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PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) INVESTIGATION WORK PLAN

MILTONS DRY CLEANERS SITE

Prepared for

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Project Number: PW0247I

October 13, 2023

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October 13, 2023

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ACRONYMS AND ABBREVIATIONS

Ecology	Washington Department of Ecology
ft	feet
ft bgs	feet below ground surface
Geosyntec	Geosyntec Consultants
HDPE	high-density polyethylene
ng/L	nanogram per liter
PCE	perchloroethene
PFAS	per- and polyfluoroalkyl substances
PVC	polyvinyl chloride
VOCs	volatile organic compounds

1. INTRODUCTION

The former Milton's Dry Cleaner (the Site), located on Fourth Plain Boulevard in Vancouver, Washington, is a part of an ongoing remedial investigation (RI). The RI is being conducted in accordance with Agreed Order (DE4239 07/4-TC-S) with the Washing Department of Ecology (Ecology) and is intended to characterize tetrachloroethene (or perchloroethene [PCE]) in soil, groundwater, and soil vapor at the Site (Ecology, 2018). Groundwater monitoring for PCE occurs quarterly.

In response to a request from Ecology dated August 14, 2023 (Letter), Geosyntec Consultants, Inc. (Geosyntec), on behalf of the Patrick Milton and Helsell Fettermen, LLC, prepared this work plan (Work Plan) to sample for per- and polyfluoroalkyl substances (PFAS) (Ecology, 2023a). In its letter, Ecology provided comments on the 2022 Annual Groundwater Monitoring Report (Geosyntec, 2023) and specifically requested PFAS testing of groundwater samples from nine groundwater wells located across and proximate to the Site. The purpose of the testing is to evaluate the potential presence of PFAS at the Site. This Work Plan describes proposed investigation to evaluate the extent of PFAS in groundwater around the Site.

2. BACKGROUND

The former Milton's Dry Cleaners property is located at 6721 NE Fourth Plain Boulevard in Vancouver, Clark County, Washington. A dry-cleaning business operated at the property from 1966 through 2001 and reportedly used PCE as a cleaning agent throughout its operation. The property is approximately 0.42 acres and is currently occupied by a retail store. The larger Study Area for the Milton's Dry Cleaners Site includes the property and extends north of NE Fourth Plain Boulevard, east to NE Andresen Road, south to NE 18th Street, and west to NE Stapleton Road. The Study Area and existing monitoring well locations are shown in Figure 1A of the 2022 Annual Monitoring Report (Geosyntec, 2023). A groundwater treatability study is currently being implemented at and near the property.

Groundwater is being monitored at the Site to determine: (1) the extent of PCE concentrations within two aquifers in four different depth zones; (2) PCE concentration trends in monitoring wells completed in each of these four depth zones; and (3) groundwater flow directions and gradients. More information regarding the aquifers, monitoring well designations, groundwater elevations and flow directions, and volatile organic carbon (VOC) distribution are provided in the 2022 Annual Report (Geosyntec, 2023).

3. PROPOSED SAMPLE LOCATIONS

Geosyntec proposes to collect PFAS samples from the nine locations summarized in Table 1. Locations were selected based on relative location with respect to the Milton's property (former source area) and groundwater flow direction in each aquifer depth zone, spatial coverage across the Site, and wells selected are outside of the ongoing treatability study currently being implemented on the Milton's property. Proposed monitoring well locations are shown on Figure 1.

Table 1. Proposed PFAS Sampling Locations

Well ID	Screened Interval or Total Depth (ft below ground surface)	Depth to Water in September 2023 (ft below top of casing)	Aquifer Depth Zone	Location Relative to Groundwater Flow Direction	Description Relative to the Milton's Property
MW-13i	71-81	64.93	Intermediate	Downgradient	Located north of the Milton's property
MW18s	40-50	25.36	Base shallow	Downgradient	Located southwest of the Milton's Property in the central portion of the Study Area
MW-20s	21-31	14.28	Base shallow	Downgradient	Located southwest of the Milton's property
MW-20i	60-70	40.32	Intermediate	Upgradient	Located southwest of the Milton's property
MW-36s	17-27	19.78	Shallow	Cross-gradient	Located east of the Milton's property
MW-15s	31-41	19.53	Base shallow	Downgradient	Located southwest side of the Milton's property
MW-37s	17-27	24.67	Shallow	Upgradient	Located east of the Milton's property
MW-09i	65-75	51.52	Intermediate	Upgradient	Located south of the Milton's property
Friends Church	135[1]	N/A	Deep	Upgradient	Domestic well; located southwest of the Milton's property in the central portion of the Study Area

[1]screen interval not available; total depth reported.

4. SAMPLE COLLECTION PROCEDURES

Groundwater samples will be collected and analyzed for PFAS as described in the Sampling and Analysis Plan (Appendix A). After recording the static groundwater elevation, each groundwater monitoring well will be purged prior to sampling. Purge and decontamination water generated during the sampling events will be characterized and approved by the City of Vancouver (the City) for disposal in accordance with a Special Discharge Permit for water discharge directly into the City sanitary sewer.

Low-flow sampling techniques will be used, in general. Sampling protocols are outlined in Appendix A and will be documented in field notes. A PFAS-free pump will be used to collect samples and will be decontaminated between each monitoring well. Dedicated tubing will be used for each well, and depth to water tapes will be decontaminated between wells.

5. SCHEDULE

Ecology approved the proposed sampling schedule in an email dated September 14, 2023 (Ecology, 2023b). The PFAS sampling will occur during the regularly scheduled groundwater monitoring event in March 2024 (Quarter 1). A report summarizing the results will be provided to Ecology 60 days following completion of data validation. The project schedule may be adjusted in consultation with Ecology based on potential delays in regulatory approval of the Work Plan or for other reasons approved by Ecology.

6. REFERENCES

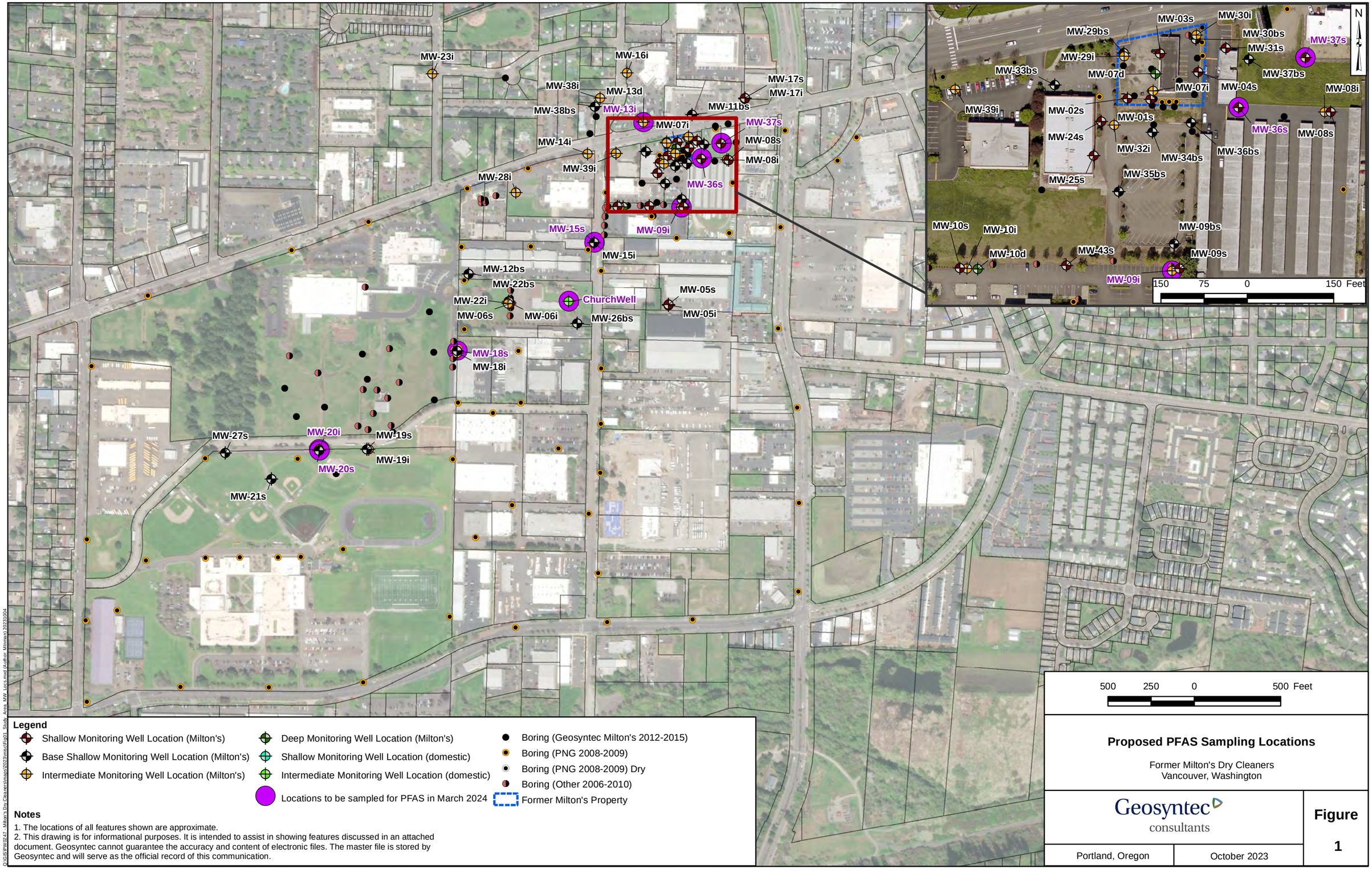
Geosyntec. 2023. 2022 Annual Report, Milton's Dry Cleaners Site – Groundwater Monitoring. Prepared for Steve Teel, Prepared by Geosyntec. 31 July.

Washington State Department of Ecology (Ecology). 2018. Ecology approval of the Milton's Dry Cleaners Groundwater Remedial Investigation, 2018 Groundwater Monitoring and Well Installation Work Plan, Milton's Dry Cleaners Site, Agreed Order DE423907/4-TC-S, Vancouver, WA. Prepared by Geosyntec, March 27, 2018; Milton's Dry Cleaners Site, Vancouver, Washington, Agreed Order DE423907/4-TC-S, Facility/Site No. 19779, Cleanup/Site ID No. 1834. 30 March.

Ecology. 2023a. Comments on 2022 Annual Groundwater Monitoring Report. 14 August.

Ecology. 2023b. email Re: Milton's PFAS Sampling. 14 September.

FIGURES



Legend

- Shallow Monitoring Well Location (Milton's)
- Base Shallow Monitoring Well Location (Milton's)
- Intermediate Monitoring Well Location (Milton's)
- Deep Monitoring Well Location (Milton's)
- Shallow Monitoring Well Location (domestic)
- Intermediate Monitoring Well Location (domestic)
- Locations to be sampled for PFAS in March 2024
- Boring (Geosyntec Milton's 2012-2015)
- Boring (PNG 2008-2009)
- Boring (PNG 2008-2009) Dry
- Boring (Other 2006-2010)
- Former Milton's Property

Notes

1. The locations of all features shown are approximate.
2. This drawing is for informational purposes. It is intended to assist in showing features discussed in an attached document. Geosyntec cannot guarantee the accuracy and content of electronic files. The master file is stored by Geosyntec and will serve as the official record of this communication.

Proposed PFAS Sampling Locations

Former Milton's Dry Cleaners
Vancouver, Washington

Geosyntec consultants

Portland, Oregon | October 2023

Figure 1

Q:\GIS\PW0247 - Milton's Dry Cleaners\maps\2023\misc\Fig01 Study Area MW Locs.mxd (Author: Mhiman) 20231004

APPENDIX A

Sampling and Analysis Plan

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SAMPLING AND ANALYSIS PLAN

MILTON'S DRY CLEANERS PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) GROUNDWATER INVESTIGATION

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Table 3: Summary of QA/QC Sample Purpose, Typical Frequency, and Typical Measurement Performance Criteria

LIST OF ATTACHMENTS

Attachment 1: Daily Sampling Checklist

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
CAS	Chemical Abstract Service
CoC	chain of custody
DoD	U.S. Department of Defense
DOT	U.S. Department of Transportation
Ecology	Washington Department of Ecology
EDD	electronic data deliverable
EIM	Environmental Information Management System
ELAP	Environmental Laboratory Accreditation Program
ETFE	Ethylene tetrafluoroethylene
Eurofins	Eurofins Environment Testing, Northern California
FEP	Fluorinated ethylene propylene
Geosyntec	Geosyntec Consultants, Inc.
HDPE	high-density polyethylene
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IDW	investigation derived waste
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LDPE	low-density polyethylene
MDL	method detection limit
mL	milliliters
MS	matrix spike
MSD	matrix spike duplicate
NA	not available
ng/L	nanograms per liter
PCTFE	polychlorotrifluoroethylene
PFAS	per- and polyfluoroalkyl substances
PTFE	polytetrafluoroethylene
PVC	polyvinyl chloride
PVDF	polyvinylidene fluoride

QA/QC	Quality Assurance/Quality Control
QSM	Quality Systems Manual
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SPE	solid phase extraction
SOP	standard operating procedure
USEPA	United States Environmental Protection Agency
UV	ultraviolet

1. INTRODUCTION

1.1 Objectives

Geosyntec Consultants, Inc. (Geosyntec) has prepared this Sampling and Analysis Plan (SAP) on behalf of Patrick Milton and Helsell Fettermen, LLC. This is in response to a request by the Washington Department of Ecology (Ecology) to sample for PFAS at the former Milton's Dry Cleaner (the Site), located on Fourth Plain Boulevard in Vancouver, Washington, as a part of an ongoing remedial investigation (RI). This SAP is included as part of a Work Plan.

This SAP documents the field and analytical procedures for PFAS sample collection, lab selection and analytical methods, and QA/QC procedures. Overall, the objectives of this document are to outline and clearly define sampling precautions and procedures specific to per- and polyfluoroalkyl substances (PFAS), list acceptable materials and field equipment as well as those materials and equipment which may contain PFAS and should be avoided, and define sample documentation and packaging procedures. Further, related to the analysis of PFAS in the samples, this document outlines what PFAS analytes will be included for this sampling event, as well as the data validation and QA/QC steps that will be followed.

1.2 Report Organization

Information in the SAP is organized as follows:

- **Section 2 – Field sampling activities**: General procedures for conducting groundwater elevation gauging and groundwater sample collection are provided. Details regarding sample collection and site access will be provided in the Milton's Dry Cleaners Work Plan. This section describes field documentation, chain of custody (CoC), and sample packaging and shipping instructions. This section also provides an overview of the sampling precautions and decontamination procedures for equipment that will be followed to avoid cross-contamination or biased results for PFAS. PFAS-free sampling equipment and appurtenances will be utilized to the extent practicable.
- **Section 3 – Laboratory selection and analytical methods**: This section describes information relevant to the selection and contracting process with a commercial analytical laboratory, an overview of laboratory accreditations, PFAS analytical methods, sample containers, sample volumes, provision of laboratory-certified PFAS-free water, and other topics related to laboratory coordination prior to the field sampling event.
- **Section 4 – Quality assurance and quality control (QA/QC) procedures**: Because of the prevalence of PFAS in equipment and consumer products, precautions will be taken to minimize potential sources of cross-contamination and collect QA/QC samples to incorporate into the evaluation of sample results. QA/QC procedures and samples are described in this section, including field QA/QC samples, laboratory procedures, sample holding times, and data validation and obtain and report valid and representative data.
- **Section 5 – References**: A list of references cited is provided in this section.

2. FIELD SAMPLING ACTIVITIES

2.1 PFAS Sampling Precautions

PFAS are potentially present in a variety of equipment, products, and materials that are commonly used in the field during groundwater sampling. In addition, laboratory analytical reporting limits (RLs) are very low (low nanograms per liter concentrations). Therefore, conservative precautions will be taken to avoid sample cross-contamination and false positive results. The following precautions in Table 1 are consistent with those published by Ecology in their PFAS investigation and remediation document (Washington Department of Ecology, 2023b, citing Michigan Department of Environmental Quality PFAS Sampling Guidance, 2018).

The precautions described in Table 1 will be followed to avoid inadvertent sample contamination in the field. These precautions will be discussed with the field crew prior to the start of the field sampling. The field crew will review a daily checklist to remind them of these precautions before the start of sampling (Attachment 1).

Field personnel will always wear disposable nitrile gloves during sample collection and handling. Staff will don a new pair of nitrile gloves prior to conducting the following activities:

- Collecting a sample;
- Change in sampling location;
- Handling sample bottles, cooler ice, or PFAS-free water;
- Handling QA/QC samples, including field blanks and equipment blanks; and
- Handling sampling equipment.

Staff will wash hands thoroughly and don a new pair of nitrile gloves after the following activities:

- Contact with a material potentially containing PFAS; and
- Entry into the project site sampling area.

2.2 Groundwater Monitoring Well Gauging and Sampling

Prior to the sampling event, field staff will review information from previous groundwater monitoring events to inform their knowledge of monitoring well locations, field equipment, and field conditions. Upgradient wells will typically be monitored first. At the beginning of each sampling day, field staff will inspect field equipment to ensure that it is in good working order. Analytical field meters will be calibrated according to instrument manufacturer specifications, and calibration results recorded in field notes. Dedicated silicone, vinyl, or HDPE tubing will be used for the PFAS sampling event. During the PFAS sampling event, tubing will not be decontaminated or reused from one location to another.

2.2.1 Groundwater Elevation Monitoring

The following method will be used to measure groundwater elevations:

1. Remove well caps and allow wells to sufficiently vent any accumulated pressure and water levels to equilibrate.
2. Use a water level meter with 0.01-foot increments to measure and record the static groundwater level using a thoroughly decontaminated (see Section 2.4 for decontamination methodology) groundwater elevation probe relative to a permanently marked survey point located at the top of the well casing.
3. Record the measurement in the field notes.
4. Decontaminate the water level meter and any other non-dedicated equipment prior to proceeding to the next groundwater monitoring well location. Decontamination procedures are described in Section 2.4.

2.2.2 Groundwater Purging

After recording the static groundwater elevation, each groundwater monitoring well will be purged prior to sampling. Low-flow sampling techniques will be used, in general. A PFAS-free bladder pump will be used to collect samples. In general, the following method will be used for purging groundwater monitoring wells prior to sample collection:

1. Assemble the PFAS-free pump and sampling line components in an area free from PFAS. Ensure that the discharge line is affixed so that the initial discharge is captured in a graduated cylinder or purge water collection bucket or drum.
2. Start the pump. Slowly increase the speed of discharge if using a variable speed pump.
3. Maintain laminar flow throughout the sample tubing and flow-through cell; keep all lines and the cell completely filled and air-free during parameter measurement and sampling.
4. Adjust the purge rate to minimize and stabilize drawdown, as measured by the water level probe. Typical low-flow pumping rates are between approximately 100 and 500 milliliters per minute; actual rates will be recorded on field forms.
5. Once drawdown is stable, start recording water quality parameters.
6. Routinely measure and record water level, pumping rate, total volume of water purged, routine water quality parameters (e.g., temperature, pH, conductivity, oxidation reduction potential, dissolved oxygen, and turbidity) throughout well purging at approximately 2- to 3-minute intervals. These measurements are performed in the field with a flow-through cell and multi-parameter meter and are used to assess whether aquifer water (rather than casing water) is being pumped.
7. Continue to measure and record the groundwater parameters until the parameters stabilize, the well is pumped dry, or three well volumes have been removed. If a dedicated pump or

tubing containing PFAS is present in the well, efforts will be made to purge at least three well volumes prior to returning to low flow rates and initiating sampling. Stabilization of water quality indicators is typically defined as follows: pH – three successive readings within ±0.1 pH unit; specific conductance – three successive readings within ±3%; temperature – three successive readings within 0.5 °C; and turbidity – three successive readings within ±10% and less than 10 Nephelometric Turbidity Units. Parameter stability is an indication that the well has achieved stable, laminar flow and well water is in equilibrium with the surrounding aquifer.

8. For slowly recharging wells, parameters may not stabilize before the well casing is emptied, even when using low flow rates. In this case, purging will be considered complete if one well volume (well casing plus filter pack volume) has been purged from the well, and the well goes dry. The well will be allowed to recharge, and sampling will be initiated within 24 hours of purging. The depth to water in the well will be measured and recorded immediately prior to sample collection. The date and time of each sample collection will be recorded.

2.2.3 Groundwater Sampling

Groundwater samples will be collected by directing the discharge from the sampling pump tubing into the sample containers. Samples will be collected directly into the sample containers from the pump discharge tubing, not through the flow-through cell. The following sequence will be used to collect groundwater samples:

1. Disconnect the tubing from the analytical field meter.
2. Remove the cap from the sample container.
3. Place the sample container under the water stream. Fill the container to the level specified by the laboratory (samples do not need to be collected headspace free) and then turn off the pump.
4. Close the container by screwing on the cap.
5. Using a paper towel, dry the outside of the sample container if necessary.
6. Label the sample as described in Section 2.3.
7. Decontaminate reusable equipment prior to proceeding to the next groundwater monitoring well location, as described in Section 2.4.

Turbid samples will not be field filtered. Samples received by the lab that are turbid or contain sediment, despite purging efforts, will be centrifuged prior to supernatant extraction and sample processing. This practice is consistent with the DoD QSM version 5.3 Table B-15 that states that "samples with >1% solids may require centrifugation prior to [solid phase extraction] SPE extraction." The need to centrifuge a sample will be determined based on laboratory recommendation, in lieu of sample dilution, which would raise RLs.

2.3 Sample Documentation, Handling, and Shipping

2.3.1 Labeling

As noted in Table 1, some water-resistant inks may be potential sources of PFAS. Laboratory pre-printed labels can be used, or labels can be filled out using a ballpoint pen. Per Washington Department of Ecology (Ecology, 2023b) citing Michigan Department of Environmental Quality guidance (MDEQ, 2018), field staff can also fill out the container labels using Fine or Ultra-Fine point Sharpie® markers in the staging area with the sample container closed. Container labels will include the following information:

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

Except for temperature blanks, all QC samples will be labeled and included on the CoC record. Field duplicate samples will not be indicated as duplicates; they will be blind duplicates.

2.3.2 Daily Field Notes

Field notes and forms will be used to record daily events, observations, and measurements and document sampling activities. Field documents will be kept in field staff possession while in the field and maintained with the project records. Field notes and forms will be provided in the summary report.

2.3.3 Sample Handling and Packaging

After labeling, sample bottles will be double bagged in re-sealable plastic bags and placed in a cooler for shipment. Sample containers should be packed for shipment using the following steps:

1. Choose an insulated cooler with structural integrity that will withstand shipment.
2. Secure and tape the drain plug with duct tape from the inside and outside.
3. Fill the cooler at least one-third full with double-bagged wet ice. (Chemical blue ice will not be used). Taping the ends of bags with duct tape will aid in waterproofing.
4. Check that the caps on all sample containers are tight and will not leak.
5. Check that the sample labels are intact, filled out, legible, and that the sample identifier exactly matches the CoC record.
6. Seal each sample container in a sample bag to prevent melt water from getting into the sample or degrading the sample label.

7. Place sample containers into the cooler with their caps upright.
8. Fill excess space within the cooler with bubble wrap (try to avoid using paper, cardboard, or polystyrene foam).
9. Seal the entire cooler with duct tape, particularly the lid and drain plug (if present), to prevent leaks.

2.3.4 Chain of Custody

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

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

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

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

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

- Site name and project reference number;
- Laboratory name and address;
- Name of person that collected the samples;
- Sample identifier;
- Sample date and time (time in 24-hour format);
- Laboratory analysis requested;
- Preservatives added to each sample (if any);
- Sample matrix (e.g., soil, water)

- Number of containers per sample; and
- Airway bill tracking number, if applicable.

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

- Contractor name and address;
- Matrix spike and matrix spike duplicate (MS/MSD) sample volume (if necessary) (Section 4.1.2);
- A request for rapid turnaround time; and
- A note regarding the potential concentrations in a highly contaminated sample.

The CoC form will be completed and signed by field personnel and the courier (if other than the sampler) for the samples transported to the laboratory. When samples are transported by a commercial carrier, the carrier will not sign the CoC record; however, the airway bill tracking number should be recorded on the CoC record. Airway bills should also be retained with the CoC record as documentation of transport. For this reason, the date and time of the receiver and relinquisher will not match when shipping with a commercial carrier.

The CoC record will accompany all sample shipments. One CoC record should be prepared for each cooler and the cooler number recorded on the CoC. The samples in the cooler should be listed on the CoC record. The CoC record should be placed in a sealed plastic bag (e.g., Ziploc®) and taped to the inside lid of the cooler.

Since the samples will be delivered to the laboratory in the custody of a courier or commercial shipment service, custody seals will be used on each ice chest to provide tampering detection. The signed and dated custody seals will be placed on the front right and back left of the shipping container and will be covered with wide, clear tape.

Shipped coolers will be scheduled for priority overnight service to maintain temperature requirements. Saturday deliveries will be coordinated with the laboratory. Samples will be shipped as non-hazardous material unless the samples meet the established Department of Transportation (DOT) criteria for a "hazardous material" or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) for air definition of "dangerous goods." If the samples meet the criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed. Prior to shipping samples, field personnel will complete the appropriate air waybill or manifest. A copy of the air waybill or manifest will be kept for recordkeeping.

2.4 Decontamination

Decontamination will occur prior to leaving the sampling area or at a central decontamination location after each sampling location (as needed) and at the end of each workday. The area may include basins or tubs (e.g., 5-gallon buckets) to capture decontamination wastes, which can be

transferred to larger containers as necessary. Alconox®, Liquinox®, Luminox®, or Citranox® detergents are acceptable for decontamination purposes. Decon 90™ should be avoided during decontamination activities. Decontamination wastes will be contained and disposed of in accordance with typical site practices (Section 2.5).

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

1. Remove any gross (e.g., soil) contamination from sampling equipment with a brush and/or rag.
2. Wash water-resistant equipment thoroughly and vigorously with PFAS-free or potable water containing detergent (Alconox®, Liquinox®, and Luminox®) using a bristle brush or similar utensil to remove any remaining residual contamination.
3. Rinse equipment thoroughly with PFAS-free or potable water (1st rinse).
4. Rinse equipment thoroughly with PFAS-free water (2nd rinse).
5. Complete a free-standing (i.e., non-bucket) rinse with PFAS-free water (3rd rinse). This free-standing rinse can be conducted with a spray bottle made from HDPE or by pumping/pouring PFAS-free water over the equipment.
6. Dry the wet equipment with a paper towel or leave the equipment to air dry in a location away from dust or fugitive contaminants.

Cleaning and decontamination of the equipment should be accomplished in stages and in such a way that the contamination does not discharge into the environment. Disposable sample tubing is recommended to minimize the need for decontamination.

2.5 Investigation-Derived Waste

Investigation-derived waste (IDW) will primarily consist of wastewater from the decontamination process of non-dedicated and non-disposable sampling equipment as well as purge water from the groundwater monitoring wells. Purge water and decontamination fluids will be managed and disposed of consistent with the site-specific monitoring program procedures. Used disposable sampling equipment, paper towels, and personal protective equipment (e.g., nitrile gloves) will be placed in heavy-duty garbage bags. IDW will be transferred to site personnel for management under site protocols.

3. LABORATORY SELECTION AND ANALYTICAL METHODS

The project team has selected Eurofins Environment Testing, Northern California (Eurofins) as the preferred analytical laboratory to conduct the sample analysis. Geosyntec has previously worked with Eurofins for PFAS analyses; the lab has provided high-quality PFAS analytical results in the past and performed well in previous Geosyntec audits of data quality and defensibility. This section provides information on Eurofins's PFAS analytical method, accreditations, reporting limits (RLs), sample containers, preservatives, holding times, storage conditions, and other information to supplement site-specific work plans.

3.1 Laboratory Analytical Method and Accreditations

The project team has selected Eurofins as the preferred analytical laboratory to conduct the PFAS sample analyses for this Work Plan. Eurofins is accredited by U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) using a PFAS method that is consistent with Table B-15 of DoD Quality Systems Manual (QSM) version 5.1 or later. Eurofins is also accredited by the National Environmental Laboratory Accreditation Conference for PFAS analysis using draft EPA Method 1633 for PFAS in non-potable water.

Samples will be submitted for laboratory analysis of the 40 PFAS compounds as requested by Ecology on August 14, 2023, and summarized in Table 2 (Ecology, 2023c).

3.2 Parameters and Reporting Limits

Eurofins provided Geosyntec with typical PFAS RLs for groundwater, which are summarized in Table 2.

3.3 Sample Containers, Preservation, Holding Times, and Storage

Information on PFAS sample bottle requirements, preservative, storage conditions, and holding times was provided by Eurofins. Two 250-milliliter (mL) high-density polyethylene (HDPE) bottles are used to collect each sample. A minimum of 250-mL sample volume is required for the laboratory to extract and analyze the sample. No preservative will be added to each sample bottle, since the groundwater that will be sampled is not chlorinated. The laboratory is required to ensure that the sample bottles provided to clients are verified as clean (i.e., meet the acceptance criteria required for blank analysis). Samples are stored at less than 6 degrees Celsius (°C). Holding times are 14 days prior to extracting the samples and an additional 28 days prior to sample analysis. These sample guidelines are appropriate for groundwater samples.

The laboratory will provide deionized water that has been tested and confirmed to be PFAS-free for use as field blanks, equipment blanks, and decontamination.

The number and type of QA/QC samples are described in Section 4.

3.4 Sample Turnaround Time and Report Format

Eurofins will typically provide analytical results within three weeks (15 business days) of sample receipt. The laboratory will provide Geosyntec with an electronic data deliverable (EDD) in a format that can be uploaded to Washington Environmental Information Management System (EIM). Stage IV reports will be provided by the laboratory (Section 4).

4. QA/QC SAMPLES AND DATA VALIDATION

4.1 Field Quality Control Samples

Field QC samples will be assigned unique sample numbers and will be submitted blind to the analytical laboratory. If abnormalities are detected in field QC samples, the data associated with the QC samples will be reviewed by Geosyntec and appropriate action will be taken to rectify the issues.

4.1.1 Field Duplicates

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

4.1.2 MS/MSDs

Matrix spike (MS) and matrix spike duplicates (MSD) samples are aliquots of environmental samples that are spiked with a known concentration of PFAS by the laboratory. MS/MSD samples are used to assess interferences caused by the sample matrix. If needed, MS/MSD samples will be collected in the same manner and at the same time and location as a primary sample (i.e., triple the sample volume). The number of required MS/MSD samples will be determined based on discussions with the laboratory. Standard frequency is the collection of at least one MS/MSD pair for every 20 primary samples. MS/MSD samples will be labeled with the same sample name and time as the primary sample and denoted as MS/MSD samples on the CoC and sample label.

4.1.3 Blanks

Blanks should be shipped and handled in the same manner as environmental samples. Field blanks should be labeled as such on sample bottles and on the CoC. The number and type of blanks will be determined by the field team in consultation with the laboratory prior to sampling.

4.1.3.1 Equipment Blanks

Equipment blanks, or equipment rinsate blanks, are used to assess the effectiveness of decontamination process. Equipment blanks are prepared by pouring PFAS-free water over or through decontaminated field sampling equipment and collecting the rinsate in a sample container. Typically, at least one equipment blank is collected for every 10 primary samples. At least one equipment blank will be collected during the sampling event, and one equipment blank per distinct sampling method will be collected.

4.1.3.2 Field Blanks

Field blanks are used to assess ambient contamination in the field and are an effective way of assessing potential cross-contamination as a result of environmental conditions during sample handling. Field blanks will be prepared by filling a sample container with PFAS-free water in the

field in the same manner as environmental samples. Typically, one field blank is collected for each day of sampling.

4.1.3.3 Trip Blanks

Trip blanks are used to assess if contamination is introduced during sample shipment. Trip blanks will be prepared by the laboratory (Eurofins), transported to the field site, and transported back to the laboratory without having been exposed to sampling procedures. Typically, one trip blank is collected for each cooler of samples.

4.1.3.4 Temperature Blanks

Temperature blanks are used to assess the temperature of samples during shipping. Temperature blanks will be provided by the laboratory and prepared by filling a sample container with PFAS-free water prior to shipment of the sample containers. The blank will be kept in the cooler during sampling and shipment to the laboratory. Once the cooler returns to the laboratory, the laboratory sample custodian will measure the temperature of the blank to determine whether recommended sample storage criteria have been met.

Table 3: Summary of QA/QC Sample Purpose, Typical Measurement, Typical Frequency Performance Criteria

QC Sample	Purpose	Typical Metric	Frequency
Field duplicate	Assess precision	30% relative percent difference (RPD)	At least one per 10 samples and one per event
Matrix spike/matrix spike duplicate	Assess accuracy, bias, precision	Laboratory statistically derived control limits (e.g., 70 to 130%); RPD ≤ 30%	At least one per laboratory batch (typically one per 20 samples) and one per event
Equipment blanks	Assess potential cross-contamination despite decontamination practices and field equipment selection	No analyte detection > ½ RL, 10% of sample result, or 10% of regulatory limit, whichever is greater	Before sampling starts *and* at least one per 10 samples *and* one per event
Field blanks	Assess potential contamination from environmental conditions during sampling	No analyte detection > ½ RL, 10% of sample result, or 10% of regulatory limit, whichever is greater	One per day
Trip blanks	Assess whether contamination is introduced during sample shipment	Target analytes not detected at concentrations greater than MDL	One per cooler
Temperature blanks	Assess representativeness of sample due to temperature of storage conditions	Temperature < 6°C	One per cooler

4.2 Laboratory Quality Control Samples

The laboratory QA program consists of laboratory QC samples, documentation of laboratory QC practices, data validation, and laboratory audits. Laboratory QC samples may include laboratory control samples/laboratory control sample duplicates (LCS/LCSD), laboratory duplicates, MS/MSD samples, surrogates, internal standards, method blanks, and instrument blanks. MS/MSD samples and LCS/LCSD samples are analyzed with every batch of up to 20 samples and measure analytical accuracy, precision, and bias. Surrogate standards are added to samples, blanks, MS/MSDs, and LCS/LCSDs to evaluate laboratory sample preparation, and matrix interferences. If QC results are outside the laboratory-specified acceptance criteria range, corrective action will be taken based on procedures in the DoD QSM version 5.1 and the laboratory QA program. Laboratory flags are used to indicate sample results associated with QC sample results that are outside of the laboratory-specified acceptance criteria. Level II laboratory reports will include sample and QC sample results (e.g., method blanks, LCS, surrogates, and MS/MSDs).

4.3 Data Review, Verification and Validation

Hand-entered data from field forms (e.g., groundwater elevation data) will be peer reviewed to minimize data entry errors. Field notes, photographs, and other records of field activity will be saved in the Geosyntec project file.

Geosyntec will conduct verification and validation of data provided by the analytical laboratory. Data verification includes checking that laboratory sample receipt forms match CoC documentation. Verification of laboratory data also includes checking that QA/QC samples defined in this SAP are within the acceptance criteria and ensuring that holding times, precision, accuracy, laboratory blanks, and detection limits are within the laboratory acceptance criteria. For this project, Stage 4 data validation will be implemented for groundwater samples consistent with EIM requirements.

Stage 4 validation includes an assessment of laboratory results reported in a standard Level IV data package and confirmation/issuance of data qualifiers. Data quality will be assessed by comparing the QC parameters to the appropriate criteria (or limits) by method-specific and project-specific requirements. Any verification of laboratory calculations for quantitation is done on a limited basis. Stage 4 data validation is performed in general conformance to United States Environmental Protection Agency (USEPA) protocols set forth in the functional guidelines (USEPA, 2020) as well as the laboratory SOPs, analytical methods, and professional and technical judgement. Analytical data may be qualified based on data validation reviews, consistent with USEPA functional guidelines, and will be used to provide data users with an estimate of the level of uncertainty associated with the "qualified" result. If data validation qualifiers impact the overall data interpretation, these will be described in a data validation report.

5. REFERENCES

Michigan Department of Environmental Quality (MDEQ). 2018. General PFAS Sampling Guidance. October.

United States Environmental Protection Agency (USEPA), 2020. National Functional Guidelines for Organic Superfund Methods Data Review, EPA 540-R-20-005. November.

Washington State Department of Ecology (Ecology). 2023a. Comments on 2022 Annual Groundwater Monitoring Report. 14 August.

Ecology. 2023b. Guidance for Investigating and Remediating PFAS Contamination in Washington State. Publication Number 22-09-058. June.

Ecology. 2023c. email Re: Milton's PFAS Sampling. 14 September.

Tables

Table 1. Items that Are to be Avoided and Items that are Acceptable and during PFAS Sampling

Items to be Avoided	Acceptable Items
Clothing and Personnel Care Products (Ecology, 2023b**)**	
• New unwashed clothing • Clothing recently washed with fabric softener	• Well-laundered clothing with most recent washing not using fabric softener
• Clothing treated to be water-, stain- or dirt-resistant (including but not limited to Gore-Tex™, Scotchguard™, RUCO®) • Clothing chemically treated to provide insect resistance or ultraviolet (UV) protection	• Waterproof clothing made of polyurethane, polyvinyl chloride (PVC), wax-coated fabrics, rubber, or neoprene
• Coated Tyvek®	• Plain/non-coated Tyvek®
• Latex gloves	• Powderless nitrile gloves
• UV-resistant or insect-resistant clothing • Use of cosmetics, moisturizers, hand creams and other products after previous shower (e.g., day of or night before field sampling)	• See list of allowable sunscreen and insect repellants in Washington PFAS sampling guidelines[1]
• Boots containing Gore-Tex™ or other fluoropolymers or boots treated with stain or water-resistant compounds	• Boots made with polyurethane or PVC OR covered with PFAS-free overboots[2]
Food and Drink (Ecology, 2023b**)**	
• Packaged food or snack items (e.g., paper plates, foil, bags, and wrappers) in the sampling area or in the staging area while sampling	• Food and drink outside of the sampling area, in designated area • Hand washing and new gloves upon re-entering the sampling area
Sample Containers and Other Materials in Direct Contact with Sample (Ecology, 2023b**)**	
• Glass sample containers, due to PFAS adherence to glass surfaces • Teflon® liners, caps, or sample container lids • Low density polyethylene (LDPE) sample containers or liners, due to sorption of PFAS to LDPE materials	• HDPE or polypropylene containers with screw caps that do not contain Teflon® or other fluoropolymers
Field Equipment and Materials (Ecology, 2023b**)**	
• Materials or equipment components containing fluoropolymers. Trademark examples include Teflon®, Hostaflon®, Kynar®, Neoflon®, Tefzel®, and Viton™. Fluorinated ethylene propylene (FEP), ethylene tetrafluoroethylene (ETFE), polytetrafluoroethylene (PTFE), polyvinylidene fluoride (PVDF) and polychlorotrifluoroethylene (PCTFE) are other examples	• Equipment with these components can be used if the PFAS is internal to the equipment and does not contact the external environment • If in doubt about a product, collect and analyze an equipment blank sample • LDPE[1] not in direct contact with the sample (e.g., Ziploc® bags)
• In the sampling area, avoid using waterproof paper, field books, and forms; plastic clipboards, Post-it Notes® • Regular/thick-size Sharpie® or other felt-tip markers, felt pens and pens with water-resistant ink	• Ball-point pens • Pre-printed labels from the laboratory • Fine and Ultra-Fine point Sharpie® markers and Rite-in-the-rain® notebooks in staging area only

[1] LDPE plastics are commonly identified by a recycling symbol with a number 4 inside it.

Table 1. Items that Are to be Avoided and Items that are Acceptable and during PFAS Sampling

Items to be Avoided	Acceptable Items
• Decon 90®	• Alconox®, Liquinox®, or Citranox®
• Chemical (blue) ice packs	• Regular (wet) ice that is double-bagged and kept in the staging area and does not contact sample media
Field Equipment and Materials (Based on Geosyntec's Experience)	
• None	Dedicated or decontaminated equipment including the following: • Submersible pumps, bladder pumps, peristaltic pumps, and inertia pumps that do not have Teflon® components • Silicon and/or HDPE tubing • HDPE Hydrasleeve samplers, Nylon string, and stainless-steel weights • Water quality field meters • Water level probes • Stainless steel bailers without PTFE components (e.g., PFTE ball valves), bacon bomb samplers • Telescoping pole
• Binders, or spiral hard cover notebooks • Aluminum foil	• Standard/loose plain paper and sample container labels • Boring log sampling forms • CoC record • Masonite or aluminum clipboards
• None	• Thin HDPE sheeting, HDPE trash bags • Paper towels • Hard shell coolers • Bubble wrap • Duct tape and packing tape

Notes:

[1] Per Washington Department of Ecology (Ecology, 2023b) citing Michigan Department of Environmental Quality (MDEQ, 2018) guidance, sunscreen or insect-repellant will not be applied in the exclusion zone. **Allowable** insect repellents include OFF Deep Woods, Sawyer Permethrin, Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, and California Baby Natural Bug Spray. **Allowable** sunscreens include Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30, Meijer Sunscreen Lotion Broad Spectrum SPF 30, Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30, Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30, Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30, Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30, Banana Boat Sport Performance Sunscreen Stick SPF 50, Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50, Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30, Coppertone Sunscreen Stick Kids SPF 55, L'Oréal Silky Sheer Face Lotion 50+, Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50, Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70, Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70, Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30, and Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+.

[2] Per Washington Department of Ecology (2023) citing Michigan Department of Environmental Quality guidance (2018) guidance, if the Health and Safety Plan requires a specific type of boot (such as steel-toed), and PFAS-free boots cannot be purchased, PFAS-free over-boots may be worn. Over-boots must be put on in the staging area, and hands washed after donning the over-boots before the beginning of sampling activities. Over-boots may only be removed in the staging area after the sampling activities are complete.

Table 2. Typical Eurofins Reporting Limits for Draft EPA Method 1633 Quantification of PFAS in Groundwater Samples

PFAS Chemical Name	Abbreviation	CAS No.	Reporting Limit (ng/L)	Method Detection Limit (ng/L)
Perfluorobutanoic acid	PFBA	375-22-4	8.00	0.941
Perfluoropentanoic acid	PFPeA	2706-90-3	4.00	0.552
Perfluorohexanoic acid	PFHxA	307-24-4	2.00	0.454
Perfluoroheptanoic acid	PFHpA	375-85-9	2.00	0.501
Perfluorooctanoic acid	PFOA	335-67-1	2.00	0.367
Perfluorononanoic acid	PFNA	375-95-1	2.00	0.657
Perfluorodecanoic acid	PFDA	335-76-2	2.00	0.810
Perfluoroundecanoic acid	PFUnA	2058-94-8	2.00	0.609
Perfluorododecanoic acid	PFDoA	307-55-1	2.00	0.603
Perfluorotridecanoic acid	PFTrDA	72629-94-8	2.00	0.478
Perfluorotetradecanoic acid	PFTeDA	376-06-7	2.00	0.554
Perfluorobutanesulfonic acid	PFBS	375-73-5	2.00	0.289
Perfluoropentanesulfonic acid	PFPeS	2706-91-4	2.00	0.351
Perfluorohexanesulfonic acid	PFHxS	355-46-4	2.00	0.393
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	2.00	0.395
Perfluorooctanesulfonic acid	PFOS	1763-23-1	2.00	0.441
Perfluorononanesulfonic acid	PFNS	68259-12-1	2.00	0.402
Perfluorodecanesulfonic acid	PFDS	335-77-3	2.00	0.328

Table 2. Typical Eurofins Reporting Limits for Draft EPA Method 1633 Quantification of PFAS in Groundwater Samples

PFAS Chemical Name	Abbreviation	CAS No.	Reporting Limit (ng/L)	Method Detection Limit (ng/L)
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	2.00	0.431
1H,1H,2H,2H-Perfluorohexane sulfonic acid	4:2 FTS	757124-72-4	8.00	1.65
1H,1H,2H,2H-Perfluorooctane sulfonic acid	6:2 FTS	27619-97-2	8.00	1.07
1H,1H,2H,2H-Perfluorodecane sulfonic acid	8:2 FTS	39108-34-4	8.00	1.41
Perfluorooctanesulfonamide	PFOSA	754-91-6	2.00	0.346
N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8	2.00	0.453
N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2	2.00	0.365
N-methylperfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9	2.00	0.735
N-ethylperfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6	2.00	0.554
N-methylperfluorooctane sulfonamidoethanol	NMeFOSE	24448-09-7	20.0	2.33
N-ethylperfluorooctane sulfonamidoethanol	NEtFOSE	1691-99-2	20.0	1.86
Hexafluoropropylene Oxide Dimer Acid	HFPO-DA	13252-13-6	8.00	1.85
4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4	8.00	1.67
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	4.00	0.578
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	4.00	0.608
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	4.00	0.630
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1	8.00	0.757
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9	8.00	0.818

Table 2. Typical Eurofins Reporting Limits for Draft EPA Method 1633 Quantification of PFAS in Groundwater Samples

PFAS Chemical Name	Abbreviation	CAS No.	Reporting Limit (ng/L)	Method Detection Limit (ng/L)
Perfluoro (2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7	4.00	0.730
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5	10.0	0.860
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3	50.0	5.54
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4	50.0	6.53

CAS – chemical abstract service
NA – not available
ng/L – nanograms per liter

ATTACHMENT 1
Daily Sampling Checklist

Attachment 1. Daily Sampling Checklist

Date: _____

Site Name: _____

Weather (*temperature/precipitation*): _____

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

Field clothing and personal protective equipment:

- ☐ No water- or stain-resistant boots or clothing (e.g., GORE-TEX®)
- ☐ Boots made of polyurethane, PVC, rubber, or untreated leather
- ☐ Clothing has not been recently laundered with a fabric softener
- ☐ No coated HDPE suits (e.g., coated Tyvek® suits)
- ☐ Field crew has not used cosmetics, moisturizers, or other related products today
- ☐ Field crew has not used sunscreen or insect repellants today, other than products approved as PFAS-free

Field equipment:

- ☐ Sample containers are made of HDPE or polypropylene, not LDPE
- ☐ Sample caps are made of HDPE or polypropylene and are not lined with Teflon™
- ☐ No materials containing Teflon™, Viton™, or other fluoropolymers
- ☐ No materials containing LDPE in direct contact with the sample (e.g., LDPE tubing)
- ☐ Equipment in direct contact with the sample is made from stainless steel, HDPE, acetate, silicon, or polypropylene
- ☐ No plastic clipboards, binders, or spiral hard cover notebooks
- ☐ No waterproof field books
- ☐ No waterproof or felt pens or markers (e.g., certain Sharpie® products)
- ☐ No chemical (blue) ice, unless it is contained in a sealed bag
- ☐ No aluminum foil
- ☐ No sticky notes (e.g., certain Post-It® products)

Decontamination:

- ☐ Reusable sampling equipment decontaminated before and after each sample location
- ☐ "PFAS-free" water is on site for decontamination of sample equipment
- ☐ Alconox®, Liquinox®, Luminox® or Citranox® used as decontamination detergent

Food and drink:

- ☐ No food or drink on-site, except within staging area
- ☐ Food in staging area is contained in HDPE or stainless-steel container (continued)

Wet weather (as applicable):

- ☐ Field staff rain gear is made of polyurethane, PVC, vinyl, wax-coated or rubber

Notes:

_____

_____

_____

_____

_____

Field Team Leader Name (Print): _____

Field Team Leader Signature: _____

Date/Time: _____