County of Brunswick

3954 Clearwell Dr NE
Leland, NC 28451

Northwest Plant Lab / 211 WTP

Leland, NC / Southport, NC
Samples Received: 02/06/2020

Analytical Report
0220-710

Isotope Dilution Method

PFAS – NPW Legacy 24, Gen-X, PFMOAA

Enthalpy Analytical, LLC – Ultratrace

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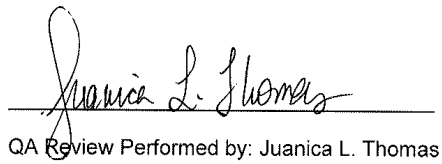
I certify that to the best of my knowledge all analytical data presented in this report:

- 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.



QA Review Performed by: Juanica L. Thomas

Report Issued Date: 02/20/20

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Summary of Results

Enthalpy Analytical

Job No.: 0220-710 PFAS by Isotope Dilution (non-potable water)

County of Brunswick Client ID: N/A Site: NW Plant Leland/211 WTP

Summary

	Compound	CAS	Method Blank ng/L	020620-S01 ng/L	020620-E01 ng/L	020520-E02 ng/L
Acids	PFBA	375-22-4	ND U	ND U	ND U	ND U
	PFPeA	2706-90-3	ND U	ND U	ND U	ND U
	PFHxA	307-24-4	0.0622 JL-IR	8.06	7.83	ND U
	PFHpA	375-85-9	ND U	4.95	4.74	ND U
	PFOA	335-67-1	0.126 J-IR	4.57 IR	3.68	ND U
	PFNA	375-95-1	ND U	0.719	0.483 IR	ND U
	PFDA	335-76-2	0.130 J-IR	0.371 IR	0.221 IR	ND U
	PFUnDA	2058-94-8	ND U	ND U	ND U	ND U
	PFDoDA	307-55-1	0.174 J	ND U	ND U	ND U
	PFTrDA	72629-94-8	ND U	ND U	ND U	ND U
	PFTeDA	376-06-7	0.554 IR	ND U	ND U	0.0145 JLB-IR
Sulfonates	PFBS	375-73-5	ND U	ND U	ND U	ND U
	PFPeS	2706-91-4	ND U	ND U	ND U	ND U
	PFHxS	355-46-4	ND U	2.71	2.02	ND U
	PFHpS	375-92-8	ND U	ND U	ND U	ND U
	PFOS	1763-23-1	ND U	6.41 IR	3.37 IR	0.113 J-IR
	PFNS	68259-12-1	ND U	ND U	ND U	ND U
	PFDS	335-77-3	ND U	ND U	ND U	ND U
	4:2 FTS	757124-72-4	ND U	ND U	ND U	ND U
	6:2 FTS	27619-97-2	ND U	0.372	0.466 IR	ND U
	8:2 FTS	39108-34-4	ND U	ND U	ND U	ND U
Other	PFOSA	754-91-6	ND U	ND U	ND U	ND U
	N-MeFOSAA	2355-31-9	ND U	ND U	ND U	ND U
	N-EtFOSAA	2991-50-6	ND U	ND U	ND U	ND U
	HFPO-DA	13252-13-6	ND U	2.87 J	2.93 J	ND U
	PFMOAA	674-13-5	ND U	23.0	21.2	2.26
Lab ID			MB-10680-PFAS	0220-710-001-1	0220-710-002-1	0220-710-003-1

Narrative Summary

Enthalpy Analytical Narrative Summary

Company	County of Brunswick
Job No.	0220-710 PFAS by Isotope Dilution (non-potable water)
Client ID.	N/A Site: NW Plant Leland/211 WTP

1. Custody

Robin Appelle received the samples on 02-06-20 at 5.6°C on ice after being relinquished by the 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
0220-710-003-1	020520-E02	Aqueous
0220-710-002-1	020620-E01	Aqueous
0220-710-001-1	020620-S01	Aqueous

Table 2 - Sample Inventory – not analyzed

EU Lab Sample ID	Client Sample ID

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:

NPW

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

Enthalpy Analytical Narrative Summary

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Client ID.	N/A Site: NW Plant Leland/211 WTP

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

In the initial calibration, the analytes passed the R^2 coefficient correlation criteria. The internal calibration verification (ICV) and continuing calibration (concal) met the ±30% criteria for all native analytes.

5. QC Notes

The initial analysis did not meet method criteria for several OPR analytes. All samples were reinjected and reported below.

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

QC samples that did not meet method acceptance criteria were:

ES Recoveries

MB-10680-PFAS M3HFPO-DA

The ES recovery above fell outside the upper limits. There is no impact on data due to this analyte meeting method criteria in the OPR.

Analytes

OPR-10680-PFAS PFBS
MB-10680-PFAS PFDA
MB-10680-PFAS PFDoDA
MB-10680-PFAS PFHxA
MB-10680-PFAS PFOA
MB-10680-PFAS PFTeDA

PFBS in the OPR did not meet method criteria but met marginal exceedance criteria, therefore data is accepted. The above analytes detected in the method blank (MB) were below the Reporting Limit (RL) with values more than 1/10 the sample amount. Any analytes detected in the samples affected by the MB amount were notated

with a "B" qualifier.

The samples were extracted within the 14-day from collection holding time. Extracts were analyzed within the 28-days 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. Because the target analytes are quantified based on their ratio to the labeled standards and undergo the same losses as the labeled standards, low or high recoveries do not cause any change to those ratios or result in 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 is 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)
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
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 analytical

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: N.W. PLANT
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 ID	Date	Time	Sample Volume	Type	Matrix	Sample Containers: # of Bottles	# of Jars	# of Bags	# Other	Analyses: Method 1613	Method 8290	Method 1668A/B/C PCB	PFAS by LC/MS/MS	PAHs by HRGC/HRMS	Sample on Hold	Method 23	EPA-537+6ENX PFMOAA	Notes:
020620-S01	2-6-20	0755	250 mL	G	NW	2											✓	
020620-E01	2-6-20	0755	250 mL	G	DW	2											✓	

Relinquished By:	Date:	Received By:	Date:	Time:	Sample Temperature Upon Receipt:
			2/6/20	1430	☒ Iced ☐ Ambient °C 5.6 T9
					☐ Iced ☐ Ambient °C_____
					☐ Iced ☐ Ambient °C_____

Client Courier, on Ice, No seals, Good condition NA 2/6/20

0220-710 2 of 2

Chain of Custody Record

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Enthalpy Ultratrace Job#: _____ COC Page____of____

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Client Name: BRUNSWICK COUNTY WATER
Project Manager: GLENN WALKER
Report To: SAME

Project Number:
Site Name: 211 WTP
Location: SOUTH POINT

PO#:
Telephone#:
Email:

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

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

Sample ID	Date	Time	Sample Volume	Type	Matrix	Sample Containers: # of Bottles	# of Jars	# of Bags	# Other	Analyses: Method 1613	Method 8290	Method 1668A/B/C PCB	PFAS by LC/MS/MS	PAHs by HRGC/HRMS	Sample on Hold	EPA 537 + 6624 PFAMA	Notes:
020520-E02	2-5-20	11:55 AM	250mL	G	DW	2										✓	

Relinquished By: _____ Date: 2.6.20

Received By: _____ Date: 2/6/20 Time: 1430

Sample Temperature Upon Receipt:
- ☑ Iced ☐ Ambient °C 5.6 T9
- ☐ Iced ☐ Ambient °C_____
- ☐ Iced ☐ Ambient °C_____

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Client Courier, 0 - Ice, No seals, Good condition M 2/6/20

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