stock (ng/mL)	Vol. of IS Stock (mL)	Final Vol. of IS PDS (mL)	Final Conc. of IS PDS (ng/mL)
ADONA	2000	1	4	500
PFHxDA	2000	1	4	500
PFODA	2000	1	4	500
HFPO-DA	100,000	.4	4	10,000
9CIPF3ONS	50,000	0.04	4	500
11CIPF3OUdS	50,000	0.04	4	500

- 8.2.6** LOW, MEDIUM AND HIGH LEVEL LCS – The LCS's will be prepared at the following concentrations and rotated per batch; 2 ng/L, 40 ng/L, 500 ng/L for drinking waters. The analyte PDS contains all the method analytes of interest at various concentrations in methanol. The analyte PDS has been shown to be stable for six months when stored at  $\leq 4^{\circ}\text{C}$ .
- 8.2.7** Isotope Dilution Labeled Recovery Stock Solutions (ID REC) – ID REC Stock solutions are stable for at least 6 months when stored at  $4^{\circ}\text{C}$ . The stock solution is purchased at a concentration of 1000 ng/mL.
- 8.2.8** Isotope Dilution Labeled Recovery Primary Dilution Standard (ID REC PDS) - Prepare the ID REC PDS at a concentration of 500 ng/mL. The ID REC PDS is prepared in 80:20% (vol/vol) methanol:water. The ID REC PDS is stable for at least six months when stored in polypropylene centrifuge tubes at  $\leq 4^{\circ}\text{C}$ .

**Table 5**

Analyte	Conc. of REC Stock (ng/mL)	Vol. of REC Stock (mL)	Final Vol. of REC PDS (mL)	Final Conc. of REC PDS (ng/mL)
M2PFOA	2000	1	4	500
M2PFDA	2000	1	4	500
M3PFBA	2000	1	4	500
M4PFOS	2000	1	4	500

**8.2.9 CALIBRATION STANDARDS (CAL) –**

Current Concentrations (ng/mL): 0.5, 1.0, 5.0, 10.0, 50.0, 125, 150, 250, 500

Prepare the CAL standards over the concentration range of interest from dilutions of the analyte PDS in methanol containing 20% reagent water. 20  $\mu\text{L}$  of the EIS PDS and REC PDS are added to the CAL standards to give a constant concentration of 10 ng/mL. The lowest concentration CAL standard must be at or below the RL (2 ng/L), which may depend on system sensitivity. The CAL standards may also be used as CCVs (Sect. 9.8). To make calibration stock standards:

**Table 6**

Calibration Standard Concentration	Final Aqueous Cal STD Level Concentration	Final Soil Cal STD Level Concentration	24 compound stock added (ul)	PFHxDA Stock added (ul)	500 ng/ml PFHxDA dilution added (ul)	PFODA Stock added (ul)	500 ng/ml PFODA dilution added (ul)	ADONA, HFPO-DA, 11Cl-PF3OUdS, 9Cl-PF3ONS Stock added (ul)	500 ng/ml ADONA dilution added (ul)	Final Volume in MeOH/H <sub>2</sub> O (82:20)
.5 ng/ml	2 ng/L	.25 ng/g	6.25		25		25		25	25 mls
1 ng/ml	4 ng/L	.5 ng/g	5		20		20		20	10 mls
5 ng/ml	20 ng/L	1 ng/g	25		100		100		100	10 mls
10 ng/ml	40 ng/L	5 ng/g	125	5		5		5		25 mls

50 ng/ml	200 ng/L	25 ng/g	250	10		10		10		10 mls
125 ng/ml	500 ng/L	62.5 ng/g	625	25		25		25		10 mls
150 ng/ml	600 ng/L	75 ng/g	750	30		30		30		10 mls
250 ng/ml	1000 ng/L	125 ng/g	625							5 mls
500 ng/ml	2000 ng/L	250 ng/g	1250							5 mls

## 9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

### 9.1 MINIMUM REPORTING LIMIT (MRL) CONFIRMATION

- 9.1.1 Fortify, extract, and analyze seven replicate LCSs at 2 ng/l. Calculate the mean measured concentration (*Mean*) and standard deviation for these replicates. Determine the Half Range for the prediction interval of results ( $HR_{PIR}$ ) using the equation below

$$HR_{PIR} = 3.963s$$

Where:

$s$  = the standard deviation

3.963 = a constant value for seven replicates.

- 9.1.2 Confirm that the upper and lower limits for the Prediction Interval of Result ( $PIR = Mean \pm HR_{PIR}$ ) meet the upper and lower recovery limits as shown below

The Upper PIR Limit must be  $\leq 150\%$  recovery.

$$\frac{Mean + HR_{PIR}}{Fortified\ Concentration} \times 100\% \leq 150\%$$

The Lower PIR Limit must be  $\geq 50\%$  recovery.

$$\frac{Mean - HR_{PIR}}{Fortified\ Concentration} \times 100\% \geq 50\%$$

- 9.1.3 The RL is validated if both the Upper and Lower PIR Limits meet the criteria described above. If these criteria are not met, the RL has been set too low and must be determined again at a higher concentration.

### 9.2 Blank(s)

- 9.2.1 **METHOD BLANK (MB)** - A Method Blank (MB) is required with each extraction batch to confirm that potential background contaminants are not interfering with the identification or quantitation of method analytes. Prep and analyze a MB for every 20 samples. If the MB produces a peak within the retention time window of any analyte that would prevent the determination of that analyte, determine the source of contamination and eliminate the interference before processing samples. Background contamination must be reduced to an acceptable level before proceeding. Background from method analytes or other contaminants that



interfere with the measurement of method analytes must be below the RL. If the method analytes are detected in the MB at concentrations equal to or greater than this level, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch. Because background contamination is a significant problem for several method analytes, it is highly recommended that the analyst maintain a historical record of MB data.

- 9.2.2 FIELD REAGENT BLANK (FRB)** - The purpose of the FRB is to ensure that PFAS's measured in the Field Samples were not inadvertently introduced into the sample during sample collection/handling. Analysis of the FRB is required only if a Field Sample contains a method analyte or analytes at or above the RL. The FRB is processed, extracted and analyzed in exactly the same manner as a Field Sample.

### **9.3 Laboratory Control Sample (LCS) and Laboratory Control Sample Duplicates (LCSD)**

- 9.3.1** An LCS is required with each extraction batch. The fortified concentration of the LCS may be rotated between low, medium, and high concentrations from batch to batch. Default limits of 50-150% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%R) for each analyte using the equation

$$\%R = \frac{A \times 100}{B}$$

Where:

A = measured concentration in the fortified sample  
B = fortification concentration.

- 9.3.2** Where applicable, LCSD's are to be extracted and analyzed. The concentration and analyte recovery criteria for the LCSD must be the same as the batch LCS. The RSD's must fall within  $\leq 30\%$  of the true value for medium and high level replicates, and  $\leq 50\%$  for low level replicates. Calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation

$$RPD = \frac{|LCS - LCSD|}{(LCS + LCSD) / 2} \times 100$$

- 9.3.3** If the LCS and or LCSD results do not meet these criteria for method analytes, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.

### **9.4 Labeled Recovery Standards (REC)**

The analyst must monitor the peak areas of the REC(s) in all injections during each analysis day.

#### **9.5 Extracted Internal Standards (EIS)**

- 9.5.1** The EIS standard is fortified into all samples, CCVs, MBs, LCSs, MSs, MSDs, FD, and FRB prior to extraction. It is also added to the CAL standards. The EIS is a means of assessing method performance from extraction to final

chromatographic measurement. Calculate the recovery (%R) for the EIS using the following equation

$$\%R = (A / B) \times 100$$

Where:

A = calculated EIS concentration for the QC or Field Sample  
B = fortified concentration of the EIS.

- 9.5.2** Default limits of 50-150% may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. A low or high percent recovery for a sample, blank, or CCV does not require discarding the analytical data but it may indicate a potential problem with future analytical data. When EIS recovery from a sample, blank, or CCV are outside control limits, check 1) calculations to locate possible errors, 2) standard solutions for degradation, 3) contamination, and 4) instrument performance. For CCVs and QC elements spiked with all target analytes, if the recovery of the corresponding target analytes meet the acceptance criteria for the EIS in question, the data can be used but all potential biases in the recovery of the EIS must be documented in the sample report. If the associated target analytes do not meet the acceptance criteria, the data must be reanalyzed.

## 9.6 Matrix Spike (MS)

- 9.6.1** Analysis of an MS is required in each extraction batch and is used to determine that the sample matrix does not adversely affect method accuracy. Assessment of method precision is accomplished by analysis of a Field Duplicate (FD) (Sect. 9.6); however, infrequent occurrence of method analytes would hinder this assessment. If the occurrence of method analytes in the samples is infrequent, or if historical trends are unavailable, a second MS, or MSD, must be prepared, extracted, and analyzed from a duplicate of the Field Sample. Extraction batches that contain MSDs will not require the extraction of a field sample duplicate. If a variety of different sample matrices are analyzed regularly, for example, drinking water from groundwater and surface water sources, method performance should be established for each. Over time, MS data should be documented by the laboratory for all routine sample sources.
- 9.6.2** Within each extraction batch, a minimum of one Field Sample is fortified as an MS for every 20 Field Samples analyzed. The MS is prepared by spiking a sample with an appropriate amount of the Analyte Stock Standard (Sect. 8.2.3). Use historical data and rotate through the low, mid and high concentrations when selecting a fortifying concentration. Calculate the percent recovery (%R) for each analyte using the equation

$$\%R = \frac{(A - B)}{C} \times 100$$

Where:

A = measured concentration in the fortified sample  
B = measured concentration in the unfortified sample  
C = fortification concentration.

- 9.6.3** Analyte recoveries may exhibit matrix bias. For samples fortified at or above their native concentration, recoveries should range between 50-150%. If the accuracy of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCS, the recovery is judged to be

matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

## 9.7 Laboratory Duplicate

**9.7.1** FIELD DUPLICATE OR LABORATORY FORTIFIED SAMPLE MATRIX DUPLICATE (FD or MSD) – Within each extraction batch (not to exceed 20 Field Samples), a minimum of one FD or MSD must be analyzed. Duplicates check the precision associated with sample collection, preservation, storage, and laboratory procedures. If method analytes are not routinely observed in Field Samples, an MSD should be analyzed rather than an FD.

**9.7.2** Calculate the relative percent difference (RPD) for duplicate measurements (FD1 and FD2) using the equation

$$RPD = \frac{|FD1 - FD2|}{(FD1 + FD2) / 2} \times 100$$

**9.7.3** RPDs for FDs should be ≤30%. Greater variability may be observed when FDs have analyte concentrations that are within a factor of 2 of the RL. At these concentrations, FDs should have RPDs that are ≤50%. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCV, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

**9.7.4** If an MSD is analyzed instead of a FD, calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation

$$RPD = \frac{|MS - MSD|}{(MS + MSD) / 2} \times 100$$

**9.7.5** RPDs for duplicate MSs should be ≤30% for samples fortified at or above their native concentration. Greater variability may be observed when MSs are fortified at analyte concentrations that are within a factor of 2 of the RL. MSs fortified at these concentrations should have RPDs that are ≤50% for samples fortified at or above their native concentration. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the LCSD where applicable, the result is judged to be matrix biased. If no LCSD is present, the associated MS and MSD are to be re-analyzed to determine if any analytical has occurred. If the resulting RPDs are still outside control limits, the result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

## 9.8 Initial Calibration Verification (ICV)

**9.8.1** As part of the IDC (Sect. 13.2), and after each ICAL, analyze a QCS sample from a source different from the source of the CAL standards. If a second vendor is not available, then a different lot of the standard should be used. The QCS should be prepared and analyzed just like a CCV. Acceptance criteria for the QCS are identical to the CCVs; the calculated amount for each analyte must be ±

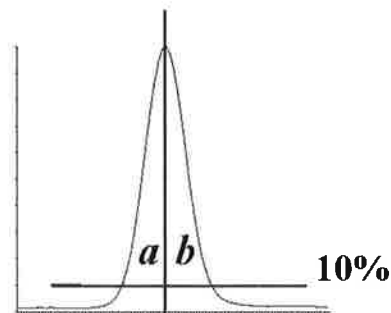
30% of the expected value. If measured analyte concentrations are not of acceptable accuracy, check the entire analytical procedure to locate and correct the problem.

## 9.9 Continuing Calibration Verification (CCV)

- 9.9.1 CCV Standards are analyzed at the beginning of each analysis batch, after every 10 Field Samples, and at the end of the analysis batch. See Section 10.7 for concentration requirements and acceptance criteria.

## 9.10 Method-specific Quality Control Samples

- 9.10.1 PEAK ASYMMETRY FACTOR – A peak asymmetry factor must be calculated using the equation below during the IDL and every time a calibration curve is generated. The peak asymmetry factor for the first two eluting peaks in a midlevel CAL standard (if only two analytes are being analyzed, both must be evaluated) must fall in the range of 0.8 to 1.5. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted. See guidance in Section 10.6.4.1 if the calculated peak asymmetry factors do not meet the criteria.



$$A_s = b / a$$

Where:

$A_s$  = peak asymmetry factor

$b$  = width of the back half of the peak measured (at 10% peak height) from the trailing edge of the peak to a line dropped perpendicularly from the peak apex

$a$  = the width of the front half of the peak measured (at 10% peak height) from the leading edge of the peak to a line dropped perpendicularly from the apex.

## 9.11 Method Sequence

- CCV-LOW
- MB
- LCS
- LCSD
- MS
- Duplicate or MSD
- Field Samples (1-10)
- CCV-MID
- Field Samples (11-20)
- CCV-LOW

## 10. Procedure

### 10.1 Equipment Set-up

- 10.1.1 This procedure may be performed manually or in an automated mode using a robotic or automatic sample preparation device. If an automated system is used to prepare samples, follow the manufacturer's operating instructions, but all extraction and elution steps must be the same as in the manual procedure. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. If an automated system is used, the MBs should be rotated among the ports to ensure that all the valves and tubing meet the MB requirements (Sect. 9.2).
- 10.1.2 Some of the PFAS's adsorb to surfaces, including polypropylene. Therefore, the aqueous sample bottles must be rinsed with the elution solvent (Sect 10.3.4) whether extractions are performed manually or by automation. The bottle rinse is passed through the cartridge to elute the method analytes and is then collected (Sect. 10.3.4).
- 10.1.3 **NOTE:** The SPE cartridges and sample bottles described in this section are designed as single use items and should be discarded after use. They may not be refurbished for reuse in subsequent analyses.

### 10.2 Sample Preparation and Extraction of Aqueous Samples

- 10.2.1 Samples are preserved, collected and stored as presented in Section 6.

The entire sample that is received must be sent through the SPE cartridge. In addition, the bottle must be solvent rinsed and this rinse must be sent through the SPE cartridge as well. The method blank (MB) and laboratory control sample (LCS) must be extracted in exactly the same manner (i.e., must include the bottle solvent rinse). It should be noted that a water rinse alone is not sufficient. This does not apply to samples with high concentrations of PFAS that are prepared using serial dilution and not SPE.

- 10.2.2 Determine sample volume. Weigh all samples to the nearest 1g. If visible sediment is present, centrifuge and decant into a new 250mL HDPE bottle and record the weight of the new container.

**NOTE:** Some of the PFAS's adsorb to surfaces, thus the sample volume may **NOT** be transferred to a graduated cylinder for volume measurement.

- 10.2.3 The MB, LCS and FRB may be prepared by measuring 250 mL of reagent water with a polypropylene graduated cylinder or filling a 250-mL sample bottle to near the top.
- 10.2.4 Adjust the QC and sample pH to 3 by adding acetic acid in water dropwise
- 10.2.5 Add 20  $\mu$ L of the EIS PDS (Sect. 8.2.2) to each sample and QC, cap and invert to mix.
- 10.2.6 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS (Sect. 8.2.3). Cap and invert each sample to mix.

### 10.3 Cartridge SPE Procedure

- 10.3.1 CARTRIDGE CLEAN-UP AND CONDITIONING** – DO NOT allow cartridge packing material to go dry during any of the conditioning steps. Rinse each cartridge with 3 X 5 mL of 2% ammonium hydroxide in methanol, followed by 5mls of methanol. Next, rinse each cartridge with 5 mls of the 25 mM acetate buffer, followed by 15 mL of reagent water, without allowing the water to drop below the top edge of the packing. If the cartridge goes dry during the conditioning phase, the conditioning must be started over. Add 4-5 mL of reagent water to each cartridge, attach the sample transfer tubes (Sect. 7.9.3), turn on the vacuum, and begin adding sample to the cartridge.
- 10.3.2 SAMPLE EXTRACTON** – Adjust the vacuum so that the approximate flow rate is approximately 4 mL/min. Do not allow the cartridge to go dry before all the sample has passed through.
- 10.3.3 SAMPLE BOTTLE AND CARTRIDGE RINSE** – After the entire sample has passed through the cartridge, rinse the sample bottles with 4 ml reagent water followed by 4 ml 25 mM acetate buffer at pH 4 and draw the aliquot through the sample transfer tubes and the cartridges. Draw air or nitrogen through the cartridge for 5-10 min at high vacuum (10-15 in. Hg). **NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the entire sample has passed through the cartridge, the reservoirs must be rinsed to waste with reagent water.**
- 10.3.4 SAMPLE BOTTLE AND CARTRIDGE ELUTION, Fraction 1** – Turn off and release the vacuum. Lift the extraction manifold top and insert a rack with collection tubes into the extraction tank to collect the extracts as they are eluted from the cartridges. Rinse the sample bottles with 12 mls of methanol and draw the aliquot through the sample transfer tubes and cartridges. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion.
- SAMPLE BOTTLE AND CARTRIDGE ELUTION, Fraction 2** In a separate collection vial, rinse the sample bottles with 12 mL of 2% ammonium hydroxide in methanol and elute the analytes from the cartridges by pulling the 4 mL of methanol through the sample transfer tubes and the cartridges. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion. To the final extract, add 50 ul of acetic acid.
- NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the reservoirs have been rinsed in Section 10.3.3, the elution solvent used to rinse the sample bottles must be swirled down the sides of the reservoirs while eluting the cartridge to ensure that any method analytes on the surface of the reservoirs are transferred to the extract.**
- CLEAN-UP CARTRIDGE ELUTION**, Elute the clean-up cartridge with 8 additional mls of methanol and draw the aliquot through the cartridge. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion.
- 10.3.5** Fractions 1 and 2 are to be combined during the concentration stage (section 10.6)

## 10.4 Sample Prep and Extraction Protocol for Soils

- 10.4.1 Homogenize and weigh 2 grams of sample (measured to the nearest hundredth of a gram) into a 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 2 grams of clean sand is used.
- 10.4.2 Add 20 µL of the EIS PDS (Sect. 8.2.2) to each sample and QC.
- 10.4.3 If the sample is an LCS, LCSD, MS, or MSD, add the necessary amount of analyte PDS (Sect. 8.2.3). Cap and invert each sample to mix.
- 10.4.4 To all samples, add 10 mls of methanol, cap, vortex for 25 seconds at 3000RPM and mix for 30 minutes using a shaker table or tumbler at 120RPM.
- 10.4.5 Following mixing, sonicate each sample for 30 minutes and let samples sit overnight (at least 2 hours is required for RUSH samples).
- 10.4.6 Centrifuge each sample at 3500RPM for 10 minutes.
- 10.4.7 Remove supernatant, and reserve for clean-up.

## 10.5 Extract Clean-up

- 10.5.1 CARTRIDGE CLEAN-UP AND CONDITIONING – Rinse each cartridge with 15 mL of methanol and discard. If the cartridge goes dry during the conditioning phase, the conditioning must be started over. Attach the sample transfer tubes (Sect. 7.9.3), turn on the vacuum, and begin adding sample to the cartridge.
- 10.5.2 Adjust the vacuum so that the approximate flow rate is 1-2 mL/min. Do not allow the cartridge to go dry before all the sample has passed through.
- 10.5.3 SAMPLE BOTTLE AND CARTRIDGE RINSE – After the entire sample has passed through the cartridge, rinse the sample collection vial with two 1-mL aliquots of methanol and draw each aliquot through the cartridges. Draw air or nitrogen through the cartridge for 5 min at high vacuum (10-15 in. Hg).
- 10.5.4 If extracts are not to be immediately evaporated, cover collection tubes and store at ambient temperature till concentration.

## 10.6 Extract Concentration

- 10.6.1 Concentrate the extract to dryness under a gentle stream of nitrogen in a heated water bath (60-65 °C) to remove all the water/methanol mix. Add the appropriate amount of 80:20% (vol/vol) methanol:water solution and 20 µL of the ID REC PDS (Sect. 8.2.7) to the collection vial to bring the volume to 1 mL and vortex. Transfer two aliquots with a plastic pipet (Sect. 7.6) into 2 polypropylene autosampler vials.

**NOTE:** It is recommended that the entire 1-mL aliquot not be transferred to the autosampler vial because the polypropylene autosampler caps do not reseal after injection. Therefore, do not store the extracts in the autosampler vials as evaporation losses can occur occasionally in these autosampler vials. Extracts can be split between 2 X 700 µL vials (Sect. 7.4).

## 10.7 Sample Volume Determination

- 10.7.1 If the level of the sample was marked on the sample bottle, use a graduated cylinder to measure the volume of water required to fill the original sample bottle to the mark made prior to extraction. Determine to the nearest 10 mL.
- 10.7.2 If using weight to determine volume, weigh the empty bottle to the nearest 10 g and determine the sample weight by subtraction of the empty bottle weight from the original sample weight (Sect. 10.2.2). Assume a sample density of 1.0 g/mL. In either case, the sample volume will be used in the final calculations of the analyte concentration (Sect. 11.2).

**10.8 Initial Calibration** - Demonstration and documentation of acceptable initial calibration is required before any samples are analyzed. After the initial calibration is successful, a CCV is required at the beginning and end of each period in which analyses are performed, and after every tenth Field Sample.

**10.8.1 ESI-MS/MS TUNE**

- 10.8.1.1 Calibrate the mass scale of the MS with the calibration compounds and procedures prescribed by the manufacturer.
- 10.8.1.2 Optimize the [M-H]<sup>-</sup> for each method analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.4 mL/min). This tune can be done on a mix of the method analytes. The MS parameters (voltages, temperatures, gas flows, etc.) are varied until optimal analyte responses are determined. The method analytes may have different optima requiring some compromise between the optima.
- 10.8.1.3 Optimize the product ion for each analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.4 mL/min). This tune can be done on a mix of the method analytes. The MS/MS parameters (collision gas pressure, collision energy, etc.) are varied until optimal analyte responses are determined. Typically, the carboxylic acids have very similar MS/MS conditions and the sulfonic acids have similar MS/MS conditions.
- 10.8.2 Establish LC operating parameters that optimize resolution and peak shape. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

**Cautions:** LC system components, as well as the mobile phase constituents, contain many of the method analytes in this method. Thus, these PFAS's will build up on the head of the LC column during mobile phase equilibration. To minimize the background PFAS peaks and to keep background levels constant, the time the LC column sits at initial conditions must be kept constant and as short as possible (while ensuring reproducible retention times). In addition, prior to daily use, flush the column with 100% methanol for at least 20 min before initiating a sequence. It may be necessary on some systems to flush other LC components such as wash syringes, sample needles or any other system components before daily use.

- 10.8.3 Inject a mid-level CAL standard under LC/MS conditions to obtain the retention times of each method analyte. If analyzing for PFTA, ensure that the LC



conditions are adequate to prevent co-elution of PFTA and the mobile phase interferants. These interferants have the same precursor and products ions as PFTA, and under faster LC conditions may co-elute with PFTA. Divide the chromatogram into retention time windows each of which contains one or more chromatographic peaks. During MS/MS analysis, fragment a small number of selected precursor ions ( $[M-H]^-$ ) for the analytes in each window and choose the most abundant product ion. For maximum sensitivity, small mass windows of  $\pm 0.5$  daltons around the product ion mass were used for quantitation.

- 10.8.4** Inject a mid-level CAL standard under optimized LC/MS/MS conditions to ensure that each method analyte is observed in its MS/MS window and that there are at least 10 scans across the peak for optimum precision.

**10.8.4.1** If broad, split or fronting peaks are observed for the first two eluting chromatographic peaks (if only two analytes are being analyzed, both must be evaluated), change the initial mobile phase conditions to higher aqueous content until the peak asymmetry ratio for each peak is 0.8 – 1.5. The peak asymmetry factor is calculated as described in Section 9.9.1 on a mid-level CAL standard. The peak asymmetry factor must meet the above criteria for the first two eluting peaks during the IDL and every time a new calibration curve is generated. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

**NOTE:** PFHxS, PFOS, NMeFOSAA, and NeFOSAA have multiple chromatographic peaks using the LC conditions in Table 5 due to chromatographic resolution of the linear and branched isomers of these compounds. Most PFAS's are produced by two different processes. One process gives rise to linear PFAS's only while the other process produces both linear and branched isomers. Thus, both branched and linear PFAS's can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all the chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in a sample must be integrated in the same way as the CAL standard.

- 10.8.5** Prepare a set of CAL standards as described in Section 8.2.5. The lowest concentration CAL standard must be at or below the RL (2 ng/L), which may depend on system sensitivity.
- 10.8.6** The LC/MS/MS system is calibrated using the IS technique. Use the LC/MS/MS data system software to generate a linear regression or quadratic calibration curve for each of the analytes. This curve **must always** be forced through zero and may be concentration weighted, if necessary. Forcing zero allows for a better estimate of the background levels of method analytes. A minimum of 5 levels are required for a linear calibration model and a minimum of 6 levels are required for a quadratic calibration model.
- 10.8.7 CALIBRATION ACCEPTANCE CRITERIA** – A linear fit is acceptable if the coefficient of determination ( $r^2$ ) is greater than 0.99. When quantitated using the initial calibration curve, each calibration point, except the lowest point, for each analyte should calculate to be within 70-130% of its true value. The lowest CAL point should calculate to be within 50-150% of its true value. If these criteria cannot be met, the analyst will have difficulty meeting ongoing QC criteria. It is

recommended that corrective action is taken to reanalyze the CAL standards, restrict the range of calibration, or select an alternate method of calibration (forcing the curve through zero is still required).

**10.8.7.1 CAUTION:** When acquiring MS/MS data, LC operating conditions must be carefully reproduced for each analysis to provide reproducible retention times. If this is not done, the correct ions will not be monitored at the appropriate times. As a precautionary measure, the chromatographic peaks in each window must not elute too close to the edge of the segment time window.

**10.9 CONTINUING CALIBRATION CHECK (CCV)** – Minimum daily calibration verification is as follows. Verify the initial calibration at the beginning and end of each group of analyses, and after every tenth sample during analyses. In this context, a “sample” is considered to be a Field Sample. MBs, CCVs, LCSSs, MSs, FDs FRBs and MSDs are not counted as samples. The beginning CCV of each analysis batch must be at or below the RL in order to verify instrument sensitivity prior to any analyses. If standards have been prepared such that all low CAL points are not in the same CAL solution, it may be necessary to analyze two CAL standards to meet this requirement. Alternatively, the analyte concentrations in the analyte PDS may be customized to meet these criteria. Subsequent CCVs should alternate between a medium and Low concentration CAL standard.

**10.9.1** Inject an aliquot of the appropriate concentration CAL standard and analyze with the same conditions used during the initial calibration.

**10.9.2** Calculate the concentration of each analyte and EIS in the CCV. The calculated amount for each analyte for medium level CCVs must be within  $\pm 30\%$  of the true value with an allowance of 10% of the reported analytes to be greater than 30%, but less than 40%. The calculated amount for each EIS must be within  $\pm 50\%$  of the true value. The calculated amount for the lowest calibration point for each analyte must be within  $\pm 50\%$ . If these conditions do not exist, then all data for the problem analyte must be considered invalid, and remedial action should be taken (Sect. 10.7.4) which may require recalibration. Any Field or QC Samples that have been analyzed since the last acceptable calibration verification should be reanalyzed after adequate calibration has been restored, with the following exception. **If the CCV fails because the calculated concentration is greater than 130% (150% for the low-level CCV) for a particular method analyte, and Field Sample extracts show no detection for that method analyte, non-detects may be reported without re-analysis.**

**10.9.3 REMEDIAL ACTION** – Failure to meet CCV QC performance criteria may require remedial action. Major maintenance, such as cleaning the electrospray probe, atmospheric pressure ionization source, cleaning the mass analyzer, replacing the LC column, etc., requires recalibration (Sect 10.6) and verification of sensitivity by analyzing a CCV at or below the RL (Sect 10.7).

## 10.10 EXTRACT ANALYSIS

- 10.10.1 Establish operating conditions equivalent to those summarized in Tables 6-8 of Section 16. Instrument conditions and columns should be optimized prior to the initiation of the IDC.
- 10.10.2 Establish an appropriate retention time window for each analyte. This should be based on measurements of actual retention time variation for each method analyte in CAL standard solutions analyzed on the LC over the course of time. A value of plus or minus three times the standard deviation of the retention time obtained for each method analyte while establishing the initial calibration and completing the IDC can be used to calculate a suggested window size. However, the experience of the analyst should weigh heavily on the determination of the appropriate retention window size.
- 10.10.3 Calibrate the system by either the analysis of a calibration curve (Sect. 10.6) or by confirming the initial calibration is still valid by analyzing a CCV as described in Section 10.7. If establishing an initial calibration, complete the IDC as described in Section 13.2.
- 10.10.4 Begin analyzing Field Samples, including QC samples, at their appropriate frequency by injecting the same size aliquots under the same conditions used to analyze the CAL standards.
- 10.10.5 At the conclusion of data acquisition, use the same software that was used in the calibration procedure to identify peaks of interest in predetermined retention time windows. Use the data system software to examine the ion abundances of the peaks in the chromatogram. Identify an analyte by comparison of its retention time with that of the corresponding method analyte peak in a reference standard.
- 10.10.6 The analyst must not extrapolate beyond the established calibration range. If an analyte peak area exceeds the range of the initial calibration curve, the sample should be re-extracted with a reduced sample volume in order to bring the out of range target analytes into the calibration range. If a smaller sample size would not be representative of the entire sample, the following options are recommended. Re-extract an additional aliquot of sufficient size to insure that it is representative of the entire sample. Spike it with a higher concentration of internal standard. Prior to LC/MS analysis, dilute the sample so that it has a concentration of internal standard equivalent to that present in the calibration standard. Then, analyze the diluted extract.

## 11. Data Evaluation, Calculations and Reporting

- 11.1 Complete chromatographic resolution is not necessary for accurate and precise measurements of analyte concentrations using MS/MS. In validating this method, concentrations were calculated by measuring the product ions listed in Table 7.
- 11.2 Calculate analyte concentrations using the multipoint calibration established in Section 10.6. Do not use daily calibration verification data to quantitate analytes in samples. Adjust final analyte concentrations to reflect the actual sample volume determined in Section 10.6 where:

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*Printouts of this document may be out of date and should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online.*

$$C_{ex} = (\text{Area of target analyte} * \text{Concentration of Labeled analog}) / (\text{area of labeled analog} * CF)$$

$$C_s = (C_{ex} / \text{sample volume in ml}) * 1000$$

$C_{ex}$  = The concentration of the analyte in the extract

CF = calibration factor from calibration.

- 11.3** Prior to reporting the data, the chromatogram should be reviewed for any incorrect peak identification or poor integration.
- 11.4** PFHxS, PFOS, PFOA, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 5 due to the linear and branch isomers of these compounds (Sect. 10.6.4.1). The areas of all the linear and branched isomer peaks observed in the CAL standards for each of these analytes must be summed and the concentrations reported as a total for each of these analytes.
- 11.5** Calculations must utilize all available digits of precision, but final reported concentrations should be rounded to an appropriate number of significant figures (one digit of uncertainty), typically two, and not more than three significant figures.

## 12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

- 12.1** Section 9.0 outlines sample batch QC acceptance criteria. If non-compliant organic compound results are to be reported, the Organic Section Head and/or the Laboratory Director, and the Operations Manager must approve the reporting of these results. The laboratory Project Manager shall be notified, and may choose to relay the non-compliance to the client, for approval, or other corrective action, such as re-sampling and re-analysis. The analyst, Data Reviewer, or Department Supervisor performing the secondary review initiates the project narrative, and the narrative must clearly document the non-compliance and provide a reason for acceptance of these results.
- 12.2** All results for the organic compounds of interest are reportable without qualification if extraction and analytical holding times are met, preservation requirements (including cooler temperatures) are met, all QC criteria are met, and matrix interference is not suspected during extraction or analysis of the samples. If any of the below QC parameters are not met, all associated samples must be evaluated for re-extraction and/or re-analysis.

## 13. Method Performance

### 13.1 Detection Limit Study (DL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

- 13.1.1** The laboratory follows the procedure to determine the DL, LOD, and/or LOQ as outlined in Alpha SOP ID 1732. These studies performed by the laboratory are maintained on file for review.

### 13.2 Demonstration of Capability Studies

- 13.2.1 The IDC must be successfully performed prior to analyzing any Field Samples. Prior to conducting the IDC, the analyst must first generate an acceptable Initial Calibration following the procedure outlined in Section 10.6.
- 13.2.2 INITIAL DEMONSTRATION OF LOW SYSTEM BACKGROUND – Any time a new lot of SPE cartridges, solvents, centrifuge tubes, disposable pipets, and autosampler vials are used, it must be demonstrated that an MB is reasonably free of contamination and that the criteria in Section 9.2.1 are met. If an automated extraction system is used, an MB should be extracted on each port to ensure that all the valves and tubing are free from potential PFAS contamination.
- 13.2.3 INITIAL DEMONSTRATION OF PRECISION (IDP) – Prepare, extract, and analyze four to seven replicate LCSs fortified near the midrange of the initial calibration curve according to the procedure described in Section 10. Sample preservatives as described in Section 6.2.1 must be added to these samples. The relative standard deviation (RSD) of the results of the replicate analyses must be less than 20%.
- 13.2.4 INITIAL DEMONSTRATION OF ACCURACY (IDA) – Using the same set of replicate data generated for Section 13.2.3, calculate average recovery. The average recovery of the replicate values must be within  $\pm 30\%$  of the true value.
- 13.2.5 INITIAL DEMONSTRATION OF PEAK ASYMMETRY FACTOR – Peak asymmetry factors must be calculated using the equation in Section 9.10.1 for the first two eluting peaks (if only two analytes are being analyzed, both must be evaluated) in a mid-level CAL standard. The peak asymmetry factors must fall in the range of 0.8 to 1.5. See guidance in Section 10.6.4.1 if the calculated peak asymmetry factors do not meet the criteria.
- 13.2.6 Refer to Alpha SOP ID 1739 for further information regarding IDC/DOC Generation.
- 13.2.7 The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

### 14. Pollution Prevention and Waste Management

- 14.1 Refer to Alpha's Chemical Hygiene Plan and Hazardous Waste Management and Disposal SOP for further pollution prevention and waste management information.
- 14.2 This method utilizes SPE to extract analytes from water. It requires the use of very small volumes of organic solvent and very small quantities of pure analytes, thereby minimizing the potential hazards to both the analyst and the environment as compared to the use of large volumes of organic solvents in conventional liquid-liquid extractions.
- 14.3 The analytical procedures described in this method generate relatively small amounts of waste since only small amounts of reagents and solvents are used. The matrices of concern are finished drinking water or source water. However, laboratory waste management practices must be conducted consistent with all applicable rules and regulations, and that laboratories protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Also, compliance is required with any sewage discharge permits and regulations, particularly the hazardous waste identification rules and land disposal restrictions.

## 15. Referenced Documents

Chemical Hygiene Plan – ID 2124

SOP ID 1732 Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ) SOP

SOP ID 1739 Demonstration of Capability (DOC) Generation SOP

SOP ID 1728 Hazardous Waste Management and Disposal SOP

## 16. Attachments

Table 7: LC Method Conditions

Time (min)	2 mM Ammonium Acetate (5:95 MeOH/H <sub>2</sub> O)	100% Methanol
Initial	100.0	0.0
1.0	100.0	0.0
2.2	85.0	15.0
11	20.0	80.0
11.4	0.0	100.0
12.4	100.0	00.0
15.5	100.0	0.0
Waters Aquity UPLC® BEHC <sub>18</sub> 2.1 x 50 mm packed with 1.7 µm BEH C <sub>18</sub> stationary phase Flow rate of 0.4 mL/min 2-5 µL injection		

Table 8: ESI-MS Method Conditions

ESI Conditions	
Polarity	Negative ion
Capillary needle voltage	.5 kV
Cone Gas Flow	25 L/hr
Nitrogen desolvation gas	1000 L/hr
Desolvation gas temp.	500 °C

Table 9: Method Analyte Source, Retention Times (RTs), and EIS References

#	Analyte	Transition	RT	IS	Type
1	M3PBA	216>171	2.65		REC
2	PFBA	213 > 169	2.65	2: M4PFBA	
3	M4PFBA	217 > 172	2.65	1: M3PBA	EIS
4	PFPeA	263 > 219	5.67	4: M5PFPEA	
5	M5PFPEA	268 > 223	5.66	1: M3PBA	EIS
6	PFBS	299 > 80	6.35	6: M3PFBS	
7	M3PFBS	302 > 80	6.35	29:M4PFOS	EIS
8	FtS 4:2	327 > 307	7.47	9: M2-4:2FTS	

#	Analyte	Transition	RT	IS	Type
9	M2-4:2FTS	329 > 81	7.47	29:M4PFOS	EIS
10	PFHxA	303 > 269	7.57	10: M5PFHxA	
11	M5PFHxA	318 > 273	7.57	19:M2PFOA	EIS
12	PFPeS	349 > 80	7.88	18: M3PFHxS	
13	PFHpA	363 > 319	8.80	14: M4PFHpA	
14	M4PFHpA	367 > 322	8.80	19:M2PFOA	EIS
15	L-PFHxS	399 > 80	8.94	18: M3PFHxS	
16	br-PFHxS	399 > 80	8.72	18: M3PFHxS	
17	PFHxS Total	399 > 80	8.94	18: M3PFHxS	
18	M3PFHxS	402 > 80	8.94	29:M4PFOS	EIS
19	MPFOA	415 > 370	9.7		REC
20	PFOA	413 > 369	9.7	23: M8PFOA	
21	br-PFOA	413 > 369	9.48	23: M8PFOA	
22	PFOA Total	413 > 369	9.7	23: M8PFOA	
23	M8PFOA	421 > 376	9.7	19: M2PFOA	EIS
24	FiS 6:2	427 > 407	9.66	25: M2-6:2FTS	
25	M2-6:2FTS	429 > 409	9.66	29:M4PFOS	EIS
26	PFHpS	449 > 80	9.78	33: M8PFOS	
27	PFNA	463 > 419	10.41	33: M8PFOS	
28	M9PFNA	472 > 427	10.41	19: M2PFOA	EIS
29	M4PFOS	501 > 80	10.45		REC
30	PFOS	499 > 80	10.45	33: M8PFOS	
31	br-PFOS	499 > 80	10.27	33: M8PFOS	
32	PFOS Total	499 > 80	10.45	33: M8PFOS	
33	M8PFOS	507 > 80	10.45	29: M4PFOS	EIS
34	FiS 8:2	527 > 507	10.99	38: M2-8:2FTS	
35	M2-8:2FTS	529 > 509	10.99	29:M4PFOS	EIS
36	M2PFDA	515 > 470	11.00		REC
37	PFDA	513 > 469	11.00	38: M6PFDA	
38	M6PFDA	519 > 474	11.00	36: M2PFDA	EIS
39	PFNS	549 > 80	11.02	33:M8PFOS	
40	NMeFOSAA	570 > 419	11.41	41: D3-NMeFOSAA	
41	d3-NMeFOSAA	573 > 419	11.41	36: M2PFDA	EIS
42	PFOSA	498 > 78	11.48	29: M8FOSA	
43	M8FOSA	506 > 78	11.48	19: M2PFOA	EIS
44	PFUnDA	563 > 519	11.51	41: M7-PFUDA	
45	M7-PFUDA	570 > 525	11.51	36: M2PFDA	EIS
46	PFDS	599 > 80	11.51	33:M8PFOS	
47	NEtFOSAA	584 > 419	11.68	48: d5-NEtFOSAA	

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#	Analyte	Transition	RT	IS	Type
48	d5-NEtFOSAA	589 > 419	11.68	36: M2PFDA	EIS
49	PFDaA	613 > 569	11.96	50: MPFDOA	
50	MPFDOA	615 > 570	11.96	36: M2PFDA	EIS
51	PFTriA	663 > 619	12.34	50: MPFDOA	
52	PFTeA	713 > 669	12.6	53: M2PFTEDA	
53	M2PFTEDA	715 > 670	12.6	36: M2PFDA	EIS
54	M3HFPO-DA	329>285	7.97	19: M2PFOA	EIS
55	HFPO-DA	332>287	7.97	54: M3HFPO-DA	
56	ADONA	377>251	8.00	23: M8PFOA	
57	PFHxDA	813>769	13.20	59: M2PFHxDA	
58	PFODA	913>869	13.50	59: M2PFHxDA	
59	M2PFHxDA	815>770	13.20	36:M2PFDA	EIS
60	NEtFOSA	526>169	11.00	61: NMeFOSA	
61	NMeFOSA	512>169	10.50	63: d3-NMeFOSA	
62	d3-NMeFOSA	515>169	10.50	29: M4PFOS	EIS
63	d5-NEtFOSA	531>169	11.00	29: M4PFOS	EIS
64	NMeFOSE	556>122	11.25	66: d7-NMeFOSE	
65	NEtFOSE	570>136	10.75	67: d9-NEtFOSE	
66	d7-NMeFOSE	563>126	11.25	29: M4PFOS	EIS
67	d9-NEtFOSE	579>142	10.75	29: M4PFOS	EIS
68	FIS 10:2	627>607	11.50	25: M2-6:2FTS	
69	PFDoS	699>99	12.50	33: M8PFOS	



**APPENDIX G**

**PROJECT PERSONNEL RÉSUMÉS**

# ELIZABETH ADKINS, P.E.

## PROJECT ENGINEER

## ENVIRONMENTAL ENGINEERING

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Ms. Adkins is an environmental engineer with experience in environmental consulting in the New York metropolitan area. Ms. Adkins has a background in conducting and managing environmental site assessments and investigations, remedial oversight and implementation, data management and analysis, and report writing. She is currently managing various environmental projects in the greater New York City area that require air quality screening and collection of soil, groundwater, soil vapor, and indoor air samples.



### SELECTED PROJECTS

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- Silvercup West, Brownfield Redevelopment, Remediation Oversight, Long Island City, NY
- Hudson Yards Culture Shed, Remediation Oversight, New York, NY
- 601 Washington Street, Remediation Oversight, New York, NY
- Dock 72 at Brooklyn Navy Yard, Remediation Oversight, Brooklyn, NY
- 50 Hudson Yards, Remedial Investigation and Waste Characterization Report preparation, New York, NY
- Northern Boulevard and Steinway Street, Subsurface Investigation, Remedial Investigation Report, and Remedial Action Work Plan, Long Island City, NY
- Fort Totten Training Academies, Phase II ESI, Queens, NY
- 535 4<sup>th</sup> Avenue, Quarterly Groundwater Sampling and Reporting, Brooklyn, NY
- 4 Hudson Square, Remedial Investigation and Reporting, Office Support during Waste Characterization, New York, NY
- 190 Riverside Drive, Spill Response, Groundwater Discharge Permitting, Spill Closure, New York, NY
- 730 Fifth Avenue, Phase I ESA report preparation, Waste Characterization implementation and report preparation, New York, NY
- 1185 Broadway, NYCOER VCP Site Investigation Report, Remedial Action Work Plan, VCP Application, Office Support during Remediation Oversight, New York, NY
- 215 North 10<sup>th</sup> Street, Waste characterization implementation and report preparation, NYSDEC BCP Office Support, Brooklyn, NY
- 561 Greenwich Street, NYSDEC BCP Remedial Investigation Report, Remedial Action Work Plan, BCP Application, Office Support, New York, NY
- 92 Avenue of the Americas, Phase I ESA, Phase II ESI Report, NYSDEC BCP Application, Office Support, New York, NY
- The Women's Building- 550 West 20<sup>th</sup> Street, Phase II ESI Work Plan and Report, Office Support, Remediation Cost Estimates, New York, NY
- 551 Greenwich Street, Brownfield Redevelopment, New York, NY
- 111 Leroy Street, Environmental Remediation, New York, NY
- 122 Varick Street, Environmental Assessment, New York, NY
- 46-15 Kissena Boulevard, Brownfield Redevelopment, Flushing, NY

### EDUCATION

B.Sc., Earth and  
Environmental Engineering  
Columbia University

B.A., Environmental  
Science  
Barnard College

### PROFESSIONAL REGISTRATION

Professional Engineer

LEED Green Associate

OSHA 40-Hour HAZWOPER

OSHA 10-Hour Construction

Qualified SWPPP  
Practitioner

Long Island Railroad  
Roadway Worker Protection

AMTRAK Transportation  
Worker Identification  
Credential

### AFFILIATIONS

American Society of Civil  
Engineers - Metropolitan  
Section, Younger  
Members Forum K-12  
Outreach Committee Chair

**LANGAN**

# LAURA GROSE

## SENIOR STAFF SCIENTIST

## ENVIRONMENTAL ENGINEERING

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Ms. Grose is an environmental scientist with five years of experience in field investigation implementation and coordination, due diligence report writing, construction oversight, field implementation, remediation work plan drafting and implementation, and regulatory agency coordination. Her field experience includes conducting Phase II Environmental Site Investigations (ESI), remedial investigations, and indoor air quality analysis investigations, and performing remediation oversight. She is experienced in soil, groundwater, and air sampling, and well installation.

Ms. Grose has experience with projects in the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP), Voluntary Cleanup Program (VCP) and Spill Programs, and New York City Office of Environmental Remediation (NYCOER) "E" Designated and VCP sites.

### SELECTED PROJECTS

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- Pratt Landing, Echo Bay Redevelopment, NYSDEC BCP Remedial Investigation and Remedial Action Work Plan, New Rochelle, NY
- 250 Water Street, NYSDEC BCP Remedial Investigation, Bro New York, NY
- 561 Greenwich Street, Off-Site Investigation and Remediation, New York, NY
- 111 Leroy Street, E-Designation Consulting, New York, NY
- Former Xerox Blauvelt, NYDEC Superfund Site Management Plan Compliance, Site Monitoring, Blauvelt, NY
- Bronx Psychiatric Center, NYSDEC Superfund PCB Remedial Investigation and Self-Implementing Cleanup Plan, Bronx, NY
- 1120 Bronx River Avenue, Remedial Investigation, Bronx, NY
- 58-80 Borden Avenue, NYSDEC Petroleum Spill Investigation, Delineation, and Remediation via Recovery Wells, Queens, NY
- Project Gateway, Site Investigation, Port Chester, NY
- 929-965 Remsen Avenue, Phase I, Phase II, and Site Investigation, Brooklyn, NY
- 107 Charles Lindbergh Boulevard, Phase I, Phase II, and Site Investigation, Garden City, NY
- 400-600 Prime Place, Phase I ESA, Hauppauge, NY
- 335 Eighth Avenue, Phase I ESA, New York, NY
- 133 West 22<sup>nd</sup> Street, Phase I ESA, New York, NY
- 123-131 Pearl Street, Phase I ESA, Port Chester, NY
- Avalon Polychrome East Manufacturing Site, NYSDEC BCP, Yonkers, NY\*
- Avalon Polychrome West Research and Development Site, NYSDEC BCP, Yonkers, NY\*
- BICC Cables Site, NYSDEC BCP, Yonkers, NY\*
- Chappaqua Station Site Remediation, NYSDEC BCP, Chappaqua, NY\*

*\*Projects represent experience with a previous firm*



### EDUCATION

B.S., Environmental  
Science  
State University of New  
York at Oneonta

### PROFESSIONAL REGISTRATION

40-Hour OSHA  
HAZWOPER

10-Hour OSHA

NYSDEC GP-0-15-002  
Erosion and Sediment  
Control (SWPPP  
Inspector)

### AFFILIATIONS

Society of Women  
Environmental  
Professionals (SWEP)

# JASON J. HAYES, PE, LEED AP

## PRINCIPAL/VICE PRESIDENT

## ENVIRONMENTAL ENGINEERING

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Mr. Hayes has experience in New York, New Jersey, Washington D.C., California, Washington, Oregon, Alaska, and Internationally. His experience includes Environmental Protection Agency (EPA), New York State (NYS) Brownfields applications, investigation, and remediation; New York City Department of Environmental Protection (NYCDEP) and New York City Office of Environmental Remediation (OER) E-designated site applications, investigations, and remediation. His expertise also includes Phase I and II Environmental Site Investigations and Assessments; contaminated building cleanup and demolition; Underground Storage Tank (UST) permitting, removal specifications, and closure reporting; soil vapor intrusion investigation and mitigation system design (depressurization systems, etc.); development of groundwater contaminant plume migration models; environmental analysis; and oversight, design and specification generation for remediation operations with contaminants of concern to include polychlorinated biphenyls (PCBs), solvents, mercury, arsenic, petroleum products, asbestos, mold and lead.

### SELECTED PROJECTS

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- Confidential Location (Remediation for Mercury-Contaminated Site), New York, NY
- Confidential Location (Phase II ESI and Remedial Design for Mercury Impacted Site), Brooklyn, NY
- NYC School Construction Authority (PCB Remediation), Various Locations, New York, NY
- 28-29 High Line (Phase I ESA, Phase II ESI, and Environmental Remediation), New York, NY
- Georgetown Heating Plant (Phase II ESI and Remedial Design for Mercury Impacted Site), Washington D.C.
- 268 West Street (BCP Application, RI and RIWP), New York, NY
- Confidential Multiple Mixed-Use Tower Location (BCP Application, RI, Phase I ESA, and Phase II ESI), New York, NY
- Dock 72 at Brooklyn Navy Yard, (NYS Voluntary Cleanup Program), Brooklyn, NY
- 27-21 44<sup>th</sup> Drive (BCP Application, Remedial Investigation Phase I ESA, and Phase II ESI), Long Island City, NY
- Purves Street Development, BCP Application, RAWP, and Phase II ESI, Long Island City, NY
- 267-273 West 87<sup>th</sup> Street (BCP Application, Remedial Investigation, RIWP, RAWP), New York, NY
- New York Aquarium, Shark Tank and Animal Care Facility (Environmental Remediation), Coney Island, NY
- International Leadership Charter School (Environmental Remediation), Bronx, NY
- West & Watts (BCP Application), New York, NY
- Hudson Yards Redevelopment (Phase I ESA and Phase II ESI), New York, NY



### EDUCATION

M.S., Environmental Engineering  
Columbia University

B.S., Chemistry,  
Environmental Toxicology  
Humboldt State University

Business Administration  
(minor) Humboldt State  
University

### PROFESSIONAL REGISTRATION

Professional Engineer (PE)  
in NY

LEED Accredited  
Professional (LEED AP)

Troxler Certification for  
Nuclear Densometer  
Training

CPR and First Aid  
Certification

OSHA 40-Hour  
HAZWOPER

OSHA HAZWOPER Site  
Supervisor

### AFFILIATIONS

US Green Building  
Council, NYC Chapter  
(USGBC),  
Communications  
Committee

**LANGAN**

## JASON J. HAYES, PE, LEED AP

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- 627 Smith Street (RI and Report), Brooklyn, NY
- Gateway Center II Retail (Phase I ESA and Phase II ESI), Brooklyn, NY
- 261 Hudson Street (Phase I ESA, Phase II ESI, BCP, and RAWP), New York, NY
- Riverside Center, Building 2 (BCP, Phase I ESA and Phase II ESI), New York, NY
- New York Police Academy, (Sub-Slab Depressurization and Vapor Barrier System), College Point, NY
- Bronx Terminal Market (BCP, RIWP, RAWP, Phase I ESA and Phase II ESI), Bronx, NY
- Jacob Javits Convention Center (Phase I ESA and Phase II ESI), New York, NY
- Yankee Stadium Development Waterfront Park (NYSDEC Spill Sites), Bronx, NY
- Bushwick Inlet Park (Phase I ESA, Approvals for NYC E-Designation), Brooklyn, NY
- Silvercup West (BCP, RIWP, RIR, RAWP, and RAA), Long Island City, NY
- 29 Flatbush, Tall Residential Building (Groundwater Studies, RIR and RAWP), Brooklyn, NY
- Gowanus Village I (BCP, RIWP and RIR), Brooklyn, NY
- Sullivan Street Hotel (Site Characterization Study and Owner Representation), New York, NY
- Riker's Island Co-Generation Plant (Soil and Soil Vapor Quality Investigations), Bronx, NY
- The Shops at Atlas Park (Sub-Slab Depressurization and Vapor Barrier Design), Glendale, NY
- Memorial Sloan-Kettering Cancer Center (Subsurface and Soil Vapor Intrusion Investigations), New York, NY
- Element West 59<sup>th</sup> Street (Oversight and Monitoring of Sub-Slab Depressurization and Vapor Barrier Systems), New York, NY
- Teterboro Airport (Delineation and Remedial Oversight of Petroleum-Contaminated Soils), Teterboro, NJ
- Proposed New York JETS Stadium (Phase I ESA), New York, NY
- Former Con Edison Manufactured Gas Plant Sites (Research Reports), New York, NY
- 7 World Trade Center (Endpoint Sampling and Final Closure Report), New York, NY
- Peter Cooper Village, Environmental Subsurface Investigations, New York, NY

Urban Land Institute (ULI), member

Commercial Real Estate Development Associations (NAIOP), member

NYC Brownfield Partnership, member

## SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS

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NYC Mayor's Office of Environmental Remediation – Big Apple Brownfield Workshop – Presented on Soil Vapor Intrusion Remedies (e.g., SSD Systems, Vapor Barriers, Modified HVAC)

New York City Brownfield Partnership – Presented on environmental considerations and complications of the Hudson Yards Development

**JASON J. HAYES, PE, LEED AP**

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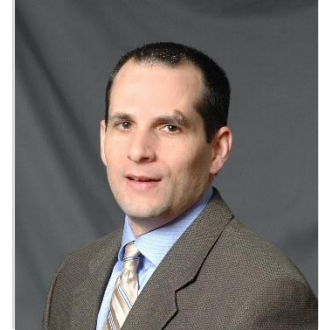
Waterfront Development Technical Course – Presented on Impacted  
Waterfront Planning Considerations

# **ANTHONY MOFFA, JR., ASP, CHMM, COSS**

## **ASSOCIATE/CORPORATE HEALTH AND SAFETY MANAGER**

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Anthony is Langan's Corporate Health & Safety Manager and is responsible for managing health and safety compliance in all Langan office locations. He has nearly 20 years of experience in the health and safety field. He is responsible for ensuring compliance with all federal and state occupational health and safety laws and development and implementation of corporate health and safety policies. His responsibilities include reviewing and updating Langan's Corporate Health and Safety Program and assisting employees in the development of site specific Health & Safety Plans. He maintains and manages health and safety records for employees in all Langan office locations including medical evaluations, respirator fit testing, and Hazardous Waste Operations and Emergency Response training. He is also responsible for documentation and investigation of work-related injuries and incidents and sharing this information with employees to assist in the prevention of future incidents. He is also the chairman of the Corporate Health & Safety Committee and Health & Safety Leadership Team that meet periodically throughout the year. He is responsible for coordinating and providing health and safety training to Langan employees. He was formerly the Environmental, Health and Safety Coordinator at a chemical manufacturer. His experience included employee hazard communications, development of material safety data sheets for developed products, respirator fit testing and conducting required Occupational Health & Safety Association and Department of Transportation training.



### **EDUCATION**

B.S., Physics  
West Chester University

### **PROFESSIONAL REGISTRATION**

Associate Safety  
Professional (ASP)

Certified Hazardous  
Material Manager (CHMM)

Certified Occupational  
Safety Specialist (COSS)

### **AFFILIATIONS**

Pennsylvania Chamber of  
Business & Industry

Chemical Council of New  
Jersey

New Jersey Business &  
Industry Association

Geoprofessional Business  
Association

# GERALD F. NICHOLLS, PE, CHMM

## ASSOCIATE

### ENVIRONMENTAL ENGINEERING & HAZARDOUS MATERIALS MANAGEMENT

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Mr. Nicholls' 19 years of expertise includes management of remediation and site investigations, litigation support, brownfield cleanups, remedial design, industrial hygiene, air monitoring and environmental health and safety projects including data collection, inspection and reporting for projects throughout New York and New Jersey. He works closely with various private, state, commercial, industrial, and municipal clients, acting as a liaison between the client and project team.

In 2019, Real Estate Weekly named Mr. Nicholls one of the Rising Stars of Real Estate.

#### SELECTED PROJECTS

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- 491 Wortman Ave, Air Sparge/Soil Vapor Extraction Design and Implementation, Brownfield Cleanup Program, Bid Documents, Construction Administration, Brooklyn, NY
- Whitehead Realty, Acme Sites, DNAPL Delineation, Site Characterization, Remedial Investigation and Reporting, Brooklyn, NY
- West 17th Street Development, DNAPL Assessment, DNAPL Recovery, Remedial Design, Closure through Brownfield Cleanup Program, Remediation Oversight, Bid Documents, ISS and Containment Wall Design, Construction Administration, New York, NY
- 2 Ingraham Street, Brooklyn, NY
- New York City School Construction Authority On-Call Contract for Hazmat Consulting Services, Various Locations, Five Boroughs of New York, NY
- G4 Capital third party due diligence reviews and environmental risk evaluations, Various Locations, New York, NY
- 140 6th Avenue, Sub-Membrane Depressurization System Design, Spill Remediation, Subslab Remediation and Monitoring Well Piping Design, Remediation Oversight, and Construction Administration, New York, NY
- Gowanus Canal Northside, Demolition and Decommissioning of MOSF, Remediation Investigation, Brownfield Cleanup Program, Brooklyn, NY
- 23-01 42nd Road, Phase I, Phase II Remedial Investigation, Remedial Action Work Plan, Sub-Membrane Depressurization System Design, Underground Storage Tank Closure and Remediation, Brownfield Cleanup Program, Remediation Oversight, Construction Administration, Long Island City, NY
- 23-10 Queens Plaza South, Phase I, Phase II Remedial Investigation, Remedial Action Work Plan, Sub-Membrane Depressurization System Design, Underground Storage Tank Closure and Remediation, Brownfield Cleanup Program, Remediation Oversight, Construction Administration, Long Island City, NY



#### EDUCATION

M.S., Environmental Engineering  
New Jersey Institute of Technology

B.S., Chemistry and Environmental Studies  
(Double Major)  
Ursinus College

#### PROFESSIONAL REGISTRATION

Professional Engineer (PE)  
in NY

Certified Hazardous Materials Manager  
(CHMM)

#### AFFILIATIONS

Real Estate Board New York

City of Jersey City  
Environmental Commission, Former Commissioner, Vice Chair and Chair

Alliance of Hazardous Materials Professionals

American Chemical Society

New York League of Conservation Voters

New York City Brownfield Partnership

**LANGAN**



## GERALD F. NICHOLLS, PE, CHMM

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- 163 6<sup>th</sup> Street, Phase I and Phase II Due Diligence, Spill Response, Remedial Action Work Plan, Brooklyn, NY
- 170 Amsterdam Avenue, Remedial Action Work Plan, Voluntary Cleanup Program, Remediation Oversight, Construction Administration, New York, NY
- Urban Health Plan, Medical Building, DNAPL Delineation, Remedial Action Work Plan, Hazardous Waste Management and Minimization, Brownfield Cleanup Program, Bronx, NY
- Second Avenue Subway, Air Monitoring and Ventilated Air Treatment Program, New York, NY
- New York University Spill Sites, 4 Washington Square Village, 7-13, Washington Square North, and 251 Mercer Street, Fuel Oil Spill Cleanup and Closure, New York, NY
- Dormitory Authority of New York (DASNY), City College of New York, Fuel Protection and Leak Detection System Repair and Upgrades, New York, NY
- 45 Broad Street, Waste Characterization, Construction Documents, New York, NY
- 241 West 28<sup>th</sup> Street, New York, NY
- Surfactant Remediation Project, In-Situ Chemical Oxidation Design and Implementation and Site Closure, Margate City, NJ
- Koppers Site, Trans-Hudson Express Project, Kearny, NJ
- Former Cornell Manufacturing Site, Orangeburg, NY
- Horse Pasture Site, Robins Air Force Base, GA
- Williams Air Force Base, Thermal Enhanced Extraction, Mesa, AZ
- New Jersey Transit, 32<sup>nd</sup> Street Station Stop (former Hicor Site), Bayonne, NJ
- Nikolski Radio Relay Station, Umnak Island, AK
- Middletown Post Office, Due Diligence, Middletown, NY
- Lower Manhattan Construction Command Center, Environmental Services Contract, New York, NY
- Da Nang International Airport, Da Nang, Vietnam
- 22<sup>nd</sup> to 8<sup>th</sup> Street Station Light Rail Extension, Bayonne, NJ
- 69<sup>th</sup> Street Grade Separation Project, North Bergen, NJ
- Dukes Parkway Landfill, Hillsboro/Manville, NJ
- NYU Langone Medical Center, New Science Building, Remediation Oversight and Construction Administration, Voluntary Cleanup Program, New York, NY
- 86 Warren Street, Waste Characterization and Construction Documents, New York, NY
- 459 Smith Street, Due Diligence and Cost Estimating, Brooklyn, NY
- 111 Leroy Street, New York, NY
- 411 Broadway, Phase I, Remedial Investigation, Air/Noise Coordination for E-Designation, New York, NY
- Modera on the Hudson, Remediation Oversight, Remedial Action Work Plan, Submembrane Depressurization System Design, Yonkers, NY
- Honeywell Quanta, Remedial Design Peer Review, Edgewater, NJ
- New York University Tandon School of Engineering (Spill 1009933), Remediation, Laser-Induced Fluorescence Investigation, Remedial System Optimization, Product Recovery, Spill Cleanup, Brooklyn, NY
- 237-261 North 9<sup>th</sup> Street, Peer Review and Due Diligence, Brooklyn, NY

**SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS**

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Burke, M., Ciambuschini, S., Nicholls, G., Tashji, A., Vaidya, S.,  
"Redeveloping a Remediated MGP Site", MGP Symposium 2019, Atlantic  
City, NJ.

"Biodegradation Pathways and End Products of Sodium Dioctyl  
Sulfosuccinate/Sodium Hexadecyl Diphenyl Oxide Disulfonate Surfactant  
Solution." Florida Remediation Conference, Orlando, Florida, November  
2005.

# MIMI RAYGORODETSKY

## PRINCIPAL/VICE PRESIDENT ENVIRONMENTAL ENGINEERING

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Ms. Raygorodetsky sources and directs large, complex environmental remediation and redevelopment projects from the earliest stages of pre-development diligence, through the remediation/construction phase, to long-term operation and monitoring of remedial systems and engineering controls. She has a comprehensive understanding of federal, state and local regulatory programs and she uses this expertise to guide her clients through a preliminary cost benefit analysis to select the right program(s) given the clients' legal obligations, development desires and risk tolerance. She is particularly strong at integrating the requirements of selected programs and client development needs to develop and design targeted and streamlined diligence programs and remediation strategies. Ms. Raygorodetsky is also highly skilled in integrating remediation with construction on large urban waterfront projects, which tend to more complex than landside projects.

### SELECTED PROJECTS

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- 25 Kent Avenue, Due Diligence for Purchase of a Brownfields Location, Brooklyn, NY
- Ferry Point Waterfront Park, Redevelopment of a Former Landfill into a Park, Bronx, NY
- Battery Maritime Building (10 South Street), Phase I ESA, New York, NY
- Residential Development at 351-357 Broadway, Phase 1 ESA, New York, NY
- 450 Union Street, Phase I and Phase II Remediation (NYS DEC Brownfield Cleanup Program), New York, NY
- Echo Bay Center, NYS DEC Brownfield Cleanup Program, New York, NY
- 420 Kent Avenue, NYS DEC Brownfield Cleanup Program, Brooklyn, NY
- 416 Kent Avenue, NYS DEC Brownfield Cleanup Program, Brooklyn, NY
- 264 Fifth Avenue, Phase I ESA, New York, NY
- 262 Fifth Avenue, Phase I ESA, New York, NY
- ABC Blocks 25-27 (Mixed-Use Properties), Brownfield Cleanup Program, Long Island City, NY
- Residences at 100 Barrow Street, Phase I ESA, New York, NY
- Residences at 22-12 Jackson Avenue, Due Diligence for Building Sale, Long Island City, NY
- Residences at 2253-2255 Broadway, Phase I and Phase II Services, New York, NY
- Prince Point, Phase I ESA, Staten Island, NY
- 787 Eleventh Avenue (Office Building Renovation), Phase I UST Closure, New York, NY
- 218 Front Street/98 Gold Street, Planning and Brownfield Consulting, Brooklyn, NY
- Mark JCH of Bensonhurst, Phase I and HazMat Renovation, Brooklyn, NY
- 39 West 23<sup>rd</sup> Street, E-Designation Brownfield, New York, NY



### EDUCATION

B.A., Biology and Spanish  
Literature  
Colby College

### AFFILIATIONS

New York Women  
Executives in Real Estate  
(WX) - Board Member;  
Networking and Special  
Events Committee Co-Chair

New York Building  
Congress, Council of  
Industry Women -  
Committee Member

New York City Brownfield  
Partnership - Founding  
Member and President

NYC Office of Environmental  
Remediation Technical Task  
Force - Committee Member

## MIMI RAYGORODETSKY

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- 250 Water Street, Phase I and Phase II Property Transaction, New York, NY
- 27-19 44<sup>th</sup> Drive, Residential Redevelopment, Long Island City, NY
- 515 West 42<sup>nd</sup> Street, E-Designation, New York, NY
- 310 Meserole Street, Due Diligence Property Purchase, Brooklyn, NY
- Former Georgetown Heating Plant, HazMat and Phase I ESA, Washington D.C.
- 80-110 Flatbush Avenue, Brooklyn, NY
- 132 East 23<sup>rd</sup> Street, New York, NY
- 846 Sixth Avenue, New York, NY
- Greenpoint Landing, Remediation/Redevelopment, Brooklyn, NY
- 711 Eleventh Avenue, Due Diligence/Owner's Representative, New York, NY
- Brooklyn Bridge Park, Pier 1, Waste Characterization and Remediation, Brooklyn, NY
- Post-Hurricane Sandy Mold Remediation, Various Private Homes, Far Rockaway, NY
- Brooklyn Bridge Park, One John Street Development, Pre-Construction Due Diligence and Construction Administration, Brooklyn, NY
- 7 West 21<sup>st</sup> Street, Brownfields Remediation, New York, NY
- 546 West 44<sup>th</sup> Street, Brownfields Remediation, New York, NY
- Post-Hurricane Sandy Mold Remediation, Various Private Homes, Nassau and Suffolk Counties, Long Island, NY
- 55 West 17<sup>th</sup> Street, Brownfield Site Support, New York, NY
- Pratt Institute, 550 Myrtle Avenue Renovations, Environmental Remediation, Brooklyn, NY
- 42-02 Crescent Street Redevelopment, Phase I and II Environmental, Long Island City, NY
- IAC Building (555 West 18<sup>th</sup> Street), New York, NY
- Retirement Communities on 100-acre Parcels in ME, NJ, MA, CT, and NJ
- 363-365 Bond Street/400 Carroll Street, Brooklyn, NY
- 160 East 22<sup>nd</sup> Street, New York, NY
- 110 Third Avenue, New York, NY
- Lycee Francais (East 76<sup>th</sup> Street & York Avenue), New York, NY
- Winchester Arms Munitions Factory, New Haven, CT

## SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS

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Raygorodetsky, M., "The Perils and Pleasures of Urban Waterfront Development", Environmental Law In New York, February 3, 2020.

## **APPENDIX H**

### **REMEDIAL ACTION CONSTRUCTION SCHEDULE**

**Appendix H**  
**Remedial Action Work Plan**  
**Remediation Action Construction Schedule**

City DPW Yard  
224 East Main Street  
New Rochelle, New York  
BCP Site No.: C360101  
Langan Project No.: 170331702

		2022						2023						2024						2025						2026											
Item	Action	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR			
City DPW Yard - Track 1/Track 4																																					
1	RAWP - Preparation and Submittal																																				
2	RAWP - NYSDEC Review and Public Comment Period																																				
3	Issuance of Decision Document																																				
4	Preparation of Construction Drawings																																				
5	Implement RAWP Concurrent with Construction																																				
6	Preparation and Submittal of Environmental Easement (Due June 1st)*																																				
7	SMP Preparation and Submittal (Due Aug 1st)*																																				
8	SMP Review and Approval*																																				
9	FER Preparation and Submittal (Due Oct 1st)*																																				
10	FER Review and Approval*																																				
11	Certificate of Completion*																																				

**Notes:**

NYSDEC: New York State Department of Environmental Conservation

BCP: Brownfield Cleanup Program

RIWP: Remedial Investigation Work Plan

CPP: Citizen Participation Plan

RIR: Remedial Investigation Report

RAWP: Remedial Action Work Plan

SMP: Site Management Plan

FER: Final Engineering Report

\* Milestones must be met to achieve a Certificate of Completion (CoC) in the same year