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Evaluation of Port Huron Wastewater Treatment Plant (WWTP) Biosolids Land Application Fort Gratiot Agricultural Field Parcel ID 74-20-019-1007-01

St. Claire County, Michigan

Project Number: 60588767

Prepared for
Michigan Department of Environment, Great Lakes, and Energy

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Table of Contents

Figures

Tables

Appendices

1. Introduction

This technical memorandum summarizes and reports the findings of site investigations conducted at the Fort Gratiot, Michigan owned agricultural site, Parcel ID 74-20-019-1007-01 (Parcel 1007-01), in St. Claire County, MI (**Figure 1**). The purpose of the investigation was to determine the impact, if any, from the land application of Per- and Polyfluoroalkyl Substances (PFAS)-impacted biosolids from the Port Huron Wastewater Treatment Plant (WWTP) in the soil, groundwater, and adjacent surface water bodies.

The field investigation activities were designed to characterize soil, groundwater, and surface water conditions and collect data to evaluate the risk to human health and the environment from land applying potential PFAS-impacted biosolids. A review of existing data was used to guide the scope of this investigation. Field investigation activities at the Site included soil, spoil piles, groundwater, and surface water sampling activities.

2. Background

The Fort Gratiot Landfill was in operation from 1969 to 1994 and accepted industrial waste including paper pulp waste, paint sludge, and contaminated soil from environmental clean-up projects. In 1994, the landfill stopped accepting waste in response to the Michigan Department of Natural Resources (MDNR) order to Cease and Desist. The landfill was added to the list of Michigan PFAS sites after elevated levels of Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) were measured in landfill leachate/groundwater and surface water samples collected near the landfill. Additional surface water samples collected by EGLE detected significant concentrations of PFOS in various drainages in Fort Gratiot Township near fields known to have received biosolids from the Port Huron WWTP. The highest PFOS concentration of 3,200 ng/L was detected in the Brandymore Drain (**Appendix A [*Appendix II: Figure 3]***), located downgradient of Parcel 1007-01. Parcel 1007-01 was therefore selected for further investigation of PFAS impacts from the land application of biosolids from the Port Huron WWTP.

Parcel ID 1007-01 is a 200-acre Site located southwest of Keewahdin Road and State Road in Fort Gratiot Township, Michigan, approximately five (5) miles northwest of the Port Huron WWTP. Parcel 1007-01 is comprised of six (6) smaller fields based on biosolids application requests: 07N17E19-CK01 (CK01), 07N17E19-CK02 (CK02), 07N17E19-CK03 (CK03), 07N17E19-CK04 (CK04), 07N17E19-CK05 (CK05), and 07N17E19-CK06 (CK06) (**Figure 2, Appendix B**). All six (6) smaller fields were approved for biosolids application; however, only fields CK01 and CK02 land-applied Port Huron WWTP biosolids. Field CK01 was split into two (2) smaller fields for additional biosolids application: 07N17E19-CK1A (CK1A) and 07N17E19-CK2A (CK2A) (**Figure 2, Appendix C**).

Application to apply biosolids from the Port Huron WWTP to Parcel 1007-01 was first received by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division (WRD) in 1982. Records indicate field CK01 received 72.74 dry tons (dT) of biosolids from two (2) applications by the Port Huron WWTP from 1982 to 1983, with an average application rate of 2.61 dT per acre. These applications covered a majority or entirety of field CK01. Records indicate field CK02 received 23.85 dT of biosolids from a single application by the Port Huron WWTP in 1983. This application covered approximately nine (9) of the 13 acres, with an application rate of 2.51 dT per acre. Fields CK1A and CK2A each

received approximately 10 dT of biosolids from a single application by the Port Huron WWTP in 1983. These applications covered the entirety of each field.

The investigation conducted by AECOM on behalf of EGLE was performed in accordance with applicable AECOM, EGLE, and US Environmental Protection Agency (USEPA) guidance documents, including the Scope of Work and the Quality Assurance Project Plan (QAPP), previously developed in 2018. The first objective of this investigation was to assess the PFAS concentrations in soils, spoil piles, and adjacent surface waters to identify the potential source area for the high PFAS detections previously identified in September 2019 within the Brandymore Drain. The second objective was to identify potential PFAS concentration variations between the portions of the Site where biosolids were land applied and not land applied. The third objective was to sample surface water upstream of previously measured locations, to aid the EGLE WRD in identifying the source(s) of PFAS in these drainages. The fourth and final objective of this investigation was to evaluate the potential impact on neighboring residential wells. The 2019 AECOM investigation at Parcel 1007-01 included the collection of six (6) surface soil samples, three (3) spoil pile samples, seven (7) surface water samples, and three (3) residential groundwater well samples (**Figure 2**).

The USEPA has classified PFAS as emerging contaminants that are regulated by EGLE under Part 201, Environmental Remediation, and Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, Act 451 of 1994, as amended and their respective administrative rules, specifically Rule 299.44-299.50 (Generic Cleanup Criteria) and Rule 323.1057 (Rule 57) (Toxic Substances) of the Michigan Administrative Code. PFAS are a complex family of more than 4,750 human-made fluorinated organic chemicals. Due to their unique chemical properties, PFAS have been used in many industries and consumer products since the late 1950s. The Interstate Technology Regulatory Council (ITRC) has identified four (4) primary sources of PFAS: fire training/fire response sites, industrial sites, landfills, and wastewater treatment plants/biosolids.

AECOM initially sampled the Port Huron WWTP on November 15, 2018. Port Huron WWTP has an approved Industrial Pretreatment Program (IPP) and authorization to discharge treated municipal wastewater under NPDES permit number MI0023833. The influent, effluent, and biosolids from this sampling event were analyzed for EGLE's recommended minimum analyte list of 24 PFAS compounds. The influent and effluent samples collected during the AECOM November 2018 event exceeded Rule 57 Water Quality Standards (WQS) for PFOS (11 ng/L) and PFOA (420 ng/L). The final effluent from the Port Huron WWTP is to a surface water body used for drinking water, and the lower WQS are applicable. The Port Huron WWTP has frequently sampled their influent and effluent since November 2018 for PFAS. For a short period between February and April 2019, a total of three (3) effluent samples exceeded the WQS for PFOA with concentrations between 570 to 660 ng/L. However, after these higher detections, PFOA concentrations ranged between 32 to 61 ng/L, with the most recent result of 37 ng/L. PFAS fate and transport within WWPTs, including Port Huron, are discussed in detail in the *Evaluation of PFAS in Influent, Effluent, and Residuals of WWTPs in Michigan* report. The results from the Port Huron WWTP sampling events are summarized below, listed as the range of values detected by year.

Sample Location	Sample Year	PFOA[1] (detection range)	PFOS[1] (detection range)
Influent	2018	40 – 64.6	19.5 – 40
Influent	2019	27 – 80	16 – 36
Influent	2020	46 – 58	14 – 29
Effluent	2018	40 – 90	13.1 – 80
Effluent	2019	32 – 660	15 – 1,150
Effluent	2020	37 – 54	9.7 – 21
Biosolids	2018	4.42	77.6
Biosolids	2019	2.7	13

[1]Units for aqueous samples are in nanograms per liter (ng/L) or parts per trillion (ppt), and solid samples are in micrograms per kilogram (µg/Kg) or parts per billion (ppb).

The analytical results from sampling the influent, effluent, and biosolids at the Port Huron WWTP represent only the conditions at the time of sampling. There is not enough historic information to accurately estimate the concentrations of PFOA and PFOS within the Port Huron WWTP in the past, including the biosolids. It is documented that PFOA and PFOS were much more widely used in the past. As a result, concentrations in all environmental matrices found in agricultural fields where Port Huron WWTP biosolids were land applied in the past may not be closely correlated to current concentrations found within the WWTP. However, biosolids associated with IPP WWTPs are expected to have higher PFAS concentrations than those from non-IPP WWTPs. The Port Huron WWTP and agricultural field Parcel, 1007-01, was selected to compare with other WWTPs and agricultural fields that participate in the IPP that had lower PFAS concentrations in their biosolids and non-IPP WWTPs and agricultural fields.

3. Hydrogeology/Geology

The geology and topography of Parcel 1007-01 is the result of glacial activity. The glacial aquifers consist of sand and gravel that are part of a thick sequence of Pleistocene glacial deposits. The area is composed of moraines and lacustrine deposits from drainage channels, and deltas and plains that are predominately composed of sandy loam and till. No soil borings were installed during this investigation. Only surface water, surface soil, and spoil piles samples were collected on Site.

The USDA Natural Resources Conservation Service Web Soil Survey identified three (3) primary types of surface soils from where samples were collected (**Appendix D**). The surface soils are described as the Londo loam (LoA), Wainola-Deford fine sands (WdA), and Parkhill loam (Pc). The agricultural field is composed primarily of the Londo loam, which covers a majority of the Site except the southwest region. The Londo loam was deposited from water-lain moraines and glacial drainage channels, as a loamy till. The Wainola-Deford fine sands are located in the southwest region of the field. These fine sands were typically deposited as knolls on deltas, outwash plains, and beaches, composed of a sandy glaciolacustrine deposit. The Parkhill loam is sparsely present around the edges of the Site. The Parkhill loam was deposited as drainageways, moraines, and lake plains, consisting of a loamy lodgment till.

Regional groundwater flow is expected to generally be towards surface water bodies such as ponds and streams. The Brandymore Drain runs along the western edge of the Site, flowing from the southwest to the northeast. There is an enclosed drainage ditch that cuts through the

central portion of the Site. This drainage ditch potentially provided previous contaminant movement through the channel, flowing from the south to the north (**Figure 2**).

4. Scope of Work

Surface soil, spoil piles, surface water, and residential samples were collected from Parcel 1007-01 to evaluate the potential PFAS impact from the Port Huron WWTP biosolids. The surface soil, spoil piles and surface water samples were submitted to Vista Analytical Laboratories and analyzed for EGLE's recommended minimum analyte list of 28 PFAS compounds provided below, using an isotope dilution method.

PFAS Name	Carbon Chain length (C#)	Acronym	CAS #
Perfluorobutanoic Acid[1]	C4	PFBA	375-22-4
Perfluoropentanoic Acid[1]	C5	PFPeA	2706-90-3
Perfluorohexanoic Acid[1]	C6	PFHxA	307-24-4
Perfluoroheptanoic Acid[1]	C7	PFHpA	375-85-9
Perfluorooctanoic Acid[1]	C8	PFOA	335-67-1
Perfluorononanoic Acid[1]	C9	PFNA	375-95-1
Perfluorodecanoic Acid[1]	C10	PFDA	335-76-2
Perfluoroundecanoic Acid[1]	C11	PFUnDA	2058-94-8
Perfluorododecanoic Acid[1]	C12	PFDoDA	307-55-1
Perfluorotridecanoic Acid[1]	C13	PFTrDA	72629-94-8
Perfluorotetradecanoic Acid[1]	C14	PFTeDA	376-06-7
Perfluorobutane Sulfonic Acid[2]	C4	PFBS	375-73-5
Perfluoropentane Sulfonic Acid[2]	C5	PFPeS	2706-91-4
Perfluorohexane Sulfonic Acid[2]	C6	PFHxS	355-46-4
Perfluoroheptane Sulfonic Acid[2]	C7	PFHpS	375-92-8
Perfluorooctane Sulfonic Acid[2]	C8	PFOS	1763-23-1
Perfluorononane Sulfonic Acid[2]	C9	PFNS	474511-07-4
Perfluorodecane Sulfonic Acid[2]	C10	PFDS	335-77-3
Perfluorooctane Sulfonamide[3]	C8	FOSA	754-91-6
4:2 Fluorotelomer Sulfonic Acid[4]	C4	4:2 FTSA	757124-72-4
6:2 Fluorotelomer Sulfonic Acid[4]	C6	6:2 FTSA	27619-97-2
8:2 Fluorotelomer Sulfonic Acid[4]	C8	8:2 FTSA	39108-34-4
N-Ethyl Perfluorooctane Sulfonamidoacetic Acid[5]	C8	EtFOSAA	2991-50-6
N-Methyl Perfluorooctane Sulfonamidoacetic Acid[6]	C8	MeFOSAA	2355-31-9

PFAS Name	Carbon Chain length (C#)	Acronym	CAS #
Perfluoro (2-methyl-3-oxahexanoic) Acid[7]	C6	HFPO-DA (Gen-X)	13252-13-6
4,8-Dioxa-3H-perfluorononanoic Acid[7]	C7	ADONA	919005-14-4
9-chlorohexadecafluoro-3-oxanone-1-sulfonic Acid[7]	C8	F-53B Minor	756426-58-1
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid[7]	C10	F-53B Major	763051-92-9

[1]Perfluoroalkyl Carboxylic Acids (PFCAs) Family is composed of the following PFAS: PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFTeDA

[2]Perfluoroalkane Sulfonic Acids (PFSAs) Family is composed of the following PFAS: PFBS, PFPeS, PFHxS, PFHpS, PFOS, PFNS, PFDS

[3]Perfluoroalkane Sulfonamides (FASAs) Family is composed of the following PFAS: FOSA

[4](n:2) Fluorotelomer Sulfonic Acids (FTSAs) Family is composed of the following PFAS: 4:2 FTSA, 6:2 FTSA, 8:2 FTSA

[5]N-Ethyl Perfluoroalkane Sulfonamidoacetic Acids (EtFASAAs) Family is composed of the following PFAS: EtFOSAA

[6]N-Methyl Perfluoroalkane Sulfonamidoacetic Acids (MeFASAAs) Family is composed of the following PFAS: MeFOSAA

[7]Recent PFAS developed as replacement chemistry

In November 2019, residential well samples collected from Resident 1 and 2 were submitted to Vista Analytical Laboratories and analyzed for United States Environmental Protection Agency (USEPA) Method 537 Rev 1.1 which had an analyte list of 14 PFAS. In December 2019, the residential well sample collected from Resident 3 was analyzed by Vista Analytical Laboratories using USEPA Method 537.1 which had an analyte list of 18 PFAS. The full list of 18 PFAS analytes is provided below with the final four (4) compounds on the list being the additional analytes that were later added for analysis.

PFAS Name	Carbon Chain length (C#)	Acronym	CAS #
Perfluorohexanoic Acid[1]	C6	PFHxA	307-24-4
Perfluoroheptanoic Acid[1]	C7	PFHpA	375-85-9
Perfluorooctanoic Acid[1]	C8	PFOA	335-67-1
Perfluorononanoic Acid[1]	C9	PFNA	375-95-1
Perfluorodecanoic Acid[1]	C10	PFDA	335-76-2
Perfluoroundecanoic Acid[1]	C11	PFUnDA	2058-94-8
Perfluorododecanoic Acid[1]	C12	PFDoDA	307-55-1
Perfluorotridecanoic Acid[1]	C13	PFTrDA	72629-94-8
Perfluorotetradecanoic Acid[1]	C14	PFTeDA	376-06-7
Perfluorobutane Sulfonic Acid[2]	C4	PFBS	375-73-5
Perfluorohexane Sulfonic Acid[2]	C6	PFHxS	355-46-4
Perfluorooctane Sulfonic Acid[2]	C8	PFOS	1763-23-1

PFAS Name	Carbon Chain length (C#)	Acronym	CAS #
N-Ethyl Perfluorooctane Sulfonamidoacetic Acid[3]	C8	EtFOSAA	2991-50-6
N-Methyl Perfluorooctane Sulfonamidoacetic Acid[4]	C8	MeFOSAA	2355-31-9
Perfluoro (2-methyl-3-oxahexanoic) Acid[5]	C6	HFPO-DA (Gen-X)	13252-13-6
4,8-Dioxa-3H-perfluorononanoic Acid[5]	C10	ADONA	919005-14-4
9-chlorohexadecafluoro-3-oxanone-1-sulfonic Acid[5]	C8	F-53B Minor	756426-58-1
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid[5]	C10	F-53B Major	763051-92-9

[1]Perfluoroalkyl Carboxylic Acids (PFCAs) Family is composed of the following PFAS: PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFTeDA

[2]Perfluoroalkane Sulfonic Acids (PFSAs) Family is composed of the following PFAS: PFBS, PFHxS, PFOS

[3]N-Ethyl Perfluoroalkane Sulfonamidoacetic Acids (EtFASAAs) Family is composed of the following PFAS: EtFOSAA

[4]N-Methyl Perfluoroalkane Sulfonamidoacetic Acids (MeFASAAs) Family is composed of the following PFAS: MeFOSAA

[5]Recent PFAS developed as replacement chemistry

5. Surface Soil

5.1 Surface Soil Samples (DUs)

The locations of soil samples were selected to identify a potential difference in PFAS concentration between the western portion of the Site where biosolids were historically applied compared to the eastern portion of the field where records show minimal land application. The biosolids were assumed to have been applied consistently at a depth of eight (8) inches across the agricultural fields based on information provided by EGLE. Soil samples were collected from four (4) Decision Units (DUs) using one (1) of two (2) methods: composite sampling or the Incremental Sampling Method (ISM) (**Figure 2**). Composite sampling is a technique that physically combines several spatially discrete aliquots from a body of material into a single sample for analysis. For DU3 and DU4, composite samples were collected within a 50 by 50 feet (ft) grid, which were each composed of nine (9) aliquots, from a depth of zero (0) to 12 inches below ground surface (bgs), using a ¾" diameter soil sampler core. All nine (9) aliquots from each DU were homogenized into one (1) composite sample for that DU. In comparison, ISM is a structured sampling method designed to obtain a sample representative of the entire volume of environmental media targeted for sampling. An increased number of aliquots are collected in a random systematic approach throughout the DU. Further, ISM sampling has additional sampling standards on the particle size, and the analytical laboratory has prescribed procedures on how the sample is homogenized and sub-sampled. ISM was utilized for samples at DU1 and DU2. The DU1 ISM sample was composed of 52 aliquots from a depth of zero (0) to 12 inches bgs, using a ¾" diameter soil sampler core and ISM processing. Three (3) triplicate ISM samples (A, B, C) were collected from DU2, each composed of 52 aliquots collected from zero (0) to 12 inches using a ¾" diameter soil core sampler and ISM processing.

The ISM sampling methodology is very labor-intensive and expensive and can therefore limit the extent of sampling. As a result, EGLE and AECOM evaluated using a screening composite method to assess potential PFAS impacts in soils. Both sampling methods were used at Parcel 1007-01 to evaluate any differences in results between ISM methodology for DU2 with the

collection of 52 aliquots from field 07N17E19-CK01 and composite sampling of DU3 and DU4 using nine (9) aliquots within a 50 by 50-foot area. Comparison sampling using both the ISM methodology and composite sampling of nine (9) aliquots within a 50 by 50-foot area was conducted at also conducted at field 08N10E33-CL01 associated with Lapeer WWTP. Initially, soil sampling at multiple fields was conducted from six (6) to eight (8) inches. To provide soil samples from for the entire horizon where the majority of many of the crop roots reside the sampling was than done from zero (0) to 12 inches. The soil concentrations in the top 12 inches of the soil horizon are expected to be well homogenized, integrating the biosolids uniformly within the soil.

The first soil sample (DU1, consists of the eastern fields CK02 and CK03) was collected within the Londo loam and is representative of the farmland that received minimal or no biosolids applied from the Port Huron WWTP. Records show only one (1) biosolids application to field CK02, and no applications to field CK03. At the time of sampling, these records were not available and DU1 was assumed to have no biosolids applied. Ideally all field historical information is known before establishing a DU for sampling. The second soil sample (DU2, consists of western fields CK01, CK1A, and CK2A) was sampled within the Londo loam and Wainola-Deford fine sands and represents the farmland that received biosolids applications from the Port Huron WWTP. Field CK01 received two (2) biosolid application events, and fields CK1A and CK2A received one (1) biosolids application each. The third and fourth soil samples (DU3 and DU4) were collected within the Londo loam and Wainola-Deford fine sands in the southwest region of the Site, within DU2. The third and fourth DUs represent the 50 x 50' soil sampling grid, which were used to verify the accuracy of the screening composite method compared to sampling the entire field by incremental sampling methods (ISM). Parcel 1007-01 biosolids fields are shown in **Figure 2** and **Appendices B, C.** The analytical results are summarized in the table below and attached in **Table 2** and **Figure 3.**

Soil Sample ID	Sample Date	Field Site	Sample Depth	Total PFAS[1]	PFOA[1]	PFOS[1]
SXDU0102141912181700LM	12/18/2019	DU1	0-12" ISM	**0.544**	< 0.511	**0.544**
SXDU0202141912181100LM	12/18/2019	DU2 – Sample A	0-12" ISM	**120**	**2.24**	**98.4**
SXDU0202141912181105LM	12/18/2019	DU2 – Sample B	0-12" ISM	**125**	**2.33**	**108**
SXDU0202141912181110LM	12/18/2019	DU2 – Sample C	0-12" ISM	**156**	**3.00**	**134**
SXDU0302141912181300LM	12/18/2019	DU3	0-12"	**124**	**0.831**	**112**
SXDU0402141912181330LM	12/18/2019	DU4	0-12"	**191**	**2.40**	**150**

[1]Units are in micrograms per kilogram (µg/Kg) or parts per billion (ppb)

The soil samples collected from DU2, DU3, and DU4, with multiple known biosolids applications, detected relatively high Total PFAS, ranging from 120 to 191 µg/Kg. The soil sample collected from DU1, detected a low Total PFAS concentration of 0.544 µg/Kg. PFOS was the highest detected compound in all six (6) samples, ranging from 0.554 to 150 µg/Kg. PFOS is considered a long-chain PFAS, which is expected to concentrate and be present in the biosolids and soils at higher concentrations. The significantly lower Total PFAS concentration at DU1 supports the records that Port Huron WWTP biosolids were minimally land-applied to this region, from only one (1) application on field CK02 and zero (0) to field CK03. The results between the DU2 samples using the ISM sampling method were comparable with DU3 and DU4 that used the composite of nine (9) aliquots within a 50 by 50-foot area. Similar agreement between the two sampling methods was also determine at agricultural field 08N10E33-CL01 associated with Lapeer WWTP.

5.2 Spoil Piles Samples

In the northwest region of Parcel 1007-01, AECOM identified dredge spoils from a nearby culvert replacement stockpiled on the field. Field staff recorded physical characteristics and assessed the homogeneity of each pile at the time of sampling. The dredge spoil piles were divided into three (3) composite samples based on homogeneity. Each composite sample was collected from zero (0) to 12 inches using a ¾“ diameter soil core sampler. The top four (4) to six (6) inches of possible vegetation and topsoil from each spoil pile was removed before sampling. The analytical results are summarized in the table below and attached in **Table 2** and **Figure 3.**

Soil Sample ID	Sample Date	Field Site	Total PFAS[1]	PFOA[1]	PFOS[1]
SX04161912181400LM	12/18/2019	SP-1	**1.13**	< 0.498	**1.13**
SX04161912181405LM	12/18/2019	SP-2	**1.01**	< 0.497	**1.01**
SX04161912181410LM	12/18/2019	SP-3	< 0.500	< 0.500	< 0.500
SX04161912181410LM-FD	12/18/2019	SP-3 Duplicate	< 0.497	< 0.497	< 0.497

[1]Units are in micrograms per kilogram (µg/Kg) or parts per billion (ppb)

All samples collected from the three (3) spoil piles reported very low or non-detectable values of Total PFAS, ranging from < 0.497 to 1.13 µg/Kg, which implies the spoil piles are not likely the source of PFAS in the area.

6. Surface Water

A total of seven (7) surface water samples were collected from Parcel 1007-01. Surface water samples SW-01 and SW-05 were collected along the Brandymore Drain on the west and northwest edges of the Site. Surface water samples SW-02, SW-03, SW-04, and SW-07 were collected from the enclosed drainage channel that cuts through the center of the Site between DU1 and DU2 (**Figure 2**). Surface water sample SW-06 was collected from the on-site pond, in the southeast region of DU2. Surface water was collected approximately 6-inches below the water surface, upstream of any sampling equipment and personnel and at a point where the flow was determined to be the greatest. Samples were obtained by hand or with a dipping pole depending on accessibility. The analytical results are summarized in the table below and attached in **Table 3** and **Figure 4**.

Surface Water Sample ID	Sample Date	Field Site	Total PFAS[1]	PFOA[1]	PFOS[1]
SW011912181325ML	12/18/2019	SW-01	**83.8**	**14.6**	**22.7**
SW021912181332ML	12/18/2019	SW-02	**1012**	**164**	**813**
SW031912181310ML	12/18/2019	SW-03	**949**	**167**	**747**
SW041912181318ML	12/18/2019	SW-04	**9.70**	**1.96**	**2.00**
SW051912181245ML	12/18/2019	SW-05	**94.4**	**14.7**	**24.8**
SW051912181245ML-FD	12/18/2019	SW-05	**92.5**	**13.9**	**22.8**
SW061912181140ML	12/18/2019	SW-06	**168**	**27.9**	**120**
SW071912181217ML	12/18/2019	SW-07	**14.81**	**1.89**	< 2.10

[1]Units are in nanograms per liter (ng/L) or parts per trillion

All surface water samples collected detected some PFAS compounds, with significant variance of Total PFAS from 14.81 to 1012 ng/L. All surface water samples, excluding samples collected

from SW-04 and SW-07, exceeded Rule 57 Water Quality Standards (WQSs) for PFOS of 12 ng/L (**Section 10**), with detections ranging from 22.8 to 813 ng/L. None of the surface water samples collected exceeded Rule 57 WQS for PFOA (12,000 ng/L).

The highest Total PFAS concentrations were reported at SW-02 (1012 ng/L) and SW-03 (949 ng/L). Both samples were collected in the northern region above CK02. This area is downgradient of the highly impacted PFAS surface soils in DU2. It is presumed that the enclosed drainage ditch possibly provided previous transport of PFAS into this northern region where SW-02 and SW-03 were collected.

7. Residential Groundwater Wells

On November 14, 2019 two (2) residential wells were sampled along Keewahdin Road, north of Parcel 1007-01. On December 18, 2019, an additional residential well was sampled along Keewahdin Road, northwest of the Site (**Figure 2**). The sampling nomenclature "WT" indicates that the well water collected was raw and untreated. The sampling nomenclature "WR" indicates that a raw sample was collected before treatment, in Resident 1's case, a reverse osmosis system. Samples collected from Resident 1 and Resident 2 were analyzed using USEPA Method 537 Rev 1.1 for 14 PFAS and Resident 3 was analyzed using USEPA Method 537.1 for 18 PFAS. The analytical data is summarized in the table below and attached in **Table 4** and **Figure 5**.

Groundwater Sample ID	Sample Date	Sample Location	Total PFAS[1]	PFOA[1]	PFOS[1]
WR1911141350GGA	11/14/2019	Resident 1	< 4.00	< 2.00	< 2.00
WT1911141405GGA	11/14/2019	Resident 2	< 4.00	< 2.00	< 2.00
WT1912180852ML	12/18/2019	Resident 3	< 4.00	< 2.00	< 2.00

[1]Units are in nanograms per liter (ng/L) or parts per trillion

The three (3) residential wells reported PFAS concentrations below detection limits. All residential well samples did not exceed Part 201 Residential and Nonresidential Drinking Water Criteria (DWC) for PFOS, PFOA, PFNA, PFHxS, PFHxA, and PFBS of 16, 8, 6, 51, 400,000, and 420 ng/L, respectively (**Section 10**). The PFAS concentrations below detectable limits in all residential samples suggest that neighboring wells and groundwater are not impacted by the high PFAS detected in the surface soil and surface water in the area.

8. QA/QC Results

Laboratory reports 1904441 (Soil and Surface Water), 1904442, 1904024, and 1904025 (Residential Groundwater Wells) from Vista Analytical Laboratories were subjected to data quality review (**Appendix E**). The reports were evaluated for data completeness, holding times and sample preservation, method and field blanks, ongoing precision and recovery (OPR), field duplicate precision, extracted internal standard recoveries, and reporting issues.

The initial calibration and continuing calibration verifications met the method acceptance criteria. A method blank and ORP sample was extracted and analyzed with each preparation batch. No analytes were detected in the method blank above half (1/2) the Limit of Quantification (LOQ). The OPR recoveries were within the method acceptance criteria. No quality issues were identified for any of the samples, and all of the results were considered usable.

9. Investigation-Derived Waste (IDW)

Investigation-derived waste (IDW) generated during the investigation included the following:

- Disposable material such as personal protective equipment (PPE), plastic sheeting, paper towels, sampling waste (e.g., label backings) etc.
- Excess soil leftover from sampling activities
- Decontamination water

Minimally contaminated disposable sampling materials and PPE were containerized and disposed of as ordinary solid waste. Excess soil from sampling and decontamination water were discharged to the ground surface adjacent to where the material was generated.

10. Pathway and Receptors Evaluation

An exposure pathway includes five (5) components: the source of contamination, environmental media and transport mechanism, the point of exposure, route of exposure, and receptor population. A pathway is considered potentially complete if all five components are present, and one or more hazardous substances are detected. The human health risk associated with a potentially complete exposure pathway is acceptable if concentrations do not exceed the applicable criteria and background concentrations (Rule 299.1013(3)). Ecological risks are acceptable if concentrations do not exceed water quality values or soil screening values. Potentially complete groundwater exposure pathways associated with Parcel 1007-01 and corresponding Part 201 cleanup criteria are:

- Part 201 Residential and Nonresidential Drinking Water Criteria (DWC):
  - PFOA = 8 ng/L
  - PFOS = 16 ng/L
  - Perfluorononanoic acid (PFNA) = 6 ng/L
  - Perfluorohexane sulfonic acid (PFHxS) = 51 ng/L
  - Perfluorohexanoic acid (PFHxA) = 400,000 ng/L
  - Perfluorobutane sulfonic acid (PFBS) = 420 ng/L
  - Hexafluoropropylene oxide dimer acid (HFPO-DA) = 370 ng/L
- Groundwater-Surface Water Interface (GSI) Criteria: PFOA = 12,000 ng/L and PFOS = 12 ng/L

Additionally, EGLE only regulates PFOA and PFOS in the surface water. Criteria under the Michigan Rule 57 WQS were developed to protect humans, wildlife, and aquatic life. Potentially complete surface water exposure pathways associated with all Sites and corresponding Rule 57 WQS are:

PFAS	Human Noncancer Value (nondrinking water source)	Human Noncancer Value (drinking water source)	Final Chronic Value	Final Acute Value	Aquatic Maximum Value
PFOS[1]	12	11	140,000	1,600,000	780,000
PFOA[1]	12,000	420	880,000	15,000,000	7,700,000

[1]Units are in nanograms per liter (ng/L) or parts per trillion (ppt).

Potentially complete soil exposure pathways associated with the Site and corresponding Part 201 cleanup criteria (if available) are:

- Direct Contact Criteria (DCC; criteria not available)
- Human exposure by consuming impacted vegetation (gardening, farming; screening levels not available)

Potential receptors associated with groundwater are:

- People who use impacted groundwater for drinking water

Potential receptors associated with surface water are:

- People using the drains and streams and other impacted surface waters for recreation and fishing.
- Fish and other aquatic life

Potential receptors associated with soil are:

- Residents living at or near impacted soil areas
- Non-residential use of impacted soil areas, such as farming and commercial use

10.1 Surface Soil & Spoil Piles Evaluation

On-site farm workers may encounter surficial soils with detectable PFAS concentrations; however, no Part 201 DCC have been established for any PFAS compounds, including PFOS and PFOA. All soil samples collected from the four (4) DUs had some PFAS compounds detected. The soil sample collected from DU1 reported the lowest Total PFAS of 0.544 µg/Kg. The soil samples collected from DU2, DU3, and DU4 detected significantly higher levels of PFAS, ranging from 120.3 to 191 µg/Kg. Of the 28 PFAS analytes, only five (5) PFAS compounds were detected in all soil samples: PFOA, PFOS, FOSA, EtFOSAA and MeFOSAA. PFOS was the compound with highest detections, varying from 0.544 to 150 µg/Kg. The soil sample collected from DU1 detected low PFOS concentrations (0.544 ug/Kg) compared to soil samples collected from DU2, DU3 and DU4, which ranged from 98.4 to 150 µg/Kg. Two (2) of the three (3) samples collected from the on-Site spoil piles reported concentrations just above the detection limit (~ 0.50 µg/Kg) of 1.13 and 1.01 µg/Kg. The third sample from the spoil spiles reported non-detectable concentrations of PFAS. The Total PFAS detected in spoil piles 1 and 2 is significantly lower compared to the surface soil concentrations.

Studies have shown that PFAS does have the potential for plant uptake. Depending on the plant type and PFAS compound, the accumulation of PFAS is not evenly distributed throughout the major components of the plant. Some of the PFAS will accumulate more in the roots, while others accumulate in the leaves or fruits. However, exposure to PFAS via plant uptake through direct or indirect ingestion of PFAS-impacted plants may also be possible. Crops used for

animal feed production (e.g., silage) may potentially allow the PFAS to bioaccumulate in the livestock. Currently, there are no PFAS criteria for plants; however, a consumption advisory could be developed in the future like those for fish.

10.2 Surface Water Evaluation

PFAS concentrations were detected at all seven (7) surface water sample locations. All samples reported detectable values of PFOA, and seven (7) of eight (8) samples detected concentrations of PFOS. Rule 57 WQS for PFOA (12,000 ng/L) was not exceeded in any surface water samples. Rule 57 WQS for PFOS (12 ng/L) was exceeded in the following surface water samples: SW-01, SW-02, SW-03, SW-05 (and its duplicate sample), and SW-06. Of the 28 PFAS analytes, only the following nine (9) PFAS compounds were detected in the surface water samples: PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFBS, PFHxS, PFHpS, PFOS, and EtFOSAA. PFOS reported the highest concentrations, ranging from 2.00 to 813 ng/L.

10.3 Groundwater (Residential Well) Evaluation

The groundwater collected from the three (3) residential wells adjacent to Parcel ID 1007-01 reported non-detectable values (< 4.00 ng/L) for all PFAS analytes. The residential well samples detected levels below Part 201 DWC for PFOA, PFOS, PFNA, PFHxS, PFHxA, and PFBS of 8, 16, 6, 51, 400,000, and 420 ng/L, respectively (**Figure 5**, **Table 4**). The majority of this Fort Gratiot area is connected to the Port Huron municipal drinking water system, which is monitored and tested for PFAS. However, the non-detect concentrations of PFAS in these residential wells suggest that neighboring wells and groundwater are not impacted by the high PFAS in the surface soil and surface water.

11. Summary and Discussion

AECOM conducted a field investigation to determine the impact, if any, from the land application of biosolids suspected of containing high levels of PFAS concentrations from the Port Huron WWTP. This investigation expands EGLE's knowledge of PFAS at land application sites that may be associated with industrially impacted biosolids. Further, the investigation allows for comparison of PFAS in the soil, spoil piles, groundwater, and adjacent surface water bodies at Parcel ID 1007-01 to other agricultural fields associated with land application of biosolids not considered to be industrially impacted from non-IPP and IPP WWTPs. Land application field investigations will also help guide understanding of fate and transport of PFAS in environmental matrices and supplement fate and transport modeling analysis being conducted on this topic.

The soil, spoil piles, surface water, and groundwater sampling results show contrasting contamination levels. Relatively low PFAS concentrations were detected in the spoil piles and residential groundwater wells. However, the surface soil and surface water sampling results reported high PFAS detections. All sampling results are summarized in **Tables 2**, **3**, and **4**. PFAS were detected in all six (6) surface soil samples, two (2) of the three (3) spoil piles, and all seven (7) surface water locations (**Figures 3, 4,** and **5**). The laboratory reports are included in **Appendix E**.

PFAS such as PFBA, PFPeA, PFHxA, PFHpA, PFBS, and PFPeS have a shorter carbon chain length and are referred to as short-chain PFAS. While PFAS such as PFHxS, PFOA, and PFOS have longer fluorinated carbon chain lengths referred to as long-chain PFAS. The carbon chain length for short-chain PFAS is four (4), and eight (8) for long-chain PFAS. The shorter the carbon chain length for PFAS, the more mobile they are in the environment. As a result, long-chain PFAS are expected to concentrate and be present in the biosolids and soils at higher

concentrations, while short-chain PFAS to be more frequently detected in the aqueous phases such as surface water and groundwater. The detection limits for the solid phase (i.e., biosolids and soil) are in micrograms per kilogram (µg/Kg) or parts per billion (ppb). For the aqueous phase (i.e., surface water and groundwater), the detection limits are in nanograms per liter (ng/L) or parts per trillion (ppt). As a result, PFAS that are non-detect in the solid phase may still be present at very low concentrations below the detection limit and may be detected in the aqueous phases.

PFAS properties, including fate and transport in the environment, are still being studied and are currently not fully understood. Equations developed to estimate leachability and migration of PFAS have not been empirically verified at this time. EGLE is currently evaluating additional agricultural fields and performing subsurface modeling to better understand the fate and transport of PFOA and PFOS in the environment.

11.1 Surface Soil & Spoil Piles

Six (6) soil samples from four (4) DUs were collected using two (2) different sampling methods at Parcel 1007-01. At DU1, a single sample was composed of 52 aliquots collected at a depth of zero (0) to 12 inches bgs and processed using ISM methodology by the analytical laboratory. At DU2, triplicate soil samples A, B and C were collected from 52 aliquots taken at a depth of zero (0) to 12 inches bgs and were processed using ISM methodology by the analytical lab. At DU3 and DU4, a single sample was collected at each DU using composite sampling from nine (9) aliquots of zero (0) to 12 inches bgs within a 50 by 50-foot grid.

11.1.1 Surface Soil

PFOS was the highest detected compound in all six (6) DUs, ranging from 0.554 to 150 µg/Kg. PFOS is considered a long-chain PFAS, which is expected to concentrate and be present in biosolids and surface soils at higher concentrations. Soil samples collected from DU2, DU3, and DU4 reported high Total PFAS concentrations, ranging from 120 to 191 µg/Kg. Records show that a total of 93 dT of biosolids were applied across DU2 on fields CK01, CK1A, and CK2A (**Table 1**). The entirety of samples from DU2, DU3, and DU4 was collected within fields that received biosolid applications. The soil sample collected from DU1 detected a low Total PFAS concentration of 0.544 µg/Kg. DU1 comprises of fields CK02 and CK03. CK02 received only one (1) biosolids application of 24 dT (**Table 1**) and comprised approximately one third (1/3) of DU1. CK03 did not receive any biosolids applications, and the northwest portion of DU1 was not approved for biosolid application. DU1 consisted of soil from two thirds (2/3) majority of fields that did not receive biosolids, resulting in the low Total PFAS concentrations at DU1.

This investigation's first objective was to identify the potential source area for high PFAS detections in previous surface water samples. The high PFAS concentrations reported at DU2, DU3, and DU4 suggest the PFAS-impacted biosolids that were land applied to fields CK01 and CK02 are likely sources the high PFAS detections in surface water in the area. The second objective was to identify potential PFAS variations between the portions of the field where biosolids were land applied and not land applied. The significantly lower concentration of Total PFAS at DU1 provides evidence that minimal PFAS-impacted biosolids from the Port Huron WWTP were land-applied to this region. The significantly higher concentration of Total PFAS in DU2, DU3, DU4 is likely the result of PFAS-impacted biosolids applications from the Port Huron WWTP.

The results from five (5) soil samples from DU2, DU3, and DU4 and additional evaluations at agricultural field 08N10E33-CL01 associated with Lapeer WWTP showed that ISM and composite sampling methods could produce comparable results when used for screening of potential PFAS impacts from land applications of biosolids with properly selected decision units. The ISM sampling methodology has unique benefits and is recommended when evaluating a

large area but is not needed for proper screening of PFAS impacts to all soils from land-application of biosolids.

11.1.2 Spoil Piles

Part of this investigation's first objective was to determine if the on-site spoil piles were a source of the high PFAS in the area. Three (3) locations within the spoil piles were collected for sampling. Spoil piles 1 and 2 detected concentrations just over the detection limit (~ 0.500 µg/Kg) of 1.13 and 1.01 µg/Kg. The third spoil pile reported non-detectable concentrations of PFAS. The detected concentrations in spoil piles 1 and 2 are significantly lower than the surface soil concentrations, which reported values as high as 191 µg/Kg Total PFAS. Therefore, based on the considerably lower Total PFAS concentrations reported in the spoil piles, they are unlikely to be the source of the high PFAS in the area.

A discussion about the PFAS concentrations in surface water and groundwater in relation to the surface soil and spoil piles samples is provided in **Section 11.2** and **11.3** below.

11.2 Surface Water

The third objective of this investigation was to sample surface water upstream of previously measured locations and to aid the EGLE WRD in identifying PFAS in these drainages. PFAS concentrations detected in surface water are likely related to a combination of surface runoff, surface water flow direction, and discharge of shallow, perched groundwater into the surface water body.

The following two (2) surface water samples collected were below the Rule 57 WQSs for PFOA and PFOS: SW-04 and SW-07. The remaining five (5) surface water samples (SW-01, SW-02, SW-03, SW-05, and SW-06) reported PFOA concentrations below Rule 57 WQS (12,000 ng/L); however, reported PFOS concentrations above Rule 57 WQS (12 ng/L) (**Table 3**). The highest Total PFAS concentrations were collected at SW-02 and SW-03, downstream of the enclosed drainage ditch. The drainage ditch is adjacent to DU2, which reported high Total PFAS soil concentrations of 120 to 156 µg/Kg. SW-04 was collected along the adjacent unnamed creek, which flows along the northern edges of CK02 and CK03, which received low to no PFAS-impacted biosolids, likely explaining the low Total PFAS at SW-04 compared to SW-03. SW-06 was collected from the standing water where a small pond was historically located. SW-06 reported high Total PFAS, likely due to its location within DU2, which received numerous biosolids applications. SW-01 and SW-05 reported lower Total PFAS concentrations of 83.8 and 94.4 ng/L. These samples were collected along the Brandymore Drain, which flows along the eastern edge of Parcel 1007-01, with only some interference of DU2. A significant portion of this drain runs along with the fields without biosolids applications. SW-07 reported the lowest Total PFAS value of 14.81 ng/L. This sample was collected along the southern portion of the Site, near CK03, which did not receive land applications of biosolids.

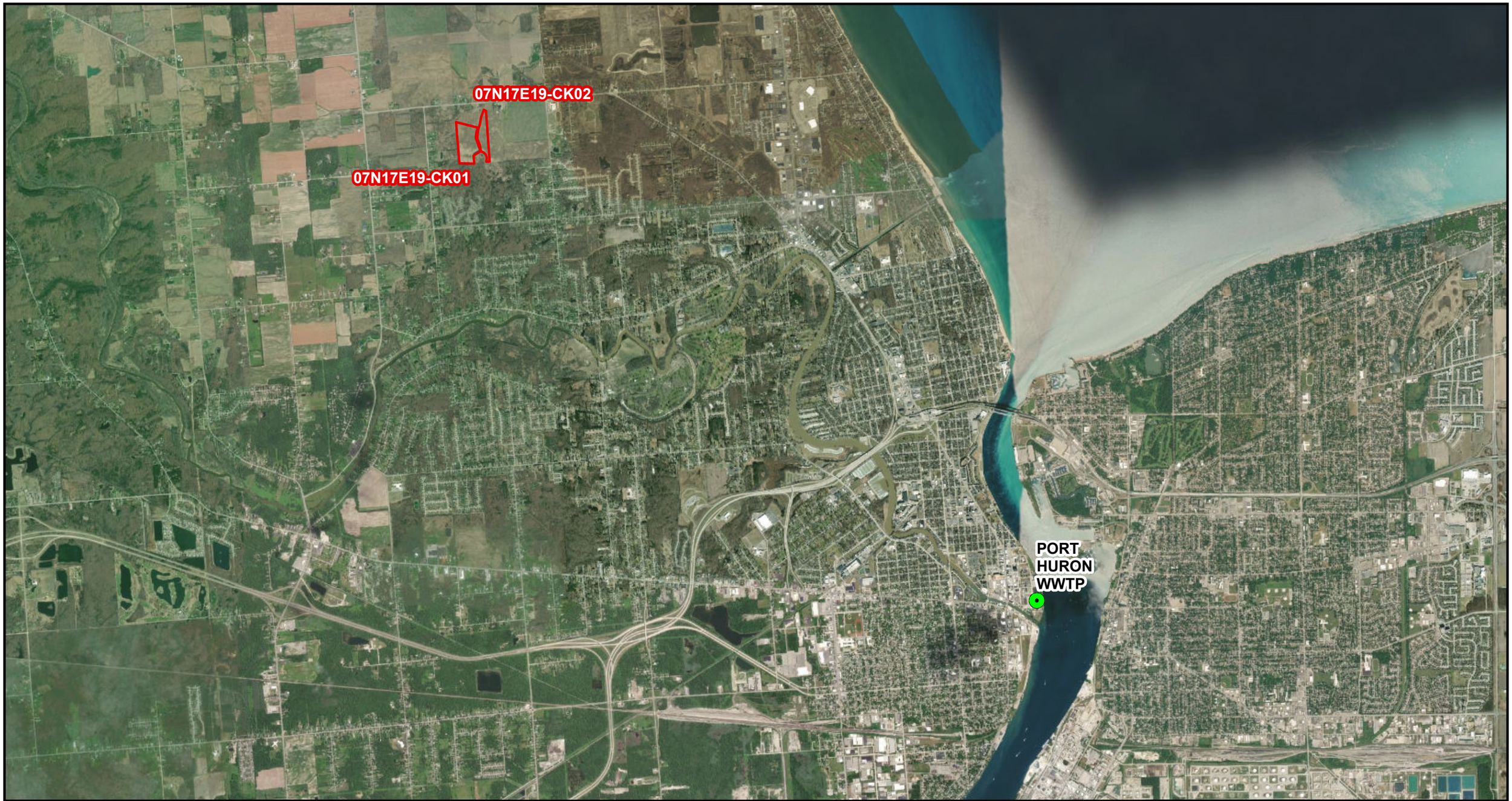
The environmental impact on the surface waters from land-applications of biosolids at Parcel 1007-01 is significant, with high Total PFAS concentrations and Rule 57 WQS exceedances of PFOS.

11.3 Residential Groundwater Wells

The fourth and final objective of this investigation was to evaluate the potential impact on local residential wells. A total of three (3) residential wells were sampled along the Keewahdin Road, north of Parcel 1007-01. All samples reported non-detectable concentrations of Total PFAS and did not exceed Part 201 DWC (**Table 4**). Based on the non-detectable PFAS concentrations in the sampled residential wells and the majority of Fort Gratiot Township utilizing municipal water

from the Port Huron municipal drinking water system, there does not appear to be a potential risk to neighboring groundwater and drinking water wells.

Figures



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Legend

- Waste Water Treatment Plant
- Biosolids Application Field

N

0 1 2 Miles

FIGURE 1
FORT GRATIOT PARCEL 1007-01
BIOSOLIDS APPLICATION
FIELDS OVERVIEW

ST. CLAIRE COUNTY, MI

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Resident 3
Resident 2
Resident 1
SW01
SW02
SW03
SW04
SW05
SW06
SW07
SP-1
SP-2
SP-3
Pc
LpA
LoA
WdA
CK01
CK1A
CK2A
CK02
CK03
CK04
CK05
CK06
DU3
DU4
Pond

Composite Soil Sampling Points

DU2 Sample Points
- Location A
- Location B
- Location C

DU1 Sample Points
- Location A

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Approved: DB	Date: 1/22/2021
Project #: 60588767	

Sarnia

Legend
- Surface Water Sample
- Residential Sample
- Spoils Pile Sample
- Soil Type
- Surface Water Body
- Enclosed Drainage Ditch
- ISM Soil Sampling Area - DU 1
- ISM Soil Sampling Area - DU 2
- 50' x 50' Grid Soil Sampling Area (DU3, DU4)
- Biosolids Application Field
- Field approved for biosolid applications, did not apply
- Field not approved for biosolids application
- Parcel Boundary

N

0 0.1 0.2 Miles

FIGURE 2
FORT GRATIOT PARCEL 1007-01
SAMPLE LOCATIONS

ST. CLAIRE COUNTY, MI

L:\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Biosolids_MDEQ\MXD\Fort_Gratiot\Fig2_Sample_Locs_HeatMap.mxd

SP-1
1.13 (0 | 1.13)

SP-3
0 (0 | 0)

SP-2
1.01 (0 | 1.01)

DU2-A
120.3 (2.24 | 98.4)
DU2-B
125 (2.33 | 108)
DU2-C
156 (3 | 134)

DU3
124 (0.831 | 112)

DU4
191 (2.4 | 150)

DU1
0.544 (0 | 0.544)

CK01
CK1A
CK2A
CK02
CK03
CK04
CK05
CK06

LpA
Pc
LoA
WdA
Pond

Legend

- Composite Soil Sampling Point (DU1, DU2)
- 50' x 50' Grid Soil Sampling Area (DU3, DU4)
- Spoils Pile Sample

PFOS (ppb)

- Non-Detect
- >0 - 10
- >10 - 50
- >50 - 100
- >100 - 500
- >500

Sample Location
Total PFAS (PFOA | PFOS)
*results reported in units of ppb

- Biosolids Application Field
- ISM Soil Sampling Area - DU 1
- ISM Soil Sampling Area - DU 2
- Field approved for biosolid applications, did not apply
- Field not approved for biosolids application
- Surface Water Body
- Enclosed Drainage Ditch
- Soil Type
- Parcel Boundary

N

0 0.05 0.1 Miles

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FIGURE 3
FORT GRATIOT PARCEL 1007-01
SURFACE SOIL AND SPOILS PILE SAMPLING RESULTS

ST. CLAIRE COUNTY, MI

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SW01
83.8 (14.6 | 22.7)

SW02
1012 (164 | 813)

SW03
950 (167 | 747)

SW04
9.7 (1.96 | 2)

SW05
94.4 (14.7 | 24.8)

SW06
168 (27.9 | 120)

SW07
14.81 (1.89 | 0)

CK01

CK02

CK1A

CK2A

Pond

LpA

Pc

LoA

WdA

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Project #: 60588767	

Legend

Surface Water Sample
PFOS (ppt)
- Non-Detect
- >0 - 12
- >12

- Biosolids Application Field
- Soil Type
- Parcel Boundary
- Surface Water Body
- Enclosed Drainage Ditch

Sample Location
Total PFAS (PFOA | PFOS)
*results reported in units of ppt

N

0 0.1 0.2 Miles

FIGURE 4
FORT GRATIOT PARCEL 1007-01
SURFACE WATER SAMPLING RESULTS

ST. CLAIRE COUNTY, MI

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RESIDENT 3
0 (0 | 0 | 0 | 0 | 0 | 0)

RESIDENT 1
0 (0 | 0 | 0 | 0 | 0 | 0)

RESIDENT 2
0 (0 | 0 | 0 | 0 | 0 | 0)

LpA
Pc
Pc
LpA
Pc
CK02
CK01
CK1A
CK2A
Pond
LoA
WdA
WdA
WdA
WdA

AECOM

Drawn:	DP	Date: 1/22/2021
Approved:	DB	Date: 1/22/2021
Project #:	60588767	

Legend

- Residential Sample
- Surface Water Body
- Enclosed Drainage Ditch
- Biosolids Application
- Soil Type
- Parcel Boundary

Sample Location
Total PFAS (PFHxA | PFOA | PFNA | PFBS | PFHxS | PFOS)

red text indicates exceedance of Part 201 DWC
All sample results are in ng/L

Michigan Part 201 Residential & Nonresidential Drinking Water Criteria (DWC), ng/L
PFHxA = 400,000
PFOA = 8
PFNA = 6
PFBS = 420
PFHxS = 51
PFOS = 16

N

0 150 300 450 600 750 1,500 Feet

FIGURE 5
FORT GRATIOT PARCEL 1007-01 GROUNDWATER RESIDENTIAL WELL SAMPLING RESULTS

ST. CLAIRE COUNTY, MI

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Tables

Table 1

Ft. Gratiot Parcel ID 1007-07 (Site IDs: 07N17E19-CK01, CK02, CK1A, CK2A)
Biosolids Application Data

Year	Site ID	Dry Ton (dT) Land Applied	Acres Used	Acres Approved	Dry Ton (dT) / Acre	Dates/Notes
1982	07N17E19-CK01	52.80	15	15.8	3.52	N/A
1983	07N17E19-CK01	19.94	11.8	15.8	1.69	N/A
Total dry tons:		**72.74**	**Average application rate (dry tons/acre):**		**2.61**	
1983	07N17E19-CK02	23.85	9.5	13.52	2.51	N/A
Total dry tons:		**23.85**	**Average application rate (dry tons/acre):**		**2.51**	
1983	07N17E19-CK1A	10.52	4	4.05	2.63	Northwest portion of field 07N17E19-CK01, See Figure 2
Total dry tons:		**10.52**	**Average application rate (dry tons/acre):**		**2.63**	
1983	07N17E19-CK2A	10	4	4.05	2.50	Southwest portion of field 07N17E19-CK01, See Figure 2
Total dry tons:		**10**	**Average application rate (dry tons/acre):**		**2.50**	

dT = dry tons
N/A = Not Available

Table 2

Ft. Gratiot Parcel ID: 1007-01

EGLE Soil and Spoil Piles PFAS Analytical Results Summary

Soil Sample ID	Sample Date	Sample Location	Total PFAS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFBS	PFPeS	PFHxS	PFHpS	PFOS	PFNS	PFDS	FOSA	4:2 FTSA	6:2 FTSA	8:2 FTSA	EtFOSAA	MeFOSAA	HFPO-DA (Gen-X)	ADONA	F-53B Minor	F-53B Major
SXDU0102141912181700LM	12/18/2019	DU1	**0.544**	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	**0.544**	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511	< 0.511
SXDU0202141912181100LM	12/18/2019	DU2 (Sample A)	**120.3**	< 0.507	< 0.507	< 0.507	< 0.507	**2.24**	< 0.507	< 0.507	< 0.507	< 0.507	< 0.507	< 0.507	< 0.507	< 0.507	< 0.507	< 0.507	**98.4**	< 0.507	< 0.507	**7.27**	< 0.507	< 0.507	< 0.507	**11.6**	**0.753**	< 0.507	< 0.507	< 0.507	< 0.507
SXDU0202141912181105LM	12/18/2019	DU2 (Sample B)	**125**	< 0.505	< 0.505	< 0.505	< 0.505	**2.33**	< 0.505	< 0.505	< 0.505	< 0.505	< 0.505	< 0.505	< 0.505	< 0.505	< 0.505	< 0.505	**108**	< 0.505	< 0.505	**5.77**	< 0.505	< 0.505	< 0.505	**8.39**	**0.591**	< 0.505	< 0.505	< 0.505	< 0.505
SXDU0202141912181110LM	12/18/2019	DU2 (Sample C)	**156**	< 0.504	< 0.504	< 0.504	< 0.504	**3.00**	< 0.504	< 0.504	< 0.504	< 0.504	< 0.504	< 0.504	< 0.504	< 0.504	< 0.504	< 0.504	**134**	< 0.504	< 0.504	**7.33**	< 0.504	< 0.504	< 0.504	**11.0**	**0.732**	< 0.504	< 0.504	< 0.504	< 0.504
SXDU0302141912181300LM	12/18/2019	DU3	**124**	< 0.500	< 0.500	< 0.500	< 0.500	**0.831**	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	**112**	< 0.500	< 0.500	**3.36**	< 0.500	< 0.500	< 0.500	**7.22**	**0.494**	< 0.500	< 0.500	< 0.500	< 0.500
SXDU0402141912181330LM	12/18/2019	DU4	**191**	< 0.498	< 0.498	< 0.498	< 0.498	**2.40**	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	**150**	< 0.498	< 0.498	**13.5**	< 0.498	< 0.498	< 0.498	**23.6**	**1.63**	< 0.498	< 0.498	< 0.498	< 0.498
SX04161912181400LM	12/18/2019	SP-1	**1.13**	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	**1.13**	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498	< 0.498
SX04161912181405LM	12/18/2019	SP-2	**1.01**	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	**1.01**	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497
SX04161912181410LM	12/18/2019	SP-3	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
SX04161912181410LM-FD	12/18/2019	SP-3 DUP	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497	< 0.497

All values are in micrograms per kilogram (**ug/Kg**) or parts per billion (**ppb**)
"**<**" = Values Below Detection Limit (**DL**)
SP = Spoil Pile
Bolded values indicate detection

Perfluoroalkyl Carboxylic Acids (**PFCAs**)
Perfluoroalkane Sulfonic Acids (**PFSAs**)
Perfluoroalkane Sulfonamides (**FASAs**)
Fluorotelomer Sulfonic Acids (**FTSAs**)
N-Ethyl Perfluoroalkane Sulfonamidoacetic Acids (**EtFASAAs**)
N-Methyl Perfluoroalkane Sulfonamidoacetic Acids (**MeFASAAs**)
Per- and Polyfluoroalkyl Ether Carboxylic Acids
Additional Substances

PFBA = Perfluorobutanoic acid
PFPeA = Perfluoropentanoic acid
PFHxA = Perfluorohexanoic acid
PFHpA = Perfluoroheptanoic acid
PFOA = Perfluorooctanoic acid
PFNA = Perfluorononanoic acid
PFDA = Perfluorodecanoic acid

PFUnDA = Perfluoroundecanoic acid
PFDoDA = Perfluorododecanoic acid
PFTrDA = Perfluorotridecanoic acid
PFTeDA = Perfluorotetradecanoic acid
PFBS = Perfluorobutane sulfonic acid
PFPeS = Perfluoropentanesulfonic acid
PFHxS = Perfluorohexane sulfonic acid

PFHpS = Perfluoroheptane sulfonic acid
PFOS = Perfluorooctane sulfonic acid
PFNS = Perfluorononanesulfonic acid
PFDS = Perfluorodecane sulfonic acid
FOSA = Perfluorooctane sulfonamide
4:2 FTSA = 4:2 Fluorotelomer sulfonic acid
6:2 FTSA = 4:2 Fluorotelomer sulfonic acid

8:2 FTSA = 4:2 Fluorotelomer sulfonic acid
EtFOSAA = N-Ethyl perfluorooctane sulfonamidoacetic acid
MeFOSAA = N-Methyl perfluorooctane sulfonamidoacetic acid
HFPO-DA (Gen-X) = Perfluoro-2-methyl-3-oxahexanoicacid
ADONA = 4,8-Dioxa-3H-perfluorononanoicacid
F-53B Minor = 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid
F-53B Major = 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid

Table 3

Ft. Gratiot Parcel ID: 1007-01

Surface Water PFAS Analytical Results Summary

Surface Water Sample ID	Sample Date	Sample Location	Total PFAS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFBS	PFPeS	PFHxS	PFHpS	PFOS	PFNS	PFDS	FOSA	4:2 FTSA	6:2 FTSA	8:2 FTSA	EtFOSAA	MeFOSAA	HFPO-DA (Gen-X)	ADONA	F-53B Minor	F-53B Major
SW011912181325ML	12/18/2019	SW-01	**83.8**	**7.70**	**16.4**	**11.6**	**7.62**	**14.6**	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	**1.51**	< 2.02	**1.67**	< 2.02	**22.7**	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 3.04	< 2.02	< 2.02	< 2.02
SW021912181332ML	12/18/2019	SW-02	**1012**	**4.60**	< 2.07	**3.91**	**13.2**	**164**	**2.23**	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	**11.3**	**813**	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 3.10	< 2.07	< 2.07	< 2.07
SW031912181310ML	12/18/2019	SW-03	**950**	**3.92**	< 2.02	**4.05**	**13.8**	**167**	**2.01**	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	**2.00**	< 2.02	< 2.02	**10.2**	**747**	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 2.02	< 3.02	< 2.02	< 2.02	< 2.02
SW041912181318ML	12/18/2019	SW-04	**9.70**	**5.74**	< 2.10	< 2.10	< 2.10	**1.96**	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	**2.00**	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 3.15	< 2.10	< 2.10	< 2.10
SW051912181245ML	12/18/2019	SW-05	**94.4**	**8.22**	**19.7**	**14.2**	**11.0**	**14.7**	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	**1.74**	< 2.07	< 2.07	< 2.07	**24.8**	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 2.07	< 3.11	< 2.07	< 2.07	< 2.07
SW051912181245ML-FD	12/18/2019	SW-05	**92.5**	**8.62**	**20.4**	**14.8**	**9.76**	**13.9**	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	**2.26**	< 2.10	< 2.10	< 2.10	**22.8**	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 3.15	< 2.10	< 2.10	< 2.10
SW061912181140ML	12/18/2019	SW-06	**168**	**10.1**	**2.83**	**1.77**	**3.09**	**27.9**	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	**120**	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	< 2.05	**2.25**	< 2.05	< 3.07	< 2.05	< 2.05	< 2.05
SW071912181217ML	12/18/2019	SW-07	**14.81**	**8.38**	< 2.10	< 2.10	< 2.10	**1.89**	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	**4.54**	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 2.10	< 3.15	< 2.10	< 2.10	< 2.10

All values are in nanograms per liter (**ng/L**) or parts per trillion (**ppt**)
"**<**" = Values Below Detection Limit (**DL**)
Bolded values indicate detection

- Perfluoroalkyl Carboxylic Acids (**PFCAs**)
- Perfluoroalkane Sulfonic Acids (**PFSAs**)
- Perfluoroalkane Sulfonamides (**FASAs**)
- Fluorotelomer Sulfonic Acids (**FTSAs**)
- N-Ethyl Perfluoroalkane Sulfonamidoacetic Acids (**EtFASAAs**)
- N-Methyl Perfluoroalkane Sulfonamidoacetic Acids (**MeFASAAs**)
- Per- and Polyfluoroalkyl Ether Carboxylic Acids
- Additional Substances

PFBA = Perfluorobutanoic acid
PFPeA = Perfluoropentanoic acid
PFHxA = Perfluorohexanoic acid
PFHpA = Perfluoroheptanoic acid
PFOA = Perfluorooctanoic acid
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PFDS = Perfluorodecane sulfonic acid
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6:2 FTSA = 4:2 Fluorotelomer sulfonic acid
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EtFOSAA = N-Ethyl perfluorooctane sulfonamidoacetic acid
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HFPO-DA (Gen-X) = Perfluoro-2-methyl-3-oxahexanoicacid
ADONA = 4,8-Dioxa-3H-perfluorononanoicacid
F-53B Minor = 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid
F-53B Major = 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid

Rule 57 Water Quality Standards (WQS) (ng/L)

	PFOA	PFOS
Human Noncancer Value (HNV) (non-drinking water source)	12,000	12
Final Chronic Value (FCV)	880,000	140,000
Final Acute Value (FAV)	15,000,000	1,600,000
Aquatic Maximum Value (AMV)	7,700,000	780,000

- # Concentration exceeds Rule 57 WQS: HNV
- # Concentration exceeds Rule 57 WQS: FCV and HNV
- # Concentration exceeds Rule 57 WQS: FAV, FCV and HNV
- # Concentration exceeds Rule 57 WQS: AMV, FAV, FCV and HNV

Table 4

Ft. Gratiot Parcel ID: 1007-01

Residential Groundwater Wells PFAS Analytical Results Summary

Surface Water Sample ID	Sample Date	Sample Location	Total PFAS	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFBS	PFHxS	PFOS	EtFOSAA	MeFOSAA	HFPO-DA (Gen-X)	ADONA	F-53B Minor	F-53B Major
WR1911141350GGA	11/14/2019	Resident 1	< 4.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 4.00	< 4.00	< 4.00	< 4.00	< 2.00	< 2.00	< 2.00	< 4.00	< 4.00	N/A	N/A	N/A	N/A
WT1911141405GGA	11/14/2019	Resident 2	< 4.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 4.00	< 4.00	< 4.00	< 4.00	< 2.00	< 2.00	< 2.00	< 4.00	< 4.00	N/A	N/A	N/A	N/A
WT1912180852ML	12/18/2019	Resident 3	< 4.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 4.00	< 4.00	< 4.00	< 4.00	< 2.00	< 2.00	< 2.00	< 4.00	< 4.00	< 4.00	< 4.00	< 4.00	< 4.00

All values are in nanograms per liter (**ng/L**) or parts per trillion (**ppt**)
"**<**" = Values Below Detection Limit (**DL**)
Bolded values indicate detection
N/A = Not Analyzed

EGLE Part 201 Drinking Water Criteria (DWC) (ng/L)
PFOA = 8; PFOS = 16; PFNA =6; PFHxS=51
PFHxA = 400,000; PFBS = 420

Perfluoroalkyl Carboxylic Acids (**PFCAs**)
Perfluoroalkane Sulfonic Acids (**PFSAs**)
N-Ethyl Perfluoroalkane Sulfonamidoacetic Acids (**EtFASAAs**)
N-Methyl Perfluoroalkane Sulfonamidoacetic Acids (**MeFASAAs**)
Per- and Polyfluoroalkyl Ether Carboxylic Acids
Additional Substances

Concentration exceeds DWC criteria

PFHxA = Perfluorohexanoic acid
PFHpA = Perfluoroheptanoic acid
PFOA = Perfluorooctanoic acid
PFNA = Perfluorononanoic acid
PFDA = Perfluorodecanoic acid
PFUnDA = Perfluoroundecanoic acid
PFDoDA = Perfluorododecanoic acid
PFTrDA = Perfluorotridecanoic acid
PFTeDA = Perfluorotetradecanoic acid

PFBS = Perfluorobutane sulfonic acid
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F-53B Minor = 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid
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Appendix A

Fort Gratiot Area
Per and Polyfluoroalkyl Substances (PFAS) Investigation
December 2019

Quality Assurance Project Plan (QAPP)

QAPP APPROVAL

This QAPP has been reviewed and approved by the following persons (signatures):

Stephanie Kammer

Stephanie Kammer, EGLE-WRD Supervisor — Date: 1/22/2020

QAPP Distribution List

Stephanie Kammer, District Supervisor, WRD-Field Operations Section-Lansing District

Melinda Steffler, District Supervisor, WRD-Field Operations Section-Warren District

Dorin Bogdan, Ph.D., PFAS Technical Practice Group Leader, AECOM

Table of Contents

1.0 Introduction

The Michigan Department of Environment, Great Lakes and Energy (EGLE) has prepared this Quality Assurance Project Plan (QAPP) for sampling to investigate sources of elevated per/polyfluoroalkyl substances (PFAS), specifically perfluorooctane sulfonic acid (PFOS) previously measured in various drainages in Burtchfield, Clyde, and Fort Gratiot Townships. Biosolids applications and dredge spoils from a nearby culvert replacement stockpiled on the field have been identified as potential sources of PFAS, to these surface water bodies.

Soil and water samples will be collected from an agricultural field with the Parcel ID 74-20-019-1007-01 (Parcel 1007-01) which received historic biosolids applications, stockpiles believed to be composed of dredge spoils/soils from a culvert replacement, tile drain outlets, and surface waters within multiple drainages.

This QAPP includes information on the following:

- 2.0 Project Organization and Responsibility
- 3.0 Project Objectives
- 4.0 Sampling Procedures
- 5.0 Sample Custody
- 6.0 Quality Assurance Objectives for Measurement
- 7.0 Health and Safety Plan

In the following pages, we have outlined our approach for each of the above listed components.

2.0 Project Organization and Responsibility

Sampling of the residential well, farm field, tile drains, stockpiles, and surface waters in the immediate vicinity of Parcel 1007-01 will be coordinated by AECOM and supported by staff from the EGLE Water Resources Division (WRD). The analysis of aqueous (surface water and residential well) and solid (soil and dredge spoils) samples for select PFAS compounds will be performed by Vista Analytical Laboratories in El Dorado Hills, California or TestAmerica as detailed in **Section 4.5**.

Sampling of surface waters outside the immediate vicinity of Parcel 1007-01 will be coordinated by staff of the WRD's Point Source Monitoring (PSM) Program, supported by staff from the WRD's Warren and Lansing District Offices.

2.1 Training and Certifications

There is no special training or certification required of the EGLE, WRD staff to perform this sampling.

3.0 Project Objectives

The first objective of this project is to assess the levels of PFAS in soils at (Parcel 1007-01), the spoils stockpiled on-site and in adjacent surface waters to identify potential source materials for the PFAS previously identified in the Howe-Brandymore Drain.

The second objective is to identify whether there are significant differences in PFAS concentrations between the portion of the field where biosolids were historically applied versus the portion of the field where there are no records of land application occurring.

The third objective of the project is to sample surface water tributaries upstream of previously measured locations, to aid WRD in identifying the source(s) of PFAS in these drainages.

Finally, the fourth objective is to evaluate the potential impact the residential well for the owner of Parcel 1007-01.

4.0 Sampling Procedures

Sample locations, types of samples collected, analyses to be performed, and rationale was determined in order to meet the project objectives.

4.1 Sampling Locations, Type, and Schedule

Spoils Pile Sampling

At the Parcel 1007-01, AECOM and WRD staff will identify individual dredge spoils piles, recording physical characteristics and assessing the homogeneity of each pile at the time of sampling. Soil samples will be collected from the spoil piles in a manner based on field observations. Three composite samples will be homogenized for each sample. The dredge spoils piles will be divided into three samples based on field observations. Each composite sample will be collected from 0-12 inches (in) using 3/4" diameter soil core sampler. The top 4 to 6 in of possible vegetation and topsoil from each spoils pile will be removed before sampling. If erosion of any of the spoils piles to the drain is observed, one additional sample of the eroded spoils piles will be collected. The samples will be processed by the analytical laboratory using Incremental Sampling Method (ISM) procedures only if the WRD staff determines that the spoils piles are not well homogenized.

Surface Water Sampling

Outside the vicinity of Parcel 1007-01, grab samples of ambient surface water will be collected at 20 (Table 1, Appendix II) locations in the Howe-Brandymore Drain, Doe Creek, Galbraith Drain, and Burtch Creek drainages. Additional ambient samples may be collected based upon observations by field staff.

In the event that surface waters are completely frozen, a sample of ice may be collected at a single sampling location.

Two field duplicate water samples will be collected. The two duplicate water samples will be collected at two separate sites, as specified in Table 1; depending on site conditions, the location of the duplicate samples may change. An equipment blank will be prepared if water sampling equipment is used and field staff believe there is a potential for cross-contamination to occur. A field blank will also be prepared.

In the vicinity of Parcel 1007-01, seven surface water grab samples from the area around the farm fields will be collected as presented in Appendix II.

Residential Well Sample

A single residential well sample will be collected from the home of owner of Parcel 1007-01.

Farm Field Samples

Soil samples will be collected from four areas (Appendix II). Samples for area DU1 will consist of 1 sample composed of 50 aliquots collected from 0-12 in using 3/4" diameter soil core sampler. DU2 will consist of 3 samples (triplicate) of 50 aliquots collected from 0-12 in using 3/4" diameter soil core sampler. DU3 and DU4 will consist of 1 sample composed of 9 composite samples from 0-12 in using 3/4" diameter soil core sampler.

4.2 Sampling Techniques

Because PFAS are present in a wide variety of consumer products, steps will be taken to reduce the risk of cross-contamination. Field staff will take practical and appropriate precautions to avoid items that are likely to contain PFAS at the sampling site as well as avoid specific items the day of sample collection following EGLE's PFAS Sampling Guidances presented in **Appendix III**. All sampling equipment will be cleaned using Alconox® or Liquinox® soap, triple-rinsed with deionized water, and stored in polyethylene bags prior to initial use and triple-rinsed with deionized water between sampling locations. All personnel handling sample bottles will use powderless nitrile gloved hands. Gloves will be replaced after each sample collection at each location.

Spoils Pile Sampling

The Spoils pile will be evaluated to determine homogeneity. Based on field observations, composite soil samples will be collected composed of multiple compose samples. Staff will clear vegetation and access clean soil at each pile. Each sample will be compromised of multiple composite samples collected from 0-12 in using 3/4" diameter soil core sampler. Each sample will be collected using a decontaminated stainless-steel shovel with gloved hands in a LDPE Ziploc bag or 4-oz HDPE jars. Sample locations will be marked and identified using GPS, or photographically, if GPS is unavailable. The samples will be processed by the analytical laboratory using Incremental Sampling Method (ISM) procedures only if the WRD staff determines that the spoils piles are not well homogenized.

Surface Water Sampling

Each sample will consist of two filled 250 ml high-density polyethylene (HDPE) bottles (certified PFAS-free bottles to be provided by the lab). Care should be taken during sample collection to avoid collecting surface scums.

In wadeable stream reaches, samples will be collected by hand or by using a dip pole by dipping bottles into the stream and opening approximately 6 in below the water surface, upstream of any sampling equipment and personnel. Samples should be collected at a point where the flow is determined to be the greatest, with both samples being taken simultaneously, if possible.

A field blank is used to determine the effect of sample exposure to ambient on-site conditions, collection methods, and possible contamination during transit and at the laboratory. A field blank will be collected at one selected sampling site by filling two sample bottles with deionized water. The deionized water used for the field blanks has been found to be PFAS-free.

Field duplicate samples are collocated samples collected to provide an estimate of contaminant variability in the stream. A set of duplicate samples will be collected sequentially at each selected duplicate site (4 bottles per site) by the same person from the same stream location and using the same sampling method.

An equipment blank will be prepared for each type of equipment used (e.g., chlorophyll sampler) by filling the equipment with deionized water and then pouring the water into the sample container. The deionized water used for equipment blanks has been found to be PFAS-free.

Residential Well Sample

The sample will consist of two filled 250 ml high-density polyethylene (HDPE) bottles (certified PFAS-free bottles to be provided by the lab).

Farm Field Samples

Samples for area DU1 will consist of 1 sample, 50 aliquots, from the 0-12 in depth, using a 3/4" diameter core analyzed using the ISM. Samples for the area DU2 will consist of 3 samples (triplicate), 50 aliquots, from the 0-12 in depth, using a 3/4" diameter core analyzed using the ISM. Samples for the decision units DU3 and DU4 will consist of 1 sample, 9 composites from the 0-12 in depth, using a 3/4" diameter core.

4.3 Sample Preservation

No preservatives will be added to samples in the 250 ml HDPE sample bottles. Once collected, all samples will immediately be placed on wet ice (in a re-sealable low-density polyethylene (LDPE) bag) in plastic coolers. Samples will be kept on ice then repacked in ice and overnight shipped to the Vista laboratory.

4.4 QC Sample Collection

Field Staff should complete a documented review of 100 percent of the field data for compliance with QC requirements. Specific requirements are outlined below. Field QC sample results are reported with the data report.

Equipment blanks – Equipment blanks will be collected by pouring laboratory PFAS-free water over the decontaminated sampling equipment and collecting the rinsate into the appropriate sample containers. Equipment blanks will not be collected when dedicated sampling equipment is used (e.g., peristaltic pump with dedicated tubing or dedicate stainless steel tools for the program).

Field Blanks – A field blank is a sample of reagent water poured into a sample bottle. It is collected in the same type of container as the environmental sample, preserved in the same manner, and analyzed for the same parameter. These blanks document the potential for cross-contamination of the samplers and the sampling methods.

Field Duplicates – A field duplicate is defined as a second sample (or measurement) from the same location, collected in immediate succession, and using identical techniques. Duplicate samples are sealed, handled, stored, shipped, and analyzed in the same manner as the primary sample. Precision of duplicate results is calculated by the relative percent deviation (RPD) as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set.

4.5 Sample Analysis

All samples will be delivered to the Vista Analytical Laboratories in El Dorado Hills, California

laboratory for analysis or TestAmerica. EGLE is recommending the use of United States Environmental Protection Agency (USEPA) Methods 537 Rev.1.1 or 537.1 for drinking water samples, and the Vista or TestAmerica PFAS isotope dilution method for analysis of any other environmental samples**.** The isotope dilution method (IDM) is widely accepted as a better technique for quantification where matrix interference may be present and/or analyte loss may occur during the sample preparation process. The lab will utilize both analytical methods, using USEPA Method 537.1 or 537.1 for the residential well and IDM for the rest of environmental samples.

The residential well will be analyzed for 18 PFAS compounds listed in USEPA Method 537.1 and the rest of environmental samples will be analyzed for 28 PFAS compounds as presented in EGLE's Minimum Laboratory Analyte List Water as presented in **Appendix I**.

5.0 Sample Custody

5.1 Sample Containers, Preservation, and Holding Times

Sample bottles and chemical preservatives will be provided by the laboratories. The containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest USEPA's Specifications and Guidance for Contaminant-Free Sample Containers. A summary of sample container, preservation, and holding time requirements is presented in **Table 3**.

5.2 Sample Labeling

Immediately upon collection, each sample will be labeled with an adhesive label. Samples will be assigned unique sample identifications. Each sample label will include the sample number, location, date/time of collection, and analysis. Each sample number will consist of a four-part identification system that describes the sampling method, location ID, depth, and sample type, as described in the sections below in **Section 5.5**.

5.3 Chain of Custody

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continue through transport, sample receipt, preparation, and analysis. The WRD's procedure WB-004, Chain of Custody (COC), dated December 1, 2005, will be followed in the field. The list of items below should be included on the COC form:

1. Date and time of collection
2. Site identification
3. Sample matrix
4. Number of containers
5. Preservative used
6. Analyses required
7. Name of collector
8. Custody transfer signatures, and dates and time of transfer
9. Name of laboratory admitting the sample

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory and among contractors.

COC forms from Vista will be used for this project.

5.4 Failures in Chain of Custody and Corrective Actions

All failures associated with COC procedures are immediately reported to the Supervisor. These include such items as delays in transfer (resulting in holding time violations); violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples, broken or spilled samples, etc. The Supervisor will determine if the procedure violation may have compromised the validity of the resulting data. Any failures that have a reasonable potential to compromise data validity will invalidate the data and the sampling event should be repeated, or if unaffected the second sample shall be analyzed by Vista. The resolution of the situation will be reported to the Supervisor and corrective action reports will be maintained by staff.

5.5 Sample Designation

All sample bottles will be labeled with permanent ink or Sharpie marker or immediately upon collection, each sample will be labeled with an adhesive label. Information on the sample bottle label must include the site number (Table 1) and include the date and time of sampling and type of analysis. The COC form that accompanies the samples must contain all this information.

Sample designation for the farm field will use a unique nomenclature that identifies each sample under the analytical program. Each sample label will include the sample ID, location ID, date/time of collection, sampler initials, and analysis. Each sample ID for groundwater, soil, and sediments samples will consist of a five-part identification system that describes the sampling method, screen depth interval, date, time, and sampler, as described below.

5.5.1 Sample Identification

Sampling Method – This part is represented by a two-letter code as follows:

- SX (composite soil sample)
- SW (surface water sample)
- WT (untreated drinking water sample)
- WF (effluent drinking water sample collected post treatment)

Decision Unit (Farm Field): The decision unit will be identified using two letters and two-digit number (e.g., DU01– Decision Unit 01).

Sample Interval (Farm Field and Spoils Pile): Sample interval will be identified using a four-digit number describing the top of the sample interval and the bottom of the sample interval (e.g., 0012 – where the top of the sample interval is located at the surface 0 in and the bottom of the sample interval is located at 12 in below ground surface (bgs).

Sample Date: Sample date will be identified using a six-digit number (year, month, and day).

Sample Time: Sample time will be identified using a four-digit number (hour, minute; 24hr time)

Sampler Initials: Sampler initials will be identified with two to three characters indicating the name of the field professional collecting the sample (first, middle, last name initials).

Field Duplicate: “FD” will follow the sample ID (e.g., SX04121912181255DB-FD).

Equipment Blank: “EB” followed by date (year, month, day - e.g., EB-191218). If multiple EBs are collected on the same day for differing types of sampling equipment, numerical designations

will be used to differentiate the type of equipment blank (e.g., EB01-191218, EB02-191218), with the type of sampling equipment associated with each type of equipment blank documented in the location ID and in the field log book (e.g., EB01-191218 collected from tubing, EB02-191218 collected from sampling screen)

Field Reagent Blank: “FB” followed by date, time, and sampler’s initials (e.g., FB1912280905DB).

Spoils Pile Sampling

An example of a complete spoils pile sample ID would be SX00121912181255DB representing a spoils sample collected from 0-12 in bgs on December 18, 2019, at 12:55 p.m. by sampler “DB.”

Surface Water Sampling

An example of a surface water sample ID would be SW011912181340DB for the first surface water sample (SW01) collected on December 18, 2019, and 13:40 hrs (1:40 p.m.) by sampler “DB.”

Residential Well Sample

An example of a residential sample ID would be WT1912180850DB for the drinking water sample collected prior to a water softener, sediment filter etc. on December 18, 2019, at 08:50 hrs by sampler “DB.”

Farm Field Samples

An example of a complete soil sample from the farm field sample ID would be SXDU0100121912181250DB representing a spoils sample collected from Decision Unit one (DU01) from the surface 0-12 in bgs on December 18, 2019, at 12:50 p.m. by sampler “DB.”

5.5.2 Sample Location

Sample location for surface water locations from various drainages in Burtchfield, Clyde, and Fort Gratiot Townships are included in Table 1. The location ID for the farm field is described below. A hyphen will separate each part of the naming convention. The location ID cannot exceed 20 characters in length and should not include any spaces between characters.

• WWTP ID: The wastewater treatment plant that has been associated with the disposal of biosolids to the farm field represented by the five-letter. For example, for Port Huron WWTP is PHUR.

• Parcel ID: The farm field identification code will be used for Parcel ID 74-20-019-1007-01the last part of the parcel ID will be used 1007-01.

The location ID for all the samples, besides the residential well collected from the farm field will have the following location ID code: PHUR-1007-01.

• Residential Address: For residential drinking water samples, use up to 20 characters for the address, being as specific as possible (e.g., 1111AnywhereStNE). The sample location PHUR-1007-01 used for the environmental matrices can also be used.

6.0 Quality Assurance Objectives for Measurement

A mixture of laboratory and field variables may affect data quality. The variables include sample matrix variability, sample collection/handling procedures and equipment, sample analysis techniques, and recordkeeping. To control these variables, the Data Quality Objective (DQO) process is used. DQOs developed for this project specify discrete parameters in six areas: Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity (PARCCS). A brief description of each of these parameters is presented below, along with the formulas for calculation of precision, accuracy, and completeness for the scheduled analyses.

Precision and completeness are expressed and evaluated quantitatively. Representativeness, accuracy, comparability, and sensitivity are more subjective in nature and are addressed in both quantitative and qualitative terms. The primary QA objective is to measure the quantity of target analytes in each sample without unacceptable bias.

Data quality objectives for the analytical results are presented in **Table 2**.

6.1 Precision

Precision is determined as a measurement of the closeness of individual test results under prescribed conditions, and reflects a combination of random and systematic error, as well as natural variation within a specific matrix. Only data generated within the required precision criteria will be deemed usable. However, the Laboratory Supervisors, prior to rejecting data as unusable, will closely evaluate the data for potential matrix interference and its effects on the results.

The precision of measured data is affected by natural variability in the sampling matrix, as well as laboratory and sampling factors. Laboratory precision will be assessed through the analysis of laboratory control samples, as well as by initial and continuing calibration of instrumentation following protocols documented in the Vista Quality Assurance Manual (on file). In addition, a semi-quantitative evaluation of laboratory precision will be assessed through the analysis of field blanks.

Field precision, or the ability of the sampling team to collect two samples with a high degree of similarity, will also be assessed by the collection and submission for analysis of field duplicate QC samples.

6.2 Accuracy

Accuracy refers to the closeness of a measured value to the actual value and evaluates the bias in a system. Accuracy will be assessed by the laboratory through positive and negative controls following steps described in the Vista Quality Assurance Manual (on file).

6.3 Representativeness

Representativeness is an expression of the extent to which measured data accurately represents actual conditions. The objective of this sampling effort is to collect samples that accurately represent conditions in the field. Field duplicates consisting of two grab samples collected sequentially from the same location in an identical manner provide a measure of variability due to actual fluctuations in ambient water concentrations as well as sample collection and handling.

6.4 Comparability

In order to maximize the degree of comparability of data generated for this project with previous sampling and analysis program results, sampling locations will, whenever possible, correspond to locations used in the foregoing studies. Sample collection methods, holding times, sample preservation, and laboratory analysis methods will all be conducted in accordance with specified standard methods and protocols. The object is to facilitate observations and conclusions that can be directly compared with historical and/or available background data.

6.5 Sensitivity

Sensitivity is a term broadly applied to the minimum detection capabilities of the specified methods of analysis and instruments used to conduct the scheduled analyses. A Reporting Limit (RL) is the limit of detection for a specific target analyte for a specific sample after any adjustments have been made for dilutions or percent moisture. In contrast, the Method Detection Limit (MDL) is lower than the RL and is a statistical calculation. Typically, reported values between the RL and MDL are flagged by the laboratory; such flagged values indicate that the analyte is present, but the result should be considered to be an estimate. The Vista analytical method for the analysis of PFAS in a typical ambient water sample produces MDLs less than 1 ng/L (ppt) with an RL of 2.0 ng/L for all analytes listed in Table 1. These limits are sufficient for this project.

6.6 Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements are contained within each individual method and laboratory QA manuals. Lab QC sample results are included with the data report.

6.7 Status Reports and Quality Assurance Reports

A report summarizing the sampling results, quality assurance analysis, and outlining recommended next steps will be produced by WRD staff.

7.0 Health and Safety Plan

The prevailing goal of any monitoring undertaken by EGLE-WRD is to have zero incidents/near misses, zero accidents, and cause zero harm to human health or the environment. This goal can be accomplished by creating a culture of safe work practices which include the selection and use of appropriate personal protective equipment (PPE), identifying and communicating potential hazards, and remaining attentive to changing conditions and the task at hand, taking ownership of personal safety and the safety of coworkers.

There are four major categories of hazards that may be associated with the planned sampling activities. These categories are discussed below and include (1) biological hazards, (2) chemical exposures, (3) physical hazards, and (4) behavioral hazards.

(1) Biological hazards include exposure to bacterial and viral diseases in contaminated water or sediments, vector-borne diseases from mosquitos or ticks, and skin rashes or systemic ailments resulting from contact with poisonous plants or animals. These hazards may be mitigated by using appropriate PPE, insect repellents, immunizations, and contact avoidance behaviors.

(2) Chemical hazards include exposure to chemicals in the air, water, or soil/sediment. These hazards may be mitigated by using appropriate PPE (e.g. puncture resistant insoles) and avoidance behaviors.

(3) Physical hazards can be associated with things like vehicular traffic, boating, machinery and tools, fatigue, and weather hazards. Physical hazards can be further subdivided in the following categories:
- Kinetic/mechanical – Slip/trip/fall injuries, falling objects cause struck-by injuries.
- Thermal – Fire, explosions, hot or cold environments cause burns, heat stress, hypothermia.
- Electrical – electrofishing units and overhead/underground power lines. Electrical shock, burns, and fires.
- Acoustic – loud machinery (boat motors, generators) can prevent proper communication and fatigue.
- Radiological – ionizing radiation, UV/IR light or microwaves from equipment/instruments or sunlight.
- Physical hazards can be mitigated by using appropriate PPE and avoidance behaviors.

(4) Behavioral hazards include acting without thinking, planning, or communicating, distracted attention, continuing with an activity when questions or concerns arise, group-think (not exercising freedom of thought, reluctance to ask questions or speak up, assuming someone else will take action), or multi-tasking (cell phone usage while driving, side conversations during a critical action or meeting).

Although a single hazard may not be significant under normal working conditions, combinations of hazards and long working hours, fatigue, or challenging environmental conditions require closer attention to ensure safe work practices. Task-specific hazards should be identified and discussed before work begins at each site (e.g., tailgate meeting). Discussion should include not only potential hazards, but ways in which to prevent, avoid, and mitigate those hazards.

Table 1. Surface water sample locations in the Fort Gratiot Area, December 2019.			
Site ID	Sample Type	Latitude	Longitude
1	Regular Sample	43.053354604	-82.556509199
2	Regular Sample	43.060389059	-82.557089360
3	Regular Sample	43.055892809	-82.536880410
3D	Duplicate Sample	43.055892809	-82.536880410
4	Regular Sample	43.048157326	-82.556194945
5	Regular Sample	43.044096197	-82.557500308
6	Regular Sample	43.044397153	-82.532208593
7	Regular Sample	43.044316222	-82.526608206
8	Regular Sample	43.066195977	-82.526674854
9	Regular Sample	43.070431897	-82.522438934
10	Regular Sample	43.071014760	-82.503055362
11	Regular Sample	43.068778194	-82.481828318
11D	Duplicate Sample	43.068778194	-82.481828318
12	Regular Sample	43.081953601	-82.506308549
13	Regular Sample	43.155193260	-82.505800389
14	Regular Sample	43.152044005	-82.523805220
15	Regular Sample	43.026169139	-82.540069410
16	Regular Sample	43.023990070	-82.525127228
17	Regular Sample	43.140488138	-82.502577677
18	Regular Sample	43.146771665	-82.523223549
19	Regular Sample	43.142977068	-82.523019539

Table 2. Quality objectives and criteria for water measurement data.

Data Quality Indicator	Measurement	Data Quality Objective
Precision	Field Sample Replicates (ISM) or Field Duplicates	%RPD < 50%
Accuracy/Bias	1 Lab Control Spike (LCS) 1 method blank per preparation batch Every sample (spiked, standard or method blank) will receive a labeled internal standard for the IDA method	60 to 140 % recovery, or as specified in the lab SOPs No target analytes greater than or equal to the reporting limit As specified in the lab SOPs
Comparability	LC/MS Analytical work to be conducted by Vista laboratory	Laboratory will provide verification that methods were properly implemented, and results meet QA/QC standards
Completeness	Measured as the number of valid samples collected against the total sample collected for the project	>90%
Sensitivity	LC/MS/MS is tested daily or as needed following the laboratory's SOP	Each analyte will pass continuing calibration verification (CCV) criteria of 40 or 50 % difference (analyte specific)

Table 3. Summary of Sample Container, Preservation, and Holding Time Requirements			
Parameter	**Container**	**Preservation**	**Holding Time**
Aqueous			
PFAS by Method 537.1	2x 250 ml HDPE	Cool 4^0C, include Trizma	14 days to extraction; 28 days from extraction to analysis
PFAS by Isotope Dilution	2x 250 ml HDPE	Cool 4^0C	14 days to extraction; 28 days from extraction to analysis
Solids			
PFAS by Isotope Dilution	Ziploc® Bag or HDPE container	Cool 4^0C	60 days to extraction; 28 days from extraction to analysis

Appendix I

PERFLUOROALKYL AND POLYFLUOROALKYL SUBSTANCES (PFAS) MINIMUM LABORATORY ANALYTE LIST

Below is the minimum laboratory PFAS analyte list for analysis of deer, drinking water, groundwater, surface water, soil, wastewater effluent, and landfill leachate samples collected by Michigan's Departments of Environment, Great Lakes, and Energy, Health and Human Services, Agriculture and Rural Development, and Natural Resources.

This minimum analyte list was developed based on the potential for these chemicals to be found in Michigan, the availability of the chemical standards used for testing, and the ability of available laboratories to test for these PFAS. This list includes PFAS that can be tested for in drinking water using United States Environmental Protection Agency (USEPA) Methods 537 Rev.1.1 or 537.1, which are the only methods that should be used when analyzing drinking water samples. Other testing methodology may be used to test for PFAS in other media (not drinking water). This list is not exhaustive of PFAS in Michigan's environment.

A fish icon (🐟) precedes those compounds that are also currently being tested for in fish tissue.

Analyte Name	Acronym	Fluorinated Carbon Chain Length	Molecular Formula	CAS Number	USEPA Method 537 Rev. 1.1	USEPA Method 537.1
🐟 Perfluorotetradecanoic acid	PFTeA	C_{14}	$C_{13}F_{27}COOH$	376-06-7	X	X
🐟 Perfluorotridecanoic acid	PFTriA	C_{13}	$C_{12}F_{25}COOH$	72629-94-8	X	X
🐟 Perfluorododecanoic acid	PFDoA	C_{12}	$C_{11}F_{23}COOH$	307-55-1	X	X
🐟 Perfluoroundecanoic acid	PFUnA	C_{11}	$C_{10}F_{21}COOH$	2058-94-8	X	X
🐟 Perfluorodecanoic acid	PFDA	C_{10}	$C_9F_{19}COOH$	335-76-2	X	X
🐟 Perfluorononanoic acid	PFNA	C_9	$C_8F_{17}COOH$	375-95-1	X	X
🐟 Perfluorooctanoic acid	PFOA	C_8	$C_7F_{15}COOH$	335-67-1	X	X
🐟 Perfluoroheptanoic acid	PFHpA	C_7	$C_6F_{13}COOH$	375-85-9	X	X
🐟 Perfluorohexanoic acid	PFHxA	C_6	$C_5F_{11}COOH$	307-24-4	X	X
🐟 Perfluoropentanoic acid	PFPeA	C_5	C_4F_9COOH	2706-90-3		
🐟 Perfluorobutanoic acid	PFBA	C_4	C_3F_7COOH	375-22-4		
🐟 Perfluorodecanesulfonic acid	PFDS	C_{10}	$C_{10}F_{21}SO_3H$	335-77-3		

EGLE Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Minimum Laboratory Analyte List

Analyte Name	Acronym	Fluorinated Carbon Chain Length	Molecular Formula	CAS Number	USEPA Method 537 Rev. 1.1	USEPA Method 537.1
Perfluorononanesulfonic acid	PFNS	C_9	$C_9F_{19}SO_3H$	68259-12-1		
 Perfluorooctanesulfonic acid	PFOS	C_8	$C_8F_{17}SO_3H$	1763-23-1	X	X
Perfluoroheptanesulfonic acid	PFHpS	C_7	$C_7F_{15}SO_3H$	375-92-8		
 Perfluorohexanesulfonic acid	PFHxS	C_6	$C_6F_{13}SO_3H$	355-46-4	X	X
Perfluoropentanesulfonic acid	PFPeS	C_5	$C_5F_{11}SO_3H$	2706-91-4		
 Perfluorobutanesulfonic acid	PFBS	C_4	$C_4F_9SO_3H$	375-73-5	X	X
 Perfluorooctanesulfonamide	PFOSA	C_8	$C_8F_{17}SO_2NH_2$	754-91-6		
Fluorotelomer sulphonic acid 8:2	FtS 8:2	C_8	$C_8F_{17}CH_2CH_2SO_3$	39108-34-4		
Fluorotelomer sulphonic acid 6:2	FtS 6:2	C_6	$C_6F_{13}CH_2CH_2SO_3$	27619-97-2		
Fluorotelomer sulphonic acid 4:2	FtS 4:2	C_4	$C_4F_9CH_2CH_2SO_3$	757124-72-4		
2-(N-Ethylperfluorooctanesulfonamido) acetic acid	N-EtFOSAA	C_8	$C_8F_{17}SO_2N(C_2H_5)CH_2COOH$	2991-50-6	X	X
2-(N-Methylperfluorooctanesulfonamido) acetic acid	N-MeFOSAA	C_8	$C_8F_{17}SO_2N(CH_3)CHCOOH$	2355-31-9	X	X
Hexafluoropropylene oxide dimer acid	HFPO-DA	C_6	$C_6HF_{11}O_3$	13252-13-6		X
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	C_{10}	$C_{10}HF_{20}ClSO_4$	763051-92-9		X
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	C_8	$C_8HF_{16}ClSO_4$	756426-58-1		X
4,8-dioxa-3H-perfluorononanoic acid	ADONA	C_7	$C_7H_2F_{12}O_4$	919005-14-4		X

Laboratories Providing PFAS Analytical Services

(*The list that turns up in the search results from the following links does not constitute an endorsement of those firms on the list, nor is it a statement against any firm not on the list. Additionally, the capacity of the labs to provide services consistent with EGLE's recommendations above has not been verified and these details should be addressed prior to contracting with the laboratories below*.)

The **United States Environmental Protection Agency (US EPA)** has a list of laboratories approved under the UCMR3 program using US EPA Method 537 Rev. 1.1 for PFAS in drinking water:
https://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule

The **United States Department of Defense, Environmental Laboratory Accreditation Program (US DoD ELAP)** maintains a list of labs for the determination of PFAS in various environmental media other than drinking water on the Defense Environmental Network Information Exchange (DENIX) server:
http://www.denix.osd.mil/edqw/accreditation/accreditedlabs/

Contact Information

Questions regarding PFAS in general, contact:

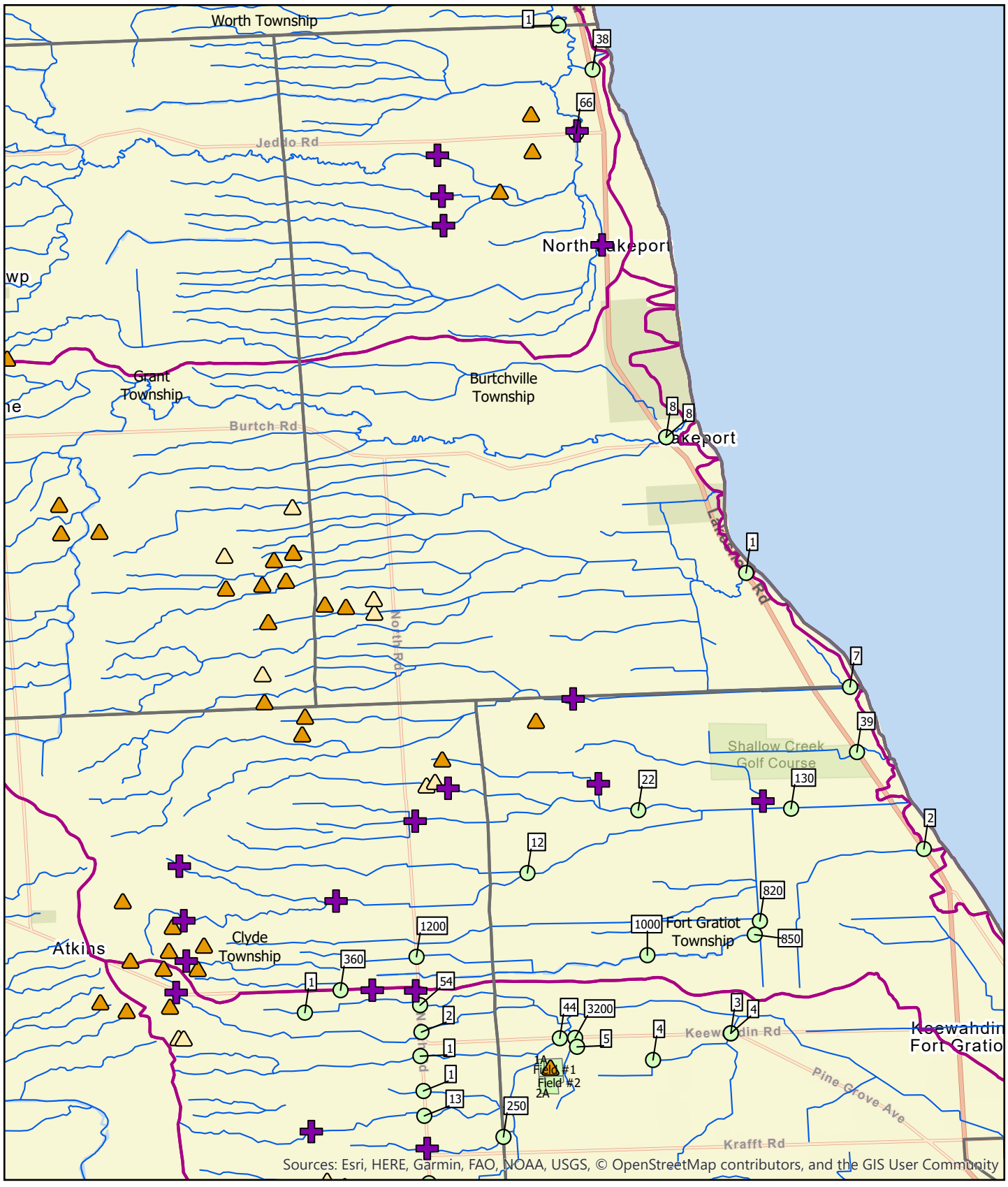
- **MDHHS General Information**
  (517) 373-3740
- **EGLE Environmental Assistance Center**
  (800) 662-9278

Questions regarding laboratory information, contact:

- **MDHHS Chemistry & Toxicology Division**
  (517) 335-9490
- **EGLE Drinking Water Analysis Laboratory**
  (517) 335-8184

Appendix II

Figure 1 - Proposed PFAS Sample Location Fort Gratiot



Biosolids Sites
- Not Applied
- Applied

2019-12-18 Sample Locations

2019-11-6&7 Surface Water PFOS (ppt)

Michigan Townships

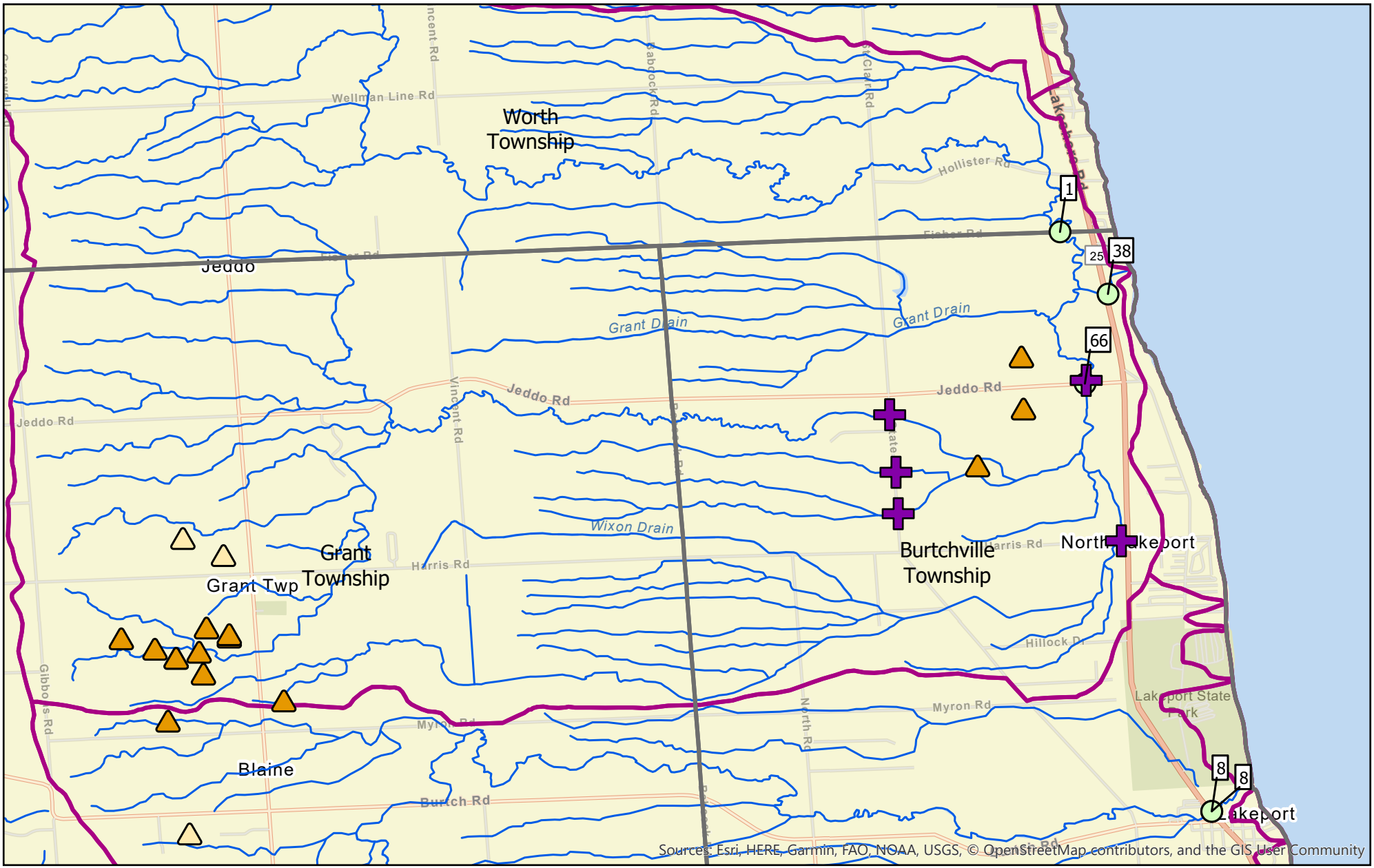
Watershed Boundary - HUC12

Rivers

Miles
0 0.5 1 2

N W E S

Figure 2 - Proposed PFAS Sample Location Fort Gratiot - North



2019-12-18 Sample Locations

2019-11-6&7 Surface Water PFOS (ppt)

Biosolids Sites

Not Applied

Applied

Michigan Townships

Watershed Boundary - HUC12

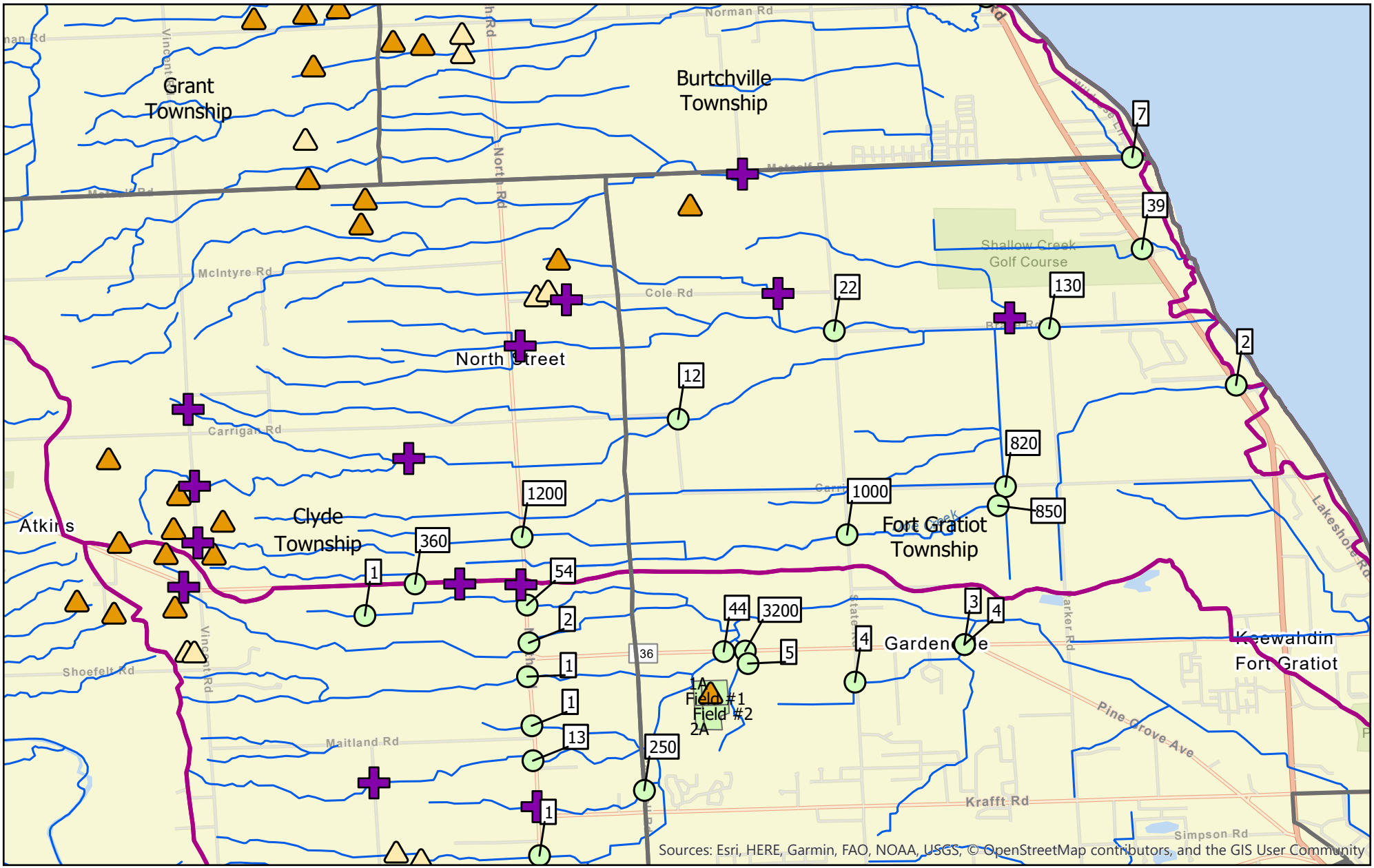
Rivers

Miles

0 0.5 1 2

N W E S

Figure 3 - Proposed PFAS Sample Location Fort Gratiot - South



SW-01
SW-02
SW-03
SW-04
SW-05
SW-06
SW-07
Pc
LpA
LoA
WdA
DU3
DU4

Composite Soil Sampling Points

DU1 Sample Points
- Location 1

DU2 Sample Points
- Location 1
- Location 2
- Location 3

AECOM

Drawn:	Date: 12/17/2019
Approved:	Date: 12/17/2019
Project #:	

Legend

- Proposed Spoils Pile Sampling
- Proposed Surface Water Sample Location
- Proposed Composite Soil Sampling Area - DU 1
- Proposed Composite Soil Biosolids Application Area - DU 2
- 50' x 50' Composite Soil Sampling Areas
- Parcel Boundary

0 0.15 0.3 Miles

N

FIGURE 4
PROPOSED PFAS SAMPLE LOCATION AT FORT GRATIOT AGRICULTURAL FIELD

ST CLAIRE COUNTY, MI

G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Biosolids_MDEQ\MXD\Fort_Gratiot_CK_Fields_proposed_sampling_locations.mxd

Appendix III

GENERAL PFAS SAMPLING GUIDANCE

This document contains an introduction to PFAS, biosecurity recommendations, and general recommendations to decrease the possibility of cross-contamination.

Michigan Department of Environmental Quality

Revised 10/16/2018

GENERAL PFAS SAMPLING

Guidance

CONTENTS

Acronyms

Acronyms used throughout the **General PFAS Sampling Guidance** document and/or each sampling guidance are as follows:

AFFF – Aqueous film forming foam
CAS Number – Chemical abstracts service number
COC – Chain of Custody
DEPA – Danish Environmental Protection Agency (Denmark)
EINECS – European List of Notified Chemical Substances (European Union)
ENCS – Existing and New Chemical Substances Inventory (Japan)
ETFE – Ethylene-tetrafluoroethylene
FCMP – Fish Contaminant monitoring program
FCSV – Fish consumption screening values
FDA – Food and Drug Administration (United States of America)
FEP – Fluorinated ethylene propylene
HASP – Health and Safety Plan
HDPE – High-density polyethylene
IECSC – Inventory of Existing Chemical Substances Produced or Imported in China
ITRC – Interstate Technology & Regulatory Council
KECI – Korea Existing Chemicals Inventory (South Korea)
KEMI – Swedish Chemical Agency (Sweden)
LDPE – Low-density polyethylene
LHA – Lifetime Health Advisory (United States Environmental Protection Agency)
MDEQ – Michigan Department of Environmental Quality
MDHHS – Michigan Department of Health and Human Services
MPART – Michigan PFAS Action Response Team
MSDS – Material Safety Data Sheet (former reference)
ng/L – Nanograms per liter
NZIoC – New Zealand Inventory of Chemicals (New Zealand)
PCPs – Personal care products
PID – Photoionization detector
PFAA – Perfluoroalkyl acids
PFAS – Per- and Polyfluoroalkyl Substances
PFC – Polyfluorocarbons
PFCA – Perfluoroalkyl carboxylic acids
PFOA – Perfluorooctanoic acid
PFOS – Perfluorooctanesulfonic acid
PFPE – Perfluoropolyethers
PFSA – Perfluoroalkyl sulfonic acids
PICCS – Philippine Inventory of Chemicals and Chemical Substances (Philippines)
ppb – Parts per billion
PPE – Personal protection equipment
ppt – Parts per trillion
PTFE – Polytetrafluoroethylene
PVC – Polyvinyl chloride
PVDF – Polyvinylidene fluoride
PVF – Polyvinyl fluoride
QA/QC – Quality assurance/quality control
QAPP – Quality Assurance Project Plan
OECD – Organization for Economic Cooperation and Development
SDS – Safety Data Sheet
SWAS – Surface Water Assessment Section (MDEQ)
TSCA – Toxic Substances Control Act (United States of America)
USEPA – United States Environmental Protection Agency
UV – Ultraviolet
VOC – Volatile organic compounds
WRD – Water resources division (MDEQ)

Disclaimer

The Michigan Department of Environmental Quality (MDEQ) intends to update the information contained within this PFAS Sampling Guidance document as new information becomes available. The user of this PFAS Sampling Guidance is encouraged to visit the Michigan PFAS Action Response Team webpage (www.michigan.gov/PFASresponse) to access the current version of this document.

1. Introduction

Per- and polyfluoroalkyl Substances (PFAS) are a class of **emerging contaminants** composed of more than 3,000 human-made, fluorinated, organic chemicals (Buck et al., 2011, Wang et al., 2017). The actual number of compounds is continuously changing, as some PFAS are no longer produced due to regulatory and voluntary actions, while new ones are created as alternatives. The carbon-fluorine bond that exists in PFAS is one of the strongest bonds in nature, they are tough to break and are resistant to thermal, chemical, and biological degradation.

NOTE: Emerging Contaminants are chemicals and materials in the environment and present real or potential human health or environmental risks, and either…

- Do not have peer-reviewed human health standards
  or:
- Standards/regulations are evolving due to new science, new laboratory analytical capabilities, and new knowledge about the chemicals.

Due to their unique chemical properties, various PFAS can lower surface tension (act as surfactants), are oil-repelling (oleophobic), and are water-repelling (hydrophobic), yet are also relatively water soluble. They have been used extensively in many industries worldwide for a wide variety of applications. PFAS were first invented in the late 1930's and commercially used from the 1940's as non-stick coatings. PFAS continued to be used in many industries and various products as more PFAS were developed with unique chemical properties. Some of the documented PFAS uses are in hydraulic fluids, biocides, construction products, fire-fighting foams, household products, wetting and mist suppressing agents, surfactants for oil and natural gas recovery enhancement, polymerization agents, low-friction bearings and seals, insulators, cables, wires, protective coatings for a wide variety of materials, nonstick coatings, surgical patches, cardiovascular grafts, implants, oil and water repellent coatings for a wide range of materials such as paper and cardboard packaging products, carpets, leather products, and textiles (OECD, 2013). The presence of PFAS in these materials is a potential source of environmental concern and cross-contamination.

The probability of false positives is relatively high during PFAS sample collection due to the potential for many sources of cross-contamination, combined with low laboratory detection limits (nanograms per liter (ng/L) or parts per trillion (ppt)). There are many products that could be found in the sampling environment, that have not been documented to either contain or not contain PFAS, and may come into contact with the samples, introducing causing cross-contamination.

The United States Environmental Protection Agency (USEPA) has established a Lifetime Health Advisory (LHA) for Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS), separately or combined, of 70 ppt. The MDEQ cleanup criteria protective of groundwater used for drinking water purposes is also 70 ppt for PFOS and PFOA, individually or combined. The MDEQ has also promulgated a standard under Rule 57 for PFOS of 11 ppt for surface water that is used as a drinking water source and 12 ppt for surface water that is not used as a drinking water source.

2. Purpose and Objectives

The purpose of this document is to provide guidance and information to staff who will:

- Collect or handle PFAS environmental samples.
- Perform subsurface activities such as soil borings and/or well installation or well abandonment at PFAS sites.

This document is intended to supplement the MDEQ media-specific PFAS sampling guidance documents and is a resource for PFAS sampling.

The objectives of this document are as follows:

- Provide guidance on avoiding PFAS cross-contamination during sampling.
- Improve sampling consistency and data quality.
- Provide guidance to MDEQ staff and contractors.

Because PFAS are emerging contaminants and information about their use in various materials is still not available; the MDEQ will update this document as new information becomes available.

NOTE: This guidance does not include specific information for sampling environmental media and should not be used to replace specific sampling guidance documents required for use by MDEQ staff.

3. Farm Biosecurity

In the event PFAS sampling occurs on or near a farm, staff need to follow the requirements in this document when conducting sample collection, to reduce the likelihood of transporting animal diseases.

3.1 Scheduling

To avoid cross-contamination from previous sampling locations, it is preferable that staff visit only one farm in a day.

3.2 Before Sampling

Staff should review **Section 4.2.4. Field Clothing and Personal Protective Equipment (PPE)** before going into the field.

Staff must have a clean vehicle, clean clothing, and clean boots to visit the sampling location. Before arriving at the farm, staff should call the owner of the farm to indicate they will be arriving shortly and ask if there are any additional biosecurity requirements for their farm. Once at the farm, staff should park away from any animals and barns; preferably in a designated visitor area or on concrete.

Immediately before exiting the vehicle, place disposable PFAS-free boot covers over boots. (*NOTE: Disposable boot covers can be slippery, especially in icy/snowy conditions.*)

3.3 While Sampling

Staff should not approach animal areas unless necessary for testing. If access to an animal area is needed, staff should always be accompanied by farm personnel.

3.4 After Sampling

Dispose of used disposable boot covers at the facility if possible; otherwise, place in a plastic bag, seal and place in the vehicle trunk to dispose of properly later.

4. General PFAS Sampling

The following sections discuss technical issues such as the need to use PFAS-free water; information about PFAS-free clothing and PPE; and laboratory issues that should be considered when sampling for PFAS.

4.1 Sampling Objectives

Before conducting any PFAS sampling, it is recommended that a project-specific Quality Assurance Project Plan (QAPP) should be developed. The QAPP must meet MDEQ policy and should include the analyte list, method of analysis, environmental matrices, and reporting limits, which are based on the project objectives. All of these considerations will be discussed in more detail in this guidance document.

4.2 PFAS Cross-Contamination Potential Sources

Potential sources of PFAS cross-contamination in the typical sampling environment include water used during drilling or decontamination, materials used within the sampling environment, sampling equipment, field clothing and personal protective equipment (PPE), sun and biological protection products, personal hygiene and personal care products (PCPs), food packaging, and the environment itself.

The materials associated with sampling that have the potential for PFAS cross-contamination have been divided into three major groups:

- Prohibited (●) identifies items and materials that should not be used when sampling. It is well documented that they contain PFAS or that PFAS are used in their manufacture.

- Allowable (■) identifies items and materials that have been proven not to be sources of PFAS cross contamination and are considered allowable for sampling.

- Needs Screening (▲) identifies items and materials that have the potential for PFAS cross-contamination due to a lack of scientific data or statements from manufacturers to prove otherwise. These items and materials are further sub-divided into two categories:

    - **Category 1:** Items and materials that <u>will come in direct contact</u> with the sample. These should not be used when sampling unless they are known to be PFAS-free, by collecting an equipment blank sample prior to use.

    - **Category 2:** Items and materials that <u>will not come in direct contact</u> with the sample. These should be avoided, if possible, unless they are known to be PFAS-free by collecting an equipment blank sample prior to use.

All of the materials or items discussed in each of the MDEQ's PFAS Sampling Guidance Documents will be divided into ● Prohibited ■ Allowable, or ▲ Needs Screening. Several examples of prohibited and allowable materials and materials that need screening are listed in the **MDEQ PFAS Sampling Quick Reference Field Guide** at the end of this document. Also, materials and items that are specific to a particular environmental media or sampling method will be thoroughly explained in that media's sampling guidance document (such as peristaltic pumps for groundwater sampling).

NOTE: If recommended PPE will be used during sampling, **Category 2** materials are not expected to be a source of cross-contamination as long as they do not come into contact with the samples.

●- Prohibited ■- Allowable ▲- Needs Screening

Please note that at this time no published research is available that documents the use of various materials and their effect on sample results. Therefore, a conservative approach is recommended in this guidance based on the evaluation of multiple environmental samples at various PFAS sites. Field sampling occurring during extreme weather (e.g., rainfall, snowfall, or extreme heat) should be conducted while wearing the appropriate clothing that will not pose a risk for cross-contamination but will also ensure the safety of the field personnel.

4.2.1 PFAS-Free Water

The term PFAS-free water is defined here as water that does not contain significant concentrations of any compound in a specific PFAS analyte list that is being analyzed at a project-defined level. The significant concentrations depend on project data quality objectives and could, for instance, be less than the laboratory reporting limit, <1/2 the limit of quantitation, or other defined criteria for the specific PFAS compound of interest (ITRC, 2017).

NOTE: The confirmation of PFAS-free water should always be performed prior to the commencement of work. Site or public water supplies have been identified in many instances to contain detectable levels of PFAS.

One important consideration for each project is to identify a PFAS-free water source to use for decontamination of sampling and drilling equipment when applicable. The decontamination of sampling tools or small equipment parts can be performed using laboratory-supplied verified PFAS-free water. Other water can only be used for decontamination purposes if it has been analyzed and shown to be PFAS-free as defined for the project.

4.2.2 Materials Screening

Materials screening should be performed during the Health and Safety Plan (HASP) and QAPP development or the planning phase of sampling programs. The screening should be performed on all of the items and materials that are expected to come into contact with the samples and defined as **Category 1**.

Material screening should include a review of Safety Data Sheets (SDSs; formerly Material SDS [MSDSs]). Make sure the review uses current SDSs, because the actual composition of a particular item or material may have changed over time without changing the actual item or material name. All products from the United States or abroad should be screened. Text fragments such as “perfluoro,” “fluoro,” or “fluorosurfactant” may identify the use of PFAS in specific items or materials.

NOTE: Manufacturers can change the chemical composition of any product. As a result, equipment blank samples should be collected for all materials that will come into direct contact with the sample media, regardless of what category they might be in, to confirm they are “PFAS-free”, i.e. will not contaminate samples at detectable levels. **There is no guarantee that materials in the ‘Allowable category will always be PFAS-free.**

Some countries have official national lists of industrial chemicals defined by regulations, such as:

- Toxic Substances Control Act (TSCA) in the United States.
- European List of Notified Chemical Substances (EINECS), as well as substances pre-registered under the Registration, Evaluation, Authorization, and restriction of Chemicals (REACH) in the European Union.
- Swedish Chemical Agency (KEMI) in Sweden.

● - Prohibited ■ - Allowable ▲ - Needs Screening

- Domestic Substances List (DSL) in Canada.
- Inventory of Existing New Chemical Substances Produced or Imported in China (IECSC)
- Existing and New Chemical Substances Inventory (ENCS) in Japan.
- Korea Existing Chemicals Inventory (KECI) in South Korea.
- New Zealand Inventory of Chemicals (NZIoC) in New Zealand.
- Philippine Inventory of Chemicals and Chemical Substances (PICCS) in the Philippines.

The information available on these lists includes the chemical names and various identity numbers, which is usually the Chemical Abstracts Service number (CAS Number) (KEMI, 2015). The lists may not contain a substantial amount of information because of laws in regards to proprietary information, which gives the suppliers the right to not name newly developed chemicals. The information is not always sufficient to identify if the items or materials contain PFAS, as many of the PFAS do not have an assigned CAS Number at this time (KEMI, 2015). The most recent summary conducted by the Organization for Economic Co-operation and Development (OECD) identified 4,730 PFAS-related CAS numbers (OECD, 2018).

Sometimes manufacturers provide information about their products online or upon request, which may indicate if PFAS were used in the manufacturing of a particular item or material.

4.2.3 Sampling Equipment

The actual list of PFAS-containing materials potentially encountered onsite will change based on the specific sampled media and site-specific sampling conditions. Do not use any equipment that contains any known fluoropolymers. Consider all of the following:

- Do not use polytetrafluoroethylene (PTFE) that includes the trademark Teflon® and Hostaflon®, which can be found in many items, including but not limited to the lining of some hoses and tubing, some wiring, certain kinds of gears, and some objects that require the sliding action of parts.
- Do not use Polyvinylidene fluoride (PVDF) that includes the trademark Kynar®, which can be found in many items, including but not limited to tubing, films/coatings on aluminum, galvanized or aluminized steel, wire insulators, and lithium-ion batteries.
- Do not use Polychlorotrifluoroethylene (PCTFE) that includes the trademark Neoflon®, which can be found in many items, including but not limited to valves, seals, gaskets, and food packaging.
- Do not use Ethylene-tetrafluoroethylene (ETFE) that includes the trademark Tefzel®, which can be found in many items, including but not limited to the wire and cable insulation and covers, films for roofing and siding, liners in pipes, and some cable tie wraps.
- Do not use Fluorinated ethylene propylene (FEP) that includes the trademarks Teflon® FEP and Hostaflon® FEP, and may also include Neoflon®, which can be found in many items, including but not limited to the wire and cable insulation and covers, pipe linings, and some labware.
- Do not use low-density polyethylene (LDPE) for any items that will come into direct contact with the sample media. LDPE can be found in many items, including but not limited to containers and bottles, plastic bags, and tubing.
    - **However**, LDPE may be used if an equipment blank has confirmed it to be PFAS-free. LDPE does not contain PFAS in the raw material but may contain PFAS cross-contamination from the manufacturing process.

● - Prohibited ■ - Allowable ▲ - Needs Screening

- ■ LDPE bags (e.g., Ziploc®) that do not come into direct contact with the sample media and do not introduce cross-contamination with samples may be used.
- ■ Use materials that are either made of high-density polyethylene (HDPE), polypropylene, silicone, or acetate.
- ■ Glass bottles or containers may be used if they are known to be PFAS-free, however, PFAS have been found to adsorb to glass, especially when the sample is in contact with the glass for a long period of time (e.g. being stored in a glass container). If the sample comes into direct contact with the glass for a short period of time (e.g. using a glass container to collect the sample, then transferring the sample to a non-glass sample bottle), the adsorption is minimal.
- ■ Powderless nitrile gloves (which can be found at some hardware and major retail outlets).
- ▲ Latex gloves should be screened before use.
- ▲ Some sampling guidance documents allow the use of aluminum foil provided the shiny side is placed away from the sample (e.g., fish tissue sampling guidance). As a precaution, MDEQ recommends that aluminum foil not is used unless equipment blank samples confirm it is PFAS-free.

4.2.4 Field Clothing and Personal Protective Equipment (PPE)

Any field planning and mobilization effort should address the physical, chemical, and biological hazards associated with each PFAS site. The mitigation of potential risks may be documented in a site-specific HASP or a QAPP. Due to the extensive use of PFAS in many industries and products, PPE may contain PFAS. During PFAS investigation, PPE containing PFAS should be avoided to prevent cross-contamination. The development of the HASP or QAPP should consider these factors before mobilization in the field. All HASPs or QAPPs need to address the concern of potential exposure of staff to PFAS through PPE.

Personal safety is paramount. The safety of staff should not be compromised by fear of PFAS containing materials without any scientific basis. Any deviation from this guidance, including those necessary to ensure the health and safety of sampling personnel, must be recorded in field notes and discussed in the final report.

Globally, protective coatings for textiles are estimated to be about 50 percent of the total use of PFAS (DEPA, 2015). Due to its unique properties of water and oil repellency, PFAS has been used to coat various clothing (i.e., pants, jackets, and t-shirts) and leather products (i.e., boots, shoes, and jackets). Many of these types of clothing and PPE have the potential to be used in the sampling environment.

NOTE: The Danish Ministry of the Environment identified alternative polymer technology as being PFAS-free. Products treated with this technology are water- resistant, but not oil and dirt repellent to the same extent as products treated with PFAS- based agents (DEPA, 2015).

While preparing for sampling, particular focus should be made on clothing that has been advertised as having waterproof, water-repellant, or dirt and/or stain resistant characteristics. These types of clothing are most likely to have had PFAS used in their manufacturing.

Field Clothing and PPE that should be avoided (●) in the immediate sampling environment include the following:

- ● Do not use clothing that has been washed with fabric softener which may contain PFAS.
- ● Do not use clothing that has been made with or washed with water, dirt, and/or stain resistant chemicals.
- ● Do not use clothing chemically treated for insect resistance and ultraviolet protection (See **Section 4.2.5** on biological hazards).
- ● Do not use clothing or PPE items that have any of the brand or product names that have been found to contain PFAS by the Danish Ministry of the Environment and presented in **Table 1** below (DEPA, 2015).

Field Clothing and PPE that are allowable (■) to wear within the immediate sampling environment include the following:

- ■ Powderless nitrile gloves.
- ■ Polyvinyl chloride (PVC) or wax-coated fabrics.
- ■ Neoprene.
- ■ Any boots made of polyurethane and/or PVC. If the HASP requires a specific type of boot such as (steel-toed), and PFAS-free cannot be purchased, PFAS- free over-boots may be worn. The overboots must be put on, and hands washed after putting the overboots on before the beginning of sampling activities. Overboots may only be removed in the staging area and after the sampling activities have been completed.
- ■ Synthetic and natural fibers (preferably cotton) that are well laundered (more than six times with no fabric softener) clothes and cotton overalls.

NOTE: There could be many PPE materials used during various sampling events, including hard hats and safety glasses. All clothing and PPE should be evaluated prior to sampling.

Field Clothing and PPE that must be evaluated (▲) before wearing within the immediate sampling environment include the following:

- ▲ Latex gloves.
- ▲ Water resistant or stain-treated clothing and PPE.
- ▲ Tyvek suits and clothing that contain Tyvek® (USEPA PFAS sampling guidance from USEPA Region 2 prohibits the use of Tyvek; available product information suggests Tyvek® may be used if required. Coated Tyvek® requires further evaluation; therefore, MDEQ recommends the collection of an Equipment Blank before Tyvek® use).

● - Prohibited ■ - Allowable ▲ - Needs Screening

Table 1 below provides a list of prohibited field clothing (DEPA, 2015). However, the manufacturer and/or vendor for the field clothing and/or PPE should be contacted to confirm that these brand or product names still contain PFAS. There have been instances where manufacturers have kept the same brand and/or product name but have changed the chemicals used during the manufacturing of a particular item.

Table 1. Prohibited Field Clothing and PPE Brand and Product Names

● Prohibited Materials[1] (DEPA, 2015)	
Advanced Dual Action Teflon® fabric protector.	Release Teflon®
Repel Teflon® fabric protector	High-Performance Release Teflon®
High performance Repel Teflon® fabric protector	Ultra Release Teflon®
NK Guard S series	GreenShield®
Tri-Effects Teflon® fabric protector	Lurotex Protector RL ECO®
Oleophobol CP®	Repellan KFC®
Rucostar® EEE6	UnidyneTM
Bionic Finish®	RUCO-GUARD®
RUCOSTAR®	RUCO-COAT®
RUCO-PROTECT®	RUCOTEC®
RUCO®	Resist Spills™
Resists Spills and Releases Stains™	Scotchgard™ Fabric Protector

[1]This list is not considered to be a complete listing of prohibited materials. All materials should be evaluated before use during sampling.

4.2.5 Sun and Biological Protection

Because biological hazards (sunburn, mosquitos, ticks, etc.) may be encountered during sampling, the elimination of specific clothing materials or PPE (sunscreens and insect repellants) could pose a health and safety hazard to staff.

The safety of staff should not be compromised by fear of PFAS containing materials without any scientific basis. Personal safety is paramount. Any deviation from this guidance, including those necessary to ensure the health and safety of MDEQ staff, should be recorded in field notes and discussed in the final report.

Prolonged sun exposure will require sunscreens, which may have included PFAS in their manufacture. Protection against insects may require the use of insect repellant. **Table 2** contains a detailed list of sunscreens and insect repellants that have been analyzed and found to be PFAS-free as of the date of this document. Note that this is not a comprehensive list of allowable insect repellants or sunscreens; other products may meet the requirements for use. Listing or omission of any product does not imply endorsement or disapproval. Also, there is no guarantee that these products will always remain PFAS free.

NOTE: Sunscreens and insect repellants must be evaluated on a case-by-case basis. Refer to **Section 4.6 Quality Control Samples** for details on collecting equipment blanks.

The MDEQ recommends that additional sunscreens and insect repellents be treated as (▲) Needs Screening and should be evaluated before use.

- ● Sunscreens and insect repellants should not be applied near the sample collection area.
- ■ Hands should be well washed after application or handling of these products, and afterwards, powderless nitrile gloves should be worn.

● - Prohibited ■ - Allowable ▲ - Needs Screening

Table 2. Sunscreen and Insect Repellents[1]

■ Allowable Insect Repellants	
Photos	**Insect Repellent Spray**
	• OFF Deep Woods • Sawyer Permethrin

■ Allowable Sunscreens	
Photos	**Sunscreens**
	• 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.

■ Allowable Sunscreens
• 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
• Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+
▲ Materials That Require Screening
Sunscreens: Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, and baby sunscreens that are "free" or "natural."
Insect Repellents: Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, California Baby Natural Bug Spray, Baby Ganics.
Sunscreen and Insect Repellent: Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion.

[1]This table is not considered to be a complete listing of allowable materials and materials that require screening. All materials should be evaluated before use during sampling. Some of the sunscreen and insect repellent testing has been performed using a PFAS screening Method known as Particle Induce Gamma-Ray Emission (PIGE). The use of approved gloves should always be used, and the sample should never come into contact with any of the sunscreen or insect repellent products. An Equipment Blank sample could also be collected to verify the product as PFAS-free.

●- Prohibited ■- Allowable ▲- Needs Screening

If an insect repellant has not been approved and staff needs protection against biting insects:

NOTE: The words "Natural" and/or "Organic" in the product name or to describe it does not mean that it is PFAS-free.

- Tuck pant legs into socks and/or boots to seal the gap between the boots and the pants to reduce the risk of being bitten by ticks.
- Wear well-washed, light-colored clothing to easily see ticks during field activities.
- Light-colored clothing, long sleeves, and large-brimmed hats also prevent sunburn.
- Equipment Blank samples should be collected to verify that the preferred insect repellant or sunscreen is PFAS-free by using the testing procedures identified in **Section 4.6 Quality Control Samples**.

4.2.6 Personnel Hygiene and Personal Care Products (PCPs)

A number of sampling guidance documents recommend that personal hygiene and personal care products (PCPs) (e.g., cosmetics, shampoo, sunscreens, dental floss, etc.) not be used prior to and on the day(s) of sampling because the presence of PFAS in these products has been documented (OECD, 2002, Fujii, 2013, Borg and Ivarsson, 2017). However, if the MDEQ's sampling SOPs are followed, these items should not come into contact with the sampling equipment or the sample being collected. As of the date of this sampling guidance, cross-contamination of samples due to the use of PCPs has not been documented during the collection of thousands of samples. However, field personnel should be aware of the potential of cross-contamination if the sampling equipment or actual samples would come into contact with these products. The following precautions should be taken when dealing with personal hygiene or PCPs before sampling:

- ● Do not handle or apply PCPs in the sampling area.
- ● Do not handle or apply PCPs while wearing PPE that will be present during sampling.
- ■ Move to the staging area and remove PPE if applying personal care products becomes necessary.
- ■ Wash hands thoroughly after the handling or application of PCPs and, when finished, put on a fresh pair of powderless nitrile gloves.

4.2.7 Food Packaging

PFAS has been used by the paper industry as a special protective coating against grease, oil, and water for paper and paperboards, including food packaging since the late 1950s (Trier et al., 2018). PFAS application for food packaging includes paper products that come into contact with food such as paper plates, food containers, bags, and wraps (OECD, 2002). In January 2016, the Food and Drug Administration (FDA) banned the use of PFAS which has eight carbon atoms (such as PFOA and PFOS) or more, in food packaging materials. However, PFOA and PFOS or other eight or more carbon chain PFAS may still be detected in food packaging because of the use of recycled paper which may contain PFAS. Various studies have found up to 57percent detection frequency in food contact materials such as paper (Trier et al., 2011; Rosenmai et al., 2013; Schaider et al., 2017).

NOTE: Short-chain PFAS have not been banned for use in the manufacturing of contact food materials in the United States.

PFAS has been used by the paper industry as a special protective coating against grease, oil, and water for paper and paperboards, including food packaging since the late 1950s (Trier et al., 2018). PFAS application for food packaging includes paper products that come into contact with food such as paper plates, food containers, bags, and wraps (OECD, 2002). Pre-wrapped food or snacks (such as candy bars, microwave popcorn, etc.) must not be in the sampling and staging areas during sampling due to PFAS contamination of the packaging. When staff

requires a break to eat or drink, they should remove their gloves, coveralls, and any other PPE, if worn, in the staging area and move to the designated area for food and beverage consumption. When finished, staff should wash their hands and put on a fresh pair of powderless nitrile gloves at the staging area, before returning to the sampling area.

- ● Do not handle, consume, or otherwise interact with pre-wrapped food or snacks, carry-out food, fast food, or other food items while on-site during sampling.
- ■ Move to the staging area and remove PPE prior to leaving the sampling and staging areas if consuming food on site becomes necessary.

4.3 PFAS Sampling Procedures

4.3.1 Sample Containers, Handling, and Collection

All bottles used for PFAS sampling should come from the laboratory that will also be performing the PFAS analysis. Commercial laboratories that have demonstrated awareness and elimination of possible PFAS cross-contamination from sample containers and laboratory supplies should be used. Recommended sampling containers will be discussed for each environmental media. Any sampling containers provided by the laboratory should be verified as PFAS-free.

Before sampling, staff may come into contact with textiles and fabrics treated with PFAS, such as carpets and car interiors. Staff should be aware that these materials, and any other surfaces that repel water and are stain resistant, have the potential of being treated with PFAS. However, these are considered **Category 2** materials and the field personnel should be aware of the possible PFAS use. Sample containers and equipment that will be used for sampling should not be stored on or come into contact with materials suspected to contain PFAS.

For all environmental media, hands should be well washed before sampling. Clean powderless nitrile gloves must be put on before sample collection, handling of sample containers, and handling sampling equipment. The sample container must be kept sealed at all times and only open during the sample collection. The sampling container cap or lid should never be placed on any surface unless it is PFAS-free. The sampling container cap or lid must never be placed directly on the ground. A list of various materials used in sampling and handling can be found in the **MDEQ Quick Reference Field Guide** located at the end of this document.

In the absence of formal USEPA guidance for PFAS sample storage, the documentation in EPA Method 537 Rev. 1.1 should be used as a guide for thermal preservation (holding temperature), and holding times for other environmental media samples (with the exception of biota – in order to limit microbial growth, biota samples such as fish and vegetation are recommended to be kept frozen until the sample is prepared).

If published analytical reference methods, other than EPA Method 537 Rev. 1.1 are used, follow the guidelines or requirements in those methods for sample storage, preservation, and hold times. Otherwise EPA Method 537 Rev. 1.1 requries that samples must be chilled during storage and shipment, and must not exceed 50°F (10°C) during the first 48 hours after collection.

4.3.2 Sample Shipment

In general, for all environmental media sampled for PFAS, samples must be kept on ice from the time of sample collection to the arrival at the laboratory. The following procedures should be used for sample shipment:

● - Prohibited ■ - Allowable ▲ - Needs Screening

- Regular ice should be used to cool and maintain the sample at or below the proper temperature.
  - ▲ Chemical or blue ice may be used if it is known to be PFAS-free and it is absolutely certain that the sample is cooled and maintained at or below the proper temperature during collection and through transit to the laboratory.
- Refresh with regular ice, if needed, double bagged in LDPE resealable storage bags if needed.
- Fish and other wildlife samples should be placed on dry ice and frozen before the shipment to the lab. If fish is frozen, shipping the samples overnight on ice should be acceptable.
- The samples, ice, and chain of custody (COC) should always be bagged in polyethylene (i.e., Ziploc®) bags.
- Chain of Custody and other forms should be single bagged in LDPE resealable storage bags and taped to the inside of the cooler lid.
- The cooler should be taped closed with a custody seal and shipped by overnight courier.
- Samples should be shipped as soon as possible (e.g. overnight) to ensure the samples arrive within the analytical holding time specified by the lab.

4.3.3 Preferential Sampling Sequence

A preferred sampling sequence should be established before any sampling event to reduce the risk of cross-contamination. In general, the sampling sequence should be such that sampling starts in areas where it is expected or known to be least contaminated, to areas anticipated or identified to be most contaminated. If analytical results from past sampling events are available, the sampling sequence can be readily determined.

For many PFAS investigation sites, no PFAS sampling has been conducted. In these cases, all site information on possible PFAS uses and potential PFAS migration patterns (e.g., upgradient, downgradient) from PFAS sources at the site should be reviewed before the sampling event to help establish the sampling sequence.

If multiple samples (i.e., monitoring wells) will be collected for an area where a particular or potential PFAS release in the environment might have been documented, samples that are known to be upgradient from the impacted area should be sampled first, followed by those that are furthest downgradient from the suspected source. The remaining wells should be progressively sampled from the most distant downgradient to those closer to the known PFAS source.

If no information is available about the site, samples are to be collected in the following order:

1) drinking water (e.g., residential wells).
2) surface water.
3) groundwater.

4.4 Decontamination Procedures

It is customary with sampling that equipment is decontaminated at the conclusion of the sampling event. If the previous user of the equipment is not known, and it is unclear how the equipment was handled, especially rental equipment, the equipment should be decontaminated.

Disposable **Category 1** sampling equipment should be used, especially for sample bottles and other materials that are used where the sample may be in contact with the sampling equipment for an extended time period.

● - Prohibited ■ - Allowable ▲ - Needs Screening

Non-disposable sampling equipment used at multiple sites or sampling locations can become highly contaminated with PFAS. Decontamination procedures must be implemented to prevent cross-contamination, especially between individual sample locations. It is customary to decontaminate sampling equipment at the end of the sampling event, whether the event is a single sampling location or several sites that conclude at the end of the workday.

Throughout the sampling guidance documents, information will be provided about any media-specific decontamination procedures. For non-dedicated **Category 1** sampling equipment, there are many decontamination methods, two of which are listed below.

Decontamination Method 1:

- ● Do not use Decon 90®.
- ● Do not put equipment away without decontaminating it.
- ■ Laboratory supplied PFAS-free deionized water is preferred for decontamination.
- ■ Alconox®, Liquinox®, and Citranox® can be used for equipment decontamination.
- ■ Sampling equipment can be scrubbed using polyethylene or polyvinylchloride (PVC) brush to remove particulates.
- ■ Decontamination procedures should include triple rinsing with PFAS-free water.
- ■ Do decontaminate sampling equipment after sampling at each location, or at the end of the workday.
- ■ Commercially available deionized water in an HDPE container may be used for decontamination if the water is verified to be PFAS-free as defined in **Section 4.2.1** of this document.
- ▲ Municipal drinking water may be used for decontamination purposes if it is known to be PFAS-free.

Decontamination Method 2:

1. In a PFAS-free bucket, wash the equipment with a mixture of PFAS-free water and PFAS-free soap (bucket #1)
2. In a second PFAS-free bucket (bucket #2), rinse the equipment with PFAS-free water
3. A second rinse should be done with PFAS-free water using either a third bucket (bucket #3) or, if washed and rinsed, the second bucket (bucket #2).
4. For decontamination of additional equipment, change the decontamination water between cleanings.

4.5 Laboratory Considerations

The PFAS analytical list is available on the MPART website (www.michigan.gov/PFASresponse) under Testing and Treatment. This list includes the 14 analytes required to be analyzed for drinking water samples when using USEPA Method 537 Rev. 1.1, and the 24 analytes the MDEQ recommends be analyzed for all other environmental media. The MPART website should be visited to download the most recent document. Laboratories should be able to analyze and report PFAS results that will meet the project-specific data quality objectives identified in the QAPP.

Drinking Water Samples

USEPA Method 537 Revision 1.1 must be used for testing finished drinking water samples. Other methods are available for non-drinking water samples. Many laboratories refer to the isotope dilution method as 'modified Method 537,' however, the USEPA does not recognize isotope dilution as an acceptable modification of USEPA Method 537 Rev. 1.1 for drinking water analysis. USEPA drinking water methods are generally prescriptive, and only limited modifications are allowed because the finished treated drinking water is assumed to be free of significant interferences.

NOTE: USEPA Method 537 Rev. 1.1 was developed to be used only for finished drinking water samples, and contains specific requirements for sample preservation, shipping storage, and holding times.

USEPA Method 537 Rev. 1.1 was designed for finished drinking water and chemical preservation using Trizma® to buffer the sample and remove free chlorine. Non-chlorinated finished drinking water may also be analyzed using USEPA Method 537 Rev. 1.1.

Other Environmental Media Samples

There are currently no published USEPA methods using isotope dilution for determining PFAS in non-drinking water matrices or other sample media. There are USEPA methods for analyzing PFAS in additional matrices going through the development and validation process and may be available as early as fall of 2018. Some commercial laboratories have developed isotope dilution methods based on existing published methods, however, there may be significant differences between SOPs from different commercial laboratories regarding the details of the preparation and analysis of PFAS samples. A review of the laboratory's procedure and certifications should be done to ensure that the laboratory is capable of providing data that meet the data quality objectives of the project. MDEQ is implementing a laboratory SOP review process. Staff should refer to the MDEQ internal shared drive to see whether SOPs have been reviewed for the lab they are considering.

The following non-USEPA analytical methods have been published for use in determining PFAS in various media:

- ISO (International Organization for Standardization) Method 25101 (ISO, 2009) - Water quality Determination of PFOA and PFOS - Method for unfiltered samples of drinking water, groundwater, and surface water, using solid phase extraction and liquid chromatography/mass spectrometry (HPLC/MS/MS.)

- ASTM D7979 (ASTM, 2017) - Standard Test Method for Determination of Per- and Polyfluoroalkyl Substances in Water, Sludge, Influent, Effluent and Wastewater by Liquid Chromatography-Tandem Mass Spectrometry (LC/MS/MS). This method has been investigated for use with surface water, sludge, and wastewater for selected PFAS. This method has not been evaluated on drinking water matrices. Some commercial laboratories have modified this method and are using isotope dilution.

- ASTM D7968 (ASTM, 2017) - Standard Test Method for Determination of Polyfluorinated Compounds in Soil by Liquid Chromatography-Tandem Mass Spectrometry (LC/MS/MS). This procedure utilizes a quick extraction and is not intended to generate an exhaustive accounting of the content of PFAS in difficult soil matrices.

4.6 Quality Control Samples

4.6.1 Laboratory Quality Control Samples

The QAPP should describe what batch quality control (QC) samples – such as method blank (MB), laboratory control sample (LCS), laboratory control sample duplicate (LCSD), field duplicate (FD), matrix spike (MS), and matrix spike duplicate (MSD) – are prepared for each media type. In some cases, depending on the project, additional QC samples may be required. For samples with high concentrations of PFAS, an FD may be warranted. The QAPP should also reference the laboratory SOP.

4.6.2 Field Quality Control Samples

Field QC samples can be used to evaluate the field equipment and supplies as well as assess the possibility of cross-contamination during sampling, transport, and storage of samples. For samples such as equipment rinse blanks (EB), field blanks (FB), and trip blanks (TB) the following is required:

- EB should be collected by passing laboratory verified PFAS-free water over or through decontaminated field sampling equipment before the collection of samples to assess the adequacy of the decontamination process and/or to evaluate potential contamination from the equipment used during sampling. The recommended frequency should be in the QAPP.

- FB are prepared in the laboratory by placing an aliquot of PFAS-free water reagent water in a sample container and treating it as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment. The recommended frequency should be in the QAPP.

- TB are a bottle of PFAS-free water that should be prepared in the laboratory, should then travel from the laboratory to the site, and then get transported back to the laboratory without having been exposed to any sampling procedures. Typically, a TB is used for volatile compounds, but it may be recommended for PFAS sampling to assess cross-contamination introduced from the laboratory and during shipping procedures. The recommended frequency should be in the QAPP

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Michigan Department of Environmental Quality

MDEQ PFAS Sampling Quick Reference Field Guide[1]

All Items Used During Sampling Event

● Prohibited

• Items or materials that contain fluoropolymers such as
  ○ Polytetrafluoroethylene (PTFE), that includes the trademarks Teflon® and Hostaflon®
  ○ Polyvinylidene fluoride (PVDF), that includes the trademark Kynar®
  ○ Polycholotrifluoroethylene (PCTFE), that includes the trademark Neoflon ®
  ○ Ethylene-tetrafluoro-ethylene (ETFE), that includes the trademark Tefzel®
  ○ Fluorinated ethylene propylene (FEP), that includes the trademarks Teflon® FEP and Hostaflon® FEP
• Items or materials that contain any other fluoropolymer

Pumps, Tubing, and Sampling Equipment

● Prohibited	■ Allowable	▲Needs Screening[2]

• Items or materials containing any fluoropolymer (potential items include tubing, valves, or pipe thread seal tape)	• High-density polyethylene (HDPE)
	• Low-density polyethylene (LDPE) tubing
	• Polypropylene
	• Silicone
	• Stainless-steel
	• Any items used to secure sampling bottles made from:
	  ○ Natural rubber
	  ○ Nylon (cable ties)
	  ○ Uncoated metal springs
	  ○ Polyethylene
		• Any items or materials that will come into direct contact with the sample that have **not** been verified to be PFAS-free
		  ○ Do not assume that any sampling items or materials are PFAS-free based on composition alone

Sample Storage and Preservation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Polytetrafluoroethylene (PTFE): Teflon® lined bottles or caps	• Glass jars[4] • Laboratory-provided PFAS-Free bottles: ○ HDPE or polypropylene • Regular wet ice • Thin HDPE sheeting • LDPE resealable storage bags (i.e. Ziploc®) that will not contact the sample media[6]	• Aluminium foil[4] • Chemical or blue ice[5] • Plastic storage bags other than those listed as ■ Allowable • Low-density polyethylene (LDPE) bottles

Field Documentation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Clipboards coated with PFAS • Notebooks made with PFAS treated paper • PFAS treated loose paper • PFAS treated adhesive paper products	• Loose paper (non-waterproof, non-recycled) • Rite in the Rain® notebooks • Aluminium, polypropylene, or Masonite field clipboards • Ballpoint pens, pencils, and Fine or Ultra-Fine Point Sharpie® markers	• Plastic clipboards, binders, or spiral hard cover notebooks • All markers not listed as ■ Allowable • Post-It® Notes or other adhesive paper products • Waterproof field books

Decontamination

● Prohibited	■ Allowable	▲Needs Screening[2]
• Decon 90® • PFAS treated paper towel	• Alconox®, Liquinox®, or Citranox® • Triple rinse with PFAS-free deionized water • Cotton cloth or untreated paper towel	• Municipal water • Recycled paper towels or chemically treated paper towels

Clothing, Boots, Rain Gear, and PPE

● Prohibited	■ Allowable	▲Needs Screening[2]
• New or unwashed clothing • Anything made of or with: ○ Gore-Tex™ or other water-resistant synthetics • Anything applied with or recently washed with: ○ Fabric softeners ○ Fabric protectors, including UV protection ○ Insect resistant chemicals ○ Water, dirt, and/or stain resistant chemicals	• Powderless nitrile gloves • Well-laundered synthetic or 100% cotton clothing, with most recent launderings not using fabric softeners • Made of or with: ○ Polyurethane ○ Polyvinyl chloride (PVC) ○ Wax coated fabrics ○ Rubber / Neoprene ○ Uncoated Tyvek®	• Latex gloves • Water and/or dirt resistant leather gloves • Any special gloves required by a HASP • Tyvek® suits, clothing that contains Tyvek®, or coated Tyvek®

Food and Beverages

● Prohibited	■ Allowable
• No food should be consumed in the staging or sampling areas, including pre-packaged food or snacks. ■ If consuming food on-site becomes necessary, move to the staging area and remove PPE. After eating, wash hands thoroughly and put on new PPE.	• Brought and consumed only outside the vicinity of the sampling area: ○ Bottled water ○ Hydration drinks (i.e. Gatorade®, Powerade®)

Personal Care Products (PCPs) - for day of sample collection[6]

● Prohibited	■ Allowable	▲Needs Screening[2]
• Any PCPs[6], sunscreen, and insect repellent applied in the sampling area.	PCPs[6], sunscreens, and insect repellents applied in the staging area, away from sampling bottles and equipment followed by thoroughly washing hands: **PCPs[6]:** • Cosmetics, deodorants/antiperspirants, moisturizers, hand creams, and other PCPs[6] **Sunscreens:** • 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 50 • Meijer® Sunscreen Continuous Spray Broad Spectrum SPF 30 • Meijer® Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50 • Meijer® Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Lotion SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Spray Broad Spectrum SPF 30 • Neutrogena® Pure & Free Baby Sunscreen Broad Spectrum SPF 60+ • Neutrogena® UltraSheer Dry-Touch Sunscreen Broad Spectrum SPF 30 **Insect Repellents:** • OFF® Deep Woods • Sawyer® Permethrin	• Products other than those listed as ■Allowable

[1] This table is not considered to be a complete listing of prohibited or allowable materials. All materials should be evaluated prior to use during sampling. The manufacturers of various products should be contacted in order to determine if PFAS was used in the production of any particular product.

[2] Equipment blank samples should be taken to verify these products are PFAS-free prior to use during sampling.

[3] **For surface water foam samples:** LDPE storage bags may be used in the sampling of foam on surface waters. In this instance, it is allowable for the LDPE bag to come into direct contact with the sample media.

[4] **For fish and other wildlife samples:** Depending on the project objectives, glass jars and aluminum foil might be used for PFAS sampling. PFAS has been found to bind to glass and if the sample is stored in a glass jar, a rinse of the jar is required during the sample analysis. PFAS are sometimes used as a protective layer for some aluminum foils. An equipment blank sample should be collected prior to any aluminum foil use.

[5] Regular ice is recommended as there are concerns that chemical and blue ice may not cool and maintain the sample at or below 42.8°F (6°C) (as determined by EPA 40 CFR 136 – NPDES) during collection and through transit to the laboratory.

[6] Based on evidence, avoidance of PCPs is considered to be precautionary because none have been documented as having cross-contaminated samples due to their use. However, if used, application of PCPs must be done at the staging area and away from sampling bottles and equipment, and hands must be thoroughly washed after the use of any PCPs prior to sampling.

●- Prohibited ■- Allowable ▲- Needs Screening

SOIL PFAS SAMPLING

Guidance

Introduction

This guidance document discusses the processes, decontamination procedures, and acceptable items and materials for sampling soil for per- and polyfluoroalkyl substances (PFAS). In addition, this guidance will be used to support the sampling objectives and procedures based on any Quality Assurance Project Plan (QAPP) developed prior to sampling activities. This guidance assumes staff has basic familiarity with and/or understanding of basic soil sampling procedures.

NOTE: Review the General PFAS Sampling Guidance prior to reviewing this guidance document.

The Michigan Department of Environmental Quality (DEQ) intends to update the information contained within this PFAS Sampling Guidance document as new information becomes available. The user of this PFAS Sampling Guidance is encouraged to visit the Michigan PFAS Action Response Team webpage (www.michigan.gov/PFASresponse) to access the current version of this document.

Because PFAS compounds can be analyzed at concentrations in the parts per trillion (ppt) range, precautions must be taken to prevent cross-contamination. Field sampling equipment, either rented or not, that is used at multiple sites or sampling locations (also described as non-dedicated equipment), could become highly contaminated with PFAS. If site-specific information is available, sampling should be conducted from the least to the most contaminated locations. Additional guidance on the sampling sequence can be found in **Section 4.3.3** of the **General PFAS Sampling Guidance**.

Soil sampling involves the use of non-dedicated equipment, such as scoops, trowels, shovels, augers and other drilling-related equipment, which could be a source of cross-contamination. Decontamination procedures outlined in this guidance document should be followed to avoid cross contamination and equipment should be verified as PFAS-free.

The site-specific quality assurance document will generally provide the following information:

- Sample collection objectives.
- Locations, number, and volume of samples.
- Types of chemical analyses.
- Specific quality control procedures.
- Additional sampling requirements, as necessary.

This soil sampling guidance document discusses the collection of surface and sub-surface soil samples for PFAS and methods to prevent cross-contamination that can occur from:

- Field clothing and personal protection equipment (PPE)
- Sampling equipment
- Equipment decontamination
- Sample collection and handling
- Sample shipment

Contents

NOTE: Additional information about PFAS testing can be found on the Michigan PFAS Action Response Team (MPART) website: www.michigan.gov/PFASresponse

●- Prohibited ■ – Allowable ▲- Needs Screening

1. Potential Sources for PFAS Cross-Contamination

Potential sources for PFAS cross-contamination include items and materials used within the sampling environment, such as sampling equipment, field clothing, personal protective equipment (PPE), sun and biological protection products, personal hygiene, personal care products (PCPs), and food packaging. A detailed discussion about potential sources for PFAS cross-contamination is included in the **General PFAS Sampling Guidance**, which should be reviewed before reading this document. However, a high-level summary is presented in this guidance.

All of the items and materials discussed in each of the MDEQ's PFAS Sampling Guidance Documents are divided into three major groups:

- Prohibited (●) identifies items and materials that should not be used when sampling. It is well documented that they contain PFAS or that PFAS are used in their manufacture.

- Allowable (■) identifies items and materials that have been proven not to be sources of PFAS cross contamination and are considered acceptable for sampling.

- Needs Screening (▲) identifies items and materials that have the potential for PFAS cross-contamination due to a lack of scientific data or statements from manufacturers to prove otherwise. These items and materials are further sub-divided into two categories:

    - **Category 1:** Items and materials that <u>will come in direct contact</u> with the sample. These should not be used when sampling unless they are known to be PFAS-free, by collecting an equipment blank sample prior to use.

    - **Category 2:** Items and materials that <u>will not come in direct contact</u> with the sample. These should be avoided, if possible, unless they are known to be PFAS-free by collecting an equipment blank sample prior to use.

Please note that at this time no published research is available that documents the use of various materials and effect on sample results. Therefore, a conservative approach is recommended, and the guidance is based on the collection of multiple environmental samples at various PFAS Sites. Sampling staff should take practical and appropriate precautions to avoid items that are likely to contain PFAS at the sampling site as well as avoid specific items during the sampling event.

A general overview of PFAS contamination sources during sampling can be found in **Section 4.2** of the **General PFAS Sampling Guidance**. Any items or materials utilized that are not identified in this guidance or not discussed in **Section 4.2** should be evaluated as described in **Section 4.2.1**.

Sampling staff should take practical and appropriate precautions to avoid items that are likely to contain PFAS at the sampling site as well as avoid specific items during the sampling event (see below).

1.1 Field Clothing and Personal Protection Equipment (PPE)

A general overview of field clothing and PPE can be found in **Section 4.2.2** from the **General PFAS Sampling Guidance**. Materials, field clothing, and equipment screening should be performed during the QAPP development or the planning phase of sampling programs. The screening should be performed on all items and materials that are expected to come into contact with the samples and are defined as **Category 1**. This Soil Sampling Guidance assumes that the soil samples will be collected in an environment where only Level D protection (such as steel toe

NOTE: Both field clothing and PPE should be kept dust and fiber free.

boots, eye protection, hardhat, etc.) is required by the Health and Safety Plan (HASP). During a PFAS investigation, PPE that contains PFAS should be avoided to prevent cross-contamination.

As with any field mobilization, it is the responsibility of all personnel to be aware of the physical, chemical, and biological hazards associated with a particular site. Personal safety is paramount. Any deviation from this guidance, including those necessary to ensure the health and safety of sampling personnel, should be recorded in field notes and discussed in the final report. Any additional field clothing and/or PPE items that might be required for the soil sampling and not discussed in the Sampling Guidance should be evaluated as described in **Sections 4.2.1** and **4.2.2** of the **General PFAS Sampling Guidance**.

Field sampling during wet weather (e.g., rainfall and snow) should be conducted while wearing the proper field clothing.

- ● Dust and fibers must not be allowed to collect on field clothing or PPE.
- ■ Do not use clothing that has been advertised as waterproof, dirt and/or stain repellant that has not been verified to be made of PFAS-free materials.
- ■ Only use clothing/PPE that has been verified to be made of PFAS-free materials.

Powderless nitrile gloves should be changed frequently any time there is an opportunity for cross-contamination. See **Section 6** of this guidance for additional glove instructions.

1.2 Personal Care Products (PCPs)

A number of sampling guidance documents recommend that personal hygiene and personal care products (PCPs) (e.g., cosmetics, shampoo, sunscreens, dental floss, etc.) not be used prior to and on the day(s) of sampling because the presence of PFAS in these products has been documented (OECD, 2002, Fujii, 2013, Borg and Ivarsson, 2017). However, if the MDEQ's sampling SOPs are followed, these items should not come into contact with the sampling equipment or the sample being collected. As of the date of this sampling guidance, cross-contamination of samples due to the use of PCPs has not been documented during the collection of thousands of samples. However, field personnel should be aware of the potential of cross-contamination if the sampling equipment or actual samples would come into contact with these products.

The following precautions should be taken when dealing with personal hygiene or PCPs before sampling:

- ● Do not handle or apply PCPs in the sampling area.
- ● Do not handle or apply PCPs while wearing PPE that will be present during sampling.
- ■ Move to the staging area and remove PPE if applying personal care products becomes necessary.
- ■ Wash hands thoroughly after the handling or application of PCPs and, when finished, put on a fresh pair of powderless nitrile gloves.

1.3 Food Packaging

PFAS has been used by the paper industry as a special protective coating against grease, oil, and water for paper and paperboards, including food packaging since the late 1950s (Trier et al., 2018). PFAS application for food packaging includes paper products that come into contact with food such as paper plates, food containers, bags, and wraps (OECD, 2002). Pre-wrapped food or snacks (such as candy bars, microwave popcorn, etc.) must not be in the sampling and staging areas during

sampling due to PFAS contamination of the packaging. When staff requires a break to eat or drink, they should remove their gloves, coveralls, and any other PPE, if worn, in the staging area and move to the designated area for food and beverage consumption. When finished, staff should wash their hands and put on a fresh pair of powderless nitrile gloves at the staging area, before returning to the sampling area.

- ● Do not handle, consume, or otherwise interact with pre-wrapped food or snacks, carry-out food, fast food, or other food items while on-site during sampling.
- ■ Move to the staging area and remove PPE prior to leaving the sampling and staging areas if consuming food on site becomes necessary.

2. Soil Sampling Equipment

Soil sampling equipment is categorized into **Category 1** and **Category 2:**

NOTE: As a precautionary action, an equipment rinsate blank should be collected even if the sampling materials are made of materials that are not expected to contain PFAS.

Category 1: Any item that will directly contact with the soil, including shovels, trowels, spoons, bowls, hand augers buckets and extensions, and augers and direct push equipment, including any split spoon or sampling barrels. This equipment has a high likelihood of cross-contamination occurring if the proper decontamination procedures are not followed. These items should be known to be PFAS free.

Category 2: Any item that will not directly contact the soil, including field books, Munsell® color charts, Post-It® Notes, aluminum foil, and recycled paper towels.

Although these items will not directly contact soil samples, cross-contamination may still occur. Every effort should be made to ensure these items are PFAS-free. Be aware that surfaces of this field equipment or the containers in which they are kept may contain PFAS.

Do not use any equipment that contains any known fluoropolymers or that potentially has been cross-contamination with PFAS such as, but not limited to:

- ● Do not use Polytetrafluoroethylene (PTFE) that includes the trademark Teflon® and Hostaflon®, which can be found in many items, including but not limited to the lining of some hoses and tubing, some wiring, certain kinds of gears, and some objects that require the sliding action of parts.
- ● Do not use Polyvinylidene fluoride (PVDF) that includes the trademark Kynar®, which can be found in many items, including but not limited to tubing, films/coatings on aluminum, galvanized or aluminized steel, wire insulators, and lithium-ion batteries.
- ● Do not use Polychlorotrifluoroethylene (PCTFE), that includes the trademark Neoflon®, which can be found in many items, including but not limited to valves, seals, gaskets, and food packaging.
- ● Do not use Ethylene-tetrafluoro-ethylene (ETFE) that includes the trademark Tefzel®, which can be found in many items, including but not limited to wire and cable insulation and covers, films for roofing and siding, liners in pipes, and some cable tie wraps.
- ● Do not use Fluorinated ethylene propylene (FEP), that includes the trademarks Teflon® FEP and Hostaflon® FEP,

NOTE: Manufacturers can change the chemical composition of any product. As a result, all materials that will come into contact with the sample matrices (defined as Category 1) should be tested to confirm they are “PFAS-free”, i.e. will not contaminate samples at detectable levels. **There is no guarantee that materials in the ‘Allowable’ category will always be PFAS-free.**

●- Prohibited ■ – Allowable ▲- Needs Screening

and may also include Neoflon®, which can be found in many items, including but not limited to wire and cable insulation and covers, pipe linings, and some labware.

- ● Do not use low density polyethylene (LDPE) for any items that will come into **direct contact** with the sample media. LDPE can be found in many items, including but not limited to containers and bottles, plastic bags, and tubing.
  - ▲ **However**, LDPE may be used if an equipment blank has confirmed it to be PFAS-free. LDPE does not contain PFAS in the raw material but may contain PFAS cross-contamination from the manufacturing process.
- ■ LDPE bags (e.g. Ziploc®) that **do not** come into direct contact with the sample media and do not introduce cross-contamination with samples may be used.
- ■ Use items and materials that are either made of high density polyethylene (HDPE), polypropylene, silicone, or acetate.
- ▲ Post-It® Notes should be screened before use.

Staff should follow the **MDEQ PFAS Sampling Quick Reference Field Guide** table for approved and prohibited items for documenting and sampling residential wells for PFAS.

NOTE: Special care and consideration should be given to the field sampling equipment when stored and handled outside the site boundaries or between different sample locations.

Many times, the release of PFAS in the environment occurs concurrently with other chemicals. For example, the release of PFAS present in the aqueous film forming foam (AFFF) is generally associated with the release of flammable liquids, such as jet fuels. As a result, sampling soil for PFAS may occur within plumes of volatile organic compounds (VOCs). For staff protection, the use of a photoionization detector (PID) is recommended to measure VOCs that might be present in the soil. The PID used during PFAS sampling to screen for VOCs may be made of materials that contain PFAS. However, the PID is a **Category 2** field equipment item and will have a very low possibility of cross contamination.

3. Soil Sampling Methods

Soils are usually sampled to define the subsurface geology and presence of aquifers or aquitards (lithology), or to determine the presence or absence of contaminants—in this case, PFAS (chemical analysis).

3.1 Soil Sampling for Lithologic Description

Soil samples are collected to determine the lithologic and physical makeup of the sample (i.e.: clay, sand, gravel, brown, mottled, etc.). This is done to determine the subsurface geologic stratigraphy of the site and help identify possible aquifers and aquitards in the subsurface. Soil can be collected loose or cored.

3.1.1 Loose Soil Samples

A loose soil sample is usually obtained by auger or rotary drilling processes, where the process delivers loose drilled soil to the surface for collection and interpretation. In the auger drilling process, the auger flights deliver soil cuttings to the surface around the auger string. These soils can be collected by a shovel and bagged in LDPE bags (e.g. Ziploc) or piled for later lithologic analysis and entry into a geologic log.

3.1.2 Cored Soil Samples

A cored soil sample is collected with a coring type of mechanism in a way that preserves the soil structure. Most coring mechanisms consist of a steel core barrel with a clear plastic liner (use an acetate or other PFAS-free liner) into which the soil core enters. Once the core barrel is retrieved at the surface, this liner is removed and cut open. The soil core is then sliced open to reveal a clean face. This clean face is examined for lithology and structure.

3.2 Soil Sampling for Chemical Analysis

Soils collected for chemical analysis are usually collected by using the core soil sample method. The soil samples need to be as undisturbed as possible. The requirement of an undisturbed soil sample **excludes** the use of loose auger cuttings or rotary methods of soil collection.

During the soil sampling process, the soil sampling device is removed from the ground. The liner is removed and placed on the cutting board and opened using a liner cutting device. The soil sample is visually inspected, and observations recorded in the site field book. The core is cut open to reveal a "clean" face for sampling. This process avoids the possibility of picking up any contaminants that may have gotten smeared onto the soil surface as the soil core entered the liner.

4. Equipment Decontamination Before Sampling

It is customary with soil sampling that the equipment is decontaminated at the conclusion of the sampling event. If the previous user of the equipment is not known, and it is unclear how the equipment was handled—especially rental equipment—decontaminate the equipment prior to sampling.

Disposable **Category 1** sampling equipment should be used, especially for sample bottles and other materials that are used where the soil sample may be in contact with the sampling equipment for an extended period of time. Field sampling equipment used at multiple sites or sampling locations can become highly contaminated with PFAS. Decontamination procedures should be implemented to prevent cross-contamination, including between individual sample locations.

For non-dedicated **Category 1** sampling equipment, the following items, materials, and procedures should be used for decontamination:

- ● Do not use Decon 90®.
- ■ Laboratory supplied PFAS-free deionized water is preferred for decontamination.
- ■ Alconox®, Liquinox®, and Citranox® can be used for equipment decontamination.
- ■ Sampling equipment can be scrubbed using a polyethylene or Polyvinyl chloride (PVC) brush to remove particulates.
- ■ Decontamination procedures should include triple rinsing with PFAS-free water.
- ■ Commercially available deionized water in an HDPE container may be used for decontamination if the water is verified to be PFAS-free.
- ▲ Municipal drinking water may be used for decontamination purposes if it is known to be PFAS-free.

NOTE: All samples should be collected using PFAS-free High-Density Polyethylene (HDPE), glass, or polypropylene bottles provided by the laboratory, with Teflon®-

5. Sample Collection and Handling

The following considerations should be observed for sample collection:

- ● Dust and fibers must be kept out of sample bottles.
- ● The sample cap should never be placed directly on the ground during sampling.
  - ▲ If sampling staff must set the sample bottle cap down during sample collection and a second member of the sampling crew (wearing a fresh pair of powderless nitrile gloves) is not available, set the cap on a clean surface (cotton sheeting, HDPE sheeting, triple rinsed cooler lid, etc.).
- ● Do not sample without powderless nitrile gloves.
- ● Regular size Sharpie® are to be avoided. Thicker markers may contain PFAS.
- ■ Fine and Ultra-Fine point Sharpie® markers are acceptable.
- ■ Ballpoint pens may be used when labeling sample containers. If ballpoint pens do not write on the sample container labels, preprinted labels from the laboratory may be used.
- ■ Bottles should only be opened immediately prior to sampling.
- ■ Hands should be well washed and gloved.
- ■ Use HDPE, glass, or polypropylene sample bottles with Teflon®-free caps, provided by the laboratory.
- ■ Glass bottles or containers may be used if they are known to be PFAS-free, however, PFAS have been found to adsorb to glass, especially when the sample is in contact with the glass for a long period of time (e.g. being stored in a glass container). If the sample comes into direct contact with the glass for a short period of time (e.g. using a glass container to collect the sample, then transferring the sample to a non-glass sample bottle), the adsorption is minimal.
- ■ Commercially bought sample bottles used with automatic sampling equipment should be decontaminated prior to sampling and equipment blank samples should be collected using laboratory supplied PFAS-free water.
- ■ Samples should be double bagged using resealable low density polyethelene (LDPE) bags (e.g., Ziploc®).
- ■ Follow any guidance or requirements in the PFAS analytical reference method that will be used for testing samples, for sample collection, storage, preservation, and holding times.
- ■ If a published testing method is not used, and in the absence of formal United States Environmental Protection Agency (USEPA) guidance for PFAS sample storage, the documentation in USEPA Method 537 Rev. 1.1 should be used as a guide for thermal preservation (holding temperature) and holding times for soil or other samples. Samples must be chilled during storage and shipment and must not exceed 50°F (10º C) during the first 48 hours after collection.
- ▲ Latex gloves should be screened before use.

NOTE: USEPA Method 537 Rev. 1.1 was developed for the analysis of finished drinking water samples only. It was not designed for soils or other matrices that could cause significant interferences to the method. Other analytical methods such as ASTM D7968-14 or D7968-17a may be better at resolving interferences in soil samples. These methods were developed specifically for other matrices such as soil and sediments.

If site-specific information is available, sampling should be conducted from the least to the most contaminated location. Additional guidance on the sampling sequence can be found in **Section 4.3.3** of the **General PFAS Sampling Guidance**.

If possible, collect PFAS samples prior to collecting non-PFAS samples or field parameters (pH, temperature, etc.).

●- Prohibited ■ – Allowable ▲- Needs Screening

Powderless nitrile gloves should be changed any time there is an opportunity for cross-contamination during sampling, including, but not limited to:

- Immediately prior to sample collection
- Each time sampling equipment is placed in and then removed from soil at a new location
- Handling of any sample, including quality assurance/quality control (QA/QC) samples
- After the handling of any non-dedicated sampling equipment
- After contact with non-decontaminated surfaces
- After decontamination of sampling equipment
- When judged necessary by field personnel

6. Sample Shipment

The following procedures should be used for sample shipment:

- ■ Regular ice should be used to cool and maintain the sample at or below 42.8°F (6°C).
  - ▲ Chemical or blue ice may be used if it is known to be PFAS-free and it is absolutely certain that the sample is cooled and maintained at or below 42.8°F (6°C) during collection and through transit to the laboratory.
- ■ Check the cooler periodically to ensure samples are well iced and at the proper temperature.
- ■ Refresh with regular ice, if needed, double bagged in LDPE resealable storage bags if needed.
- ■ Chain of Custody and other forms should be single bagged in LDPE (e.g. Ziploc®) storage bags and taped to the inside of the cooler lid.
- ■ The cooler should be taped closed with a custody seal and shipped by overnight courier.
- ■ Samples should be shipped as soon as possible (e.g. overnight) to ensure the samples arrive within the analytical holding time specified by the lab.

7. Equipment Decontamination After Sampling

It is customary to decontaminate soil sampling equipment at the end of the sampling event, whether it is a single sampling location or the conclusion of the workday. This is to ensure sampling equipment is decontaminated ahead of time for the next sampling event.

- ● Do not put equipment away without decontaminating it.
- ■ Do decontaminate sampling equipment after sampling at each location, or at the end of the workday. Follow the decontamination guidelines in **Section 4 (Equipment Decontamination Before Sampling)** of this document.

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Michigan Department of Environmental Quality

MDEQ PFAS Sampling Quick Reference Field Guide[1]

All Items Used During Sampling Event

● Prohibited

• Items or materials that contain fluoropolymers such as
  ○ Polytetrafluoroethylene (PTFE), that includes the trademarks Teflon® and Hostaflon®
  ○ Polyvinylidene fluoride (PVDF), that includes the trademark Kynar®
  ○ Polycholotrifluoroethylene (PCTFE), that includes the trademark Neoflon ®
  ○ Ethylene-tetrafluoro-ethylene (ETFE), that includes the trademark Tefzel®
  ○ Fluorinated ethylene propylene (FEP), that includes the trademarks Teflon® FEP and Hostaflon® FEP
• Items or materials that contain any other fluoropolymer

Pumps, Tubing, and Sampling Equipment

● Prohibited	■ Allowable	▲Needs Screening[2]

• Items or materials containing any fluoropolymer (potential items include tubing, valves, or pipe thread seal tape)	• High-density polyethylene (HDPE)
	• Low-density polyethylene (LDPE) tubing
	• Polypropylene
	• Silicone
	• Stainless-steel
	• Any items used to secure sampling bottles made from:
	  ○ Natural rubber
	  ○ Nylon (cable ties)
	  ○ Uncoated metal springs
	  ○ Polyethylene
		• Any items or materials that will come into direct contact with the sample that have **not** been verified to be PFAS-free
		  ○ Do not assume that any sampling items or materials are PFAS-free based on composition alone

Sample Storage and Preservation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Polytetrafluoroethylene (PTFE): Teflon® lined bottles or caps	• Glass jars[4] • Laboratory-provided PFAS-Free bottles: ○ HDPE or polypropylene • Regular wet ice • Thin HDPE sheeting • LDPE resealable storage bags (i.e. Ziploc®) that will not contact the sample media[6]	• Aluminium foil[4] • Chemical or blue ice[5] • Plastic storage bags other than those listed as ■ Allowable • Low-density polyethylene (LDPE) bottles

Field Documentation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Clipboards coated with PFAS • Notebooks made with PFAS treated paper • PFAS treated loose paper • PFAS treated adhesive paper products	• Loose paper (non-waterproof, non-recycled) • Rite in the Rain® notebooks • Aluminium, polypropylene, or Masonite field clipboards • Ballpoint pens, pencils, and Fine or Ultra-Fine Point Sharpie® markers	• Plastic clipboards, binders, or spiral hard cover notebooks • All markers not listed as ■ Allowable • Post-It® Notes or other adhesive paper products • Waterproof field books

Decontamination

● Prohibited	■ Allowable	▲Needs Screening[2]
• Decon 90® • PFAS treated paper towel	• Alconox®, Liquinox®, or Citranox® • Triple rinse with PFAS-free deionized water • Cotton cloth or untreated paper towel	• Municipal water • Recycled paper towels or chemically treated paper towels

Clothing, Boots, Rain Gear, and PPE

● Prohibited	■ Allowable	▲Needs Screening[2]

• New or unwashed clothing
• Anything made of or with:
  ○ Gore-Tex™ or other water-resistant synthetics
• Anything applied with or recently washed with:
  ○ Fabric softeners
  ○ Fabric protectors, including UV protection
  ○ Insect resistant chemicals
  ○ Water, dirt, and/or stain resistant chemicals
	• Powderless nitrile gloves
	• Well-laundered synthetic or 100% cotton clothing, with most recent launderings not using fabric softeners
	• Made of or with:
	  ○ Polyurethane
	  ○ Polyvinyl chloride (PVC)
	  ○ Wax coated fabrics
	  ○ Rubber / Neoprene
	  ○ Uncoated Tyvek®
		• Latex gloves
		• Water and/or dirt resistant leather gloves
		• Any special gloves required by a HASP
		• Tyvek® suits, clothing that contains Tyvek®, or coated Tyvek®

Food and Beverages

● Prohibited	■ Allowable

• No food should be consumed in the staging or sampling areas, including pre-packaged food or snacks.
  ■ If consuming food on-site becomes necessary, move to the staging area and remove PPE. After eating, wash hands thoroughly and put on new PPE.
	• Brought and consumed only outside the vicinity of the sampling area:
	  ○ Bottled water
	  ○ Hydration drinks (i.e. Gatorade®, Powerade®)

Personal Care Products (PCPs) - for day of sample collection[6]

● Prohibited	■ Allowable	▲Needs Screening[2]
• Any PCPs[6], sunscreen, and insect repellent applied in the sampling area.	PCPs[6], sunscreens, and insect repellents applied in the staging area, away from sampling bottles and equipment followed by thoroughly washing hands: **PCPs[6]:** • Cosmetics, deodorants/antiperspirants, moisturizers, hand creams, and other PCPs[6] **Sunscreens:** • 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 50 • Meijer® Sunscreen Continuous Spray Broad Spectrum SPF 30 • Meijer® Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50 • Meijer® Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Lotion SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Spray Broad Spectrum SPF 30 • Neutrogena® Pure & Free Baby Sunscreen Broad Spectrum SPF 60+ • Neutrogena® UltraSheer Dry-Touch Sunscreen Broad Spectrum SPF 30 **Insect Repellents:** • OFF® Deep Woods • Sawyer® Permethrin	• Products other than those listed as ■Allowable

[1] This table is not considered to be a complete listing of prohibited or allowable materials. All materials should be evaluated prior to use during sampling. The manufacturers of various products should be contacted in order to determine if PFAS was used in the production of any particular product.

[2] Equipment blank samples should be taken to verify these products are PFAS-free prior to use during sampling.

[3] **For surface water foam samples:** LDPE storage bags may be used in the sampling of foam on surface waters. In this instance, it is allowable for the LDPE bag to come into direct contact with the sample media.

[4] **For fish and other wildlife samples:** Depending on the project objectives, glass jars and aluminum foil might be used for PFAS sampling. PFAS has been found to bind to glass and if the sample is stored in a glass jar, a rinse of the jar is required during the sample analysis. PFAS are sometimes used as a protective layer for some aluminum foils. An equipment blank sample should be collected prior to any aluminum foil use.

[5] Regular ice is recommended as there are concerns that chemical and blue ice may not cool and maintain the sample at or below 42.8°F (6°C) (as determined by EPA 40 CFR 136 – NPDES) during collection and through transit to the laboratory.

[6] Based on evidence, avoidance of PCPs is considered to be precautionary because none have been documented as having cross-contaminated samples due to their use. However, if used, application of PCPs must be done at the staging area and away from sampling bottles and equipment, and hands must be thoroughly washed after the use of any PCPs prior to sampling.

● - Prohibited ■ - Allowable ▲ - Needs Screening

SURFACE WATER PFAS SAMPLING

Guidance

Introduction

This sampling guidance contains the processes, decontamination procedures, and acceptable items and materials for sampling surface water for Per- and Polyfluoroalkyl Substances (PFAS). This guidance will be used to support the sampling objectives and procedures based on the Quality Assurance Project Plan (QAPP) developed prior to any field activities. This guidance assumes staff has basic familiarity with and/or understanding of basic surface water sampling procedures.

NOTE: Review the **General PFAS Sampling Guidance** prior to reviewing this guidance document.

The Michigan Department of Environmental Quality (MDEQ) intends to update the information contained within this Surface Water PFAS Sampling Guidance document as new information becomes available. The user of this Surface Water PFAS Sampling Guidance is encouraged to visit the Michigan PFAS Action Response Team webpage (www.michigan.gov/PFASresponse) to access the current version of this document.

PFAS has been detected in surface water in Michigan at concentrations of over 19,000 parts per trillion (ppt). Because PFAS compounds can be analyzed at concentrations in the parts per trillion (ppt) range, precautions must be taken to prevent cross-contamination. Therefore, there is a high possibility of false positives if decontamination procedures are not followed diligently. This sampling guidance covers both the collection of samples from shallow and deep surface water bodies.

This Surface Water PFAS Sampling Guidance discusses the collection of surface water samples and methods to prevent cross-contamination that can occur from:

- Field clothing and personal protective equipment (PPE)
- Personal care products (PCPs)
- Food packaging
- Sampling equipment
- Equipment decontamination
- Filtering of surface water
- Sample collection and handling
- Sample shipment

Contents

NOTE: Additional information about PFAS testing can be found on the Michigan PFAS Action Response Team (MPART) website: www.michigan.gov/PFASresponse

1. Potential Sources for PFAS Cross-Contamination

Potential sources for PFAS cross-contamination include items and materials used within the sampling environment, such as sampling equipment, field clothing, personal protective equipment (PPE), sun and biological protection products, personal hygiene, personal care products (PCPs), and food packaging. A detailed discussion about potential sources for PFAS cross-contamination is included in the **General PFAS Sampling Guidance**, which should be reviewed before reading this document. However, a high-level summary is presented in this guidance.

All of the items and materials discussed in each of the MDEQ's PFAS Sampling Guidance Documents are divided into three major groups:

- Prohibited (●) identifies items and materials that should not be used when sampling. It is well documented that they contain PFAS or that PFAS are used in their manufacture.

- Allowable (■) identifies items and materials that have been proven not to be sources of PFAS cross contamination and are considered acceptable for sampling.

- Needs Screening (▲) identifies items and materials that have the potential for PFAS cross-contamination due to a lack of scientific data or statements from manufacturers to prove otherwise. These items and materials are further sub-divided into two categories:

    - **Category 1:** Items and materials that will come in direct contact with the sample. These should not be used when sampling unless they are known to be PFAS-free, by collecting an equipment blank sample prior to use.

    - **Category 2:** Items and materials that will not come in direct contact with the sample. These should be avoided, if possible, unless they are known to be PFAS-free by collecting an equipment blank sample prior to use.

● - Prohibited ■ – Allowable ▲ - Needs Screening

Please note that at this time no published research is available that documents the use of various materials and effect on sample results. Therefore, a conservative approach is recommended, and the guidance is based on the collection of multiple environmental samples at various PFAS Sites. Sampling staff should take practical and appropriate precautions to avoid items that are likely to contain PFAS at the sampling site as well as avoid specific items during the sampling event.

A general overview of PFAS contamination sources during sampling can be found in **Section 4.2** of the **General PFAS Sampling Guidance**. Any items or materials utilized that are not identified in this guidance or not discussed in **Section 4.2** should be evaluated as described in **Section 4.2.1**.

Sampling staff should take practical and appropriate precautions to avoid items that are likely to contain PFAS at the sampling site as well as avoid specific items during the sampling event (see below).

1.1 Field Clothing and Personal Protection Equipment (PPE)

A general overview of field clothing and PPE can be found in **Section 4** of the **General PFAS Sampling Guidance**.

As with any field mobilization, it is the responsibility of all personnel to be aware of the physical, chemical and biological hazards associated with a particular site. Personal safety is paramount. The safety of staff should not be compromised by fear of PFAS-containing materials without any scientific basis. Any deviation from this guidance, including those necessary to ensure the health and safety of sampling personnel, should be recorded in field notes and discussed in the final report.

Depending on the project objectives and sampling plan, the collection of surface water samples could be as simple as a grab sample or as complex as a sample collected using a Van Dorn® sampler from a boat. Generally, for surface water sampling, approved field clothing (discussed in **Section 4** of the **General PFAS Sampling Guidance**) is required. Life jackets made of PFAS-free materials should be used. The coatings used on waders are of particular concern during surface water sampling. Ensure the waders are made from PFAS-free materials before use.

NOTE: Special attention should be given to clothing that has been advertised as having waterproof, water-repellant, or dirt and/or stain characteristics. They are likely to have PFAS in their manufacturing.

NOTE: Life jackets may have protective coatings that contain PFAS.

- ● Do not use waders made of Gore-Tex or other known PFAS containing materials.
- ■ Life jackets made of polyethylene foam and nylon shell fabric may be used.
- ■ Waders made of Neoprene or other PFAS-free materials may be used.

Any field clothing and/or PPE items that might be required for surface water sampling and not discussed in this guidance should be evaluated as described in **Section 4.2.2** of the **General PFAS Sampling Guidance**.

NOTE: Both field clothing and PPE should be kept dust and fiber free. During the sample collection, extra care should be taken so that no dust or fibers can fall into the sample bottle.

Powderless nitrile gloves should frequently be changed any time there is an opportunity for cross-contamination of the sampling including, but not limited to, the following activities:

- Each time sampling equipment is handled.
- Prior to sample collection.

● - Prohibited ■ – Allowable ▲ - Needs Screening

- After handling any sample, including QA/QC samples such as field reagent blanks or equipment rinsate blanks.
- After the handling of any non-dedicated sampling equipment, contact with non-decontaminated surfaces, or when judged necessary by field personnel.
- During and after decontamination of non-dedicated sampling equipment.

1.2 Personal Care Products (PCPs)

A number of sampling guidance documents recommend that personal hygiene and personal care products (PCPs) (e.g., cosmetics, shampoo, sunscreens, dental floss, etc.) not be used prior to and on the day(s) of sampling because the presence of PFAS in these products has been documented (OECD, 2002, Fujii, 2013, Borg and Ivarsson, 2017). However, if the MDEQ's sampling SOPs are followed, these items should not come into contact with the sampling equipment or the sample being collected. As of the date of this sampling guidance, cross-contamination of samples due to the use of PCPs has not been documented during the collection of thousands of samples. However, field personnel should be aware of the potential of cross-contamination if the sampling equipment or actual samples would come into contact with these products. The following precautions should be taken when dealing with personal hygiene or PCPs before sampling:

- ● Do not handle or apply PCPs in the sampling area.
- ● Do not handle or apply PCPs while wearing PPE that will be present during sampling.
- ■ Move to the staging area and remove PPE if applying personal care products becomes necessary.
- ■ Wash hands thoroughly after the handling or application of PCPs and, when finished, put on a fresh pair of powderless nitrile gloves.

1.3 Food Packaging

PFAS has been used by the paper industry as a special protective coating against grease, oil, and water for paper and paperboards, including food packaging since the late 1950s (Trier et al., 2018). PFAS application for food packaging includes paper products that come into contact with food such as paper plates, food containers, bags, and wraps (OECD, 2002). Pre-wrapped food or snacks (such as candy bars, microwave popcorn, etc.) must not be in the sampling and staging areas during sampling due to PFAS contamination of the packaging. When staff requires a break to eat or drink, they should remove their gloves, coveralls, and any other PPE, if worn, in the staging area and move to the designated area for food and beverage consumption. When finished, staff should wash their hands and put on a fresh pair of powderless nitrile gloves at the staging area, before returning to the sampling area.

- ● Do not handle, consume, or otherwise interact with pre-wrapped food or snacks, carry-out food, fast food, or other food items while on-site during sampling.
- ■ Move to the staging area and remove PPE prior to leaving the sampling and staging areas if consuming food on site becomes necessary.

2. Surface Water Sampling Equipment

Surface water sampling equipment that is also used for non-PFAS sampling such as dippers, Kemmerer®, or Van Dorn® samplers, should be decontaminated prior to collecting PFAS samples to avoid cross contamination. This non-dedicated equipment (equipment used for more than one water body or location) should be verified that it is PFAS free at least once prior to use. Surface water sampling equipment can fall into **Category 1** or **Category 2**:

● - Prohibited ■ – Allowable ▲ - Needs Screening

Category 1: Surface water sampling equipment that will come into contact with the surface water sample include sample bottles and various surface water samplers or tubing. Sample bottles should be provided by the laboratory and known to be PFAS free. Any surface water samplers, tubing, or materials that will come into contact with the surface water samples should be screened and known to be PFAS-free. The tubing should always be kept in the original cardboard or bag in which it was shipped. The tubing should always be stored in a clean location free of dust and fibers.

NOTE: As a precautionary action, an equipment rinsate blank should be collected even if the sampling materials are made of materials that are not expected to contain PFAS.

Category 2: Examples of field equipment that do **not** come into contact with the surface water samples include water quality meters, GPS receivers, notebooks, clipboards, and turbidity meters. The surface of some of these pieces of field equipment, or the storage boxes in which they are kept, might contain PFAS.

Do not use any equipment that contains any known fluoropolymers including, but not limited to:

- ● Do not use polytetrafluoroethylene (PTFE), that includes the trademark Teflon® and Hostaflon®, which can be found in many items, including but not limited to the lining of some hoses and tubing, some wiring, certain kinds of gears, and some objects that require the sliding action of parts.
- ● Do not use Polyvinylidene fluoride (PVDF), that includes the trademark Kynar®, which can be found in many items, including but not limited to tubing, films/coatings on aluminum, galvanized or aluminized steel, wire insulators, and lithium-ion batteries.
- ● Do not use Polychlorotrifluoroethylene (PCTFE), that includes the trademark Neoflon®, which can be found in many items, including but not limited to valves, seals, gaskets, and food packaging.
- ● Do not use Ethylene-tetrafluoro-ethylene (ETFE), that includes the trademark Tefzel®, which can be found in many items, including but not limited to wire and cable insulation and covers, films for roofing and siding, liners in pipes, and some cable tie wraps.
- ● Do not use Fluorinated ethylene propylene (FEP), that includes the trademarks Teflon® FEP and Hostaflon® FEP, and may also include Neoflon®, which can be found in many items, including but not limited to wire and cable insulation and covers, pipe linings, and some labware.

Note: Manufacturers can change the chemical composition of any product. As a result, all materials that will come into direct contact with the sample media should be tested to confirm they are "PFAS-free", i.e. will not contaminate samples at detectable levels. **There is no guarantee that materials in the 'Allowable' category will always be PFAS- free.**

- ● Do not use low density polyethylene (LDPE) for any items that will come into **direct contact** with the sample media. LDPE can be found in many items, including but not limited to containers and bottles, plastic bags, and tubing.
  - ▲ **However**, LDPE may be used if an equipment blank has confirmed it to be PFAS-free. LDPE does not contain PFAS in the raw material but may contain PFAS cross-contamination from the manufacturing process.
- ■ LDPE bags (e.g. Ziploc®) that **do not** come into direct contact with the sample media and do not introduce cross contamination with samples may be used.
- ■ Use materials that are either made of high density polyethylene (HDPE), polypropylene, silicone, or acetate.
- ■ Use only powderless nitrile gloves (which can be found at some hardware and major retail outlets).
- ■ Keep tubing in the original cardboard or bag in which it was shipped.

●- Prohibited ■ – Allowable ▲- Needs Screening

- ■ Store tubing in a clean location free of dust and fibers.
- ▲ Latex gloves should be screened before use.
- ▲ Post-It® Notes should be screened before use.

NOTE: Depending on the project objectives, boats might be required to be used during surface water sampling. Boats might have various parts that may contain PFAS, including protective water repellent coatings. When boats are used on rivers, samples should always be collected on the upgradient side of the boat.

Depending on the project data quality objectives, water samples can be collected as: a simple grab directly into the sample bottle; a grab sample at a selected depth using any of several collection bottles with subsequent transfer to the sample bottle(s); or as a depth integrated sample. A depth integrated sample can be collected using a simple weighted bottle constructed to allow gradual water inflow (e.g., chlorophyll sampler), or by using a Van Dorn® or Kemmerer® sampler and compositing grab samples from several depths. Composited samples are then transferred to the sample bottle.

Surface water sampling collection can be divided into two method categories as presented in the following Table 1.

Table 1. Surface Water Sampling Methods[1]

Depth to Surface Water Sample	Locations	Sampling Method
0-5 feet	Streams, rivers, creeks, tributaries, lakes, lagoons, ponds, and impoundments.	Direct method, swing, telescoping, and Van Dorn, depth integrating samplers.
Over 5 feet	Large streams, rivers, tributaries, lakes, lagoons, ponds, and impoundments.	Peristaltic pump, swing, telescoping, Van Dorn, Kemmerer, and depth integrating samplers.

[1]This table includes the most frequently used methods for surface water samples.

2.1 Container Immersion

Two types of immersion sampling equipment are available for surface water sampling: extension rods and submersible devices. Extension rods can be used to immerse the actual sample bottle, different types of beakers, or peristaltic pump tubing into the surface water. Submersible devices (i.e., Kemmerer Bottle, Van Dorn Sampler) are fully immersed into the surface water using a rope.

2.1.1 Extension Rods

The most common extension rods are telescoping or swing samplers. Both types of sampling equipment are very similar in design and concept, and both facilitate the immersion of either the sampling bottle or various beakers or scoops. Lists of various extension rod designs are provided below:

- Pendulum or angular beaker.
- Fixed scoop.
- Fix or rotatable head bottle holder.

A peristaltic pump can also be used with extension rods by attaching the tubing to the extension rods and immersing both the rods and the connected tubing to the desired depth in the surface water.

- ■ Use only sample collection equipment, tubing, beakers, and/or scoop materials that are known to be PFAS-free such as stainless steel, glass, HDPE, polyvinyl chloride (PVC), or silicone.
- ■ Extension rods made of materials such as aluminum that has been identified as being PFAS-free can be used.

A specialized extension rod that features a telescoping design for the handle could also be used as a subsurface grab sampler. The sample is collected using a cable from the handle, which has a ring that can be opened for the sample collection after the desired depth has been reached.

2.1.2 Submersible Devices

The most common submersible devices being used are Kemmerer Bottles or Van Dorn Samplers. These devices are primarily used when the samples are collected at depths greater than 5 feet from a boat and/or structure such as a bridge or pier. All submersible devices are submerged in the surface water using a rope.

NOTE: Careful evaluation of all submersible samplers' parts should be done. Any parts that might contain PFAS should be replaced with PFAS-free materials. Equipment rinsate blank samples should be collected to make certain the sampler is PFAS-free.

The Kemmerer Bottle sampler is typically constructed of a stainless-steel tube with polyurethane end seals that can collect a total sample volume of 1.2 liters. The Kemmerer Bottle is not ideal for the collection of samples close to the surface, as the tube is immersed vertically in the water.

The Van Dorn® bottle sampler is typically constructed of 1-liter transparent acrylic tube with two end stoppers. The sampler is suspended horizontally, which is ideal for the sample collection in shallow water bodies as well as sampling at depth.

When submersible samplers are used, the following recommendations should be followed:

- ● Do not use any sampling bottle with Teflon end seals.
- ■ Use a Kemmerer® Bottle made of stainless steel with polyurethane end seals.
- ■ Use a Van Dorn® bottle sampler that uses stoppers made of PFAS-free materials.
- ■ Use nylon line, stainless steel cable, or line or wires made of PFAS-free materials for sample collection.
- ■ Use tubing for the sampling ports made of HDPE, polypropylene, silicone, PVC, or other PFC-free materials.

2.2 Direct Sampling

For surface water samples collected near the shore (e.g., from streams, rivers, lakes, and other surface waters), the direct method can be used to collect the water samples directly into the sample container.

- ● Do not sample without powderless nitrile gloves.

- ● Never place the sample cap directly on the ground or boat deck during sampling.
- ■ Use powderless nitrile gloves
- ■ Hands should be well washed
- ■ Use HDPE sample bottles with Teflon®-free caps, provided by the laboratory.
- ■ If sample bottles that are known to be PFAS-free are not available, the sample container and lid should be rinsed with water that is known to be PFAS-free at least 3 times prior to collecting the sample.
- ■ If samples are collected while wading in the water body, the bottle should be immersed inverted and upstream of the collector.
- ■ If samples are collected from a boat, the bottles should be submerged upstream of the boat.

NOTE: Unless specifically required by the project objectives, surface water samples should ***not*** be taken at the top layer of the water body or of surface scums. PFAS are expected to accumulate at the surface water air interface or be present in the surface runoff, so samples taken at the surface are likely to result in high biased results that are not representative of the bulk surface water.

3. Equipment Decontamination

Field sampling equipment that is used at multiple sites or sampling locations (non-dedicated equipment) could become contaminated with PFAS.

The following should be considered when decontaminating any equipment that contacts the sampling media:

- ● Do not use Decon 90®.
- ■ Laboratory supplied PFAS-free deionized water is preferred for decontamination.
- ■ Alconox®, Liquinox®, and Citranox® can be used for equipment decontamination.
- ■ Sampling equipment can be scrubbed using a polyethylene or Polyvinyl chloride (PVC) brush to remove particulates.
- ■ Decontamination procedures should include triple rinsing with PFAS-free water.
- ■ Commercially available deionized water in an HDPE container may be used for decontamination if the water is verified to be PFAS-free.
- ▲ Municipal drinking water may be used for decontamination purposes if it is known to be PFAS-free.

4. Sample Collection and Handling

A preferred sampling sequence should be established prior to any sampling event to reduce the risk of cross contamination. In general, the sampling sequence should begin in areas expected or known to be least contaminated, proceeding to anticipated areas or identified to be most contaminated. If analytical results from past sampling events are available, the sampling sequence can be readily determined.

However, for many PFAS investigation sites, no PFAS sampling has been conducted. In these cases, all site information on possible PFAS uses and potential PFAS migration patterns (e.g., upgradient, downgradient) from PFAS sources at the site should be reviewed prior to the sampling event to help establish the sampling sequence.

If multiple samples (i.e., monitoring wells, surface water, residential) will be collected in an area where a PFAS release in the environment has been documented, samples that are known to be upgradient from the impacted area should be sampled first, followed by those that are furthest downgradient from the

suspected source. The remaining samples should be progressively sampled from the one most distant downgradient to those closer to the known PFAS source.

If no information is available about the site, samples are to be collected in the following order:

1. Drinking Water (e.g., residential wells)
2. Surface Water
3. Groundwater

When collecting and handling surface water samples:

- ● Do not insert or let tubing or any materials inside the sample bottle.
- ● Dust and fibers must be kept out of sample bottles.
- ● The sample cap should never be placed directly on the ground during sampling. If sampling staff must set the sample bottle cap down during sample collection and a second member of the sampling crew (wearing a fresh pair of powderless nitrile gloves) is not available, set the cap on a clean surface (cotton sheeting, HDPE sheeting, triple rinsed cooler lid, etc.).
- ● Regular/thick size markers (Sharpie® or otherwise) are to be avoided; as they may contain PFAS.
- ■ Fine or Ultra-Fine point Sharpies® may be used to label the empty sample bottle while in the staging area provided the lid is on the sample bottle and powderless nitrile gloves are changed following sample bottle labeling.
- ■ Ballpoint pens may be used when labeling sample containers. If ballpoint pens do not write on the sample container labels, preprinted labels from the laboratory may be used.
- ■ Hands should be well washed and gloved.
- ■ Use HDPE, or polypropylene sample bottles with Teflon®-free caps, provided by the laboratory.
- ■ Bottles should only be opened immediately prior to sampling.
- ■ Bottles should be capped immediately after collecting the sample.
- ■ Samples should be double bagged using resealable low density polyethylene (LDPE) bags (e.g., Ziploc®).
- ■ Follow any guidance or requirements in the PFAS analytical reference method that will be used for testing samples, for sample collection, storage, preservation, and holding times.

If a published testing method is not used, and in the absence of formal United States Environmental Protection Agency guidance for PFAS sample storage, the documentation in USEPA Method 537 Rev. 1.1 should be used as a guide for thermal preservation (holding temperature), and holding times for surface water or other samples. Samples must be chilled during storage and shipment, and must not exceed 50°F (10º C) during the first 48 hours after collection.

NOTE: USEPA Method 537 Rev. 1.1 was developed for the analysis of finished drinking water samples only. It was not designed for testing surface water or other matrices that could cause significant interferences to the method.

Surface water samples should be extracted as soon as possible but must be extracted within 14 days. Extracts must be stored at room temperature and analyzed within 28 days after extraction (EPA Method 537 Rev. 1.1).

5. Filtering of Surface Water

Since PFAS can adsorb to particulate matter, unfiltered samples may result in high-biased results. PFAS are known to absorb to various filters. As a result, filtering of surface water samples prior to delivery to the lab should be avoided unless called for in the project data quality objectives. To reduce the need for filtering, samples should be collected with as minimal disturbance to sediments as possible.

NOTE: It is recommended that filtering of the samples should **only be performed in the laboratory** in order to reduce the possibility of cross contamination.

If it is known beforehand that samples will need to be filtered the procedure should be discussed with the laboratory and sample handling methods and responsibilities should be described in the sampling workplan and QAPP.

The following recommendations should be used when considering filtering of the samples:

- ● **Field filtration of the sample is generally not advised.**
  - ▲ If filtering is absolutely necessary, if specifically requested by a client or for other reasons:
- ● Do not use any filters that contain any PFAS, such as PTFE filters
- ● Do not use nylon filters.
- ■ Glass filters are recommended to be used.
- ■ Consider use of a centrifuge in the laboratory to reduce the need for sample filtering.

6. Sample Shipment

When prepping samples for shipping:

- ■ Check the cooler periodically to ensure samples are well iced and at the proper temperature.
- ■ Refresh with regular ice, if needed, double bagged in LDPE resealable storage bags if needed.
- ■ Regular ice should be used to cool and maintain the sample at or below the proper temperature.
  - ▲ Chemical or blue ice may be used if it is known to be PFAS-free and it is absolutely certain that the sample is cooled and maintained at or below the proper temperature during collection and through transit to the laboratory.
- ■ Chain of Custody and other forms should be double bagged in LDPE (Ziploc®) storage bags and taped to the inside of the cooler lid.
- ■ The cooler should be taped closed with a custody seal and, if shipping, shipped by overnight courier.
- ■ Samples should be shipped as soon as possible (e.g. overnight) to ensure the samples arrive within the analytical holding time specified by the lab.

Michigan Department of Environmental Quality

MDEQ PFAS Sampling Quick Reference Field Guide[1]

All Items Used During Sampling Event

● Prohibited

• Items or materials that contain fluoropolymers such as
  ○ Polytetrafluoroethylene (PTFE), that includes the trademarks Teflon® and Hostaflon®
  ○ Polyvinylidene fluoride (PVDF), that includes the trademark Kynar®
  ○ Polycholotrifluoroethylene (PCTFE), that includes the trademark Neoflon ®
  ○ Ethylene-tetrafluoro-ethylene (ETFE), that includes the trademark Tefzel®
  ○ Fluorinated ethylene propylene (FEP), that includes the trademarks Teflon® FEP and Hostaflon® FEP
• Items or materials that contain any other fluoropolymer

Pumps, Tubing, and Sampling Equipment

● Prohibited	■ Allowable	▲Needs Screening[2]

• Items or materials containing any fluoropolymer (potential items include tubing, valves, or pipe thread seal tape)	• High-density polyethylene (HDPE)
	• Low-density polyethylene (LDPE) tubing
	• Polypropylene
	• Silicone
	• Stainless-steel
	• Any items used to secure sampling bottles made from:
	  ○ Natural rubber
	  ○ Nylon (cable ties)
	  ○ Uncoated metal springs
	  ○ Polyethylene
		• Any items or materials that will come into direct contact with the sample that have **not** been verified to be PFAS-free
		  ○ Do not assume that any sampling items or materials are PFAS-free based on composition alone

Sample Storage and Preservation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Polytetrafluoroethylene (PTFE): Teflon® lined bottles or caps	• Glass jars[4] • Laboratory-provided PFAS-Free bottles: ○ HDPE or polypropylene • Regular wet ice • Thin HDPE sheeting • LDPE resealable storage bags (i.e. Ziploc®) that will not contact the sample media[6]	• Aluminium foil[4] • Chemical or blue ice[5] • Plastic storage bags other than those listed as ■ Allowable • Low-density polyethylene (LDPE) bottles

Field Documentation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Clipboards coated with PFAS • Notebooks made with PFAS treated paper • PFAS treated loose paper • PFAS treated adhesive paper products	• Loose paper (non-waterproof, non-recycled) • Rite in the Rain® notebooks • Aluminium, polypropylene, or Masonite field clipboards • Ballpoint pens, pencils, and Fine or Ultra-Fine Point Sharpie® markers	• Plastic clipboards, binders, or spiral hard cover notebooks • All markers not listed as ■ Allowable • Post-It® Notes or other adhesive paper products • Waterproof field books

Decontamination

● Prohibited	■ Allowable	▲Needs Screening[2]
• Decon 90® • PFAS treated paper towel	• Alconox®, Liquinox®, or Citranox® • Triple rinse with PFAS-free deionized water • Cotton cloth or untreated paper towel	• Municipal water • Recycled paper towels or chemically treated paper towels

Clothing, Boots, Rain Gear, and PPE

● Prohibited	■ Allowable	▲Needs Screening[2]

• New or unwashed clothing
• Anything made of or with:
  ○ Gore-Tex™ or other water-resistant synthetics
• Anything applied with or recently washed with:
  ○ Fabric softeners
  ○ Fabric protectors, including UV protection
  ○ Insect resistant chemicals
  ○ Water, dirt, and/or stain resistant chemicals
	• Powderless nitrile gloves
	• Well-laundered synthetic or 100% cotton clothing, with most recent launderings not using fabric softeners
	• Made of or with:
	  ○ Polyurethane
	  ○ Polyvinyl chloride (PVC)
	  ○ Wax coated fabrics
	  ○ Rubber / Neoprene
	  ○ Uncoated Tyvek®
		• Latex gloves
		• Water and/or dirt resistant leather gloves
		• Any special gloves required by a HASP
		• Tyvek® suits, clothing that contains Tyvek®, or coated Tyvek®

Food and Beverages

● Prohibited	■ Allowable

• No food should be consumed in the staging or sampling areas, including pre-packaged food or snacks.
  ■ If consuming food on-site becomes necessary, move to the staging area and remove PPE. After eating, wash hands thoroughly and put on new PPE.
	• Brought and consumed only outside the vicinity of the sampling area:
	  ○ Bottled water
	  ○ Hydration drinks (i.e. Gatorade®, Powerade®)

Personal Care Products (PCPs) - for day of sample collection[6]

● Prohibited	■ Allowable	▲Needs Screening[2]
• Any PCPs[6], sunscreen, and insect repellent applied in the sampling area.	PCPs[6], sunscreens, and insect repellents applied in the staging area, away from sampling bottles and equipment followed by thoroughly washing hands: **PCPs[6]:** • Cosmetics, deodorants/antiperspirants, moisturizers, hand creams, and other PCPs[6] **Sunscreens:** • 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 50 • Meijer® Sunscreen Continuous Spray Broad Spectrum SPF 30 • Meijer® Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50 • Meijer® Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Lotion SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Spray Broad Spectrum SPF 30 • Neutrogena® Pure & Free Baby Sunscreen Broad Spectrum SPF 60+ • Neutrogena® UltraSheer Dry-Touch Sunscreen Broad Spectrum SPF 30 **Insect Repellents:** • OFF® Deep Woods • Sawyer® Permethrin	• Products other than those listed as ■Allowable

[1] This table is not considered to be a complete listing of prohibited or allowable materials. All materials should be evaluated prior to use during sampling. The manufacturers of various products should be contacted in order to determine if PFAS was used in the production of any particular product.

[2] Equipment blank samples should be taken to verify these products are PFAS-free prior to use during sampling.

[3] **For surface water foam samples:** LDPE storage bags may be used in the sampling of foam on surface waters. In this instance, it is allowable for the LDPE bag to come into direct contact with the sample media.

[4] **For fish and other wildlife samples:** Depending on the project objectives, glass jars and aluminum foil might be used for PFAS sampling. PFAS has been found to bind to glass and if the sample is stored in a glass jar, a rinse of the jar is required during the sample analysis. PFAS are sometimes used as a protective layer for some aluminum foils. An equipment blank sample should be collected prior to any aluminum foil use.

[5] Regular ice is recommended as there are concerns that chemical and blue ice may not cool and maintain the sample at or below 42.8°F (6°C) (as determined by EPA 40 CFR 136 – NPDES) during collection and through transit to the laboratory.

[6] Based on evidence, avoidance of PCPs is considered to be precautionary because none have been documented as having cross-contaminated samples due to their use. However, if used, application of PCPs must be done at the staging area and away from sampling bottles and equipment, and hands must be thoroughly washed after the use of any PCPs prior to sampling.

● - Prohibited ■ - Allowable ▲ - Needs Screening

RESIDENTIAL WELL PFAS SAMPLING

Guidance

Introduction

This sampling guidance discusses the processes and acceptable items and materials that should be used by the Michigan Department of Environmental Quality (MDEQ) and local health department staff conducting residential well sampling for per- and polyfluoroalkyl substances (PFAS). This guidance will be used to support the sampling objectives and procedures based on any and Quality Assurance Project Plan (QAPP) developed before starting field activities.

NOTE: Review the **General PFAS Sampling Guidance** document prior to reviewing this guidance document.

This guidance assumes staff has basic familiarity with and/or understanding of basic residential well sampling procedures. If you are a homeowner or resident interested in sampling your own well, please see the separate **For Homeowners – Residential Well PFAS Sampling Guidance.**

The MDEQ intends to update the information contained within this Residential Well PFAS Sampling Guidance document as new information becomes available. The user of this Residential Well PFAS Sampling Guidance is encouraged to visit the Michigan PFAS Action Response Team (MPART) webpage (www.michigan.gov/PFASresponse) to access the most current version of this document.

PFAS has been detected in groundwater in Michigan from residential wells at concentrations over 60,000 parts per trillion (ppt). Many commercial laboratories have low PFAS detection limits of about 1 ppt. Therefore, there is a high potential of false positives if proper procedures are not followed during sample collection.

This Residential Well PFAS Sampling Guidance discusses the potential for cross-contamination that can occur from:

- Field clothing and personal protective equipment (PPE)
- Sampling equipment
- Sample collection and handling
- Sample shipment

CONTENTS

NOTE: Additional information about PFAS testing can be found on the Michigan PFAS Action Response Team (MPART) website: www.michigan.gov/PFASresponse

1. Typical Well Construction

There are several different types of drinking water well construction methods found in Michigan—rotary drilling, cable tool, auger drilling, cable tool, auger drilling, hand driving, jetting, hollow-rod and dug wells. Well construction does not affect sampling methods but may provide additional insight into the meaning of the results.

Before sampling, staff should obtain the well construction record through the MDEQ's statewide groundwater database, Wellogic (https://secure1.state.mi.us/wellogic), or by contacting the local health department. Records for wells constructed since the year 2000 are typically located in Wellogic. Older well records may be found in the Scanned Water Well Record Retrieval System (see link in Wellogic). The well record will indicate the drilling method, well depth, type of formations encountered, grout (present or absent), type of pumping equipment, and more.

2. Potential Sources for PFAS Cross-Contamination

Potential sources for PFAS cross-contamination include items and materials used within the sampling environment, such as sampling equipment, field clothing, personal protective equipment (PPE), sun and biological protection products, personal hygiene, personal care products (PCPs), and food packaging, A detailed discussion about potential sources for PFAS cross-contamination is included in the **General PFAS Sampling Guidance**, which should be reviewed before reading this document. However, a high-level summary is presented in this guidance.

All of the items and materials discussed in each of the MDEQ's PFAS Sampling Guidance Documents are divided into three major groups:

- Prohibited (●) identifies items and materials that should not be used when sampling. It is well documented that they contain PFAS or that PFAS are used in their manufacture.

- Allowable (■) identifies items and materials that have been proven not to be sources of PFAS cross contamination and are considered acceptable for sampling.

- Needs Screening (▲) identifies items and materials that have the potential for PFAS cross-contamination due to a lack of scientific data or statements from manufacturers to prove otherwise. These items and materials are further sub-divided into two categories:

    - **Category 1:** Items and materials that will come in direct contact with the sample. These should not be used when sampling unless they are known to be PFAS-free, by collecting an equipment blank sample prior to use.

    - **Category 2:** Items and materials that will not come in direct contact with the sample. These should be avoided, if possible, unless they are known to be PFAS-free by collecting an equipment blank sample prior to use.

Please note that at this time no published research is available that documents the use of various materials and effect on sample results. Therefore, a conservative approach is recommended, and the guidance is based on the collection of multiple environmental samples at various PFAS Sites. Sampling staff should take practical and appropriate precautions to avoid items that are likely to contain PFAS at the sampling site as well as avoid specific items during the sampling event.

2.1 Field Clothing, Personal Protection Equipment (PPE), and Residential Well Sampling Materials and Equipment

Materials, field clothing, and equipment screening should be performed during the QAPP development or the planning phase of sampling programs. The screening should be performed on all the items and materials that are expected to come into contact with the samples and are defined as **Category 1.** Due to the extensive use of PFAS in many industries and products, PPE may contain PFAS. During a PFAS investigation, PPE-containing PFAS should be avoided to prevent cross-contamination. Personal safety is paramount. The safety of staff should not be compromised by fear of PFAS-containing materials without any scientific basis. Any deviation from this guidance, including those necessary to ensure the health and safety of sampling personnel, should be recorded in field notes and discussed in the final report. Do not use any materials or equipment that contains any known fluoropolymers or that potentially has been cross-contaminated with PFAS such as, but not limited to the following:

- Do not use polytetrafluoroethylene (PTFE), that includes the trademark Teflon® and Hostaflon®, which can be found in many items, including but not limited to the lining of some hoses and tubing, some wiring, certain kinds of gears, lubricant, and some objects that require the sliding action of parts.
- Do not use Polyvinylidene fluoride (PVDF), that includes the trademark Kynar®, which can be found in many items, including but not limited to tubing, films/coatings on aluminum, galvanized or aluminized steel, wire insulators, and lithium-ion batteries.
- Do not use Polychlorotrifluoroethylene (PCTFE), that includes the trademark Neoflon®, which can be found in many items, including but not limited to valves, seals, gaskets, and food packaging.
- Do not use Ethylene-tetrafluoro-ethylene (ETFE), that includes the trademark Tefzel®, which can be found in many items, including but not limited to wire and cable insulation and covers, films for roofing and siding, liners in pipes, and some cable tie wraps.
- Do not use Fluorinated ethylene propylene (FEP), that includes the trademarks Teflon® FEP and Hostaflon® FEP, and may also include Neoflon®, which can be found in many items, including but not limited to wire and cable insulation and covers, pipe linings, and some labware.
- Do not use low density polyethylene (LDPE) for any items that will come into **direct contact** with the sample media. LDPE can be found in many items, including but not limited to containers and bottles, plastic bags, and tubing.
    - ▲ **However**, LDPE may be used if an equipment blank has confirmed it to be PFAS-free. LDPE does not contain PFAS in the raw material but may contain PFAS cross-contamination from the manufacturing process.

Staff should follow the **MDEQ PFAS Sampling Quick Reference Field Guide** table for approved and prohibited items for documenting and sampling residential wells for PFAS. The following materials or items are allowable:

- ■ LDPE bags (e.g. Ziploc®) that **do not** come into direct contact with the sample media and do not introduce cross contamination with samples may be used.
- ■ Materials that are either made of high density polyethylene (HDPE), polypropylene, silicone, or acetate.
- ■ PFAS-free bottles containing Trizma® preservative provided by the laboratory.
- ■ Powderless nitrile gloves (which can be found at some hardware and major retail outlets).
- ▲ Latex gloves should be screened before use.

● - Prohibited ■ - Allowable ▲ - Needs Screening

2.2 Personal Care Products (PCPs)

A number of sampling guidance documents recommend that personal hygiene and personal care products (PCPs) (e.g., cosmetics, shampoo, sunscreens, dental floss, etc.) not be used prior to and on the day(s) of sampling because the presence of PFAS in these products has been documented (OECD, 2002, Fujii, 2013, Borg and Ivarsson, 2017). However, if the MDEQ's sampling SOPs are followed, these items should not come into contact with the sampling equipment or the sample being collected. As of the date of this sampling guidance, cross-contamination of samples due to the use of PCPs has not been documented during the collection of thousands of samples. However, field personnel should be aware of the potential of cross-contamination if the sampling equipment or actual samples would come into contact with these products. The following precautions should be taken when dealing with personal hygiene or PCPs before sampling:

- ● Do not handle or apply PCPs in the sampling area.
- ● Do not handle or apply PCPs while wearing PPE that will be present during sampling.
- ■ Move to the staging area and remove PPE if applying personal care products becomes necessary.
- ■ Wash hands thoroughly after the handling or application of PCPs and, when finished, put on a fresh pair of powderless nitrile gloves.

2.3 Food Packaging

PFAS has been used by the paper industry as a special protective coating against grease, oil, and water for paper and paperboards, including food packaging since the late 1950s (Trier et al., 2018). PFAS application for food packaging includes paper products that come into contact with food such as paper plates, food containers, bags, and wraps (OECD, 2002). Pre-wrapped food or snacks (such as candy bars, microwave popcorn, etc.) must not be in the sampling and staging areas during sampling due to PFAS contamination of the packaging. When staff requires a break to eat or drink, they should remove their gloves, coveralls, and any other PPE, if worn, in the staging area and move to the designated area for food and beverage consumption. When finished, staff should wash their hands and put on a fresh pair of powderless nitrile gloves at the staging area, before returning to the sampling area.

- ● Do not handle, consume, or otherwise interact with pre-wrapped food or snacks, carry-out food, fast food, or other food items while on-site during sampling.
- ■ Move to the staging area and remove PPE prior to leaving the sampling and staging areas if consuming food on site becomes necessary.

3. Residential Well Sample Collection and Handling Procedures

Obtain sample bottles – All bottles used for PFAS sampling must come from certified or accredited laboratories that will be performing the PFAS analysis. Bottles should contain Trizma®.

Schedule the sampling visit – Before scheduling a sampling visit:

- Obtain a copy of the well record, if available. Well records may be obtained through the on-line tool Wellogic, or by contacting the local health department.
- Contact the well owner by telephone or send a postcard or letter to the owner of record's mailing address proposing a sample collection date and request that any loose pets be secured on the day of sample collection to protect staff. Provide staff with contact information if a different sampling day or special instructions are needed. If possible, inquire ahead of time about any treatment systems installed on the residential water system, or ask the resident to bypass the

treatment system on the day of sample collection. This is so staff can get a representative sample of what is being produced by the well.

Identify water treatment devices and an appropriate sample tap – The typical residential well sample will either be collected from inside the residents' home or an outside tap. The sample should not be taken from a hose. Gain access to the interior of the home, if possible, to identify any treatment systems such as in-line filtration, softening, iron removal, or other treatment systems before selecting the sample tap location. Primary consideration for sample location should be the kitchen faucet, however, acceptable sample locations include a laundry sink, outside tap, or other commonly used distribution points-of-use within the home.

- ▲ Avoid using leaky or spraying faucets, if possible.
- ▲ When swivel or single lever faucets are used for sampling, please ensure that only cold water is used for flushing and sample collection.
- ■ The sampling of residential wells in a known PFAS-impacted area should be selected in order from least to most contaminated well, if known.

If there is no untreated tap available at the residence and the treatment system cannot be bypassed, consider utilizing the kitchen sink tap, bathroom faucet, or outside tap. Note on the sample request form if the sample was collected from a treated tap.

The sampling of irrigation wells might be required if the resident is using the water for gardening, occasionally use it for drinking water, or to better understand a PFAS plume.

- ● Do not collect the sample from any garden hose or other devices used for irrigation.
- ■ The sample should be located as close to the well as possible.

Flush using Untied States Environmental Protection Agency (USEPA) Method 537 – USEPA Method 537 v1.1, section 8.2.2 states that the sampler open the tap and allow the system to flush until the water temperature has stabilized (approximately 3 to 5 minutes). Samples are collected from the flowing system.

- Options for flushing include running water at a nearby laundry sink, another household sink, or bathtub; flushing a toilet; opening the outside tap; or a combination of any of these taps.
- If an outside tap is used, collect flushed water in a bucket and dispose of the water in the yard.

Sample Collection – Careful planning must be done in advance of the sample collection to minimize the potential for cross-contamination. Use powderless nitrile gloves during sample collection. Powderless nitrile gloves should be changed frequently, at any time there is an opportunity for cross-contamination of the sampling, including, but not limited to, the following activities:

- Before sample collection.
- While handling any sample, including quality assurance/quality control (QA/QC) samples, such as field reagent blanks.
- Handling of any non-dedicated sampling equipment (equipment used for more than one specific location), contact with non-decontaminated surfaces, or when judged necessary by staff.

The following considerations should be taken during sample collection to prevent contamination:

- ● Attention should be given such that no dust or fibers fall into the sample bottle.
- ● Never set the cap down, touch any part of the cap that contacts the bottle, or let anything touch the rim of the bottle or inside the cap.
- ● Care should be given such that no splashed drops of water from the sink or ground enter the sample bottle.

●- Prohibited ■- Allowable ▲- Needs Screening

- ● Do not let the sample bottle overflow; if the bottle overflows, the Trizma presevative will be flushed out.
- ● Do not use markers other than Fine or Ultra-Fine point Sharpies®, which have been proven to be PFAS-free.
- ■ Use PFAS-free markers to label the empty sample bottle prior to or immediately after the sample collection. Make sure the cap is on the sample bottle and gloves are changed after sample bottle labeling. Allow the ink to dry completely before proceeding. Preprinted labels from the laboratory can also be used. A recommended practice is to place the labeled container on the polyethylene bag as used below, after labeling.
- ■ Ensure that the sample tap is protected from dust, dirt, and debris, and ensure the sample tap is not too close to the sink bottom or the ground so that splashing is avoided.
- ■ Notes should be taken, and the presence of Teflon® tape on the piping should be noted.
- ■ A residential well sample should be collected from the cold water tap only.
- ■ Whenever possible, note and remove any attachments from the taps, including aerators, screens, washers, hoses, and water filters.
- ■ Use HDPE or polypropylene sample bottles provided by the laboratory, with Teflon®-free caps.
- ■ Glass bottles or containers may be used if they are known to be PFAS-free, however, PFAS have been found to adsorb to glass, especially when the sample is in contact with the glass for a long period of time (e.g. being stored in a glass container). If the sample comes into direct contact with the glass for a short period of time (e.g. using a glass container to collect the sample, then transferring the sample to a non-glass sample bottle), the adsorption is minimal.
- ■ Fill the bottle to the neck only, taking care to not flush out the Trizma preservative
- ■ Cap the bottle, then gently agitate by hand until preservative is dissolved. Do not reopen the bottle.
- ■ Samples should be double bagged using resealable low density polyethelene (LDPE) bags (e.g., Ziploc®).
- ■ Prior to shipment samples need to be chilled, and must not exceed 50° F (10°C) during the first 48 hours after collection. (EPA Method 537 Rev. 1.1).

4. Sample Shipment

The following recommendations should be used for the sample shipment:

- ■ Wet ice should be used to cool and maintain the sample at or below 50°F (10°C) during the first 48 hours after collection. (EPA Method 537 Rev. 1.1).
  - ▲ Chemical or blue ice may be used if it is known to be PFAS-free and it is absolutely certain that the sample is cooled and maintained at or below 42.8°F (6°C) during collection and through transit to the laboratory.
- ■ Use wet ice that is double bagged using resealable low density polyethelene (LDPE) bags (e.g., Ziploc®).
- ■ Check the cooler periodically to ensure samples are well iced and at the proper temperature.
- ■ Refresh with regular ice, if needed, double bagged in LDPE resealable storage bags if needed.
- ■ Samples must be chilled **during shipment** and must not exceed 50°F (10°C) during the first 48 hours after collection. (EPA Method 537 Rev. 1.1).
- ■ Chain of Custody (COC) should be single-bagged in resealable low density polyethelene (LDPE) bags (e.g., Ziploc®) and taped to the inside of the cooler lid.
- ■ The cooler should be taped closed with a custody seal and shipped by overnight courier.
- ■ Residential well samples should be shipped to the laboratory as soon as possible (e.g. overnight), so the lab may perform the necessary steps within the 14 day holding time beginning the date of sample collection (EPA Method 537 Rev. 1.1).

● - Prohibited ■ - Allowable ▲ - Needs Screening

Michigan Department of Environmental Quality

MDEQ PFAS Sampling Quick Reference Field Guide[1]

All Items Used During Sampling Event

● Prohibited

• Items or materials that contain fluoropolymers such as
  ○ Polytetrafluoroethylene (PTFE), that includes the trademarks Teflon® and Hostaflon®
  ○ Polyvinylidene fluoride (PVDF), that includes the trademark Kynar®
  ○ Polycholotrifluoroethylene (PCTFE), that includes the trademark Neoflon ®
  ○ Ethylene-tetrafluoro-ethylene (ETFE), that includes the trademark Tefzel®
  ○ Fluorinated ethylene propylene (FEP), that includes the trademarks Teflon® FEP and Hostaflon® FEP
• Items or materials that contain any other fluoropolymer

Pumps, Tubing, and Sampling Equipment

● Prohibited	■ Allowable	▲Needs Screening[2]

• Items or materials containing any fluoropolymer (potential items include tubing, valves, or pipe thread seal tape)	• High-density polyethylene (HDPE)
	• Low-density polyethylene (LDPE) tubing
	• Polypropylene
	• Silicone
	• Stainless-steel
	• Any items used to secure sampling bottles made from:
	  ○ Natural rubber
	  ○ Nylon (cable ties)
	  ○ Uncoated metal springs
	  ○ Polyethylene
		• Any items or materials that will come into direct contact with the sample that have **not** been verified to be PFAS-free
		  ○ Do not assume that any sampling items or materials are PFAS-free based on composition alone

Sample Storage and Preservation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Polytetrafluoroethylene (PTFE): Teflon® lined bottles or caps	• Glass jars[4] • Laboratory-provided PFAS-Free bottles: ○ HDPE or polypropylene • Regular wet ice • Thin HDPE sheeting • LDPE resealable storage bags (i.e. Ziploc®) that will not contact the sample media[6]	• Aluminium foil[4] • Chemical or blue ice[5] • Plastic storage bags other than those listed as ■ Allowable • Low-density polyethylene (LDPE) bottles

Field Documentation

● Prohibited	■ Allowable	▲Needs Screening[2]
• Clipboards coated with PFAS • Notebooks made with PFAS treated paper • PFAS treated loose paper • PFAS treated adhesive paper products	• Loose paper (non-waterproof, non-recycled) • Rite in the Rain® notebooks • Aluminium, polypropylene, or Masonite field clipboards • Ballpoint pens, pencils, and Fine or Ultra-Fine Point Sharpie® markers	• Plastic clipboards, binders, or spiral hard cover notebooks • All markers not listed as ■ Allowable • Post-It® Notes or other adhesive paper products • Waterproof field books

Decontamination

● Prohibited	■ Allowable	▲Needs Screening[2]
• Decon 90® • PFAS treated paper towel	• Alconox®, Liquinox®, or Citranox® • Triple rinse with PFAS-free deionized water • Cotton cloth or untreated paper towel	• Municipal water • Recycled paper towels or chemically treated paper towels

Clothing, Boots, Rain Gear, and PPE

● Prohibited	■ Allowable	▲Needs Screening[2]
• New or unwashed clothing • Anything made of or with: ○ Gore-Tex™ or other water-resistant synthetics • Anything applied with or recently washed with: ○ Fabric softeners ○ Fabric protectors, including UV protection ○ Insect resistant chemicals ○ Water, dirt, and/or stain resistant chemicals	• Powderless nitrile gloves • Well-laundered synthetic or 100% cotton clothing, with most recent launderings not using fabric softeners • Made of or with: ○ Polyurethane ○ Polyvinyl chloride (PVC) ○ Wax coated fabrics ○ Rubber / Neoprene ○ Uncoated Tyvek®	• Latex gloves • Water and/or dirt resistant leather gloves • Any special gloves required by a HASP • Tyvek® suits, clothing that contains Tyvek®, or coated Tyvek®

Food and Beverages

● Prohibited	■ Allowable
• No food should be consumed in the staging or sampling areas, including pre-packaged food or snacks. ■ If consuming food on-site becomes necessary, move to the staging area and remove PPE. After eating, wash hands thoroughly and put on new PPE.	• Brought and consumed only outside the vicinity of the sampling area: ○ Bottled water ○ Hydration drinks (i.e. Gatorade®, Powerade®)

Personal Care Products (PCPs) - for day of sample collection[6]

● Prohibited	■ Allowable	▲Needs Screening[2]
• Any PCPs[6], sunscreen, and insect repellent applied in the sampling area.	PCPs[6], sunscreens, and insect repellents applied in the staging area, away from sampling bottles and equipment followed by thoroughly washing hands: **PCPs[6]:** • Cosmetics, deodorants/antiperspirants, moisturizers, hand creams, and other PCPs[6] **Sunscreens:** • 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 50 • Meijer® Sunscreen Continuous Spray Broad Spectrum SPF 30 • Meijer® Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50 • Meijer® Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Lotion SPF 70 • Neutrogena® Beach Defense Water+Sun Barrier Spray Broad Spectrum SPF 30 • Neutrogena® Pure & Free Baby Sunscreen Broad Spectrum SPF 60+ • Neutrogena® UltraSheer Dry-Touch Sunscreen Broad Spectrum SPF 30 **Insect Repellents:** • OFF® Deep Woods • Sawyer® Permethrin	• Products other than those listed as ■Allowable

[1] This table is not considered to be a complete listing of prohibited or allowable materials. All materials should be evaluated prior to use during sampling. The manufacturers of various products should be contacted in order to determine if PFAS was used in the production of any particular product.

[2] Equipment blank samples should be taken to verify these products are PFAS-free prior to use during sampling.

[3] **For surface water foam samples:** LDPE storage bags may be used in the sampling of foam on surface waters. In this instance, it is allowable for the LDPE bag to come into direct contact with the sample media.

[4] **For fish and other wildlife samples:** Depending on the project objectives, glass jars and aluminum foil might be used for PFAS sampling. PFAS has been found to bind to glass and if the sample is stored in a glass jar, a rinse of the jar is required during the sample analysis. PFAS are sometimes used as a protective layer for some aluminum foils. An equipment blank sample should be collected prior to any aluminum foil use.

[5] Regular ice is recommended as there are concerns that chemical and blue ice may not cool and maintain the sample at or below 42.8°F (6°C) (as determined by EPA 40 CFR 136 – NPDES) during collection and through transit to the laboratory.

[6] Based on evidence, avoidance of PCPs is considered to be precautionary because none have been documented as having cross-contaminated samples due to their use. However, if used, application of PCPs must be done at the staging area and away from sampling bottles and equipment, and hands must be thoroughly washed after the use of any PCPs prior to sampling.

●- Prohibited ■- Allowable ▲- Needs Screening

Appendix B

Field 1 11.8a @ 1.69/a Sept 1983 Field 2 9.5a @ 2.51T/a Sept 1983

PHOTO NO. N-5
TWP LETTER K
SECTION NO. 19
NO. OF TRACTS 7
COUNTY ST CLAIR

Fort Gratiot

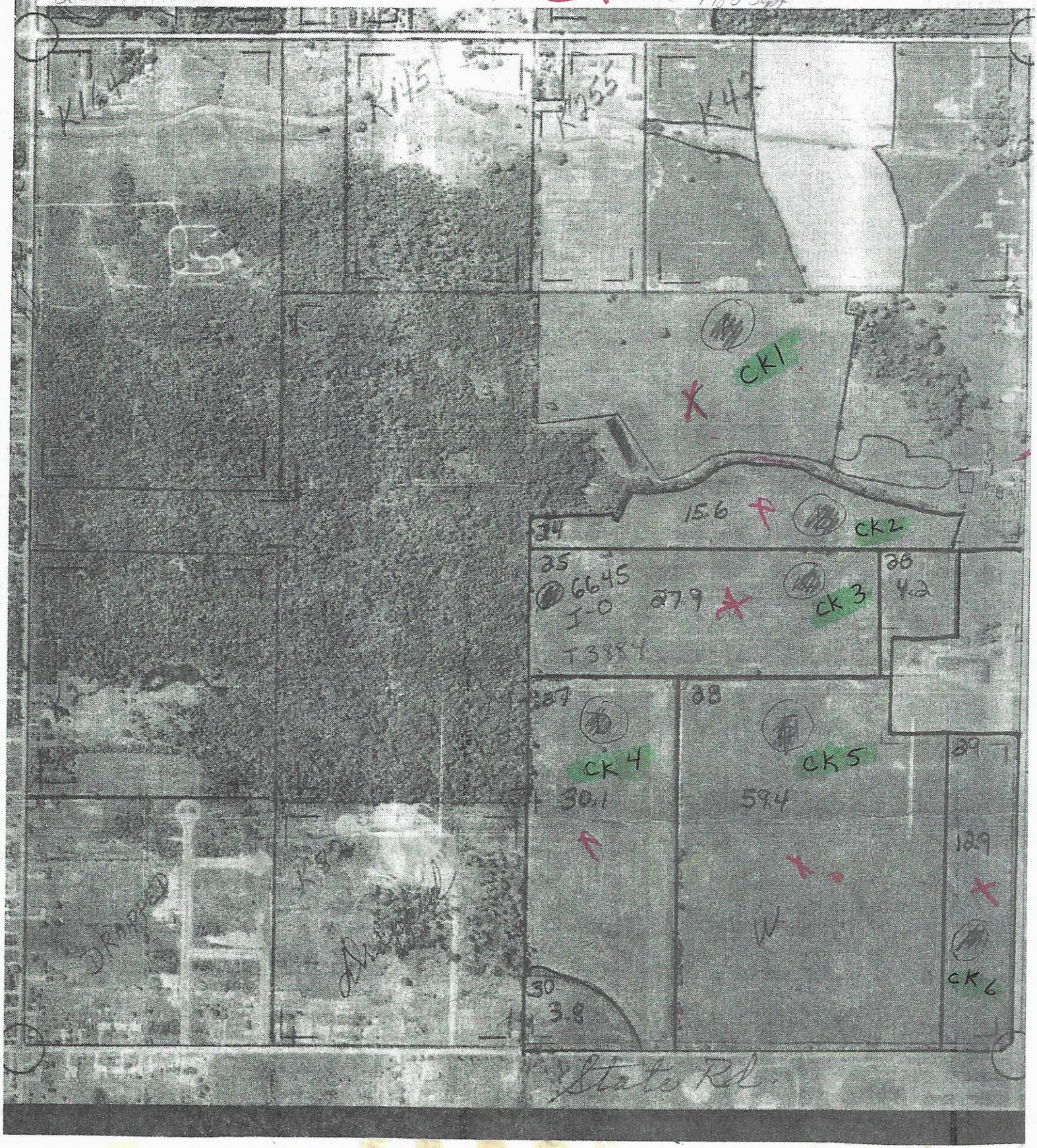
NOT TO SCALE

Wurzwell

CK

Field 1A 4a @ 263/a Sept 1983
Field 2A 4a @ 2.5/a 1983 Sept

Std N

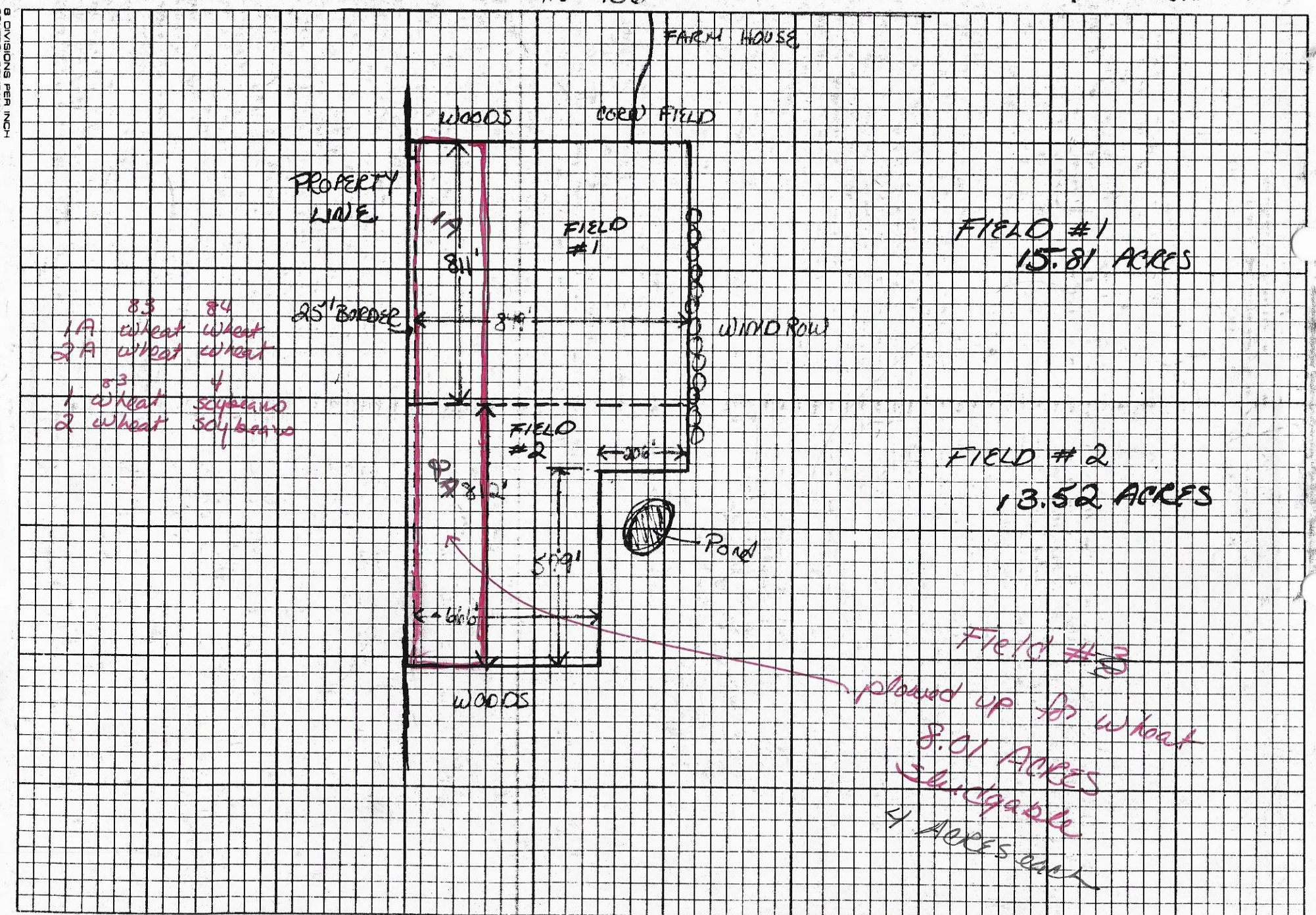


Appendix C

SIO MCINTYRE - FARMER
CHRIS & KURZWEIL - OWNER
SECTION #19 FORT GRATIOT

NT ↑

RTE 136



FIELD #1
15.81 ACRES

FIELD #2
13.52 ACRES

	83	84
1A	wheat	wheat
2A	wheat	wheat

	83	4
1	wheat	soybeans
2	wheat	soybeans

Field #3

8 DIVISIONS PER INCH
CONTROL COMPANY

Appendix D

Fort Gratiot Agricultural Field USDA Web Soil Survey – Soil Description

LoA – Londo loam (0-3% slopes), *Landform*: Water-lain moraines, glacial drainage channels, moraines, *Parent material*: loamy till

Pc – Parkhill loam (0-1% slopes), *Landform*: Drainageways, moraines, till-floored lake plains, wave-worked till plains, *Parent material*: loamy lodgment till

WdA – Wainola-Deford fine sands (0-2% slopes), *Landforms*: knolls on deltas, outwash plains, beaches, *Parent material*: sandy glaciolacustrine deposits

Appendix E

January 16, 2020

Vista Work Order No. 1904441

Ms. Maya Murshak
Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Dear Ms. Murshak,

Enclosed are the results for the sample set received at Vista Analytical Laboratory on December 27, 2019 under your Project Name 'Biosolids / Fort Gratiot'.

Vista Analytical Laboratory is committed to serving you effectively. If you require additional information, please contact me at 916-673-1520 or by email at mmaier@vista-analytical.com.

Thank you for choosing Vista as part of your analytical support team.

Sincerely,

Martha Maier
Laboratory Director

Vista Work Order No. 1904441
Case Narrative

Sample Condition on Receipt:

Ten soil samples and eight aqueous samples were received in good condition and within the method temperature requirements. The samples were received and stored securely in accordance with Vista standard operating procedures and EPA methodology. A sample ID discrepancy was noted upon sample receipt. The sample listed as "SW041912181314ML" on the sample container label has been reported as "SW041912181318ML", as it was listed on the CoC.

Analytical Notes:

PFAS Isotope Dilution Method

The aqueous samples were extracted and analyzed for a selected list of PFAS using Vista's PFAS Isotope Dilution Method. The results for PFHxS, PFOA, PFOS, MeFOSAA, and EtFOSAA include both linear and branched isomers. Results for all other analytes include the linear isomers only.

Samples "SW041912181318ML" and "SW071912181217ML" contained particulate and were centrifuged prior to extraction.

Holding Times

The samples were extracted and analyzed within the method hold times.

Quality Control

The Initial Calibration and Continuing Calibration Verifications met the method acceptance criteria.

A Method Blank and Ongoing Precision and Recovery (OPR) sample were extracted and analyzed with the preparation batch. No analytes were detected in the Method Blank above 1/2 the LOQ concentrations. The OPR recoveries were within the method acceptance criteria.

The labeled standard recoveries for all QC and field samples were within the acceptance criteria.

PFAS Isotope Dilution Method

The solid samples were extracted and analyzed for a selected list of PFAS using Vista's PFAS Isotope Dilution Method. The results for PFHxS, PFOA, PFOS, MeFOSAA, and EtFOSAA include both linear and branched isomers. Results for all other analytes include the linear isomers only.

Holding Times

The samples were extracted and analyzed within the hold times.

Quality Control

The Initial Calibration and Continuing Calibration Verifications met the method acceptance criteria.

A Method Blank and Ongoing Precision and Recovery (OPR) sample were extracted and analyzed with the preparation batch. No analytes were detected in the Method Blank above 1/2 the LOQ concentrations. The OPR recoveries were within the method acceptance criteria.

The labeled standard recoveries outside the acceptance criteria are flagged with an "H" qualifier.

TABLE OF CONTENTS

Sample Inventory Report

Vista Sample ID	Client Sample ID	Sampled	Received	Components/Containers
1904441-01	SXDU0102141912181700LM	18-Dec-19 17:00	27-Dec-19 09:18	Plastic Bag
1904441-02	SXDU0202141912181100LM	18-Dec-19 11:00	27-Dec-19 09:18	Plastic Bag
1904441-03	SXDU0202141912181105LM	18-Dec-19 11:05	27-Dec-19 09:18	Plastic Bag
1904441-04	SXDU0202141912181110LM	18-Dec-19 11:10	27-Dec-19 09:18	Plastic Bag
1904441-05	SXDU0302141912181300LM	18-Dec-19 13:00	27-Dec-19 09:18	HDPE Jar, 6 oz
1904441-06	SXDU0402141912181330LM	18-Dec-19 13:30	27-Dec-19 09:18	HDPE Jar, 6 oz
1904441-07	SX04161912181400LM	18-Dec-19 14:00	27-Dec-19 09:18	HDPE Jar, 6 oz
1904441-08	SX04161912181405LM	18-Dec-19 14:05	27-Dec-19 09:18	HDPE Jar, 6 oz
1904441-09	SX04161912181410LM	18-Dec-19 14:10	27-Dec-19 09:18	HDPE Jar, 6 oz
1904441-10	SX04161912181410LM-FD	18-Dec-19 14:10	27-Dec-19 09:18	HDPE Jar, 6 oz
1904441-11	SW011912181325ML	18-Dec-19 13:25	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL
1904441-12	SW021912181332ML	18-Dec-19 13:32	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL
1904441-13	SW031912181310ML	18-Dec-19 13:10	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL
1904441-14	SW041912181318ML	18-Dec-19 13:14	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL
1904441-15	SW071912181217ML	18-Dec-19 12:17	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL
1904441-16	SW051912181245ML	18-Dec-19 12:45	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL
1904441-17	SW051912181245ML-FD	18-Dec-19 12:45	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL
1904441-18	SW061912181140ML	18-Dec-19 11:40	27-Dec-19 09:18	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL

ANALYTICAL RESULTS

Sample ID: Method Blank **PFAS Isotope Dilution Method**

Client Data
Name: Merit Laboratories, Inc. Matrix: Solid
Project: Biosolids / Fort Gratiot

Laboratory Data
Lab Sample: B9L0298-BLK1 Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFPeA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFBS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-4:2 FTS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFHxA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFPeS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
HFPO-DA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFHpA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
ADONA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFHxS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Br-PFHxS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Total PFHxS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-6:2 FTS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFOA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Br-PFOA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Total PFOA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFHpS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFNA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFOSA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFOS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Br-PFOS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Total PFOS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
9Cl-PF3ONS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFDA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-8:2FTS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFNS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-MeFOSAA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Br-MeFOSAA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Total MeFOSAA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-EtFOSAA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Br-EtFOSAA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
Total EtFOSAA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFUnA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFDS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1

Sample ID: Method Blank

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Solid

Laboratory Data

Lab Sample: B9L0298-BLK1
Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
11Cl-PF3OUdS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFDoA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFTrDA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
L-PFTeDA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	98.0	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C3-PFPeA	IS	98.7	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C3-PFBS	IS	103	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-4:2 FTS	IS	93.3	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-PFHxA	IS	92.6	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C4-PFHpA	IS	101	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C3-PFHxS	IS	98.1	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-6:2 FTS	IS	96.3	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-PFOA	IS	95.9	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C5-PFNA	IS	103	50 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C8-PFOSA	IS	48.0	20 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C8-PFOS	IS	88.5	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-PFDA	IS	85.2	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-8:2 FTS	IS	88.2	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
d3-MeFOSAA	IS	67.9	50 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
d5-EtFOSAA	IS	67.5	50 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-PFUnA	IS	76.6	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-PFDoA	IS	63.2	30 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C2-PFTeDA	IS	65.4	20 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1
13C3-HFPO-DA	IS	103	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:46	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: OPR **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Solid

Laboratory Data

Lab Sample: B9L0298-BS1
Column: BEH C18

Analyte	Amt Found (ng/g)	Spike Amt	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	5.26	5.00	105	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFPeA	5.17	5.00	103	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFBS	5.54	5.00	111	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-4:2 FTS	5.18	5.00	104	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFHxA	5.30	5.00	106	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFPeS	4.89	5.00	97.8	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
HFPO-DA	5.52	5.00	110	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFHpA	4.79	5.00	95.8	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
ADONA	4.63	5.00	92.5	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
Total PFHxS	5.39	5.00	108	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-6:2 FTS	5.42	5.00	108	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
Total PFOA	4.95	5.00	99.0	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFHpS	5.64	5.00	113	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFNA	5.21	5.00	104	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFOSA	4.87	5.00	97.4	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
Total PFOS	5.08	5.01	101	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
9Cl-PF3ONS	4.95	5.00	98.9	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFDA	4.74	5.00	94.7	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-8:2FTS	4.84	5.00	96.8	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFNS	4.78	5.00	95.5	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
Total MeFOSAA	5.10	5.00	102	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
Total EtFOSAA	5.44	5.00	109	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFUnA	4.43	5.00	88.7	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFDS	3.99	5.01	79.7	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
11Cl-PF3OUdS	6.06	5.00	121	70 - 130	Q	B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFDoA	5.59	5.00	112	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFTrDA	5.18	5.00	104	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
L-PFTeDA	5.05	5.00	101	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	101	60- 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C3-PFPeA	IS	105	60- 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C3-PFBS	IS	99.4	60- 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-4:2 FTS	IS	91.1	40- 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-PFHxA	IS	103	70- 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C4-PFHpA	IS	108	60- 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1

Sample ID: OPR **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Solid

Laboratory Data

Lab Sample: B9L0298-BS1
Column: BEH C18

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFHxS	IS	100	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-6:2 FTS	IS	101	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-PFOA	IS	98.9	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C5-PFNA	IS	90.0	50 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C8-PFOSA	IS	61.3	20 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C8-PFOS	IS	97.3	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-PFDA	IS	92.3	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-8:2 FTS	IS	87.0	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
d3-MeFOSAA	IS	71.3	50 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
d5-EtFOSAA	IS	74.9	50 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-PFUnA	IS	76.9	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-PFDoA	IS	63.0	30 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C2-PFTeDA	IS	49.1	20 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1
13C3-HFPO-DA	IS	107	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 22:57	1

Sample ID: SXDU0102141912181700LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Soil
Date Collected: 18-Dec-19 17:00

Laboratory Data

Lab Sample: 1904441-01
Date Received: 27-Dec-19 09:18
% Solids: 97.8
Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFPeA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFBS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-4:2 FTS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFHxA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFPeS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
HFPO-DA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFHpA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
ADONA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFHxS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Br-PFHxS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Total PFHxS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-6:2 FTS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFOA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Br-PFOA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Total PFOA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFHpS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFNA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFOSA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFOS	0.472	0.432	0.511	1.02	J	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Br-PFOS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Total PFOS	0.544	0.432	0.511	1.02	J	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
9Cl-PF3ONS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFDA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-8:2FTS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFNS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-MeFOSAA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Br-MeFOSAA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Total MeFOSAA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-EtFOSAA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Br-EtFOSAA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
Total EtFOSAA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1

Sample ID: SXDU0102141912181700LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Soil
Date Collected: 18-Dec-19 17:00

Laboratory Data

Lab Sample: 1904441-01
Date Received: 27-Dec-19 09:18
% Solids: 97.8

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFDS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
11Cl-PF3OUdS	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFDoA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFTrDA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
L-PFTeDA	ND	0.432	0.511	1.02		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	98.5	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C3-PFPeA	IS	121	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C3-PFBS	IS	114	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-4:2 FTS	IS	116	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-PFHxA	IS	96.4	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C4-PFHpA	IS	125	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C3-PFHxS	IS	103	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-6:2 FTS	IS	101	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-PFOA	IS	90.9	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C5-PFNA	IS	86.9	50 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C8-PFOSA	IS	54.3	20 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C8-PFOS	IS	83.6	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-PFDA	IS	86.0	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-8:2 FTS	IS	80.1	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
d3-MeFOSAA	IS	76.5	50 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
d5-EtFOSAA	IS	79.6	50 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-PFUnA	IS	86.6	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-PFDoA	IS	71.0	30 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C2-PFTeDA	IS	36.0	20 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1
13C3-HFPO-DA	IS	139	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:07	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SXDU0202141912181100LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Soil
Date Collected: 18-Dec-19 11:00

Laboratory Data

Lab Sample: 1904441-02
Date Received: 27-Dec-19 09:18
% Solids: 98.6
Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFPeA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFBS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-4:2 FTS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFHxA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFPeS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
HFPO-DA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFHpA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
ADONA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFHxS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Br-PFHxS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Total PFHxS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-6:2 FTS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFOA	2.11	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Br-PFOA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Total PFOA	2.24	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFHpS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFNA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFOSA	7.27	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFOS	80.8	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Br-PFOS	17.6	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Total PFOS	98.4	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
9Cl-PF3ONS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFDA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-8:2FTS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFNS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-MeFOSAA	0.753	0.429	0.507	1.01	J, Q	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Br-MeFOSAA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Total MeFOSAA	0.753	0.429	0.507	1.01	J	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-EtFOSAA	7.63	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Br-EtFOSAA	3.96	0.429	0.507	1.01	Q	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
Total EtFOSAA	11.6	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1

Sample ID: SXDU0202141912181100LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Soil
Date Collected: 18-Dec-19 11:00

Laboratory Data

Lab Sample: 1904441-02
Date Received: 27-Dec-19 09:18
% Solids: 98.6

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFDS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
11Cl-PF3OUdS	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFDoA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFTrDA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
L-PFTeDA	ND	0.429	0.507	1.01		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	97.2	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C3-PFPeA	IS	127	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C3-PFBS	IS	90.9	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-4:2 FTS	IS	108	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-PFHxA	IS	85.6	70 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C4-PFHpA	IS	127	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C3-PFHxS	IS	91.8	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-6:2 FTS	IS	126	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-PFOA	IS	86.9	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C5-PFNA	IS	87.4	50 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C8-PFOSA	IS	53.8	20 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C8-PFOS	IS	95.0	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-PFDA	IS	74.5	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-8:2 FTS	IS	114	40 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
d3-MeFOSAA	IS	49.1	50 - 150	H	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
d5-EtFOSAA	IS	41.4	50 - 150	H	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-PFUnA	IS	62.1	60 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-PFDoA	IS	41.0	30 - 130		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C2-PFTeDA	IS	17.6	20 - 150	H	B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1
13C3-HFPO-DA	IS	131	60 - 150		B9L0298	02-Jan-20	2.00 g	09-Jan-20 23:18	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SXDU0202141912181105LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Soil
Date Collected: 18-Dec-19 11:05

Laboratory Data

Lab Sample: 1904441-03
Date Received: 27-Dec-19 09:18
% Solids: 98.0
Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFPeA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFBS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-4:2 FTS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFHxA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFPeS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
HFPO-DA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFHpA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
ADONA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFHxS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Br-PFHxS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Total PFHxS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-6:2 FTS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFOA	2.21	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Br-PFOA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Total PFOA	2.33	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFHpS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFNA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFOSA	5.77	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFOS	88.5	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Br-PFOS	19.5	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Total PFOS	108	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
9Cl-PF3ONS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFDA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-8:2FTS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFNS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-MeFOSAA	0.591	0.427	0.505	1.01	J, Q	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Br-MeFOSAA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Total MeFOSAA	0.591	0.427	0.505	1.01	J	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-EtFOSAA	5.77	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Br-EtFOSAA	2.63	0.427	0.505	1.01	Q	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
Total EtFOSAA	8.39	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1

Sample ID: SXDU0202141912181105LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Soil
Date Collected: 18-Dec-19 11:05

Laboratory Data

Lab Sample: 1904441-03
Date Received: 27-Dec-19 09:18
% Solids: 98.0

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFDS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
11Cl-PF3OUdS	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFDoA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFTrDA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
L-PFTeDA	ND	0.427	0.505	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	101	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C3-PFPeA	IS	137	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C3-PFBS	IS	108	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-4:2 FTS	IS	123	40 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-PFHxA	IS	103	70 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C4-PFHpA	IS	142	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C3-PFHxS	IS	104	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-6:2 FTS	IS	125	40 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-PFOA	IS	95.7	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C5-PFNA	IS	94.9	50 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C8-PFOSA	IS	56.9	20 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C8-PFOS	IS	94.9	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-PFDA	IS	74.2	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-8:2 FTS	IS	103	40 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
d3-MeFOSAA	IS	47.7	50 - 150	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
d5-EtFOSAA	IS	44.7	50 - 150	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-PFUnA	IS	59.9	60 - 130	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-PFDoA	IS	35.5	30 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C2-PFTeDA	IS	18.7	20 - 150	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1
13C3-HFPO-DA	IS	132	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:28	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SXDU0202141912181110LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Soil
Date Collected: 18-Dec-19 11:10

Laboratory Data

Lab Sample: 1904441-04
Date Received: 27-Dec-19 09:18
% Solids: 98.2
Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFPeA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFBS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-4:2 FTS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFHxA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFPeS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
HFPO-DA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFHpA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
ADONA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFHxS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Br-PFHxS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Total PFHxS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-6:2 FTS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFOA	2.86	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Br-PFOA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Total PFOA	3.00	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFHpS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFNA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFOSA	7.33	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFOS	107	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Br-PFOS	27.1	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Total PFOS	134	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
9Cl-PF3ONS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFDA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-8:2FTS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFNS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-MeFOSAA	0.732	0.426	0.504	1.01	J, Q	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Br-MeFOSAA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Total MeFOSAA	0.732	0.426	0.504	1.01	J	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-EtFOSAA	6.77	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Br-EtFOSAA	4.23	0.426	0.504	1.01	Q	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
Total EtFOSAA	11.0	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1

Sample ID: SXDU0202141912181110LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Soil
Date Collected: 18-Dec-19 11:10

Laboratory Data

Lab Sample: 1904441-04
Date Received: 27-Dec-19 09:18
% Solids: 98.2

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFDS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
11Cl-PF3OUdS	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFDoA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFTrDA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
L-PFTeDA	ND	0.426	0.504	1.01		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	96.1	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C3-PFPeA	IS	129	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C3-PFBS	IS	93.6	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-4:2 FTS	IS	105	40 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-PFHxA	IS	93.4	70 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C4-PFHpA	IS	131	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C3-PFHxS	IS	85.0	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-6:2 FTS	IS	123	40 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-PFOA	IS	83.9	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C5-PFNA	IS	84.1	50 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C8-PFOSA	IS	55.8	20 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C8-PFOS	IS	88.4	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-PFDA	IS	70.0	60 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-8:2 FTS	IS	99.8	40 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
d3-MeFOSAA	IS	39.9	50 - 150	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
d5-EtFOSAA	IS	35.2	50 - 150	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-PFUnA	IS	55.4	60 - 130	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-PFDoA	IS	30.6	30 - 130		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C2-PFTeDA	IS	10.9	20 - 150	H	B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1
13C3-HFPO-DA	IS	146	60 - 150		B9L0298	02-Jan-20	2.02 g	09-Jan-20 23:59	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SXDU0302141912181300LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Soil
Date Collected: 18-Dec-19 13:00

Laboratory Data

Lab Sample: 1904441-05
Date Received: 27-Dec-19 09:18
% Solids: 85.1

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFPeA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFBS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-4:2 FTS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFHxA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFPeS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
HFPO-DA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFHpA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
ADONA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFHxS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Br-PFHxS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Total PFHxS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-6:2 FTS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFOA	0.789	0.423	0.500	1.00	J	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Br-PFOA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Total PFOA	0.831	0.423	0.500	1.00	J	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFHpS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFNA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFOSA	3.36	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFOS	94.8	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Br-PFOS	17.4	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Total PFOS	112	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
9Cl-PF3ONS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFDA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-8:2FTS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFNS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-MeFOSAA	0.494	0.423	0.500	1.00	J	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Br-MeFOSAA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Total MeFOSAA	0.494	0.423	0.500	1.00	J	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-EtFOSAA	4.62	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Br-EtFOSAA	2.60	0.423	0.500	1.00	Q	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
Total EtFOSAA	7.22	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1

Sample ID: SXDU0302141912181300LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Soil
Date Collected: 18-Dec-19 13:00

Laboratory Data

Lab Sample: 1904441-05
Date Received: 27-Dec-19 09:18
% Solids: 85.1

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFDS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
11Cl-PF3OUdS	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFDoA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFTrDA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
L-PFTeDA	ND	0.423	0.500	1.00		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	99.6	60 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C3-PFPeA	IS	142	60 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C3-PFBS	IS	95.1	60 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-4:2 FTS	IS	118	40 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-PFHxA	IS	99.6	70 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C4-PFHpA	IS	132	60 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C3-PFHxS	IS	102	60 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-6:2 FTS	IS	131	40 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-PFOA	IS	96.9	60 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C5-PFNA	IS	90.2	50 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C8-PFOSA	IS	51.1	20 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C8-PFOS	IS	90.6	60 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-PFDA	IS	84.5	60 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-8:2 FTS	IS	108	40 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
d3-MeFOSAA	IS	48.6	50 - 150	H	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
d5-EtFOSAA	IS	45.9	50 - 150	H	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-PFUnA	IS	69.3	60 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-PFDoA	IS	46.6	30 - 130		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C2-PFTeDA	IS	19.6	20 - 150	H	B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1
13C3-HFPO-DA	IS	130	60 - 150		B9L0298	02-Jan-20	2.35 g	10-Jan-20 00:10	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SXDU0402141912181330LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Soil
Date Collected: 18-Dec-19 13:30

Laboratory Data

Lab Sample: 1904441-06
Date Received: 27-Dec-19 09:18
% Solids: 86.9
Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFPeA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFBS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-4:2 FTS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFHxA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFPeS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
HFPO-DA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFHpA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
ADONA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFHxS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Br-PFHxS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Total PFHxS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-6:2 FTS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFOA	2.21	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Br-PFOA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Total PFOA	2.40	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFHpS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFNA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFOSA	13.5	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFOS	124	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Br-PFOS	26.5	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Total PFOS	150	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
9Cl-PF3ONS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFDA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-8:2FTS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFNS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-MeFOSAA	1.63	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Br-MeFOSAA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Total MeFOSAA	1.63	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-EtFOSAA	12.4	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Br-EtFOSAA	11.2	0.421	0.498	0.996	Q	B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
Total EtFOSAA	23.6	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1

Sample ID: SXDU0402141912181330LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Soil
Date Collected: 18-Dec-19 13:30

Laboratory Data

Lab Sample: 1904441-06
Date Received: 27-Dec-19 09:18
% Solids: 86.9

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFDS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
11Cl-PF3OUdS	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFDoA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFTrDA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
L-PFTeDA	ND	0.421	0.498	0.996		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	101	60 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C3-PFPeA	IS	126	60 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C3-PFBS	IS	92.9	60 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-4:2 FTS	IS	103	40 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-PFHxA	IS	87.1	70 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C4-PFHpA	IS	124	60 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C3-PFHxS	IS	86.9	60 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-6:2 FTS	IS	123	40 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-PFOA	IS	90.6	60 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C5-PFNA	IS	88.3	50 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C8-PFOSA	IS	46.2	20 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C8-PFOS	IS	98.5	60 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-PFDA	IS	77.0	60 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-8:2 FTS	IS	111	40 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
d3-MeFOSAA	IS	58.3	50 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
d5-EtFOSAA	IS	56.9	50 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-PFUnA	IS	74.0	60 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-PFDoA	IS	53.9	30 - 130		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C2-PFTeDA	IS	42.9	20 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1
13C3-HFPO-DA	IS	135	60 - 150		B9L0298	02-Jan-20	2.31 g	10-Jan-20 00:20	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SX041619121814OOLM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:00

Laboratory Data

Lab Sample: 1904441-07
Date Received: 27-Dec-19 09:18
% Solids: 85.8

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFPeA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFBS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-4:2 FTS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFHxA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFPeS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
HFPO-DA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFHpA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
ADONA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFHxS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Br-PFHxS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Total PFHxS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-6:2 FTS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFOA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Br-PFOA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Total PFOA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFHpS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFNA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFOSA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFOS	1.07	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Br-PFOS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Total PFOS	1.13	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
9Cl-PF3ONS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFDA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-8:2FTS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFNS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-MeFOSAA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Br-MeFOSAA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Total MeFOSAA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-EtFOSAA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Br-EtFOSAA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
Total EtFOSAA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1

Sample ID: SX04161912181400LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:00

Laboratory Data

Lab Sample: 1904441-07
Date Received: 27-Dec-19 09:18
% Solids: 85.8

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFDS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
11Cl-PF3OUdS	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFDoA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFTrDA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
L-PFTeDA	ND	0.421	0.498	0.997		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	103	60 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C3-PFPeA	IS	104	60 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C3-PFBS	IS	98.7	60 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-4:2 FTS	IS	112	40 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-PFHxA	IS	101	70 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C4-PFHpA	IS	110	60 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C3-PFHxS	IS	94.7	60 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-6:2 FTS	IS	118	40 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-PFOA	IS	104	60 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C5-PFNA	IS	99.9	50 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C8-PFOSA	IS	60.9	20 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C8-PFOS	IS	94.2	60 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-PFDA	IS	91.4	60 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-8:2 FTS	IS	110	40 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
d3-MeFOSAA	IS	77.7	50 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
d5-EtFOSAA	IS	85.4	50 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-PFUnA	IS	85.3	60 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-PFDoA	IS	80.7	30 - 130		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C2-PFTeDA	IS	81.7	20 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1
13C3-HFPO-DA	IS	103	60 - 150		B9L0298	02-Jan-20	2.34 g	10-Jan-20 00:30	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SX04161912181405LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:05

Laboratory Data

Lab Sample: 1904441-08
Date Received: 27-Dec-19 09:18
% Solids: 87.9

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFPeA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFBS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-4:2 FTS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFHxA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFPeS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
HFPO-DA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFHpA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
ADONA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFHxS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Br-PFHxS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Total PFHxS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-6:2 FTS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFOA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Br-PFOA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Total PFOA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFHpS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFNA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFOSA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFOS	1.01	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Br-PFOS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Total PFOS	1.01	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
9Cl-PF3ONS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFDA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-8:2FTS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFNS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-MeFOSAA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Br-MeFOSAA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Total MeFOSAA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-EtFOSAA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Br-EtFOSAA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
Total EtFOSAA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1

Sample ID: SX04161912181405LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:05

Laboratory Data

Lab Sample: 1904441-08
Date Received: 27-Dec-19 09:18
% Solids: 87.9

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFDS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
11Cl-PF3OUdS	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFDoA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFTrDA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
L-PFTeDA	ND	0.420	0.497	0.993		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	101	60 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C3-PFPeA	IS	104	60 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C3-PFBS	IS	100	60 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-4:2 FTS	IS	113	40 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-PFHxA	IS	90.5	70 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C4-PFHpA	IS	102	60 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C3-PFHxS	IS	95.6	60 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-6:2 FTS	IS	104	40 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-PFOA	IS	95.7	60 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C5-PFNA	IS	94.9	50 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C8-PFOSA	IS	66.3	20 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C8-PFOS	IS	86.8	60 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-PFDA	IS	89.1	60 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-8:2 FTS	IS	102	40 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
d3-MeFOSAA	IS	80.1	50 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
d5-EtFOSAA	IS	79.3	50 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-PFUnA	IS	83.1	60 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-PFDoA	IS	74.7	30 - 130		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C2-PFTeDA	IS	79.3	20 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1
13C3-HFPO-DA	IS	110	60 - 150		B9L0298	02-Jan-20	2.29 g	10-Jan-20 00:41	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SX041619121814 10LM **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:10

Laboratory Data

Lab Sample: 1904441-09
Date Received: 27-Dec-19 09:18
% Solids: 89.7

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFPeA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFBS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-4:2 FTS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFHxA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFPeS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
HFPO-DA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFHpA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
ADONA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFHxS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Br-PFHxS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Total PFHxS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-6:2 FTS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFOA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Br-PFOA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Total PFOA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFHpS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFNA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFOSA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFOS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Br-PFOS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Total PFOS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
9Cl-PF3ONS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFDA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-8:2FTS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFNS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-MeFOSAA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Br-MeFOSAA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Total MeFOSAA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-EtFOSAA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Br-EtFOSAA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
Total EtFOSAA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1

Sample ID: SX04161912181410LM

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:10

Laboratory Data

Lab Sample: 1904441-09
Date Received: 27-Dec-19 09:18
% Solids: 89.7

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFDS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
11Cl-PF3OUdS	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFDoA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFTrDA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
L-PFTeDA	ND	0.422	0.500	1.00		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	95.7	60 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C3-PFPeA	IS	104	60 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C3-PFBS	IS	88.8	60 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-4:2 FTS	IS	99.6	40 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-PFHxA	IS	96.0	70 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C4-PFHpA	IS	102	60 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C3-PFHxS	IS	83.9	60 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-6:2 FTS	IS	96.4	40 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-PFOA	IS	96.0	60 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C5-PFNA	IS	90.2	50 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C8-PFOSA	IS	58.6	20 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C8-PFOS	IS	95.0	60 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-PFDA	IS	83.6	60 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-8:2 FTS	IS	97.1	40 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
d3-MeFOSAA	IS	76.1	50 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
d5-EtFOSAA	IS	87.3	50 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-PFUnA	IS	82.7	60 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-PFDoA	IS	72.2	30 - 130		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C2-PFTeDA	IS	61.2	20 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1
13C3-HFPO-DA	IS	111	60 - 150		B9L0298	02-Jan-20	2.23 g	10-Jan-20 00:51	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: SX041619121814 10LM-FD

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:10

Laboratory Data

Lab Sample: 1904441-10
Date Received: 27-Dec-19 09:18
% Solids: 88.3

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFPeA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFBS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-4:2 FTS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFHxA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFPeS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
HFPO-DA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFHpA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
ADONA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFHxS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Br-PFHxS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Total PFHxS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-6:2 FTS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFOA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Br-PFOA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Total PFOA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFHpS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFNA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFOSA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFOS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Br-PFOS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Total PFOS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
9Cl-PF3ONS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFDA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-8:2FTS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFNS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-MeFOSAA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Br-MeFOSAA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Total MeFOSAA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-EtFOSAA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Br-EtFOSAA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
Total EtFOSAA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1

Sample ID: SX041619121814 10LM-FD

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1700-01

Matrix: Soil
Date Collected: 18-Dec-19 14:10

Laboratory Data

Lab Sample: 1904441-10
Date Received: 27-Dec-19 09:18
% Solids: 88.3

Column: BEH C18

Analyte	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFDS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
11Cl-PF3OUdS	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFDoA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFTrDA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
L-PFTeDA	ND	0.420	0.497	0.994		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	102	60 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C3-PFPeA	IS	97.4	60 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C3-PFBS	IS	102	60 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-4:2 FTS	IS	106	40 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-PFHxA	IS	94.5	70 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C4-PFHpA	IS	100	60 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C3-PFHxS	IS	95.2	60 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-6:2 FTS	IS	90.6	40 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-PFOA	IS	95.4	60 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C5-PFNA	IS	89.7	50 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C8-PFOSA	IS	58.7	20 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C8-PFOS	IS	89.0	60 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-PFDA	IS	89.4	60 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-8:2 FTS	IS	84.7	40 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
d3-MeFOSAA	IS	77.2	50 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
d5-EtFOSAA	IS	81.0	50 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-PFUnA	IS	84.1	60 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-PFDoA	IS	81.7	30 - 130		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C2-PFTeDA	IS	77.8	20 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1
13C3-HFPO-DA	IS	107	60 - 150		B9L0298	02-Jan-20	2.28 g	10-Jan-20 01:01	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: Method Blank

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Aqueous

Laboratory Data

Lab Sample: B9L0277-BLK1
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFPeA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFBS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-4:2 FTS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFHxA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFPeS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
HFPO-DA	ND	2.41	3.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFHpA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
ADONA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFHxS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Br-PFHxS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Total PFHxS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-6:2 FTS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFOA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Br-PFOA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Total PFOA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFHpS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFNA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFOSA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFOS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Br-PFOS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Total PFOS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
9Cl-PF3ONS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFDA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-8:2FTS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFNS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-MeFOSAA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Br-MeFOSAA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Total MeFOSAA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-EtFOSAA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Br-EtFOSAA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
Total EtFOSAA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFUnA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFDS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1

Sample ID: Method Blank

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Aqueous

Laboratory Data

Lab Sample: B9L0277-BLK1
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
11Cl-PF3OUdS	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFDoA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFTrDA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
L-PFTeDA	ND	1.37	2.00	4.00		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	87.5	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C3-PFPeA	IS	94.6	60 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C3-PFBS	IS	90.9	60 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-4:2 FTS	IS	90.4	40 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-PFHxA	IS	87.3	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C4-PFHpA	IS	91.3	60 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C3-PFHxS	IS	86.6	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-6:2 FTS	IS	84.9	40 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-PFOA	IS	93.8	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C5-PFNA	IS	93.0	50 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C8-PFOSA	IS	59.6	20 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C8-PFOS	IS	77.9	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-PFDA	IS	81.5	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-8:2 FTS	IS	76.8	40 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
d3-MeFOSAA	IS	81.6	50 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
d5-EtFOSAA	IS	76.3	50 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-PFUnA	IS	77.8	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-PFDoA	IS	68.3	30 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C2-PFTeDA	IS	75.8	20 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1
13C3-HFPO-DA	IS	103	50 - 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:40	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: OPR **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Aqueous

Laboratory Data

Lab Sample: B9L0277-BS1 Column: BEH C18

Analyte	Amt Found (ng/L)	Spike Amt	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	44.6	40.0	112	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFPeA	43.2	40.0	108	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFBS	45.5	40.0	114	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-4:2 FTS	41.6	40.0	104	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFHxA	43.6	40.0	109	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFPeS	40.7	40.0	102	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
HFPO-DA	32.7	40.0	81.7	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFHpA	41.5	40.0	104	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
ADONA	37.7	40.0	94.3	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
Total PFHxS	43.0	40.0	107	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-6:2 FTS	44.5	40.0	111	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
Total PFOA	42.3	40.0	106	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFHpS	49.3	40.0	123	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFNA	40.7	40.0	102	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFOSA	46.7	40.0	117	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
Total PFOS	47.2	40.1	118	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
9Cl-PF3ONS	35.1	40.0	87.7	70 - 130	Q	B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFDA	38.7	40.0	96.7	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-8:2FTS	38.8	40.0	96.9	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFNS	38.9	40.0	97.2	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
Total MeFOSAA	40.5	40.0	101	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
Total EtFOSAA	44.0	40.0	110	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFUnA	35.2	40.0	87.9	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFDS	35.4	40.1	88.3	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
11Cl-PF3OUdS	43.8	40.0	110	70 - 130	Q	B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFDoA	45.1	40.0	113	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFTrDA	42.6	40.0	106	60 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
L-PFTeDA	47.6	40.0	119	70 - 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	88.8	60- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C3-PFPeA	IS	92.8	60- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C3-PFBS	IS	89.9	60- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-4:2 FTS	IS	95.3	40- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-PFHxA	IS	90.7	70- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C4-PFHpA	IS	95.7	60- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1

Sample ID: OPR **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Aqueous

Laboratory Data

Lab Sample: B9L0277-BS1
Column: BEH C18

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFHxS	IS	87.2	60- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-6:2 FTS	IS	81.6	40- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-PFOA	IS	93.5	60- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C5-PFNA	IS	87.8	50- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C8-PFOSA	IS	56.4	20- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C8-PFOS	IS	78.5	60- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-PFDA	IS	89.6	60- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-8:2 FTS	IS	75.2	40- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
d3-MeFOSAA	IS	75.3	50- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
d5-EtFOSAA	IS	69.0	50- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-PFUnA	IS	81.7	60- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-PFDoA	IS	72.3	30- 130		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C2-PFTeDA	IS	71.1	20- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1
13C3-HFPO-DA	IS	92.6	50- 150		B9L0277	31-Dec-19	0.250 L	09-Jan-20 19:50	1

Sample ID: SW011912181325ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 13:25

Laboratory Data

Lab Sample: 1904441-11
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	7.70	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFPeA	16.4	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFBS	1.51	1.39	2.02	4.04	J	B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-4:2 FTS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFHxA	11.6	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFPeS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
HFPO-DA	ND	2.44	3.04	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFHpA	7.62	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
ADONA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFHxS	1.67	1.39	2.02	4.04	J, Q	B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Br-PFHxS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Total PFHxS	1.67	1.39	2.02	4.04	J	B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-6:2 FTS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFOA	14.1	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Br-PFOA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Total PFOA	14.6	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFHpS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFNA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFOSA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFOS	10.7	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Br-PFOS	12.0	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Total PFOS	22.7	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
9Cl-PF3ONS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFDA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-8:2FTS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFNS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-MeFOSAA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Br-MeFOSAA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Total MeFOSAA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-EtFOSAA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Br-EtFOSAA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
Total EtFOSAA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1

Sample ID: SW011912181325ML

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Aqueous
Date Collected: 18-Dec-19 13:25

Laboratory Data

Lab Sample: 1904441-11
Date Received: 27-Dec-19 09:18

Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFDS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
11Cl-PF3OUdS	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFDoA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFTrDA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
L-PFTeDA	ND	1.39	2.02	4.04		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	63.1	60 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C3-PFPeA	IS	89.0	60 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C3-PFBS	IS	95.9	60 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-4:2 FTS	IS	103	40 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-PFHxA	IS	93.8	70 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C4-PFHpA	IS	94.6	60 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C3-PFHxS	IS	95.9	60 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-6:2 FTS	IS	85.2	40 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-PFOA	IS	89.1	60 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C5-PFNA	IS	98.7	50 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C8-PFOSA	IS	69.6	20 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C8-PFOS	IS	92.8	60 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-PFDA	IS	86.2	60 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-8:2 FTS	IS	82.0	40 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
d3-MeFOSAA	IS	84.7	50 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
d5-EtFOSAA	IS	95.3	50 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-PFUnA	IS	89.9	60 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-PFDoA	IS	70.2	30 - 130		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C2-PFTeDA	IS	57.5	20 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1
13C3-HFPO-DA	IS	106	50 - 150		B9L0277	31-Dec-19	0.247 L	09-Jan-20 21:03	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: SW021912181332ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Aqueous
Date Collected: 18-Dec-19 13:32

Laboratory Data

Lab Sample: 1904441-12
Date Received: 27-Dec-19 09:18

Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	4.60	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFPeA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFBS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-4:2 FTS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFHxA	3.91	1.42	2.07	4.14	J	B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFPeS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
HFPO-DA	ND	2.49	3.10	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFHpA	13.2	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
ADONA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFHxS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Br-PFHxS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Total PFHxS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-6:2 FTS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFOA	134	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Br-PFOA	29.6	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Total PFOA	164	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFHpS	11.3	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFNA	2.23	1.42	2.07	4.14	J	B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFOSA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFOS	444	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Br-PFOS	369	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Total PFOS	813	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
9Cl-PF3ONS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFDA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-8:2FTS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFNS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-MeFOSAA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Br-MeFOSAA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Total MeFOSAA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-EtFOSAA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Br-EtFOSAA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
Total EtFOSAA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1

Sample ID: SW021912181332ML

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Aqueous
Date Collected: 18-Dec-19 13:32

Laboratory Data

Lab Sample: 1904441-12
Date Received: 27-Dec-19 09:18

Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFDS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
11Cl-PF3OUdS	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFDoA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFTrDA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
L-PFTeDA	ND	1.42	2.07	4.14		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	74.8	60 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C3-PFPeA	IS	87.4	60 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C3-PFBS	IS	92.9	60 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-4:2 FTS	IS	102	40 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-PFHxA	IS	91.8	70 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C4-PFHpA	IS	90.7	60 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C3-PFHxS	IS	88.1	60 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-6:2 FTS	IS	98.4	40 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-PFOA	IS	92.3	60 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C5-PFNA	IS	99.0	50 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C8-PFOSA	IS	56.7	20 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C8-PFOS	IS	85.8	60 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-PFDA	IS	87.8	60 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-8:2 FTS	IS	90.5	40 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
d3-MeFOSAA	IS	79.6	50 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
d5-EtFOSAA	IS	80.5	50 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-PFUnA	IS	86.7	60 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-PFDoA	IS	78.5	30 - 130		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C2-PFTeDA	IS	62.6	20 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1
13C3-HFPO-DA	IS	99.3	50 - 150		B9L0277	31-Dec-19	0.242 L	09-Jan-20 21:34	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: SW031912181310ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 13:10

Laboratory Data

Lab Sample: 1904441-13
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	3.92	1.38	2.02	4.04	J	B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFPeA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFBS	2.00	1.38	2.02	4.04	J, Q	B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-4:2 FTS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFHxA	4.05	1.38	2.02	4.04	Q	B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFPeS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
HFPO-DA	ND	2.43	3.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFHpA	13.8	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
ADONA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFHxS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Br-PFHxS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Total PFHxS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-6:2 FTS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFOA	138	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Br-PFOA	28.5	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Total PFOA	167	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFHpS	10.2	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFNA	2.01	1.38	2.02	4.04	J	B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFOSA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFOS	399	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Br-PFOS	348	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Total PFOS	747	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
9Cl-PF3ONS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFDA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-8:2FTS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFNS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-MeFOSAA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Br-MeFOSAA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Total MeFOSAA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-EtFOSAA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Br-EtFOSAA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
Total EtFOSAA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1

Sample ID: SW031912181310ML

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Aqueous
Date Collected: 18-Dec-19 13:10

Laboratory Data

Lab Sample: 1904441-13
Date Received: 27-Dec-19 09:18

Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFDS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
11Cl-PF3OUdS	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFDoA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFTrDA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
L-PFTeDA	ND	1.38	2.02	4.04		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	89.6	60 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C3-PFPeA	IS	93.3	60 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C3-PFBS	IS	92.3	60 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-4:2 FTS	IS	93.4	40 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-PFHxA	IS	98.3	70 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C4-PFHpA	IS	102	60 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C3-PFHxS	IS	92.3	60 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-6:2 FTS	IS	95.8	40 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-PFOA	IS	93.7	60 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C5-PFNA	IS	97.1	50 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C8-PFOSA	IS	53.8	20 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C8-PFOS	IS	89.3	60 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-PFDA	IS	82.5	60 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-8:2 FTS	IS	101	40 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
d3-MeFOSAA	IS	80.7	50 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
d5-EtFOSAA	IS	80.6	50 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-PFUnA	IS	85.6	60 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-PFDoA	IS	67.9	30 - 130		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C2-PFTeDA	IS	29.9	20 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1
13C3-HFPO-DA	IS	122	50 - 150		B9L0277	31-Dec-19	0.248 L	09-Jan-20 21:44	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: SW041912181318ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 13:14

Laboratory Data

Lab Sample: 1904441-14
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	5.74	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFPeA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFBS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-4:2 FTS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFHxA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFPeS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
HFPO-DA	ND	2.54	3.15	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFHpA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
ADONA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFHxS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Br-PFHxS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Total PFHxS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-6:2 FTS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFOA	1.96	1.44	2.10	4.21	J	B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Br-PFOA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Total PFOA	1.96	1.44	2.10	4.21	J	B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFHpS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFNA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFOSA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFOS	2.00	1.44	2.10	4.21	J	B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Br-PFOS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Total PFOS	2.00	1.44	2.10	4.21	J	B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
9Cl-PF3ONS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFDA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-8:2FTS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFNS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-MeFOSAA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Br-MeFOSAA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Total MeFOSAA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-EtFOSAA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Br-EtFOSAA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
Total EtFOSAA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1

Sample ID: SW041912181318ML

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 13:14

Laboratory Data

Lab Sample: 1904441-14
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFDS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
11Cl-PF3OUdS	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFDoA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFTrDA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
L-PFTeDA	ND	1.44	2.10	4.21		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	65.8	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C3-PFPeA	IS	89.8	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C3-PFBS	IS	80.2	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-4:2 FTS	IS	80.7	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-PFHxA	IS	89.5	70 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C4-PFHpA	IS	94.5	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C3-PFHxS	IS	82.3	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-6:2 FTS	IS	98.5	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-PFOA	IS	93.6	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C5-PFNA	IS	93.1	50 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C8-PFOSA	IS	44.3	20 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C8-PFOS	IS	83.2	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-PFDA	IS	86.3	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-8:2 FTS	IS	96.4	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
d3-MeFOSAA	IS	85.0	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
d5-EtFOSAA	IS	90.9	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-PFUnA	IS	86.1	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-PFDoA	IS	63.3	30 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C2-PFTeDA	IS	26.0	20 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1
13C3-HFPO-DA	IS	109	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 21:54	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: SW071912181217ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 12:17

Laboratory Data

Lab Sample: 1904441-15
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	8.38	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFPeA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFBS	4.54	1.44	2.10	4.19	Q	B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-4:2 FTS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFHxA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFPeS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
HFPO-DA	ND	2.53	3.15	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFHpA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
ADONA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFHxS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Br-PFHxS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Total PFHxS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-6:2 FTS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFOA	1.89	1.44	2.10	4.19	J, Q	B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Br-PFOA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Total PFOA	1.89	1.44	2.10	4.19	J	B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFHpS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFNA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFOSA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFOS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Br-PFOS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Total PFOS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
9Cl-PF3ONS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFDA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-8:2FTS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFNS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-MeFOSAA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Br-MeFOSAA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Total MeFOSAA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-EtFOSAA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Br-EtFOSAA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
Total EtFOSAA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1

Sample ID: SW071912181217ML

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Aqueous
Date Collected: 18-Dec-19 12:17

Laboratory Data

Lab Sample: 1904441-15
Date Received: 27-Dec-19 09:18

Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFDS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
11Cl-PF3OUdS	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFDoA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFTrDA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
L-PFTeDA	ND	1.44	2.10	4.19		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	71.9	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C3-PFPeA	IS	88.2	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C3-PFBS	IS	88.9	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-4:2 FTS	IS	84.1	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-PFHxA	IS	91.8	70 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C4-PFHpA	IS	98.6	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C3-PFHxS	IS	85.3	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-6:2 FTS	IS	91.7	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-PFOA	IS	87.6	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C5-PFNA	IS	87.8	50 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C8-PFOSA	IS	56.1	20 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C8-PFOS	IS	95.4	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-PFDA	IS	89.3	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-8:2 FTS	IS	100	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
d3-MeFOSAA	IS	78.9	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
d5-EtFOSAA	IS	81.8	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-PFUnA	IS	84.2	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-PFDoA	IS	72.9	30 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C2-PFTeDA	IS	50.5	20 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1
13C3-HFPO-DA	IS	104	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:05	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: SW051912181245ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 12:45

Laboratory Data

Lab Sample: 1904441-16
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	8.22	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFPeA	19.7	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFBS	1.74	1.42	2.07	4.15	J	B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-4:2 FTS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFHxA	14.2	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFPeS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
HFPO-DA	ND	2.50	3.11	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFHpA	11.0	1.42	2.07	4.15	Q	B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
ADONA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFHxS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Br-PFHxS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Total PFHxS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-6:2 FTS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFOA	14.3	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Br-PFOA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Total PFOA	14.7	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFHpS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFNA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFOSA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFOS	12.1	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Br-PFOS	12.6	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Total PFOS	24.8	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
9Cl-PF3ONS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFDA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-8:2FTS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFNS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-MeFOSAA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Br-MeFOSAA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Total MeFOSAA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-EtFOSAA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Br-EtFOSAA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
Total EtFOSAA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1

Sample ID: SW051912181245ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 12:45

Laboratory Data

Lab Sample: 1904441-16
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFDS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
11Cl-PF3OUdS	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFDoA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFTrDA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
L-PFTeDA	ND	1.42	2.07	4.15		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	75.4	60 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C3-PFPeA	IS	92.5	60 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C3-PFBS	IS	93.4	60 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-4:2 FTS	IS	85.5	40 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-PFHxA	IS	95.7	70 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C4-PFHpA	IS	96.4	60 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C3-PFHxS	IS	94.7	60 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-6:2 FTS	IS	88.9	40 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-PFOA	IS	95.4	60 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C5-PFNA	IS	105	50 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C8-PFOSA	IS	73.7	20 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C8-PFOS	IS	89.2	60 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-PFDA	IS	90.5	60 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-8:2 FTS	IS	96.0	40 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
d3-MeFOSAA	IS	89.4	50 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
d5-EtFOSAA	IS	88.2	50 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-PFUnA	IS	88.6	60 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-PFDoA	IS	76.1	30 - 130		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C2-PFTeDA	IS	66.6	20 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1
13C3-HFPO-DA	IS	98.7	50 - 150		B9L0277	31-Dec-19	0.241 L	09-Jan-20 22:15	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: SW051912181245ML-FD **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 12:45

Laboratory Data

Lab Sample: 1904441-17
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	8.62	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFPeA	20.4	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFBS	2.26	1.44	2.10	4.20	J	B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-4:2 FTS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFHxA	14.8	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFPeS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
HFPO-DA	ND	2.53	3.15	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFHpA	9.76	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
ADONA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFHxS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Br-PFHxS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Total PFHxS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-6:2 FTS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFOA	13.4	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Br-PFOA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Total PFOA	13.9	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFHpS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFNA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFOSA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFOS	11.9	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Br-PFOS	10.9	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Total PFOS	22.8	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
9Cl-PF3ONS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFDA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-8:2FTS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFNS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-MeFOSAA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Br-MeFOSAA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Total MeFOSAA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-EtFOSAA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Br-EtFOSAA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
Total EtFOSAA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1

Sample ID: SW051912181245ML-FD

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 12:45

Laboratory Data

Lab Sample: 1904441-17
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFDS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
11Cl-PF3OUdS	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFDoA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFTrDA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
L-PFTeDA	ND	1.44	2.10	4.20		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	76.6	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C3-PFPeA	IS	93.2	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C3-PFBS	IS	85.7	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-4:2 FTS	IS	82.1	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-PFHxA	IS	93.9	70 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C4-PFHpA	IS	98.0	60 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C3-PFHxS	IS	86.9	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-6:2 FTS	IS	89.0	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-PFOA	IS	90.2	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C5-PFNA	IS	89.1	50 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C8-PFOSA	IS	71.9	20 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C8-PFOS	IS	101	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-PFDA	IS	89.4	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-8:2 FTS	IS	95.5	40 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
d3-MeFOSAA	IS	89.6	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
d5-EtFOSAA	IS	93.4	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-PFUnA	IS	94.3	60 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-PFDoA	IS	76.6	30 - 130		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C2-PFTeDA	IS	73.0	20 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1
13C3-HFPO-DA	IS	101	50 - 150		B9L0277	31-Dec-19	0.238 L	09-Jan-20 22:26	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

Sample ID: SW061912181140ML **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Aqueous
Date Collected: 18-Dec-19 11:40

Laboratory Data

Lab Sample: 1904441-18
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFBA	10.1	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFPeA	2.83	1.41	2.05	4.11	J	B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFBS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-4:2 FTS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFHxA	1.77	1.41	2.05	4.11	J, Q	B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFPeS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
HFPO-DA	ND	2.47	3.07	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFHpA	3.09	1.41	2.05	4.11	J, Q	B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
ADONA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFHxS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Br-PFHxS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Total PFHxS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-6:2 FTS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFOA	24.0	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Br-PFOA	3.87	1.41	2.05	4.11	J	B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Total PFOA	27.9	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFHpS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFNA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFOSA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFOS	83.5	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Br-PFOS	36.9	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Total PFOS	120	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
9Cl-PF3ONS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFDA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-8:2FTS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFNS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-MeFOSAA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Br-MeFOSAA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Total MeFOSAA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-EtFOSAA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Br-EtFOSAA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
Total EtFOSAA	2.25	1.41	2.05	4.11	J	B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1

Sample ID: SW061912181140ML

PFAS Isotope Dilution Method

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01

Matrix: Aqueous
Date Collected: 18-Dec-19 11:40

Laboratory Data

Lab Sample: 1904441-18
Date Received: 27-Dec-19 09:18

Column: BEH C18

Analyte	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
L-PFUnA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFDS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
11Cl-PF3OUdS	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFDoA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFTrDA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
L-PFTeDA	ND	1.41	2.05	4.11		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	68.0	60 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C3-PFPeA	IS	85.8	60 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C3-PFBS	IS	90.2	60 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-4:2 FTS	IS	94.0	40 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-PFHxA	IS	86.9	70 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C4-PFHpA	IS	88.2	60 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C3-PFHxS	IS	95.2	60 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-6:2 FTS	IS	92.0	40 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-PFOA	IS	87.1	60 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C5-PFNA	IS	92.2	50 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C8-PFOSA	IS	63.8	20 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C8-PFOS	IS	84.0	60 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-PFDA	IS	86.7	60 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-8:2 FTS	IS	89.2	40 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
d3-MeFOSAA	IS	84.4	50 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
d5-EtFOSAA	IS	82.9	50 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-PFUnA	IS	87.3	60 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-PFDoA	IS	76.4	30 - 130		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C2-PFTeDA	IS	52.6	20 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1
13C3-HFPO-DA	IS	105	50 - 150		B9L0277	31-Dec-19	0.244 L	09-Jan-20 22:36	1

DL - Detection Limit
LOD - Limit of Detection
LOQ - Limit of quantitation
Results reported to the DL.

DATA QUALIFIERS & ABBREVIATIONS

B	This compound was also detected in the method blank
Conc.	Concentration
CRS	Cleanup Recovery Standard
D	Dilution
DL	Detection limit
E	The associated compound concentration exceeded the calibration range of the instrument
H	Recovery and/or RPD was outside laboratory acceptance limits
I	Chemical Interference
IS	Internal Standard
J	The amount detected is below the Reporting Limit/LOQ
LOD	Limit of Detection
LOQ	Limit of Quantitation
M	Estimated Maximum Possible Concentration (CA Region 2 projects only)
NA	Not applicable
ND	Not Detected
OPR	Ongoing Precision and Recovery sample
P	The reported concentration may include contribution from chlorinated diphenyl ether(s).
Q	The ion transition ratio is outside of the acceptance criteria.
RL	Reporting Limit
TEQ	Toxic Equivalency
U	Not Detected (specific projects only)
*	See Cover Letter

Unless otherwise noted, solid sample results are reported in dry weight. Tissue samples are reported in wet weight.

Vista Analytical Laboratory Certifications

Accrediting Authority	Certificate Number
Alaska Department of Environmental Conservation	17-013
Arkansas Department of Environmental Quality	19-013-0
California Department of Health – ELAP	2892
DoD ELAP - A2LA Accredited - ISO/IEC 17025:2005	3091.01
Florida Department of Health	E87777-23
Hawaii Department of Health	N/A
Louisiana Department of Environmental Quality	01977
Maine Department of Health	2018017
Massachusetts Department of Environmental Protection	N/A
Michigan Department of Environmental Quality	9932
Minnesota Department of Health	1521520
New Hampshire Environmental Accreditation Program	207718-B
New Jersey Department of Environmental Protection	190001
New York Department of Health	11411
Oregon Laboratory Accreditation Program	4042-010
Pennsylvania Department of Environmental Protection	016
Texas Commission on Environmental Quality	T104704189-19-10
Vermont Department of Health	VT-4042
Virginia Department of General Services	10272
Washington Department of Ecology	C584-19
Wisconsin Department of Natural Resources	998036160

Current certificates and lists of licensed parameters are located in the Quality Assurance office and are available upon request.

NELAP Accredited Test Methods

MATRIX: Air	
Description of Test	**Method**
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA 23
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA TO-9A

MATRIX: Biological Tissue	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Drinking Water	
Description of Test	**Method**
2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) GC/HRMS	EPA 1613/1613B
1,4-Dioxane (1,4-Diethyleneoxide) analysis by GC/HRMS	EPA 522
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	ISO 25101 2009

MATRIX: Non-Potable Water	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Dioxin by GC/HRMS	EPA 613
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Solids	
Description of Test	**Method**
Tetra-Octa Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

Vista Analytical Laboratory

CHAIN OF CUSTODY

For Laboratory Use Only
Work Order #: 1904441 Temp: 3.3 °C
Storage ID: WR-2 Storage Secured: Yes ☒ No ☐

Project ID: **Biosolids / Fort Gratiot** PO#: **60588767** Sampler: **Lauren McNeely** (name)

TAT (check one): Standard: [x] 21 days; Rush (surcharge may apply): [ ] 14 days [ ] 7 days Specify:

Invoice to: Name	Company	Address	City	State	Ph#	Fax#
Stephanie Kammer	**EGLE**	**525 W. Allegan Street**	**Lansing**	**MI**	**517-897-1597**	**517-247-3571**

Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time
Garth Cousineau	12-26-19	1500	Hayden Canal	12/27/19	09:18
Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time

SHIP TO: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
(916) 673-1520 * Fax (916) 673-0106

Method of Shipment:

ATTN: Jennifer Miller

Tracking No.:

Add Analysis(es) Requested

Sample ID	Date	Time	Location/Sample Description	Container(s) Quantity	Container(s) Type	Container(s) Matrix	Istotope Dilution Method: PFOA/ PFOS	Istotope Dilution Method: UCMR3 PFAS List:6	Istotope Dilution Method: EGLE List of 24	Istotope Dilution Method: EGLE List of 28	Istotope Dilution Method: Other- Please List Below	Istotope Dilution Method: Branch and Linear	EPA Method 537(DW only): PFOA/ PFOS	EPA Method 537(DW only): UCMR3 PFAS List:6	EPA Method 537(DW only): PFAS List: 14	Comments
SXDU0102141912181700LM	12/18/19	1700	PHUR-1007-01	1	O	SO				x						DU-1 (2"-14") GAL Bag - ISM Processing
SXDU0202141912181100LM	12/18/19	1100	PHUR-1007-01	1	O	SO				x						DU-2-Sample A (2"-14") GAL Bag - ISM Processing
SXDU0202141912181105LM	12/18/19	1105	PHUR-1007-01	1	O	SO				x						DU-2-Sample B (2"-14")GAL Bag - ISM Processing
SXDU0202141912181110LM	12/18/19	1110	PHUR-1007-01	1	O	SO				x						DU-2-Sample C (2"-14") GAL Bag - ISM Processing
SXDU0302141912181300LM	12/18/19	1300	PHUR-1007-01	1	PJ	SO				x						DU-3 (2"-14") - 4oz jar
SXDU0402141912181330LM	12/18/19	1330	PHUR-1007-01	1	PJ	SO				x						DU-4 (2"-14") - 4oz jar
SX04161912181400LM	12/18/19	1400	PHUR-1007-01	1	PJ	SO				x						Spoils Pile 1 (4"-16") - 4oz jar
SX04161912181405LM	12/18/19	1405	PHUR-1007-01	1	PJ	SO				x						Spoils Pile 2 (4"-16") - 4oz jar
SX04161912181410LM	12/18/19	1410	PHUR-1007-01	1	PJ	SO				x						Spoils Pile 3 (4"-16") - 4oz jar
SX04161912181410LM-FD	12/18/19	1410	PHUR-1007-01	1	PJ	SO				x						Duplicate Sample - Spoils Pile 3 (4"-16") - 4oz jar

Special Instructions/Comments: **Send Results and Acknowledgements to the list provided**

SEND DOCUMENTATION AND RESULTS TO:

Name: **Stephanie Kammer**
Company: **EGLE**
Address: **525 W. Allegan Street, Constitution Hall, 1st South West**
City: **Lansing** State: MI Zip: 30242
Phone: **517-897-1597** Fax: **517-247-3571**
Email:

Container Types: P= HDPE, PJ= HDPE Jar
O = Other: O= GAL ZIPLOC BAG

Bottle Preservation Type: T = Thiosulfate,
TZ = Trizma: TZ

Matrix Types: AQ = Aqueous, DW = Drinking Water, EF = Effluent, PP = Pulp/Paper, SD = Sediment, SL = Sludge, SO = Soil, WW = Wastewater, B = Blood/Serum, O = Other: DW

Vista Analytical Laboratory

CHAIN OF CUSTODY

For Laboratory Use Only
Work Order #: 1904441 Temp: 3.3 °C
Storage ID: WR-2 / R-13 Storage Secured: Yes ☑ No ☐

Project ID: **Biosolids/ Fort Gratiot** PO#: **60588767** Sampler: **Mickey Leonard** (name)

TAT (check one): Standard: [x] 21 days; Rush (surcharge may apply): [ ] 14 days [ ] 7 days Specify:

Invoice to: Name	Company	Address	City	State	Ph#	Fax#
Stephanie Kammer	**EGLE**	**525 W. Allegan Street**	**Lansing**	**MI**	**517-897-1597**	**517-247-3571**

Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time
Garth Cousineau	12-26-19	1500	Hayden Ganas	12/27/19	09:18
Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time

SHIP TO: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
(916) 673-1520 * Fax (916) 673-0106

Method of Shipment:

ATTN: Jennifer Miller

Tracking No.:

Add Analysis(es) Requested

Sample ID	Date	Time	Location/Sample Description	Container(s): Quantity	Type	Matrix	Isotope Dilution Method: PFOA/ PFOS	UCMR3 PFAS List:6	EGLE List of 24	EGLE List of 28	Other: Please List Below	Branch and Linear	EPA Method 537(DW only): PFOA/ PFOS	UCMR3 PFAS List:6	PFAS List: 14	Comments
SW011912181325ML	**12/18/19**	**1325**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						
SW021912181332ML	**12/18/19**	**1332**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						
SW031912181310ML	**12/18/19**	**1310**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						
SW041912181318ML	**12/18/19**	**1314**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						
SW071912181217ML	**12/18/19**	**1217**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						
SW051912181245ML	**12/18/19**	**1245**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						
SW051912181245ML-FD	**12/18/19**	**1245**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						
SW061912181140ML	**12/18/19**	**1140**	**PHUR-1007-01**	**2**	**P**	**AQ**				x						

Special Instructions/Comments: **Send Results and Acknowledgements to the list provided**

SEND DOCUMENTATION AND RESULTS TO:

Name: **Stephanie Kammer**
Company: **EGLE**
Address: **525 W. Allegan Street, Constitution Hall, 1st South West**
City: **Lansing** State: **MI** Zip: **30242**
Phone: **517-897-1597** Fax: **517-247-3571**
Email:

Container Types: P= HDPE, PJ= HDPE Jar
O = Other: P

Bottle Preservation Type: T = Thiosulfate,
TZ = Trizma: TZ

Matrix Types: AQ = Aqueous, DW = Drinking Water, EF = Effluent, PP = Pulp/Paper, SD = Sediment, SL = Sludge, SO = Soil, WW = Wastewater, B = Blood/Serum, O = Other: DW

Vista Analytical Laboratory

Sample Log-In Checklist

Page # 1 of 1

Vista Work Order #: 1904441 TAT Std

Samples Arrival:	**Date/Time** 12/27/19 09:18		**Initials:** HOG		**Location:** WR-2 **Shelf/Rack:** NA		
Delivered By:	(FedEx)	UPS	On Trac	GSO	DHL	Hand Delivered	Other
Preservation:	(Ice)		Blue Ice		Dry Ice		None
Temp °C: 3.3 (uncorrected) **Temp °C:** 3.3 (corrected)			**Probe used:** Y / (N)		**Thermometer ID:** IR-4		

	YES	NO	NA
Shipping Container(s) Intact?	✓		
Shipping Custody Seals Intact?			✓
Airbill — Trk # 4894 6696 4407	✓		
Shipping Documentation Present?	✓		
Shipping Container: (Vista) / Client / (Retain) / Return / Dispose			
Chain of Custody / Sample Documentation Present?	✓		
Chain of Custody / Sample Documentation Complete?	✓		
Holding Time Acceptable?	✓		

Logged In:	**Date/Time** 12/27/19 0943	**Initials:** RS	**Location:** WR-2 / R-13 **Shelf/Rack:** E-4/D-7 / A-2	
COC Anomaly/Sample Acceptance Form completed?			✓	

Comments:

CoC/Label Reconciliation Report WO# 1904441

LabNumber	CoC Sample ID	SampleAlias	Sample Date/Time	Container	BaseMatrix	Sample Comments
1904441-01	A SXDU0102141912181700LM	PHUR-1007-01	18-Dec-19 17:00	Plastic Bag	Solid	
1904441-02	A SXDU0202141912181100LM	PHUR-1007-01	18-Dec-19 11:00	Plastic Bag	Solid	
1904441-03	A SXDU0202141912181105LM	PHUR-1007-01	18-Dec-19 11:05	Plastic Bag	Solid	
1904441-04	A SXDU0202141912181110LM	PHUR-1007-01	18-Dec-19 11:10	Plastic Bag	Solid	
1904441-05	A SXDU0302141912181300LM	PHUR-1007-01	18-Dec-19 13:00	HDPE Jar, 6 oz	Solid	
1904441-06	A SXDU0402141912181330LM	PHUR-1007-01	18-Dec-19 13:30	HDPE Jar, 6 oz	Solid	
1904441-07	A SX04161912181400LM	PHUR-1700-01	18-Dec-19 14:00	HDPE Jar, 6 oz	Solid	
1904441-08	A SX04161912181405LM	PHUR-1700-01	18-Dec-19 14:05	HDPE Jar, 6 oz	Solid	
1904441-09	A SX04161912181410LM	PHUR-1700-01	18-Dec-19 14:10	HDPE Jar, 6 oz	Solid	
1904441-10	A SX04161912181410LM-FD	PHUR-1700-01	18-Dec-19 14:10	HDPE Jar, 6 oz	Solid	
1904441-11	A SW011912181325ML	PHUR-1007-01	18-Dec-19 13:25	HDPE Bottle, 250 mL	Aqueous	
1904441-11	B SW011912181325ML	PHUR-1007-01	18-Dec-19 13:25	HDPE Bottle, 250 mL	Aqueous	
1904441-12	A SW021912181332ML	PHUR-1007-01	18-Dec-19 13:32	HDPE Bottle, 250 mL	Aqueous	
1904441-12	B SW021912181332ML	PHUR-1007-01	18-Dec-19 13:32	HDPE Bottle, 250 mL	Aqueous	
1904441-13	A SW031912181310ML	PHUR-1007-01	18-Dec-19 13:10	HDPE Bottle, 250 mL	Aqueous	
1904441-13	B SW031912181310ML	PHUR-1007-01	18-Dec-19 13:10	HDPE Bottle, 250 mL	Aqueous	
1904441-14	A SW041912181318ML	PHUR-1007-01	18-Dec-19 13:14	HDPE Bottle, 250 mL	Aqueous	
1904441-14	B SW041912181318ML	PHUR-1007-01	18-Dec-19 13:14	HDPE Bottle, 250 mL	Aqueous	
1904441-15	A SW071912181217ML	PHUR-1007-01	18-Dec-19 12:17	HDPE Bottle, 250 mL	Aqueous	
1904441-15	B SW071912181217ML	PHUR-1007-01	18-Dec-19 12:17	HDPE Bottle, 250 mL	Aqueous	
1904441-16	A SW051912181245ML	PHUR-1007-01	18-Dec-19 12:45	HDPE Bottle, 250 mL	Aqueous	
1904441-16	B SW051912181245ML	PHUR-1007-01	18-Dec-19 12:45	HDPE Bottle, 250 mL	Aqueous	
1904441-17	A SW051912181245ML-FD	PHUR-1007-01	18-Dec-19 12:45	HDPE Bottle, 250 mL	Aqueous	
1904441-17	B SW051912181245ML-FD	PHUR-1007-01	18-Dec-19 12:45	HDPE Bottle, 250 mL	Aqueous	
1904441-18	A SW061912181140ML	PHUR-1007-01	18-Dec-19 11:40	HDPE Bottle, 250 mL	Aqueous	
1904441-18	B SW061912181140ML	PHUR-1007-01	18-Dec-19 11:40	HDPE Bottle, 250 mL	Aqueous	

Checkmarks indicate that information on the COC reconciled with the sample label.
Any discrepancies are noted in the following columns.

	Yes	No	NA
Sample Container Intact?	✓		
Sample Custody Seals Intact?			✓
Adequate Sample Volume?	✓		
Container Type Appropriate for Analysis(es)	✓		
Preservation Documented: Na2S2O3 Trizma (None) Other		✓	✓
If Chlorinated or Drinking Water Samples, Acceptable Preservation?			✓

Comments: * 'Sample label ID says "SW041912181314ML." Reconciled by date and time.

Verifed by/Date: HDG 12/27/19

Vista Analytical Laboratory

ANOMALY FORM

Vista Work Order 1904441

Initial/Date — The following checked issues were noted during sample receipt and login:

_____ ☐ **1. The samples were received out of temperature at (WI-PHT):** _____
Was Ice present: Yes No Melted Blue Ice

_____ ☐ 2. The Chain-of-Custody (CoC) was not relinquished properly.

_____ ☐ 3. The CoC did not include collection time(s). 00:00 will be used unless notified otherwise.

_____ ☐ 4. The sample(s) did not include a sample collection time. All or Sample Name: _____

KS 12/27/19 ☒ 5. A sample ID discrepancy was found. See the Reconciliation report.
The CoC Sample ID will be used unless notified otherwise.

_____ ☐ 6. A sample date and/or time discrepancy was found. See the Reconciliation report.
The CoC Sample date/time will be used unless notified otherwise.

_____ ☐ **7. The CoC did not include a sample matrix. The following sample matrix will be used:** _____

_____ ☐ **8. Insufficent volume received for analysis. All or Sample Name:** _____

_____ ☐ 9. The backup bottle was received broken. Sample Name: _____

_____ ☐ **10. CoC not received, illegible or destroyed.**

_____ ☐ **11. The sample(s) were received out of holding time. All or Sample Name:** _____

_____ ☐ **12. The CoC did not include an analysis. All or Sample Name:** _____

_____ ☐ **13. Sample(s) received without collection date. All or Sample Name:** _____

_____ ☐ **14. Sample(s) not received. All or Sample Name:** _____

_____ ☐ **15. Sample(s) received broken. All or Sample Name:** _____

_____ ☐ **16. An incorrect container-type was used. All or Sample Name:** _____

_____ ☐ 17. Other:

Bolded items require sign-off

Client Contacted: _____

Date of Contact: _____

Vista Client Manager: _____

Resolution:

December 06, 2019

Vista Work Order No. 1904025

Ms. Maya Murshak
Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Dear Ms. Murshak,

Enclosed are the results for the sample set received at Vista Analytical Laboratory on November 15, 2019 under your Project Name 'Biosolids'.

Vista Analytical Laboratory is committed to serving you effectively. If you require additional information, please contact me at 916-673-1520 or by email at mmaier@vista-analytical.com.

Thank you for choosing Vista as part of your analytical support team.

Sincerely,

Martha Maier
Laboratory Director

Vista Analytical Laboratory certifies that the report herein meets all the requirements set forth by NELAP for those applicable test methods. Results relate only to the samples as received by the laboratory. This report should not be reproduced except in full without the written approval of Vista.

Vista Work Order No. 1904025
Case Narrative

Sample Condition on Receipt:

One drinking water sample was received in good condition and within the method temperature requirements. The sample was received and stored securely in accordance with Vista standard operating procedures and EPA methodology.

Analytical Notes:

EPA Method 537, Rev. 1.1

The sample was extracted and analyzed for a selected list of 14 PFAS using EPA Method 537, Rev. 1.1. The results have been reported following the conventions specified by the Michigan Department of Environmental Quality.

Holding Times

The sample was extracted and analyzed within the method hold times.

Quality Control

The Initial Calibration and Continuing Calibration Verifications met the method acceptance criteria.

Two Laboratory Fortified Blanks (LFB/LFBD) and a Laboratory Reagent Blank (LRB) were extracted and analyzed with the preparation batch. No analytes were detected in the Laboratory Reagent Blank. The LFB/LFBD recoveries were within the method acceptance criteria.

The surrogate recoveries for all QC and field samples were within the acceptance criteria.

TABLE OF CONTENTS

Sample Inventory Report

Vista Sample ID	Client Sample ID	Sampled	Received	Components/Containers
1904025-01	WR1911141350GGA	14-Nov-19 13:50	15-Nov-19 08:54	HDPE Bottle, 250 mL
				HDPE Bottle, 250 mL

ANALYTICAL RESULTS

Sample ID: LRB

EPA Method 537

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids
Matrix: Aqueous

Laboratory Data

Lab Sample: B9K0143-BLK1
Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	RL	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBS	375-73-5	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFHxA	307-24-4	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFHpA	375-85-9	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFHxS	355-46-4	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFOA	335-67-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFNA	375-95-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFOS	1763-23-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFDA	335-76-2	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
MeFOSAA	2355-31-9	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
EtFOSAA	2991-50-6	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFUnA	2058-94-8	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFDoA	307-55-1	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFTrDA	72629-94-8	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFTeDA	376-06-7	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-PFHxA	SURR	110	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
13C2-PFDA	SURR	118	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
d5-EtFOSAA	SURR	115	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1

RL - Reporting limit

Results reported to RL.
Reporting convention specified by MI DEQ.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: LFBD **EPA Method 537**

Name:	Merit Laboratories, Inc.	Lab Sample:	B9K0143-BS1/B9K0143-BSD1
Project:	Biosolids	QC Batch:	B9K0143
Matrix:	Aqueous	Samp Size:	0.25/0.25 L
		Date Extracted:	20-Nov-19
		Column:	BEH C18

Analyte	CAS Number	LFB (ng/L)	LFB Spike	LFB % Rec	LFB Quals	LFBD (ng/L)	LFBD Spike	LFBD % Rec	RPD	LFBD Quals	%Rec Limits	RPD Limits	LFB Analyzed	LFB Dil	LFBD Analyzed	LFBD Dil
PFBS	375-73-5	65	71	92		80	71	113	21		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFHxA	307-24-4	90	80	113		78	80	98	15		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFHpA	375-85-9	85	80	106		90	80	112	6		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFHxS	355-46-4	76	73	104		84	73	116	10		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFOA	335-67-1	87	80	109		86	80	107	2		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFNA	375-95-1	94	80	118		78	80	97	19		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFOS	1763-23-1	76	74	103		74	74	100	3		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFDA	335-76-2	100	80	125		75	80	94	28		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
MeFOSAA	2355-31-9	87	80	109		88	80	110	1		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
EtFOSAA	2991-50-6	83	80	104		78	80	97	7		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFUnA	2058-94-8	91	80	114		71	80	89	25		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFDoA	307-55-1	88	80	109		73	80	91	18		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFTrDA	72629-94-8	83	80	103		69	80	87	18		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFTeDA	376-06-7	81	80	101		70	80	87	15		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1

Labeled Standards	Type	LFB % Rec	LFB Quals	LFBD % Rec	LFBD Quals	Limits	LFB Analyzed	LFB Dil	LFBD Analyzed	LFBD Dil
13C2-PFHxA	SURR	106		106		70-130	25-Nov-19 19:16	1	04-Dec-19 21:47	1
13C2-PFDA	SURR	114		96		70-130	25-Nov-19 19:16	1	04-Dec-19 21:47	1
d5-EtFOSAA	SURR	102		96		70-130	25-Nov-19 19:16	1	04-Dec-19 21:47	1

Reporting convention specified by MI DEQ.

Sample ID: WR1911141350GGA **EPA Method 537**

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids
Location: 3996 Keewahdin

Matrix: Drinking Water
Date Collected: 14-Nov-19 13:50

Laboratory Data

Lab Sample: 1904025-01
Date Received: 15-Nov-19 08:54

Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	RL	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBS	375-73-5	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFHxA	307-24-4	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFHpA	375-85-9	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFHxS	355-46-4	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFOA	335-67-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFNA	375-95-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFOS	1763-23-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFDA	335-76-2	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
MeFOSAA	2355-31-9	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
EtFOSAA	2991-50-6	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFUnA	2058-94-8	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFDoA	307-55-1	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFTrDA	72629-94-8	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
PFTeDA	376-06-7	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-PFHxA	SURR	112	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
13C2-PFDA	SURR	125	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1
d5-EtFOSAA	SURR	94	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 20:00	1

RL - Reporting limit

Results reported to RL.
Reporting convention specified by MI DEQ..

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

DATA QUALIFIERS & ABBREVIATIONS

B	This compound was also detected in the method blank
Conc.	Concentration
CRS	Cleanup Recovery Standard
D	Dilution
DL	Detection limit
E	The associated compound concentration exceeded the calibration range of the instrument
H	Recovery and/or RPD was outside laboratory acceptance limits
I	Chemical Interference
IS	Internal Standard
J	The amount detected is below the Reporting Limit/LOQ
LOD	Limit of Detection
LOQ	Limit of Quantitation
M	Estimated Maximum Possible Concentration (CA Region 2 projects only)
NA	Not applicable
ND	Not Detected
OPR	Ongoing Precision and Recovery sample
P	The reported concentration may include contribution from chlorinated diphenyl ether(s).
Q	The ion transition ratio is outside of the acceptance criteria.
RL	Reporting Limit
TEQ	Toxic Equivalency
U	Not Detected (specific projects only)
*	See Cover Letter

Unless otherwise noted, solid sample results are reported in dry weight. Tissue samples are reported in wet weight.

Vista Analytical Laboratory Certifications

Accrediting Authority	Certificate Number
Alaska Department of Environmental Conservation	17-013
Arkansas Department of Environmental Quality	19-013-0
California Department of Health – ELAP	2892
DoD ELAP - A2LA Accredited - ISO/IEC 17025:2005	3091.01
Florida Department of Health	E87777-23
Hawaii Department of Health	N/A
Louisiana Department of Environmental Quality	01977
Maine Department of Health	2018017
Massachusetts Department of Environmental Protection	N/A
Michigan Department of Environmental Quality	9932
Minnesota Department of Health	1521520
New Hampshire Environmental Accreditation Program	207718-B
New Jersey Department of Environmental Protection	190001
New York Department of Health	11411
Oregon Laboratory Accreditation Program	4042-010
Pennsylvania Department of Environmental Protection	016
Texas Commission on Environmental Quality	T104704189-19-10
Vermont Department of Health	VT-4042
Virginia Department of General Services	10272
Washington Department of Ecology	C584-19
Wisconsin Department of Natural Resources	998036160

Current certificates and lists of licensed parameters are located in the Quality Assurance office and are available upon request.

NELAP Accredited Test Methods

MATRIX: Air	
Description of Test	**Method**
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA 23
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA TO-9A

MATRIX: Biological Tissue	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Drinking Water	
Description of Test	**Method**
2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) GC/HRMS	EPA 1613/1613B
1,4-Dioxane (1,4-Diethyleneoxide) analysis by GC/HRMS	EPA 522
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	ISO 25101 2009

MATRIX: Non-Potable Water	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Dioxin by GC/HRMS	EPA 613
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Solids	
Description of Test	**Method**
Tetra-Octa Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

Vista Analytical Laboratory

CHAIN OF CUSTODY

For Laboratory Use Only
Work Order #: 1904025 Temp: 2.3 °C
Storage ID: R-13/WR-2 Storage Secured: Yes ☒ No ☐

Project ID: Biosolids PO#: 60588767.01 Sampler: George Austin (name)

TAT (check one): Standard: [x] 21 days; Rush (surcharge may apply): [ ] 14 days [ ] 7 days Specify:

Invoice to: Name	Company	Address	City	State	Ph#	Fax#
MIKE JURY	EGLE	401 KETCHUM ST, SUITE B	BAY CITY	MI	989-894-6255	989-891-9237

Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time
Rachel Lopez	11.14.19	1800	Marissa Sparks	11/15/19	0854
Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time

SHIP TO: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
Ph: (916) 673-1520; Fax: (916) 673-0106

ATTN: Jennifer Miller

Method of Shipment:

Tracking No.:

Add Analysis(es) Requested

Container(s): Quantity, Type, Matrix

PFAS Isotope Dilution: List of 21, List of 21 w/Isomers, List of 24, List of 24 w/Isomers, List of 28, Other: Please List Below

USEPA Method 537: PFOA/PFOS, UCMR3 PFAS List 6, PFAS List 14

Sample ID	Date	Time	Location/Sample Description	Quantity	Type	Matrix	List of 21	List of 21 w/Isomers	List of 24	List of 24 w/Isomers	List of 28	Other: Please List Below	PFOA/PFOS	UCMR3 PFAS List 6	PFAS List 14	Comments
WR191114135ØGGA	11.14.19	1350	3996 Keewahdin	2	P	DW									X	TZ

Special Instructions/Comments: Send Results and Acknowledgements to the list provided by e-mail to Vista.

SEND DOCUMENTATION AND RESULTS TO:
Name: MIKE JURY
Company: EGLE
Address: 401 KETCHUM ST, SUITE B
City: BAY CITY State: MI Zip: 48708
Phone: 989-894-6255 Fax: 989-891-9237
Email: dorin.bogdan@aecom.com

Container Types: P= HDPE, PJ= HDPE Jar, O = Other.

Bottle Preservation Type: T = Thiosulfate, TZ = Trizma:

Matrix Types: AQ = Aqueous, DW = Drinking Water, EF = Effluent, PP = Pulp/Paper, SD = Sediment, SL = Sludge, SO = Soil, WW = Wastewater, B = Blood/Serum, O = Other:

Vista Analytical Laboratory

Sample Log-In Checklist

Page # 1 of 1

Vista Work Order #: 1904025 TAT Std

Samples Arrival:	Date/Time 11/15/19 0854		Initials: WS		Location: WR-2 Shelf/Rack: N/a		
Delivered By:	FedEx	UPS	On Trac	GSO	DHL	Hand Delivered	Other
Preservation:	Ice		Blue Ice		Dry Ice		None
Temp °C: 2.3 (uncorrected) Temp °C: 2.3 (corrected)	Probe used: Y / N				Thermometer ID: IR-3		

	YES	NO	NA
Shipping Container(s) Intact?	✓		
Shipping Custody Seals Intact?	✓		
Airbill — Trk # 4894 6696 3514	✓		
Shipping Documentation Present?	✓		
Shipping Container: Vista / Client / Retain / Return / Dispose			
Chain of Custody / Sample Documentation Present?	✓		
Chain of Custody / Sample Documentation Complete?	✓		
Holding Time Acceptable?	✓		

Logged In:	Date/Time 11/15/19 1339	Initials: ajm	Location: R-13/WR-2 Shelf/Rack: A-2/A-5
COC Anomaly/Sample Acceptance Form completed?		—	—

Comments:

CoC/Label Reconciliation Report WO# 1904025

LabNumber	CoC Sample ID	SampleAlias	Sample Date/Time	Container	Sample BaseMatrix	Sample Comments
1904025-01 A	WR1911141350GGA	3996 Keewahdin	14-Nov-19 13:50	HDPE Bottle, 250 mL	Aqueous	
1904025-01 B	WR1911141350GGA	3996 Keewahdin	14-Nov-19 13:50	HDPE Bottle, 250 mL	Aqueous	

Checkmarks indicate that information on the COC reconciled with the sample label.
Any discrepancies are noted in the following columns.

	Yes	No	NA
Sample Container Intact?	✓		
Sample Custody Seals Intact?			✓
Adequate Sample Volume?	✓		
Container Type Appropriate for Analysis(es)	✓		
Preservation Documented: Na2S2O3 Trizma None Other	✓		
If Chlorinated or Drinking Water Samples, Acceptable Preservation?	✓		

Comments:

Verifed by/Date: 11/15/19 KS

December 06, 2019

Vista Work Order No. 1904024

Ms. Maya Murshak
Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Dear Ms. Murshak,

Enclosed are the results for the sample set received at Vista Analytical Laboratory on November 15, 2019 under your Project Name 'Biosolids'.

Vista Analytical Laboratory is committed to serving you effectively. If you require additional information, please contact me at 916-673-1520 or by email at mmaier@vista-analytical.com.

Thank you for choosing Vista as part of your analytical support team.

Sincerely,

Martha Maier
Laboratory Director

Vista Work Order No. 1904024
Case Narrative

Sample Condition on Receipt:

One drinking water sample was received in good condition and within the method temperature requirements. The sample was received and stored securely in accordance with Vista standard operating procedures and EPA methodology.

Analytical Notes:

EPA Method 537, Rev. 1.1

The sample was extracted and analyzed for a selected list of 14 PFAS using EPA Method 537, Rev. 1.1. The results have been reported following the conventions specified by the Michigan Department of Environmental Quality.

Holding Times

The sample was extracted and analyzed within the method hold times.

Quality Control

The Initial Calibration and Continuing Calibration Verifications met the method acceptance criteria.

Two Laboratory Fortified Blanks (LFB/LFBD) and a Laboratory Reagent Blank (LRB) were extracted and analyzed with the preparation batch. No analytes were detected in the Laboratory Reagent Blank. The LFB/LFBD recoveries were within the method acceptance criteria.

The surrogate recoveries for all QC and field samples were within the acceptance criteria.

TABLE OF CONTENTS

Sample Inventory Report

Vista Sample ID	Client Sample ID	Sampled	Received	Components/Containers
1904024-01	WT1911141405GGA	14-Nov-19 14:05	15-Nov-19 08:54	HDPE Bottle, 250 mL HDPE Bottle, 250 mL

ANALYTICAL RESULTS

Sample ID: LRB

EPA Method 537

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids
Matrix: Aqueous

Laboratory Data

Lab Sample: B9K0143-BLK1
Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	RL	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBS	375-73-5	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFHxA	307-24-4	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFHpA	375-85-9	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFHxS	355-46-4	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFOA	335-67-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFNA	375-95-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFOS	1763-23-1	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFDA	335-76-2	ND	2		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
MeFOSAA	2355-31-9	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
EtFOSAA	2991-50-6	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFUnA	2058-94-8	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFDoA	307-55-1	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFTrDA	72629-94-8	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
PFTeDA	376-06-7	ND	4		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-PFHxA	SURR	110	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
13C2-PFDA	SURR	118	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1
d5-EtFOSAA	SURR	115	70 - 130		B9K0143	20-Nov-19	0.25 L	25-Nov-19 19:05	1

RL - Reporting limit

Results reported to RL.
Reporting convention specified by MI DEQ.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: LFBD **EPA Method 537**

Name:	Merit Laboratories, Inc.	Lab Sample:	B9K0143-BS1/B9K0143-BSD1
Project:	Biosolids	QC Batch:	B9K0143
Matrix:	Aqueous	Samp Size:	0.25/0.25 L
		Date Extracted:	20-Nov-19
		Column:	BEH C18

Analyte	CAS Number	LFB (ng/L)	LFB Spike	LFB % Rec	LFB Quals	LFBD (ng/L)	LFBD Spike	LFBD % Rec	RPD	LFBD Quals	%Rec Limits	RPD Limits	LFB Analyzed	LFB Dil	LFBD Analyzed	LFBD Dil
PFBS	375-73-5	65	71	92		80	71	113	21		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFHxA	307-24-4	90	80	113		78	80	98	15		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFHpA	375-85-9	85	80	106		90	80	112	6		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFHxS	355-46-4	76	73	104		84	73	116	10		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFOA	335-67-1	87	80	109		86	80	107	2		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFNA	375-95-1	94	80	118		78	80	97	19		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFOS	1763-23-1	76	74	103		74	74	100	3		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFDA	335-76-2	100	80	125		75	80	94	28		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
MeFOSAA	2355-31-9	87	80	109		88	80	110	1		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
EtFOSAA	2991-50-6	83	80	104		78	80	97	7		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFUnA	2058-94-8	91	80	114		71	80	89	25		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFDoA	307-55-1	88	80	109		73	80	91	18		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFTrDA	72629-94-8	83	80	103		69	80	87	18		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1
PFTeDA	376-06-7	81	80	101		70	80	87	15		70-130	30	25-Nov-19 19:16	1	04-Dec-19 21:47	1

Labeled Standards	Type	LFB % Rec	LFB Quals	LFBD % Rec	LFBD Quals	Limits	LFB Analyzed	LFB Dil	LFBD Analyzed	LFBD Dil
13C2-PFHxA	SURR	106		106		70-130	25-Nov-19 19:16	1	04-Dec-19 21:47	1
13C2-PFDA	SURR	114		96		70-130	25-Nov-19 19:16	1	04-Dec-19 21:47	1
d5-EtFOSAA	SURR	102		96		70-130	25-Nov-19 19:16	1	04-Dec-19 21:47	1

Reporting convention specified by MI DEQ.

Sample ID: WT1911141405GGA

EPA Method 537

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids
Location: 4189 Keewahdin

Matrix: Drinking Water
Date Collected: 14-Nov-19 14:05

Laboratory Data

Lab Sample: 1904024-01
Date Received: 15-Nov-19 08:54

Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	RL	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBS	375-73-5	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFHxA	307-24-4	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFHpA	375-85-9	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFHxS	355-46-4	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFOA	335-67-1	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFNA	375-95-1	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFOS	1763-23-1	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFDA	335-76-2	ND	2		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
MeFOSAA	2355-31-9	ND	4		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
EtFOSAA	2991-50-6	ND	4		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFUnA	2058-94-8	ND	4		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFDoA	307-55-1	ND	4		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFTrDA	72629-94-8	ND	4		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
PFTeDA	376-06-7	ND	4		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-PFHxA	SURR	114	70 - 130		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
13C2-PFDA	SURR	116	70 - 130		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1
d5-EtFOSAA	SURR	76	70 - 130		B9K0143	20-Nov-19	0.24 L	25-Nov-19 19:49	1

RL - Reporting limit

Results reported to RL.
Reporting convention specified by MI DEQ..

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

DATA QUALIFIERS & ABBREVIATIONS

B	This compound was also detected in the method blank
Conc.	Concentration
CRS	Cleanup Recovery Standard
D	Dilution
DL	Detection limit
E	The associated compound concentration exceeded the calibration range of the instrument
H	Recovery and/or RPD was outside laboratory acceptance limits
I	Chemical Interference
IS	Internal Standard
J	The amount detected is below the Reporting Limit/LOQ
LOD	Limit of Detection
LOQ	Limit of Quantitation
M	Estimated Maximum Possible Concentration (CA Region 2 projects only)
NA	Not applicable
ND	Not Detected
OPR	Ongoing Precision and Recovery sample
P	The reported concentration may include contribution from chlorinated diphenyl ether(s).
Q	The ion transition ratio is outside of the acceptance criteria.
RL	Reporting Limit
TEQ	Toxic Equivalency
U	Not Detected (specific projects only)
*	See Cover Letter

Unless otherwise noted, solid sample results are reported in dry weight. Tissue samples are reported in wet weight.

Vista Analytical Laboratory Certifications

Accrediting Authority	Certificate Number
Alaska Department of Environmental Conservation	17-013
Arkansas Department of Environmental Quality	19-013-0
California Department of Health – ELAP	2892
DoD ELAP - A2LA Accredited - ISO/IEC 17025:2005	3091.01
Florida Department of Health	E87777-23
Hawaii Department of Health	N/A
Louisiana Department of Environmental Quality	01977
Maine Department of Health	2018017
Massachusetts Department of Environmental Protection	N/A
Michigan Department of Environmental Quality	9932
Minnesota Department of Health	1521520
New Hampshire Environmental Accreditation Program	207718-B
New Jersey Department of Environmental Protection	190001
New York Department of Health	11411
Oregon Laboratory Accreditation Program	4042-010
Pennsylvania Department of Environmental Protection	016
Texas Commission on Environmental Quality	T104704189-19-10
Vermont Department of Health	VT-4042
Virginia Department of General Services	10272
Washington Department of Ecology	C584-19
Wisconsin Department of Natural Resources	998036160

Current certificates and lists of licensed parameters are located in the Quality Assurance office and are available upon request.

NELAP Accredited Test Methods

MATRIX: Air	
Description of Test	**Method**
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA 23
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA TO-9A

MATRIX: Biological Tissue	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Drinking Water	
Description of Test	**Method**
2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) GC/HRMS	EPA 1613/1613B
1,4-Dioxane (1,4-Diethyleneoxide) analysis by GC/HRMS	EPA 522
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	ISO 25101 2009

MATRIX: Non-Potable Water	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Dioxin by GC/HRMS	EPA 613
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Solids	
Description of Test	**Method**
Tetra-Octa Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

Vista Analytical Laboratory

CHAIN OF CUSTODY

For Laboratory Use Only
Work Order #: 1904024 Temp: 2.3 °C
Storage ID: R-13/WR-2 Storage Secured: Yes ☒ No ☐

Project ID: Biosolids PO#: 60588767.01 Sampler: George Austin (name)

TAT (check one): Standard: x 21 days; Rush (surcharge may apply): ☐ 14 days ☐ 7 days Specify:

Invoice to: Name	Company	Address	City	State	Ph#	Fax#
MIKE JURY	EGLE	401 KETCHUM ST, SUITE B	BAY CITY	MI	989-894-6255	989-891-9237

Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time
Rachel Lopez	11.14.19	1800	Marissa Sparks	11/15/19	0854
Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time

SHIP TO: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
Ph: (916) 673-1520; Fax: (916) 673-0106

ATTN: Jennifer Miller

Method of Shipment:

Tracking No.:

Add Analysis(es) Requested

Container(s) | PFAS Isotope Dilution | USEPA Method 537

Sample ID	Date	Time	Location/Sample Description	Quantity	Type	Matrix	List of 21	List of 21 w/Isomers	List of 24	List of 24 w/Isomers	List of 28	Other: Please List Below	PFOA/ PFOS	UCMR3 PFAS List:6	PFAS List: 14	Comments
WT191114140556nA	11.14.19	1405	4189 Keewandin	2	P	DW									X	TZ

Special Instructions/Comments: **Send Results and Acknowledgements to the list provided by e-mail to Vista.**

SEND DOCUMENTATION AND RESULTS TO:

Name: MIKE JURY
Company: EGLE
Address: 401 KETCHUM ST, SUITE B
City: BAY CITY State: MI Zip: 48708
Phone: 989-894-6255 Fax: 989-891-9237
Email: dorin.bogdan@aecom.com

Container Types: P= HDPE, PJ= HDPE Jar, O = Other:

Bottle Preservation Type: T = Thiosulfate, TZ = Trizma:

Matrix Types: AQ = Aqueous, DW = Drinking Water, EF = Effluent, PP = Pulp/Paper, SD = Sediment, SL = Sludge, SO = Soil, WW = Wastewater, B = Blood/Serum, O = Other:

Vista Analytical Laboratory

Sample Log-In Checklist

Page # 1 of 1

Vista Work Order #: 1904024 TAT Std

Samples Arrival:	**Date/Time** 11/15/19 0854		**Initials:** WS		**Location:** WR-2 **Shelf/Rack:** N/A		
Delivered By:	~~FedEx~~	UPS	On Trac	GSO	DHL	Hand Delivered	Other
Preservation:	Ice		Blue Ice		Dry Ice		None
Temp °C: 2.3 (uncorrected) **Temp °C:** 2.3 (corrected)			**Probe used: Y / (N)**		**Thermometer ID:** IR-3		

	YES	NO	NA
Shipping Container(s) Intact?	✓		
Shipping Custody Seals Intact?	✓		
Airbill — Trk # 4894 6696 3514	✓		
Shipping Documentation Present?	✓		
Shipping Container: Vista / (Client) / Retain / (Return) / Dispose			
Chain of Custody / Sample Documentation Present?	✓		
Chain of Custody / Sample Documentation Complete?	✓		
Holding Time Acceptable?	✓		

Logged In:	**Date/Time** 11/15/19 1324	**Initials:** ajm	**Location:** R-13/WR-2 **Shelf/Rack:** A-2/A-5
COC Anomaly/Sample Acceptance Form completed?		✓	✓

Comments:

CoC/Label Reconciliation Report WO# 1904024

LabNumber	CoC Sample ID		SampleAlias	Sample Date/Time		Container	Sample BaseMatrix	Sample Comments
1904024-01	A WT1911141405GGA	☑	4189 Keewahdin	14-Nov-19 14:05	☑	HDPE Bottle, 250 mL	Aqueous	
1904024-01	B WT1911141405GGA	☑	4189 Keewahdin	14-Nov-19 14:05	☑	HDPE Bottle, 250 mL	Aqueous	

Checkmarks indicate that information on the COC reconciled with the sample label.
Any discrepancies are noted in the following columns.

	Yes	No	NA
Sample Container Intact?	✓		
Sample Custody Seals Intact?			✓
Adequate Sample Volume?	✓		
Container Type Appropriate for Analysis(es)	✓		
Preservation Documented: Na2S2O3 (Trizma) None Other	✓		
If Chlorinated or Drinking Water Samples, Acceptable Preservation?	✓		

Comments:

Verifed by/Date: 11/15/1985

January 02, 2020

Vista Work Order No. 1904442

Ms. Maya Murshak
Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Dear Ms. Murshak,

Enclosed are the results for the sample set received at Vista Analytical Laboratory on December 27, 2019 under your Project Name 'Biosolids / Fort Gratiot'.

Vista Analytical Laboratory is committed to serving you effectively. If you require additional information, please contact me at 916-673-1520 or by email at mmaier@vista-analytical.com.

Thank you for choosing Vista as part of your analytical support team.

Sincerely,

Martha Maier
Laboratory Director

Vista Work Order No. 1904442
Case Narrative

Sample Condition on Receipt:

One drinking water sample was received in good condition and within the method temperature requirements. The sample was received and stored securely in accordance with Vista standard operating procedures and EPA methodology.

Analytical Notes:

EPA Method 537.1

The sample was extracted and analyzed for a selected list of 18 PFAS using EPA Method 537.1. The results have been reported following the conventions specified by the Michigan Department of Environmental Quality.

Holding Times

The sample was extracted and analyzed within the method hold times.

Quality Control

The Initial Calibration and Continuing Calibration Verifications met the method acceptance criteria.

Two Laboratory Fortified Blanks (LFB/LFBD) and a Laboratory Reagent Blank (LRB) were extracted and analyzed with the preparation batch. No analytes were detected in the Laboratory Reagent Blank. The LFB/LFBD recoveries were within the method acceptance criteria.

The surrogate recoveries for all QC and field samples were within the acceptance criteria.

TABLE OF CONTENTS

Sample Inventory Report

Vista Sample ID	Client Sample ID	Sampled	Received	Components/Containers
1904442-01	WT1912180852ML	18-Dec-19 08:52	27-Dec-19 09:18	HDPE Bottle, 250 mL HDPE Bottle, 250 mL

ANALYTICAL RESULTS

Sample ID: LRB

EPA Method 537.1

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Matrix: Aqueous

Laboratory Data

Lab Sample: B9L0274-BLK1
Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	RL	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBS	375-73-5	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFHxA	307-24-4	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFHpA	375-85-9	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFHxS	355-46-4	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFOA	335-67-1	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFNA	375-95-1	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFOS	1763-23-1	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFDA	335-76-2	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
MeFOSAA	2355-31-9	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
EtFOSAA	2991-50-6	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFUnA	2058-94-8	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFDoA	307-55-1	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFTrDA	72629-94-8	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
PFTeDA	376-06-7	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
HFPO-DA	13252-13-6	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
ADONA	919005-14-4	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
9Cl-PF3ONS	756426-58-1	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
11Cl-PF3OUdS	763051-92-9	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-PFHxA	SURR	108	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
13C2-PFDA	SURR	117	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
d5-EtFOSAA	SURR	94	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1
13C3-HFPO-DA	SURR	112	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 17:29	1

RL - Reporting limit

Results reported to RL.
Reporting convention specified by MI DEQ.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: LFBD **EPA Method 537.1**

Name:	Merit Laboratories, Inc.	Lab Sample:	B9L0274-BS1/B9L0274-BSD1		
Project:	Biosolids / Fort Gratiot	QC Batch:	B9L0274	Date Extracted:	30-Dec-19
Matrix:	Aqueous	Samp Size:	0.25/0.25 L	Column:	BEH C18

Analyte	CAS Number	LFB (ng/L)	LFB Spike	LFB % Rec	LFB Quals	LFBD (ng/L)	LFBD Spike	LFBD % Rec	RPD	LFBD Quals	%Rec Limits	RPD Limits	LFB Analyzed	LFB Dil	LFBD Analyzed	LFBD Dil
PFBS	375-73-5	15	18	85		15	18	85	0		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFHxA	307-24-4	21	20	105		21	20	106	1		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFHpA	375-85-9	22	20	110		23	20	115	4		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFHxS	355-46-4	17	18	94		17	18	93	0		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFOA	335-67-1	19	20	96		19	20	97	1		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFNA	375-95-1	20	20	102		21	20	105	3		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFOS	1763-23-1	16	19	88		17	19	92	5		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFDA	335-76-2	23	20	115		23	20	114	0		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
MeFOSAA	2355-31-9	20	20	99		19	20	96	3		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
EtFOSAA	2991-50-6	19	20	97		19	20	93	4		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFUnA	2058-94-8	22	20	111		23	20	114	3		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFDoA	307-55-1	22	20	109		22	20	108	1		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFTrDA	72629-94-8	21	20	103		20	20	99	4		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
PFTeDA	376-06-7	19	20	97		19	20	96	1		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
HFPO-DA	13252-13-6	21	20	105		21	20	106	0		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
ADONA	919005-14-4	20	19	104		20	19	105	1		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
9Cl-PF3ONS	756426-58-1	16	19	84		15	19	81	3		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1
11Cl-PF3OUdS	763051-92-9	14	19	74		14	19	74	0		70-130	30	31-Dec-19 17:40	1	31-Dec-19 17:51	1

Labeled Standards	Type	LFB % Rec	LFB Quals	LFBD % Rec	LFBD Quals	Limits	LFB Analyzed	LFB Dil	LFBD Analyzed	LFBD Dil
13C2-PFHxA	SURR	111		119		70-130	31-Dec-19 17:40	1	31-Dec-19 17:51	1
13C2-PFDA	SURR	122		128		70-130	31-Dec-19 17:40	1	31-Dec-19 17:51	1
d5-EtFOSAA	SURR	99		99		70-130	31-Dec-19 17:40	1	31-Dec-19 17:51	1
13C3-HFPO-DA	SURR	114		123		70-130	31-Dec-19 17:40	1	31-Dec-19 17:51	1

Reporting convention specified by MI DEQ.

Sample ID: WT1912180852ML

EPA Method 537.1

Client Data

Name: Merit Laboratories, Inc.
Project: Biosolids / Fort Gratiot
Location: PHUR-1007-01
Matrix: Drinking Water
Date Collected: 18-Dec-19 08:52

Laboratory Data

Lab Sample: 1904442-01
Date Received: 27-Dec-19 09:18
Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	RL	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBS	375-73-5	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFHxA	307-24-4	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFHpA	375-85-9	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFHxS	355-46-4	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFOA	335-67-1	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFNA	375-95-1	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFOS	1763-23-1	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFDA	335-76-2	ND	2		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
MeFOSAA	2355-31-9	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
EtFOSAA	2991-50-6	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFUnA	2058-94-8	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFDoA	307-55-1	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFTrDA	72629-94-8	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
PFTeDA	376-06-7	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
HFPO-DA	13252-13-6	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
ADONA	919005-14-4	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
9Cl-PF3ONS	756426-58-1	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
11Cl-PF3OUdS	763051-92-9	ND	4		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-PFHxA	SURR	112	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
13C2-PFDA	SURR	121	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
d5-EtFOSAA	SURR	92	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1
13C3-HFPO-DA	SURR	114	70 - 130		B9L0274	30-Dec-19	0.25 L	31-Dec-19 18:58	1

RL - Reporting limit

Results reported to RL.
Reporting convention specified by MI DEQ..

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

DATA QUALIFIERS & ABBREVIATIONS

B	This compound was also detected in the method blank
Conc.	Concentration
CRS	Cleanup Recovery Standard
D	Dilution
DL	Detection limit
E	The associated compound concentration exceeded the calibration range of the instrument
H	Recovery and/or RPD was outside laboratory acceptance limits
I	Chemical Interference
IS	Internal Standard
J	The amount detected is below the Reporting Limit/LOQ
LOD	Limit of Detection
LOQ	Limit of Quantitation
M	Estimated Maximum Possible Concentration (CA Region 2 projects only)
NA	Not applicable
ND	Not Detected
OPR	Ongoing Precision and Recovery sample
P	The reported concentration may include contribution from chlorinated diphenyl ether(s).
Q	The ion transition ratio is outside of the acceptance criteria.
RL	Reporting Limit
TEQ	Toxic Equivalency
U	Not Detected (specific projects only)
*	See Cover Letter

Unless otherwise noted, solid sample results are reported in dry weight. Tissue samples are reported in wet weight.

Vista Analytical Laboratory Certifications

Accrediting Authority	Certificate Number
Alaska Department of Environmental Conservation	17-013
Arkansas Department of Environmental Quality	19-013-0
California Department of Health – ELAP	2892
DoD ELAP - A2LA Accredited - ISO/IEC 17025:2005	3091.01
Florida Department of Health	E87777-23
Hawaii Department of Health	N/A
Louisiana Department of Environmental Quality	01977
Maine Department of Health	2018017
Massachusetts Department of Environmental Protection	N/A
Michigan Department of Environmental Quality	9932
Minnesota Department of Health	1521520
New Hampshire Environmental Accreditation Program	207718-B
New Jersey Department of Environmental Protection	190001
New York Department of Health	11411
Oregon Laboratory Accreditation Program	4042-010
Pennsylvania Department of Environmental Protection	016
Texas Commission on Environmental Quality	T104704189-19-10
Vermont Department of Health	VT-4042
Virginia Department of General Services	10272
Washington Department of Ecology	C584-19
Wisconsin Department of Natural Resources	998036160

Current certificates and lists of licensed parameters are located in the Quality Assurance office and are available upon request.

NELAP Accredited Test Methods

MATRIX: Air	
Description of Test	**Method**
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA 23
Determination of Polychlorinated p-Dioxins & Polychlorinated Dibenzofurans	EPA TO-9A

MATRIX: Biological Tissue	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Drinking Water	
Description of Test	**Method**
2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) GC/HRMS	EPA 1613/1613B
1,4-Dioxane (1,4-Diethyleneoxide) analysis by GC/HRMS	EPA 522
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	ISO 25101 2009

MATRIX: Non-Potable Water	
Description of Test	**Method**
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Dioxin by GC/HRMS	EPA 613
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

MATRIX: Solids	
Description of Test	**Method**
Tetra-Octa Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613
Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution GC/HRMS	EPA 1613B
Brominated Diphenyl Ethers by HRGC/HRMS	EPA 1614A
Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by GC/HRMS	EPA 1668A/C
Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS	EPA 1699
Perfluorinated Alkyl Acids in Drinking Water by SPE and LC/MS/MS	EPA 537
Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans by GC/HRMS	EPA 8280A/B
Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by GC/HRMS	EPA 8290/8290A

Vista Analytical Laboratory

CHAIN OF CUSTODY

For Laboratory Use Only
Work Order #: 1904442 Temp: 3.3 °C
Storage ID: WR-2 / R-13 Storage Secured: Yes ☒ No ☐

Project ID: **Biosolids/ Fort Gratiot** PO#: **60588767** Sampler: **Mickey Leonard** (name)

TAT (check one): Standard: x 21 days; Rush (surcharge may apply): ☐ 14 days ☐ 7 days Specify:

Invoice to: Name	Company	Address	City	State	Ph#	Fax#
Stephanie Kammer	**EGLE**	**525 W. Allegan Street**	**Lansing**	**MI**	**517-897-1597**	**517-247-3571**

Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time
Garth Cousineau	12-26-19	1500	Hayden Gana	12/27/19	09:18
Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time

SHIP TO: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
(916) 673-1520 * Fax (916) 673-0106

Method of Shipment:

ATTN: Jennifer Miller

Tracking No.:

Add Analysis(es) Requested

Container(s) | Isotope Dilution Method | EPA Method (DW only)

Sample ID	Date	Time	Location/Sample Description	Quantity	Type	Matrix	PFOA/ PFOS	UCMR3 PFAS List 6	EGLE List of 24	EGLE List of 28	Other: Please List Below	Branch and Linear	PFOA/ PFOS	537 - List of 14	537.1 - List of 18	Comments
WT1912180852ML	**12/18/19**	**0852**	**PHUR-1007-01**	**2**	**P**	**DW**									**x**	**Residential well - Owner of Field 1007-01**

Special Instructions/Comments: **Send Results and Acknowledgements to the list provided**

SEND DOCUMENTATION AND RESULTS TO:

Name: **Stephanie Kammer**
Company: **EGLE**
Address: **525 W. Allegan Street, Constitution Hall, 1st South West**
City: **Lansing** State: **MI** Zip: **30242**
Phone: **517-897-1597** Fax: **517-247-3571**
Email:

Container Types: P= HDPE, PJ= HDPE Jar
O = Other: P

Bottle Preservation Type: T = Thiosulfate,
TZ = Trizma: TZ

Matrix Types: AQ = Aqueous, DW = Drinking Water, EF = Effluent, PP = Pulp/Paper, SD = Sediment, SL = Sludge, SO = Soil, WW = Wastewater, B = Blood/Serum, O = Other: DW

Vista Analytical Laboratory

Sample Log-In Checklist

Page # 1 of 1

Vista Work Order #: 1904442 TAT Std

Samples Arrival:	**Date/Time** 12/27/19 09:18		**Initials:** HOG		**Location:** WR-2 **Shelf/Rack:** NA		
Delivered By:	(FedEx)	UPS	On Trac	GSO	DHL	Hand Delivered	Other
Preservation:	(Ice)		Blue Ice		Dry Ice		None
Temp °C: 3.3 (uncorrected) / **Temp °C:** 3.3 (corrected)			**Probe used:** Y / (N)		**Thermometer ID:** IR-4		

	YES	NO	NA
Shipping Container(s) Intact?	✓		
Shipping Custody Seals Intact?			✓
Airbill — Trk # 4894 6696 4407	✓		
Shipping Documentation Present?	✓		
Shipping Container: (Vista) / Client / (Retain) / Return / Dispose			
Chain of Custody / Sample Documentation Present?	✓		
Chain of Custody / Sample Documentation Complete?	✓		
Holding Time Acceptable?	✓		

Logged In:	**Date/Time** 12/27/19 0953 ~~0943~~ KS 12/26/19	**Initials:** KS	**Location:** WR-2 / R-13 **Shelf/Rack:** E-4 / A-2	
COC Anomaly/Sample Acceptance Form completed?			✓	✓

Comments:

CoC/Label Reconciliation Report WO# 1904442

LabNumber	CoC Sample ID		SampleAlias	Sample Date/Time		Container	Sample BaseMatrix	Sample Comments
1904442-01	A WT1912180852ML	☑	PHUR-1007-01	18-Dec-19 08:52	☑	HDPE Bottle, 250 mL	Aqueous	
1904442-01	B WT1912180852ML	☑	PHUR-1007-01	18-Dec-19 08:52	☑	HDPE Bottle, 250 mL	Aqueous	

Checkmarks indicate that information on the COC reconciled with the sample label.
Any discrepancies are noted in the following columns.

	Yes	No	NA
Sample Container Intact?	✓		
Sample Custody Seals Intact?			✓
Adequate Sample Volume?	✓		
Container Type Appropriate for Analysis(es)	✓		
Preservation Documented: Na2S2O3 Trizma None Other		✓	✓
If Chlorinated or Drinking Water Samples, Acceptable Preservation?	✓		

Comments:

Verifed by/Date: HOG 12/27/19

AECOM

About AECOM

AECOM is built to deliver a better world. We design, build, finance and operate critical infrastructure assets for governments, businesses and organizations. As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges. From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM had revenue of approximately $20.2 billion during fiscal year 2019.

See how we deliver what others can only imagine at aecom.com and @AECOM.