County of Brunswick

3954 Clearwell Dr NE
Leland, NC 28451

Northwest Plant Lab

Leland, NC
Samples Received: 03/26/2020

Analytical Report
0320-757

Isotope Dilution Method

PFAS – Legacy 24, Gen-X, PFMOAA

Enthalpy Analytical, LLC – Ultratrace
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2714 Exchange Drive, Wilmington, NC 28405

I certify that to the best of my knowledge all analytical data presented in this report:

- Have been checked for completeness
- Are accurate, error-free, and legible
- Have been conducted in accordance with approved protocol, and that all deviations and analytical problems are summarized in the appropriate narrative(s)

This analytical report was prepared in Portable Document Format (.PDF) and contains 16 pages.

Juanica L. Thomas

QA Review Performed by: Juanica L. Thomas

Report Issued Date: 04/08/20

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Summary of Results

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Enthalpy Analytical

Job No.: 0320-757   PFAS by Isotope Dilution (non-potable water)

County of Brunswick   NW Plant Lab

Summary

	Compound	CAS	32620-S01 ng/L	32620-E01 ng/L
Acids	PFBA	375-22-4	ND U	ND U
	PFPeA	2706-90-3	ND U	ND U
	PFHxA	307-24-4	4.93	4.44
	PFHpA	375-85-9	2.41	2.50
	PFOA	335-67-1	3.96	3.85
	PFNA	375-95-1	0.438	0.435
	PFDA	335-76-2	0.213	0.205 J
	PFUnDA	2058-94-8	ND U	ND U
	PFDoDA	307-55-1	ND U	ND U
	PFTrDA	72629-94-8	ND U	ND U
	PFTeDA	376-06-7	ND U	ND U
Sulfonates	PFBS	375-73-5	ND U	ND U
	PFPeS	2706-91-4	ND U	ND U
	PFHxS	355-46-4	3.29	2.81
	PFHpS	375-92-8	ND U	ND U
	PFOS	1763-23-1	6.69	6.29
	PFNS	68259-12-1	ND U	ND U
	PFDS	335-77-3	ND U	ND U
	4:2 FTS	757124-72-4	ND U	ND U
	6:2 FTS	27619-97-2	0.280	0.167 J
	8:2 FTS	39108-34-4	ND U	ND U
Other	PFOSA	754-91-6	ND U	ND U
	N-MeFOSAA	2355-31-9	ND U	ND U
	N-EtFOSAA	2991-50-6	ND U	ND U
	HFPO-DA	13252-13-6	15.4	14.5
	PFMOAA	674-13-5	8.72	7.07

QC Data

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Job No.: 0320-757 PFAS by Isotope Dilution (non-potable water)

County of Brunswick NW Plant Lab

Enthalpy ID	MB-10798-PFAS	Prep Batch	EU10798	Sample Vol (mL)	250
Sample Name	MB-10798-PFAS	Prep Date	2020-03-27	Extract Vol (mL)	0.4
Matrix		Analysis Date	2020-03-27	Dilution Factor	1
Sampling Date					

	Compound	CAS	Extract Concentration ng/L	Sample Concentration ng/L	Formatted Result ng/L	LOD ng/L	LOQ ng/L	Recovery	Flags
Acids	PFBA	375-22-4	ND	ND	ND	0.157	0.240		U
	PFPeA	2706-90-3	ND	ND	ND	0.0898	0.240		U
	PFHxA	307-24-4	ND	ND	ND	0.158	0.240		U
	PFHpA	375-85-9	ND	ND	ND	0.0695	0.240		U
	PFOA	335-67-1	ND	ND	ND	0.0795	0.240		U
	PFNA	375-95-1	ND	ND	ND	0.0509	0.240		U
	PFDA	335-76-2	ND	ND	ND	0.125	0.240		U
	PFUnDA	2058-94-8	ND	ND	ND	0.0481	0.240		U
	PFDoDA	307-55-1	ND	ND	ND	0.0475	0.240		U
	PFTrDA	72629-94-8	ND	ND	ND	0.0745	0.240		U
	PFTeDA	376-06-7	ND	ND	ND	0.0830	0.240		U
Sulfonates	PFBS	375-73-5	ND	ND	ND	0.0830	0.240		U
	PFPeS	2706-91-4	ND	ND	ND	0.0990	0.240		U
	PFHxS	355-46-4	ND	ND	ND	0.0827	0.240		U
	PFHpS	375-92-8	ND	ND	ND	0.0779	0.240		U
	PFOS	1763-23-1	ND	ND	ND	0.0471	0.240		U
	PFNS	68259-12-1	ND	ND	ND	0.0654	0.240		U
	PFDS	335-77-3	ND	ND	ND	0.135	0.240		U
	4:2 FTS	757124-72-4	ND	ND	ND	0.0646	0.240		U
	6:2 FTS	27619-97-2	ND	ND	ND	0.0723	0.240		U
	8:2 FTS	39108-34-4	ND	ND	ND	0.0569	0.240		U
Other	PFOSA	754-91-6	ND	ND	ND	0.365	0.366		U
	N-MeFOSAA	2355-31-9	ND	ND	ND	0.0544	0.240		U
	N-EtFOSAA	2991-50-6	ND	ND	ND	0.0651	0.240		U
	HFPO-DA	13252-13-6	ND	ND	ND	0.0951	0.240		U
ES	MPFBA		5398.33	8.64				67.4%	
	M5PFPeA		5787.82	9.26				71.6%	
	M3PFBS		5428.83	8.69				70.2%	
	M2-4:2 FTS		5465.57	8.74				82.0%	
	M5PFHxA		5299.03	8.48				76.2%	
	M3HFPO-DA		7037.49	11.3				94.1%	
	M4PFHpA		5224.68	8.36				75.2%	
	M3PFHxS		4574.48	7.32				72.6%	
	M2-6:2 FTS		4983.84	7.97				69.1%	
	M8PFOA		5157.11	8.25				75.5%	
	M9PFNA		5201.04	8.32				75.4%	
	M8PFOS		4787.43	7.66				75.2%	
	M2-8:2 FTS		4528.07	7.24				77.1%	
	M8FOSA-I		4103.40	6.57				61.3%	
	M6PFDA		5692.91	9.11				76.7%	
	d3-N-MeFOSAA		4984.56	7.98				77.7%	
	d5-N-EtFOSAA		6842.08	10.9				103.7%	
	M7PFUdA		6198.29	9.92				77.8%	
	MPFDoA		5673.83	9.08				68.2%	
	M2PFTeDA		4369.98	6.99				47.8%	

Narrative Summary

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Enthalpy Analytical Narrative Summary

Company	County of Brunswick
Job No.	0320-757 PFAS by Isotope Dilution (non-potable water)
Client ID.	Site: NW Plant Lab

1. Custody

Braidy May received the samples on 03/26/20 at 5.2°C after being relinquished by County of Brunswick. The samples were received in good condition.

Prior to, during, and after analysis, the samples were kept under lock with access only to authorized personnel by Enthalpy Analytical, LLC.

Table 1 - Sample Inventory

EU Lab Sample ID	Client Sample ID	Matrix
0320-757-002-1	32620-E01	Aqueous
0320-757-001-1	32620-S01	Aqueous

2. Methods and analytes

A list of analytes of interest and corresponding methods of analysis is shown in Table 3. Abbreviations are defined in the listed Appendices. The following methods were used for sample preparation:

Table 3 - Methods and Analytes

EU Method	Analytes	Cleanup Method
EU047	Legacy 24 + Gen X + PFMOAA	Envi-Carb

3. Analysis

The samples were analyzed using Waters Acquity UPLC equipped with Xevo TQ MS (LC/MS/MS "Kili").

For aqueous samples, the sample volume was measured gravimetrically by the laboratory, and spiked with Extraction Standard (ES). The sample was then mixed well and centrifuged.

Cleanup procedures were performed on the supernatant and then extracted via SPE. Each final sample extract was transferred to an autosampler vial and spiked with 400µL of Injection Standard (IS), prior to analysis.

4. Calibration

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Enthalpy Analytical Narrative Summary

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In the initial calibration, the analytes of interest met the R^2 coefficient correlation criterion and labeled standards exhibited RSDs less than 20%. The calibration standards, continuing calibration (concal) and Internal Calibration Verification (ICV) met the 30% criterion for native analytes.

5. QC Notes

Except where noted below, the QC sample analyses passed all method criteria.

QC samples that did not meet method acceptance criteria were: OPR-10798-PFAS PFBS

The aforementioned analyte fell outside the lower limit of method criteria but fell within the marginal exceedance criteria. Therefore, data accepted. Additionally, samples not affected due to non-detects of the analyte.

The samples were extracted within the 14-day from collection holding time and analyzed within the 28-day from extraction to analysis holding time required by the method.

6. Reporting Notes

Some labeled standards in the samples fell outside the limits for ES recoveries. The target analytes are quantified based on their ratio to the labeled standards, therefore, undergo the same losses as the labeled standards. As a result, low or high recoveries do not cause any change to ratios or contribute any additional error in the measurement of the target analytes. Therefore, the data are considered acceptable.

The results presented in this report are representative of the samples as provided to the laboratory.

These analyses met the requirements of the TNI Standard. Gen-X and PFMOAA are not accredited under TNI. Any deviations from the requirements of the reference method or TNI Standard have been stated above.

Enthalpy Analytical, LLC in Wilmington NC is accredited by the Louisiana Department of Environmental Quality to the 2009 TNI Standard under certificate number 05075.

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General Reporting Notes – Data Qualifiers

The following are general reporting notes that are applicable to all Enthalpy Analytical, LLC - Wilmington, NC data reports, unless specifically noted otherwise.

General Data Qualifiers

- B – The analyte was found in the method blank, at a concentration that was at least 10% of the concentration in the sample.
- Cxx – Two or more congeners co-elute. In EDDs, C denotes the lowest IUPAC congener in a co-elution group and additional co-eluters for the group ('xx') are shown with the number of the lowest IUPAC co-eluter**.**
- E – The reported concentration exceeds the calibration range (upper point of the calibration curve). For HRMS data, this condition does not imply additional measurement uncertainty. For LC-MS/MS data, these values should be considered as having measurement uncertainty higher than values within the calibration range.
- EDL – Estimated Detection Level. Specific to Dioxin/Furan tests and equivalent to MDL
- EMPC – Estimated Maximum Possible Concentration Specific to Dioxin/Furan tests to indicate the signal/noise ratio wass not sufficient for peak identification (the determined ion-abundance ratio was outside the allowed theoretical range), or where there was a co-eluting interference. Indicates that a peak was identified but did not meet the method specified ion-abundance ratio.
- IR – The ion ratio between the primary and secondary ions was observed to be outside the method criteria therefore the actual analyte concentration cannot be accurately determined as defined by DoD QSM Table B-15.
- J – The analyte has a concentration below the minimum calibration level (LOQ value) but greater than the LOD. These values should be considered as having measurement uncertainty higher than values within the calibration range
- L - Indicates that an analyte has a concentration below the Minimum Detection Limit (MDL). The reported concentration is not recommended for regulatory use as the analyte signal may have a signal-to-noise ratio less than the criteria deemed necessary to be considered a detected analyte.
- LOD – Limit of Detection: For reports conforming to the DOD ELAP QSM, this is the QSM-defined LOD. For reports conforming to TNI requirements (but not DOD ELAP QSM requirements), this value is the minimum detection limit (MDL). The LOD is adjusted for sample weight or volume.
- LOQ – Limit of Quantiation: For reports conforming to the DOD ELAP QSM, this is the QSM-defined LOQ. For reports conforming to TNI requirements (but not DOD ELAP QSM requirements), this value is the reporting limit (RL). The LOD is adjusted for sample weight or volume.
- <LOD() – Analyte was not found at a concentration high enough to be reported as detected. It is reported as less than the LOD, and the LOD is given in the parentheses.

- ND – Indicates a non-detect.
- NR – Indicates a value that is not reportable due to issues observed in sample preparation or analysis.
- PR – The associated congener(s) is(are) poorly resolved.
- QI – Indicates the presence of a quantitative interference.
- RL – Reporting Limit. Lowest reportable value. The level is higher than the MDL.
- SI – Denotes "Single Ion Mode" and is utilized for PCBs where the secondary ion trace has a significantly elevated noise level due to background PFK. Responses for such peaks are calculated using an EMPC approach based solely on the primary ion area(s) and may be considered estimates.
- U – The analyte was not detected.
- V – The labeled standard recovery is not within method control limits.
- X – Results from re-injection/repeat/second-column analysis.

Lab Identifiers/ Data Attributes

- AR – Indicates use of the archived portion of the sample extract.
- CU – Indicates a sample that required additional clean-up prior to HRMS injection/processing.
- D – Dilution Data. Result was obtained from the analysis of a dilution. The number that follows the "D" indicates the dilution factor.
- DE – Indicates a dilution performed with the addition of ES (Extraction Standard) solution.
- DUP – Designation for a duplicate sample.
- MS – Designation for a matrix spike.
- MSD – Designation for a matrix spike duplicate.
- RJ – Indicates a reinjection of the sample extract.
- S – Indicates a sample split. The number that follows the "S" indicates the split factor.
- R – Indicates a re-extraction of the sample.

PFAS Compound Acronym List	
Acronym	**Compound Name**
Target Analytes	
PFBA	Perfluorobutanoic Acid
PFPeA	Perfluoropentanoic Acid
PFHxA	Perfluorohexanoic Acid
PFHpA	Perfluoroheptanoic Acid
PFOA	Perfluorooctanoic Acid
PFNA	Perfluorononanoic Acid
PFDA	Perfluorodecanoic acid
PFUnA (PFUnDA)	Perfluoroundecanoic acid
PFDoA (PFDoDA)	Perfluorododecanoic acid
PFTrDA (PFTriA)	Perfluorotridecanoic acid
PFTeDA (PFTA)	Perfluorotetradecanoic acid
PFBS	Perfluorobutane sulfonic acid
PFPeS	Perfluoropentane sulfonic acid
PFHxS	Perfluorohexane sulfonic acid
PFHpS	Perfluoroheptane sulfonic acid
PFOS	Perfluorooctane sulfonic acid
PFNS	Perfluorononane sulfonic acid
PFDS	Perfluorodecane sulfonic acid
4:2 FTS	4:2 fluorotelomer sulfonic acid
6:2 FTS	6:2 fluorotelomer sulfonic acid
8:2 FTS	8:2 fluorotelomer sulfonic acid
PFOSA (FOSA)	Perfluorooctane sulfonamide
N-MeFOSAA	N-methyl perfluorooctane sulfonamido acetic acid
N-EtFOSAA	N-ethyl perfluorooctane sulfonamido acetic acid
HFPO-DA	2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (Gen-X)
11Cl-PF3OUdS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
9Cl-PF3ONS	9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid
DONA	4,8-dioxa-3H-perfluorononanoic acid
PFMOAA	Perfluoro-2-methoxyacetic acid
PFMOPrA	Perfluoro-3-methoxypropanoic acid
PFO2HxA	Perfluoro (3,5-dioxahexanoic) acid
PFO3OA	Perfluoro (3,5,7-trioxaoctanoic) acid
PFO4DA	Perfluoro (3,5,7,9-tetraoxadecanoic) acid
Nafion Byproduct 1	Nafion Byproduct 1
Extraction Standards	
MPFBA	Perfluoro-n-[13C4]butanoic acid
M5PFPeA	Perfluoro-n-[13C5]pentanoic acid
M3PFBS	Sodium perfluoro-1-[2,3,4-13C3]-butanesulfonic acid
M2-4:2 FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-hexane sulfonic acid
M5PFHxA	Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid

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M3HFPO-DA	2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-13C3-propanoic acid
M4PFHpA	Perfluoro-n-[1,2,3,4-13C4]heptanoic acid
M3PFHxS	Sodium perfluoro-1-[1,2,3-13C3]-hexanesulfonic acid
M2-6:2 FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-octane sulfonic acid
M8PFOA	Perfluoro-n-[13C8]octanoic acid
M9PFNA	Perfluoro-n-[13C9]nonanoic acid
M8PFOS	Sodium perfluoro-1-[13C8]-octanesulfonic acid
M2-8:2 FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-13C2]-decane sulfonic acid
M8FOSA	Perfluoro-1-[13C8]octanesulfonamide
M6PFDA	Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid
d3-N-MeFOSAA	N-methyl-d3-perfluoro-1-octanesulfonamide
d5-N-EtFOSAA	N-ethyl-d5-perfluoro-1-octanesulfonamide
M7PFUnDA (M7PFUdA)	Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid
MPFDoA	Perfluoro-n-[1,2-13C2]dodecanoic acid
M2PFTeDA	Perfluoro-n-[1,2-13C2]tetradecanoic acid
Injection Standards	
M3PFBA	Perfluoro-n-[2,3,4-13C3]butanoic acid
M2PFOA	Perfluoro-n-[1,2-13C2]octanoic acid
MPFDA	Perfluoro-n-[1,2-13C2]decanoic acid
MPFOS	Sodium perfluoro-1-[1,2,3,4-13C4]-octanesulfonic acid

Sample Custody

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Chain of Custody Record

Enthalpy Ultratrace Job#: ________ COC Page____of____

Special Handling:

☐ Standard Turn Around Time

☐ Rush Turn Around Time -- Date Needed________

- All Fast TATs Subject to Approval by Enthalpy Analytical, Inc.
- All Samples Disposed of After 6 months Unless Otherwise Instructed.

Enthalpy Analytical-Wilmington, NC has added enhancements to standard methods to improve accuracy, precision and permit an assessment of laboratory performance in the context of your specific data needs. For more information email Cindy.James@enthalpy.com.

Client Name: Brunswick County Water
Project Manager: Glenn Walker
Report To: Same

Project Number: ________
Site Name: NW Plant Lab
Location: Leland

PO#: ________
Telephone#: ________
Email: ________

This Chain of Custody is applicable to Non-Air samples. Standard TAT differ per analysis and are provided by request.

Client Special Instructions:

Matrix: GW-Groundwater, WW-Wastewater, NW-Non-Potable Water, DW-Drinking Water, S-Soil, SL-Sludge, BT-Biological Tissue, O-Other

Type: G=Grab C=Composite Q=Quality Control

						Sample Containers							Analyses:								
Sample ID	Date	Time	Sample Volume	Type	Matrix	# of Bottles	# of Jars	# of Bags	# Other				Method 1613	Method 8290	Method 1668A/B/C PCB	PFAS by LC/MS/MS	PAHs by HRGC/HRMS	Sample on Hold	EPA 537 + GenX PFMOAA		Notes:
32620 S01	3-26-20	0730	250mL	G	NW	2													✓		
32620 E01	3-26-20	0730	250mL	G	DW	2													✓		

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Temperature Upon Receipt:
[illegible]	3-26-20	[illegible]	3/26/20	13:15	☑ Iced ☐ Ambient °C 5.2 T9
					☐ Iced ☐ Ambient °C______
					☐ Iced ☐ Ambient °C______

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courier, no seal, cooler, good condition, BM 3/26/20

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