North Carolina Collective Study Report

Collective Study of PFAS and 1,4-Dioxane in Landfill Leachate and Estimated Influence on Wastewater Treatment Plant Facility Influent

National Waste & Recycling Association - Carolinas Chapter

H&H Job No. NWA-001
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1.0 Introduction

Hart & Hickman, PC (H&H) has prepared this North Carolina Collective Study Report on behalf of the Carolinas Chapter of the National Waste & Recycling Association (NWRA) and certain member companies. This report documents the results of a study of perfluoroalkyl and polyfluoroalkyl substances (PFAS) and 1,4-dioxane in municipal solid waste landfill (MSWLF) leachate and its possible influence on wastewater treatment plant (WWTP) facility influent.

In February 2019, the North Carolina Department of Environmental Quality (NCDEQ) met with representatives of the landfill industry to discuss the potential presence of PFAS and 1,4-dioxane in leachate as part of a statewide effort to better understand the presence of these emerging chemicals in the environment. During the meeting, NCDEQ inquired about sampling landfill leachate to begin to understand PFAS and 1,4-dioxane content and its influence on leachate treatment/disposal practices, including publicly owned WWTPs that receive leachate for treatment. Rather than participating landfills sampling and reporting individually, representatives of the landfill industry agreed to participate in a collective study involving active MSWLFs in North Carolina. From these discussions with NCDEQ, the Carolinas Chapter of the NWRA committed to collect leachate samples from nine privately-owned or operated MSWLFs, including four landfills that transport leachate to WWTPs located within the Cape Fear River Basin and five landfills that transport leachate to WWTPs located across the remainder of the State. This report documents the scope and results of the sampling program. Where available, the results of the sampling were evaluated in conjunction with WWTP influent volumes and published sampling data in order to estimate the relative contribution of landfill leachate to overall WWTP influent mass of PFAS and 1,4-dioxane. The goals and objectives of the sampling program were presented to NCDEQ in a Scoping Document, dated August 8, 2019. NCDEQ issued a letter, dated August 14, 2019, concurring with the plan outlined in the Scoping Document.

This North Carolina Collective Study Report is organized into sections to include the following:

- General overview of PFAS and 1,4-dioxane in landfill leachate, including background information, waste management system considerations, a summary of previous studies, and North Carolina regulatory status;
- Description of sampling activities and results; and
- Discussion of the WWTPs receiving the landfill leachate and calculations related to estimating the contribution of landfill leachate to overall WWTP influent mass.

2.0 General Overview

2.1 Background Information

PFAS are a group of man-made chemicals that have been manufactured and used in a variety of industries worldwide since the 1940s. The most extensively produced and studied PFAS compounds are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS). Another notable PFAS compound is 2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA), which has the trade name GenX and is used in manufacturing nonstick coatings (United States Environmental Protection Agency [EPA], 2019a).

PFAS have been used to make a variety of consumer products that are resistant to water, grease, or stains. PFAS have also been used in firefighting foams and various industrial processes (Interstate Technology and Regulatory Council [ITRC], 2017). PFAS do not occur naturally, but are widespread in the environment and have been found in people, wildlife, and fish all over the world. Certain PFAS can accumulate in the human body for long periods of time and do not break down easily in the environment (Agency for Toxic Substances and Disease Registry [ATSDR], 2020).

PFOS and PFOA have been largely phased out by industry in the United States, with this phase-out beginning in the early 2000s. However, PFOS and PFOA are still being produced internationally and imported into the United States in consumer goods. Landfills receive a large variety of residential and industrial waste containing PFAS compounds (see inset) (ITRC, 2017).

Products/Wastes with Potential PFAS

- Consumer products
  - Paper and packaging
  - Clothing and carpets
  - Outdoor textiles and sporting equipment
  - Ski and snowboard waxes
  - Non-stick cookware
  - Cleaning agents and fabric softeners
  - Polishes and waxes
  - Pesticides and herbicides
  - Hydraulic fluids
  - Windshield wipers
  - Paints, varnishes, dyes, and inks
  - Adhesives
  - Medical products
  - Personal care products (for example, shampoo, hair conditioners, sunscreen, cosmetics, toothpaste, dental floss)
- Sewage sludge
- Industrial wastes
- Auto shredder residue
- Debris from fire cleanup
- Discarded AFFF
- Other sources

PFAS are considered to be contaminants of emerging concern (CECs). CECs are chemicals that present known or potential human health effects or environmental risks, but either do not have regulatory cleanup standards or regulatory standards are evolving due to new science, detection capabilities or pathways, or both (ITRC, 2017). PFAS were the primary focus of the North Carolina Collective Study; however, at the request of the NCDEQ, another CEC, 1,4-dioxane, was also included in the sampling and analytical program. 1,4-Dioxane has been used as a solvent in the manufacture of other chemicals, as a stabilizer for chlorinated solvents, and as a laboratory reagent. It can also be found as a by-product in many consumer and industrial products (EPA, 2017a, ATSDR, 2011, and ATSDR, 2012) (see inset). Disposal of these products in landfills can result in 1,4-dioxane in landfill leachate (Maine Department of Environmental Protection [MDEP], 2020).

Products/Wastes with Potential 1,4-Dioxane

- Consumer products
  - Household cleaners
  - Detergents
  - Shampoos
  - Deodorants
  - Cosmetics
  - Food supplements
- Paint
- Paint strippers
- Dyes
- Greases
- Antifreeze
- Aircraft deicing fluids
- Adhesives
- Pesticides
- Industrial wastes
- Laboratory wastes

2.2 Waste Management System Considerations

Landfills and WWTPs play an important role in managing wastes for our communities. It is important to note that landfills and WWTPs are receivers of PFAS and 1,4-dioxane and are not the producers or original sources. Rather, consumer products and other wastes disposed of in these facilities represent the source. Modern landfills are well-engineered and managed facilities designed to protect the environment from contaminants that may be present in the waste stream. MSWLFs must meet stringent regulatory requirements (see inset) (EPA, 2017b). North Carolina Administrative Code (NCAC) Title 15A Subchapter 13B requires that MSWLF liner systems include either 1) a geomembrane liner installed above and in direct and uniform contact with a compacted clay liner with a minimum thickness of 24 inches and a permeability

MSWLF Regulatory Requirements

- Location restrictions
- Composite liner requirements
- Leachate collection and removal systems
- Operating practices
- Federal, state, and local environmental monitoring requirements (groundwater, surface water, stormwater, air, leachate)
- Closure and post-closure care requirements
- Corrective action provisions
- Financial assurance
- Others

of no more than 1.0 x 10^{-7} cm/sec or 2) a geomembrane liner installed above and in direct and uniform contact with a geosynthetic clay liner (GCL) overlying a compacted clay liner with a minimum thickness of 18 inches and a permeability of no more than 1.0 x 10^{-5} cm/sec. Landfill leachate is generated from rainfall travelling through landfill waste or liquids within the waste itself. The leachate is effectively captured through liner and leachate collection systems. A common method of leachate disposal is discharge to a local publicly-owned WWTP where it is handled with other household, commercial, and various industrial wastewaters. Management of leachate in this way provides for a closed system where there is no direct exposure to the public (NTH Consultants, Ltd. [NTH], 2019).

Because PFAS and 1,4-dioxane are so ubiquitous, publicly-owned WWTPs receive wastewater from multiple sources that may contain PFAS and 1,4-dioxane. In addition to landfill leachate, other potential sources containing PFAS and/or 1,4-dioxane include wastewater from industrial, commercial, and agricultural operations and domestic sewage generated from homes, workplaces, and other public and private facilities. Biosolids (sewage sludge) from WWTPs may contain PFAS compounds (EPA, 2018; MDEP, 2020a; Michigan Department of Environment, Great Lakes, and Energy, 2020). Biosolids are commonly disposed of via land application, incineration, or landfilling. Because MSWLFs are strictly regulated and include liners and leachate collection systems engineered to prevent releases of pollutants to the environment, disposal of biosolids in MSWLFs may represent the preferred management option.

2.3 Other Related Studies

NTH, on behalf of the Michigan Waste & Recycling Association (MWRA), recently performed a statewide study of landfill leachate PFAS impacts on WWTP influent in the State of Michigan (herein referred to as the Michigan Study). This effort represented one of the largest studies conducted on active landfill leachate to date. The results of the study were documented in a Technical Report dated March 1, 2019 (NTH, 2019). Testing performed as part of the Michigan Study included collection of leachate samples from 32 active MSWLFs located in the State of Michigan and analysis of the samples for PFOS and PFOA. Data related to leachate disposal methods and volumes were gathered for each of the MSWLFs tested. The results were evaluated

with respect to publicly available sampling data for WWTPs located across the State of Michigan. The North Carolina Collective Study presented in this report was performed using an approach similar to the Michigan Study. The results of the Michigan Study are discussed in conjunction with the results of the North Carolina Collective Study in Sections 3.4 and 4.0 of this report.

The Michigan Study also included a review of literature related to PFAS in landfill leachate. The literature review identified two key publications: National Estimate of Per- and Polyfluoroalkyl Substances (PFAS) Release to U.S. Municipal Landfill Leachate (Lang et al, 2017) and Review of the Fate and Transformation of Per- and Polyfluoroalkyl Substances (PFASs) in Landfills (Hamid et al, 2018). Lang et al (2017) evaluated the concentrations of PFAS compounds in 95 samples of leachate from landfills of varying climates and waste ages in the United States. According to the summary presented in the Michigan Study report, Lang et al demonstrated that PFOA and PFOS concentrations in leachate generally have been decreasing over time, with greater rates of decline in humid regions. Hamid et al (2018) compiled data from 11 literature sources that document PFAS leachate concentrations from dozens of landfills and more than 162 leachate samples from across the globe. The data show that PFOS and PFOA concentrations vary widely in different regions of the world, and are likely reflective of the consumer products and industrial materials used, produced, and disposed in each country. Reported concentrations for landfills in China were notably higher than elsewhere, which is likely due to the continued production of consumer goods containing PFAS and associated industrial waste from the manufacturing processes. Note that PFAS-containing products manufactured in China and other countries are often imported into the United States for purchase and eventually disposed of in United States landfills. PFOS and PFOA concentration data based on the literature review performed during the Michigan Study are summarized in **Table 1** and depicted in **Figure 1**.

Additional studies of PFAS in landfill leachate are underway since the date of the Michigan Study. Locally, the North Carolina Policy Collaboratory (NC Collaboratory) has funded research being performed by the NC PFAS Testing (PFAST) Network. The NC Collaboratory was established by the North Carolina General Assembly in 2016 to facilitate and fund research and make recommendations to the General Assembly. The PFAST Network consists of investigators from

various NC universities performing multiple studies related to PFAS. One of these studies is being led by Dr. Morton Barlaz at North Carolina State University and focuses on PFAS in landfill leachate. The purpose of the study is to assess the relative importance of MSWLFs and domestic wastewater as contributors of PFAS to WWTPs and potentially to surface water (PFAST Network, 2019). The results of the PFAST Network study have not yet been published and therefore could not be incorporated into the North Carolina Collective Study documented in this report.

No comprehensive studies have been identified regarding 1,4-dioxane concentrations in landfill leachate. More data are available regarding 1,4-dioxane concentrations in public water systems (PWS). Monitoring of 1,4-dioxane in PWS was required by the EPA Third Unregulated Contaminant Monitoring Rule (UCMR 3). Adamson et al (2017) documents an evaluation of 1,4-dioxane concentrations in PWS located across the United States based on data collected under the UCMR 3. The results of the study identified detectable concentrations of 1,4-dioxane in 21% of 4,864 PWS. The study concluded that the data indicated a decreasing trend in concentrations and detection frequency over time. The study also concluded that detections of 1,4-dioxane were highly associated with detections of other chlorinated solvent compounds, which is attributed to the use of 1,4-dioxane as a solvent stabilizer.

2.4 Regulatory Status

The regulatory status of PFAS and 1,4-dioxane are currently evolving as additional studies are completed regarding human health risks and ecological effects. No regulatory standards or screening levels have been developed by EPA or the State of North Carolina that are applicable to landfill leachate. Levels that have been established for drinking water are summarized below, but it should be noted that these levels do not apply to landfill leachate.

PFAS

EPA has not adopted Federal regulatory standards or Maximum Contaminant Levels (MCLs) for PFAS compounds to date. EPA has established a Health Advisory Level for combined or individual PFOS and PFOA of 70 nanograms per liter (ng/L, equivalent to parts per trillion). EPA's

health advisories are non-enforceable and non-regulatory but provide technical information to state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination (EPA, 2019b).

North Carolina also has not adopted regulatory standards for PFAS compounds to date. North Carolina has established a Drinking Water Health Goal for PFPrOPrA (GenX) of 140 ng/L. According to the North Carolina Department of Health and Human Services (NCDHHS), the PFPrOPrA Drinking Water Health Goal is not a regulatory level and is not a boundary line between a "safe" or "dangerous" level, but can be used to provide information to affected communities and residents about potential risks from exposure to GenX through drinking water (NCDHHS, 2020).

1,4-Dioxane

EPA has not adopted Federal regulatory standards or MCLs for 1,4-dioxane to date. EPA has established a Drinking Water Health Advisory Level of 35 micrograms per liter (µg/L, equivalent to parts per billion). As referenced above, EPA's health advisories are non-enforceable and non-regulatory but provide technical information to state agencies and other public health officials (EPA, 2019b).

North Carolina has established a 2L Groundwater Standard under Title 15A NCAC 2L .0202 of 3 µg/L for 1,4-dioxane. The 2L Standards are the maximum allowable concentrations resulting from any discharge of contaminants that may be tolerated without creating a threat to human health or would otherwise render the groundwater unsuitable for it intended best usage. Although a 2L Groundwater Standard has been established, NCDEQ has relied on the EPA Drinking Water Health Advisory Level of 35 µg/L when evaluating the potential for impacts to public water supplies (NCDEQ, 2020).

3.0 Sampling Activities

3.1 Locations Sampled

In accordance with the August 2019 Scoping Document, leachate samples were collected from the following nine active MSWLF facilities located across the State of North Carolina:

1. Great Oak Landfill (7607-MSWLF-2015)
2. Sampson County Disposal, LLC (8202-MSWLF-2000)
3. South Wake MSW Landfill (9222-MSWLF-2008)
4. Upper Piedmont Regional Landfill (7304-MSWLF-1997)
5. BFI-Charlotte Motor Speedway Landfill V (1304-MSWLF-1992)
6. Uwharrie Environmental Regional Landfill (6204-MSWLF-1995)
7. East Carolina Regional Landfill (0803-MSWLF-1993)
8. Chambers Development MSW Landfill (0403-MSWLF-2010)
9. Foothills Environmental Landfill (1403-MSWLF-1998)

Prior to sampling, H&H contacted each landfill and requested information regarding site contacts, leachate collection and disposal systems, access limitations, typical leachate sampling locations, leachate volumes, and leachate disposal methods. This information is summarized in **Table 2**. The landfill locations are shown on **Figure 2**.

3.2 Sampling Methodology

Sampling was performed by H&H staff with experience sampling for PFAS and other constituents of concern. Sampling procedures were in accordance with the guidance document "PFC Sampling Procedures, January 2019" issued by the NCDEQ Division of Waste Management (DWM) Solid Waste Section (herein referred to as NC DWM Sampling Guidance). Prior to sampling, a Health & Safety Plan was prepared to cover safety concerns associated with the proposed field activities. Sampling bottles, bottle coolers, and PFAS-free water for blanks and decontamination were

obtained from the laboratory, GEL Laboratories, LLC (GEL) located in Charleston, South Carolina.

Because PFAS are present in many commonly used materials, the PFCs Sampling Checklist form included with the NC DWM Sampling Guidance was followed by field personnel to reduce the potential for cross-contamination of samples with PFAS from external sources. Each sampler washed their hands before sampling and utilized a minimum of three layers of nitrile gloves at each sampling location to maintain a "clean hands" approach after encountering various surfaces. Sampling supplies were placed on new high-density polyethylene (HDPE) sheeting in close proximity to the sampling location.

Sampling was performed September 16 through 19, 2019. Leachate collection/management systems vary by landfill facility; therefore, samples were collected under three general scenarios as described below. The sampling scenario for each facility is indicated on **Table 2**.

Valve at Bottom of Holding Tank/Discharge Line

- At locations where a sample port was located at the bottom of the holding tank and/or the discharge line (all locations except BFI-Charlotte Motor Speedway Landfill V and Great Oak Landfill), the valve was opened to clear any potential sediment and to adjust the flow to an appropriate rate for sample collection. Using fresh nitrile gloves, the sampler then removed the lid of the sample container and collected the sample keeping the sample container lid in the opposite hand. Upon completion of sampling, bottles were capped, placed in Zip-lock bags, and placed into laboratory-supplied coolers filled with ice. Because samples were collected directly into laboratory-supplied sampling containers and no separate sampling apparatus was used, no equipment blanks were collected for these locations.

Direct From Lagoon

- At the BFI-Charlotte Motor Speedway Landfill V, the sampling team mobilized to the leachate lagoon and set up a sampling station on the edge of the lagoon utilizing new HDPE sheeting. Samples were collected by submerging a new unpreserved laboratory-supplied

sample container approximately 1-foot below the surface of the lagoon, then transferring the contents into the laboratory-supplied sample containers to be submitted for analysis. Upon completion of sampling, bottles were capped, placed in Zip-lock bags, and placed into laboratory-supplied coolers filled with ice. Because samples were collected using laboratory-supplied sampling containers and no separate sampling apparatus was used, no equipment blanks were collected for this location.

Direct From Holding Tank

- At the Great Oak Landfill, the level of leachate in the holding tank was insufficient to collect a sample from the discharge port; therefore, samples were collected directly from the manhole hatch located at the top of the leachate holding tank. On September 17, 2019, samples were collected using a new properly decontaminated HDPE bucket and cotton string for analysis of both PFAS and 1,4-dioxane. H&H returned to the site on September 30, 2019, to resample for 1,4-dioxane due to issues with damage to sample containers during transport to the laboratory. During the sampling on September 30, 2019, samples were collected using a new HDPE bailer and cotton string for analysis of 1,4-dioxane. To complete the sampling, leachate was extracted from the holding tank using the bucket or bailer and transferred into the sample containers. The sampling station at the platform on top of the holding tank was covered with new HDPE sheeting. In addition, the "windmill" technique was utilized while bailing to prevent the bailer or string from contacting potential PFAS containing surfaces. Upon completion of sampling, bottles were capped, placed in Zip-lock bags, and placed into laboratory-supplied coolers filled with ice. For quality assurance/quality control (QA/QC), an equipment blank was collected during each sampling event from the bucket or bailer using PFAS-free water provided by the laboratory.

Each sample was assigned a unique identification number beginning with the first four digits of the NCDEQ permit number. Samples collected for analysis of PFAS were placed in coolers separate from samples collected for analysis of 1,4-dioxane. The sample coolers were shipped to GEL under chain-of-custody protocol for analysis as described in Section 3.3.

3.3 Laboratory Analyses

The samples from each facility were analyzed for PFAS by modified EPA Method 537.1 using Method PFAS by LCMSMS Compliant with Table B-15 of Department of Defense Quality Systems Manual (QSM) Version 5.3 and 1,4-dioxane by EPA Method 8270 Selective Ion Monitoring. The list of PFAS compounds included in the analyses was based on prior discussions between NWRA member companies and NCDEQ staff. At the request of NCDEQ, samples from Sampson County Disposal, LLC were also analyzed for PFPrOPrA by modified EPA Method 537.1.

Three items were identified during review of the laboratory QA/QC data which are discussed below:

- For sample 0403-1 (Chambers Development MSWLF), the surrogate recovery for the 1,4-dioxane sample analysis was below acceptable limits. The analytical results indicated 60% surrogate recovery with an estimated sample concentration of 9.22 µg/L. If this concentration is adjusted upward based on 100% recovery instead of 60%, the estimated 1,4-dioxane concentration in the sample would be 15.4 µg/L ([9.22 µg/L x 100%] / 60% = 15.4 µg/L). Following the initial analysis, GEL re-analyzed a second portion of the sample. However, the re-analysis was performed outside the method-recommended holding time. The results of the second analysis indicated a concentration of 14.8 µg/L. Based on the adjusted initial sample analysis result and the re-analysis result, H&H concludes that there is sufficient data to conclude the concentration in the sample is reasonably on the order of approximately 15 µg/L.
- For sample 1304-1 (BFI-Charlotte Motor Speedway Landfill V), GEL inadvertently did not analyze the 1,4-dioxane sample collected on September 16, 2019. A second sample (ID 1,1A,2,2A) was collected by landfill facility personnel on December 4, 2019 and analyzed for 1,4-dioxane.

- The equipment blank sample collected from Great Oak Landfill (sample 7607-EB) contained perfluorobutyric acid (PFBA) at a laboratory estimated concentration of 1.12 ng/L. The concentration detected was J-flagged, which means the concentration is estimated above the laboratory method detection limit but below the quantification/reporting limit. PFBA was also detected in the primary leachate sample collected from Great Oak Landfill (sample 7607). Based on these data, there is less confidence in PFBA concentrations reported for the Great Oak Landfill.

Laboratory analytical reports are included in **Appendix A**.

3.4 Discussion of Sampling Results and Comparison to Other Studies

The results of the laboratory analyses indicated detectable concentrations of PFOS, PFOA, and other PFAS compounds in each of the collected samples. 1,4-Dioxane was also detected in each of the samples. A summary of laboratory analytical data for the full set of constituents of concern is provided in **Table 3**.

Concentrations of PFOS and PFOA detected in the samples were compared to concentrations detected in leachate samples collected during the Michigan Study. The comparison data are summarized in **Table 4**. The results of the comparison indicated mean concentrations detected during the North Carolina Collective Study were generally similar to those detected during the Michigan Study (see inset). Variations in minimum and maximum concentrations between the North Carolina and Michigan studies are likely a result of differing sample sizes. Comparison to published literature references (as referenced in Section 2.2) indicates that concentrations detected during the North Carolina Collective Study are also within

PFOS and PFOA Concentrations in Leachate

Parameter		Min	Max	Mean
PFOS (ng/L)	NC	82	402	199
	MI	9	960	222
PFOA (ng/L)	NC	108	3,690	1,005
	MI	16	3,200	881

the range of values reported during other studies in the United States and other Western world regions, but more than an order of magnitude lower than maximum values reported for China.

Similar to the procedure followed during the Michigan Study, the analytical data and estimated annual leachate volumes provided by each MSWLF facility were used to calculate the daily mass of PFOS and PFOA contained within landfill leachate for each facility. The calculations based on the North Carolina Collective Study data indicate a mean daily mass of less than 0.001 lbs/day of PFOS or PFOA (see inset). Comparison of estimated daily mass values for the North Carolina Collective Study to those calculated during the Michigan Study indicate generally similar values. Daily mass calculations for PFOS and PFOA are summarized in **Table 4** and depicted on **Figure 3**.

PFOS and PFOA Daily Mass in Leachate				
Parameter		Min	Max	Mean
PFOS Daily Mass (lbs/day)	NC	0.00001	0.00014	0.00004
	MI	0.00001	0.00040	0.00005
PFOA Daily Mass (lbs/day)	NC	0.00001	0.00098	0.00013
	MI	0.00002	0.00260	0.00022

Daily mass calculations were also performed for 1,4-dioxane based on data collected during the North Carolina Collective Study. The results of the calculations indicated a mean daily mass of less than 0.1 lbs/day of 1,4-dioxane (see inset). The Michigan Study did not include analysis for 1,4-dioxane, nor were comprehensive published references identified for typical 1,4-dioxane concentrations in landfill leachate. As such, no additional data are available for comparison. However, based on the general similarity in PFAS concentrations reported in the North Carolina Collective Study, Michigan Study, and United States published literature, the 1,4-dioxane concentrations detected during the North Carolina Collective Study are expected to be similar to those for other MSWLFs across the United States. Daily mass calculations for 1,4-dioxane are summarized in **Table 5** and depicted on **Figure 7**.

1,4-Dioxane Concentration and Daily Mass in Leachate			
Parameter	Min	Max	Mean
1,4-Dioxane Concentration (µg/L)	14.8	469	120
1,4-Dioxane Daily Mass (lbs/day)	0.0022	0.0944	0.0255

4.0 Influence on WWTP Influent

4.1 Description of Receiving WWTPs

The MSWLFs covered under the North Carolina Collective Study each dispose of leachate via one or more publicly-owned WWTPs. H&H compiled locations for the receiving WWTPs based on information provided by each landfill. A summary of the receiving WWTP names, addresses, and National Pollutant Discharge Elimination System (NPDES) permit numbers is provided in **Table 2**. H&H determined the permitted flow for each WWTP based on information obtained from permit applications on the NCDEQ on-line Laserfiche document repository. Permitted flows are used rather than actual flows to be consistent with the approach used by NCDEQ during evaluation of the WWTP sampling data referenced below.

4.2 WWTP Sampling Data Source

In 2019, the NCDEQ DWR issued letters to publicly owned utilities with pretreatment programs and industrial dischargers in the Cape Fear River Basin requiring influent sampling for 1,4-dioxane and PFAS for three consecutive months beginning in July 2019. The sampling was performed in July, August, and September 2019. H&H retrieved the results of the sampling from the NCDEQ website (NCDEQ, 2020). Discussions in this report are based on average concentrations detected during the three monthly sampling events between July and September 2019.

The NCDEQ website contains PFAS and 1,4-dioxane data for the following WWTPs which receive leachate from landfills in the North Carolina Collective Study, including:

- City of Asheboro WWTP
- East Burlington WWTP
- Utley Creek Water Reclamation Facility
- Harnett County Lillington Plant

4.3 Discussion of WWTP Influent Sampling Results and Comparison to Other Studies

The WWTP sampling data are summarized on **Table 6**. For the WWTPs that receive leachate from facilities in the North Carolina Collective Study, the concentrations of PFOS and PFOA in the influent range from 8.86 to 49.5 ng/L (based on the average of the samples collected at each WWTP). Based on documentation provided on the NCDEQ website, NCDEQ concluded that the PFOS and PFOA concentrations for these facilities would not cause levels at downstream PWS intakes that exceed the EPA Drinking Water Health Advisory Level of 70 ng/L.

For 1,4-dioxane, the average concentrations of WWTP influent range from 5.95 to 18.5 µg/L, with the exception of one outlier which indicated a significantly higher average concentration of 163 µg/L. Based on documentation provided on the NCDEQ website, the elevated outlier concentration is primarily attributed to an industrial discharger rather than a landfill leachate source. Overall, for the WWTPs that receive leachate from facilities in the North Carolina Collective Study, NCDEQ concluded that the 1,4-dioxane concentrations for these WWTPs are not anticipated to cause levels that exceed the EPA Drinking Water Health Advisory Level of 35 µg/L at downstream PWS intakes.

The WWTP sampling and flow data were used to calculate the estimated daily mass of PFOS, PFOA, and 1,4-dioxane for each facility with available data. For PFOS and PFOA, the calculated daily mass values were then compared to WWTP daily mass values calculated during the Michigan Study. The results of this comparison indicated that the daily PFOS and PFOA mass for the North Carolina WWTPs are generally similar to or lower than the corresponding daily mass for the Michigan WWTPs. Daily WWTP mass calculations summarized in **Tables 6** and **7**, and depicted on **Figures 4** and **8**.

4.4 Leachate Contribution to WWTP Daily Mass

In order to evaluate the relative contribution of landfill leachate to WWTP daily mass, the daily mass values calculated for leachate were compared to the daily mass values calculated for WWTP influent. The results of these calculations for the North Carolina Collective Study facilities are summarized in **Table 8**. The PFOS and PFOA data are depicted along with similar data from the Michigan Study on **Figures 5** and **6**, respectively. The 1,4-dioxane data are depicted on **Figure 8**. **Review of the graphical depiction demonstrates that the mass of PFOS, PFOA, and 1,4-dioxane from landfill leachate represents a minor contribution to overall WWTP influent mass**. The estimated percent contribution of landfill leachate to overall WWTP mass for the sites in the North Carolina Collective Study ranges from only 0.3 to 10.2% for PFOS, PFOA, and 1,4-dioxane (see inset), with an average of 3.3%. The PFOS and PFOA results are corroborated by the larger data set included in the Michigan Study, **which also confirms that landfill leachate represents a minor contribution to overall WWTP influent mass and non-leachate sources represent a much larger contribution.**

Percent Contribution to WWTP Influent Daily Mass		
Constituent	**Leachate Sources**	**Non-Leachate Sources**
PFOS	**0.7 to 2.9%**	**97.1 to 99.3%**
PFOA	**0.6 to 10.2%**	**89.8 to 99.4%**
1,4-Dioxane	**0.3 to 3.6%**	**96.4 to 99.7%**

Review of the graphical depictions on Figures 5, 6, and 8 demonstrates that the mass of PFOS, PFOA, and 1,4-dioxane from landfill leachate represents a minor contribution to overall WWTP influent mass.

5.0 Conclusions and Recommendations

The North Carolina Collective Study included collection of leachate samples from nine MSWLF facilities located across the State of North Carolina for analysis of PFAS constituents and 1,4-dioxane. Where available, the results of the sampling were evaluated in conjunction with WWTP influent volumes and published sampling data in order to estimate the relative contribution of landfill leachate to overall WWTP influent mass of PFAS and 1,4-dioxane. The data were also evaluated with respect to the results of a larger study performed in Michigan using similar methodology.

The results of the North Carolina Collective Study clearly show that **landfill leachate represents a minor contribution of PFOS, PFOA, and 1,4-dioxane mass to overall WWTP influent mass for these compounds. Non-leachate sources contribute significantly more mass to WWTP influent than leachate.** These conclusions are supported by both the North Carolina Collective Study and the Michigan Study. Importantly, NCDEQ concluded that WWTP influent sampling data for facilities in the Cape Fear River Basin that receive leachate from landfills in the Collective Study indicate that **PFOS, PFOA, and 1,4-dioxane concentrations do not pose a threat to downstream PWS intakes**.

MSWLFs and WWTPs generally have an interdependent relationship for waste management (WWTPs accept leachate from MSWLFs and MSWLFs accept biosolids from WWTPs). **Landfills and WWTPs are not producers of the original sources of PFAS and 1,4-dioxane. Rather, they both receive and manage PFAS contaminated waste and wastewater from households, business, and industry.** MSWLFs and WWTPs are designed to manage waste in ways that are protective of human health and the environment. If long term reductions of CECs in the environment are to be achieved, then manufacturing and product utilization in society need to be addressed. The evidence provided by this report that landfill leachate represents only a small percentage of total influent mass of PFAS and 1,4-dioxane into WWTPs indicates the ubiquitous nature of these compounds in society. In spite of this ubiquitous nature, it is encouraging to note

that in the Cape Fear River basin, NCDEQ concluded that WWTP discharges do not represent a threat to drinking water supplies in most cases.

Based on the findings of both the North Carolina Collective Study and the Michigan Study, continued work towards PFAS and 1,4-dioxane source reduction solutions, such as the United States' phase-out of PFOS and PFOA in manufacturing, is recommended. We also recommend collaboration between the solid waste and WWTP industries, NCDEQ, and the scientific community in order to identify best management practices and other solutions for safe management of wastes generated by our communities.

6.0 References

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TABLES

Table 1
Literature Summary of PFOS and PFOA in Landfill Leachate
North Carolina Collective Study
H&H Job No. NWA-001

Source Cited	Location/ Region	Sample Size	PFOA[1]			PFOS[2]		
			Detection Frequency (%)	Concentration Range (ng/l)[3]	Median (ng/l)	Detection Frequency (%)	Concentration Range (ng/l)	Median (ng/l)
Huset, et al (2011)	USA	5	100	380 - 1,000	490	100	56 -160	97
Allred, et al (2015)	USA	6	100	150 - 5,000	1,055	100	25 - 590	155
Lang, et al (2017)	USA	87	100	30 - 5,000	590	96	3 - 800	99
Benskin, et al (2012)	Canada	5	100	210 - 1,500	520	100	80 - 4,400	390
Kallenborn, et al (2004)	Nordic Countries	NA	NA	90 - 501	230	NA	30 - 190	80
Bossi, et al (2008)	Denmark	NA	NA	0 - 6	3	NA	0 - 4	NA
Woldegiorgis, et al (2008)	Sweden	NA	NA	40 - 1,000	540	NA	30 - 1,500	550
Busch, et al (2010)	Germany	20	95	0 - 926	57	100	0 - 235	3
Fuertes, et al (2017)	Spain	6	100	200 - 585	437	17	0 - 44	NA
Gullen, et al (2016)	Australia	17	100	19 - 2,100	450	89	0 - 100	31
Gullen, et al (2017)	Australia	97	64	17 - 7,500	600	65	13 - 2,700	220
Yan, et al (2015)	China	6	100	281 - 214,000	2,260	100	1,150 - 6,020	1,740

Notes:

1. PFOA = Perfluorooctanoic acid
2. PFOS = Perfluorooctanesulfonate
3. ng/L = nanograms per liter

Data Source: Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019).

Table 2
Landfill and WWTP Facility Information
North Carolina Collective Study
H&H Job No. NWA-001

Landfill Name	NCDEQ Permit Number	Landfill Address	Estimated Annual Leachate Volume (gallons/day)	Description of Sampling Location	Receiving WWTP[1] Name	WWTP NPDES[2] Permit Number	WWTP Permitted Flow Limit (gallons/day)*	Receiving WWTP Address	Receiving WWTP River Basin
Foothills Environmental Landfill	1403-MSWLF-1998	2800 Cheraw Road Lenoir, NC 28645	24,364	Valve at Bottom of Holding Tank	Henry Fork WWTP	NC0040797	9,000,000	4014 River Road Hickory, NC	Catawba
BFI-Charlotte Motor Speedway Landfill V	1304-MSWLF-1992	5105 Morehead Road Concord, NC 28027	40,027	Direct from Lagoon	Rocky River Regional WWTP	NC0036269	26,500,000	6400 Breezy Lane Concord, NC	Yadkin Pee Dee
Chambers Development MSWLF	0403-MSWLF-2010	375 Dozer Drive Polkton, NC 28135	17,452	Valve at Bottom of Holding Tank	Anson County WWTP	NC0041408	3,500,000	1306 Hollywood Road Wadesboro, NC	Yadkin Pee Dee
Uwharrie Environmental Regional Landfill	6204-MSWLF-1995	500 Landfill Road Mt Gilead, NC 27306	31,649	Valve at Bottom of Holding Tank	Town of Troy WWTP	NC0028916	1,200,000	Troy, NC	Yadkin Pee Dee
Great Oak Landfill	7607-MSWLF-2015	3597 Old Cedar Falls Road Randleman, NC 27317	9,589	Direct from Holding Tank	City of Asheboro WWTP	NC0026123	9,000,000	1032 Bonkemeyer Dr Asheboro, NC	Cape Fear
Upper Piedmont Regional Landfill	7304-MSWLF-1997	9650 Oxford Road Rougemont, NC 27572	31,830	Valve at Bottom of Holding Tank	East Burlington WWTP	NC0023868	12,000,000	225 Stone Quarry Road Haw River, NC	Cape Fear
Wake County South Wake MSWLF	9222-MSWLF-2008	6124 Old Smithfield Road Apex, NC 27502	5,260	Valve on Discharge Line	Utley Creek Water Reclamation Facility	NC0063096	6,000,000**	150 Treatment Plant Road Holly Springs, NC	Cape Fear
			3,890		City of Lumberton WWTP	NC0024571	20,000,000	700 Lafayette Street Lumberton, NC	Lumber
Sampson County Disposal, LLC	8202-MSWLF-2000	7434 Roseboro Highway Roseboro, NC 28382	8,658	Valve on Discharge Line	Harnett County Lillington Plant	NC0021636	7,500,000	175 Bain Street Lillington, NC	Cape Fear
			16,219		Harnett County South Plant	NC0088366	15,000,000	3224 Shady Grove Road Spring Lake, NC	Cape Fear
			20,411		City of Lumberton WWTP	NC0024571	20,000,000	700 Lafayette Street Lumberton, NC	Lumber
			22,137		Not applicable - Evaporation	Not applicable	Not applicable	Not applicable	Not applicable
East Carolina Regional Landfill	0803-MSWLF-1993	1922 Republican Road Aulander, NC 27805	41,044	Valve at Bottom of Holding Tank	Tar River Regional WWTP	NC0030317	21,000,000	3031 Treatment Plant Road Rocky Mount, NC	Tar-Pamlico

Notes:
1. WWTP = wastewater treatment plant
2. NPDES = National Pollutant Discharge Elimination System
* = Permitted flow obtained from Section A.6 of latest NPDES permit application retrieved from North Carolina Department of Environmental Quality on-line Laserfiche document repository in December 2019.
** = After receiving an Authorization to Construct, the treatment capacity will increase to 8 millions of gallons per day.

Table 3
Leachate Analytical Data
North Carolina Collective Study
H&H Job No. NWA-001

Parameter	Sample ID		9222-1	1403-1	1304-1	0403-1	6204-1	7607-1	0803-1	7304-1	8202-1
	Sampling Date		09/18/19	09/16/19	09/16/19*	09/16/19	09/17/19	09/17/19**	09/19/19	09/17/19	09/18/19
	Landfill Name		Wake County South Wake MSWLF[1]	Foothills Environmental Landfill	BFI-Charlotte Motor Speedway Landfill V	Chambers Development MSWLF	Uwharrie Environmental Regional Landfill	Great Oak Landfill	East Carolina Regional Landfill	Upper Piedmont Regional Landfill	Sampson County Disposal, LLC
	Laboratory Method	Units[2]									
Fluorotelomer sulfonate 4:2 (4:2 FTS)	EPA 537.1 Mod	ng/L	ND[3]	ND	ND	ND	ND	ND	ND	ND	ND
Fluorotelomer sulfonate 6:2 (6:2 FTS)	EPA 537.1 Mod	ng/L	ND	ND	ND	180J[4]	ND	ND	ND	ND	ND
Fluorotelomer sulfonate 8:2 (8:2 FTS)	EPA 537.1 Mod	ng/L	ND	ND	39.7	ND	35.8J	ND	ND	ND	ND
N-ethylperfluoro-1-octanesulfonamidoacetic acid (NEtFOSAA)	EPA 537.1 Mod	ng/L	ND	101	87.2	14.9J	68.0	15.6J	237	48.7	43.8
N-methylperfluoro-1-octanesulfonamidoacetic acid (NMeFOSAA)	EPA 537.1 Mod	ng/L	35.8J	257	258	50.5	180	42.4	230	106	104
Perfluorobutyric acid (PFBA)	EPA 537.1 Mod	ng/L	600	744	1920	831	2400	303EB[5]	650	743	4770
Perfluorobutanesulfonate (PFBS)	EPA 537.1 Mod	ng/L	1420	4400	5260	6290	2870	72.2	3850	1420	7530
Perfluorotetradecanoic acid (PFTeDA)	EPA 537.1 Mod	ng/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorotridecanoic acid (PFTrDA)	EPA 537.1 Mod	ng/L	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorodecanesulfonate (PFDS)	EPA 537.1 Mod	ng/L	ND	ND	6.87J	ND	ND	7.10J	ND	14.9J	ND
Perfluorodecanoic acid (PFDA)	EPA 537.1 Mod	ng/L	17.3J	82.6	590	23.6	632	18.5J	90.8	48.0	90.9
Perfluorododecanoic acid (PFDoA)	EPA 537.1 Mod	ng/L	7.40J	ND	63.3	ND	184	ND	ND	ND	9.17J
Perfluoroheptanesulfonate (PFHpS)	EPA 537.1 Mod	ng/L	ND	6.82J	8.17J	ND	9.40J	ND	9.39J	ND	ND
Perfluoroheptanoic acid (PFHpA)	EPA 537.1 Mod	ng/L	241	571	983	249	1560	68.4	689	344	5520
Perfluorohexanesulfonate (PFHxS)	EPA 537.1 Mod	ng/L	237	794	925	218	640	59.1	536	190	424
Perfluorohexanoic acid (PFHxA)	EPA 537.1 Mod	ng/L	2940	3920	3470	2200	5540	449	3610	2350	6730
Perfluorononanesulfonate (PFNS)	EPA 537.1 Mod	ng/L	20.7	ND	ND	ND	ND	ND	ND	13.4J	ND
Perfluorononanoic acid (PFNA)	EPA 537.1 Mod	ng/L	28.8	71.4	269	15.5J	326	32.8	89.0	44.1	128
Perfluorooctanesulfonamide (PFOSA)	EPA 537.1 Mod	ng/L	ND	7.08J	11.5J	ND	ND	8.75J	17.3J	ND	ND
Perfluorooctanesulfonate (PFOS)	EPA 537.1 Mod	ng/L	82.3	296	356	84.2	356	83.9	402	254	222
Perfluorooctanoic acid (PFOA)	EPA 537.1 Mod	ng/L	803	1650	2210	345	3690	108	1640	884	1790
Perfluoropentanesulfonate (PFPeS)	EPA 537.1 Mod	ng/L	32.3	50.6	73.2	19.6	41.4	10.3J	54.7	28.1	61.0
Perfluoropentanoic acid (PFPeA)	EPA 537.1 Mod	ng/L	577	1070	2160	780	2150	159	1220	621	86400
Perfluoroundecanoic acid (PFUdA)	EPA 537.1 Mod	ng/L	ND	7.04J	30.8	ND	33.0	7.44J	ND	ND	10.2J
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA)[6]	EPA 537.1 Mod	ng/L	NA[7]	NA	NA	NA	NA	NA	NA	NA	10800
1,4-Dioxane	EPA 8270 SIM	µg/L	30.0	99.7	214	14.8Q[8]	357	469	157	177	184

Notes:
1. MSWLF = municipal solid waste landfill
2. ng/L = nanograms per liter; µg/L = micrograms per liter
3. ND = Not detected above laboratory method detection limt
4. J = Estimated concentration between method detection limit and reporting limit
5. EB = Constituent was also detected in associated equipment blank sample
6. PFPrOPrA also known by trade name GenX
7. NA = Not analyzed
8. Q = Value indicates results of reanalysis outside laboratory holding time

* = BFI-Charlotte Motor Speedway Landfill V was resampled for 1,4-dioxane (new sample ID 1,1A,2,2A) on 12/4/19
** = Great Oak Landfill (sample ID 7607-1) was resampled for 1,4-dioxane analysis on 9/30/19

Table 4
PFOS and PFOA Daily Leachate Mass Calculations
North Carolina Collective Study
H&H Job No. NWA-001

Sampling Reference	Average Leachate Volume (gallons/day)	PFOS[1] (ng/L)[3]	PFOA[2] (ng/L)	PFOS Daily Mass (lbs/day)[4]	PFOA Daily Mass (lbs/day)
North Carolina Collective Study					
Wake County South Wake MSWLF[5]	9,151	82.3	803	0.00001	0.00001
Foothills Environmental Landfill	24,364	296	1,650	0.00006	0.00006
BFI-Charlotte Motor Speedway Landfill V	40,027	356	2,210	0.00012	0.00074
Chambers Development MSWLF	17,452	84	345	0.00001	0.00005
Uwharrie Environmental Regional Landfill	31,649	356	3,690	0.00009	0.00098
Great Oak Landfill	9,589	84	108	0.00001	0.00001
East Carolina Regional Landfill	41,044	402	1,640	0.00014	0.00056
Upper Piedmont Regional Landfill	31,830	254	884	0.00007	0.00024
Sampson County Disposal, LLC*	45,288	222	1,790	0.00008	0.00068
Minimum	9,151	82	108	0.00001	0.00001
Maximum	45,288	402	3,690	0.00014	0.00098
Geometric Mean	24,152	199	1,005	0.00004	0.00013
Michigan Study[6]					
Arbor Hills Landfill	98,400	220	3,200	0.00018	0.0026
Autumn Hills RDF[7]	54,800	380	1,300	0.00017	0.0006
Brent Run Landfill	16,400	110	540	0.00002	0.0001
C&C Expanded Sanitary Landfill	42,000	450	1,300	0.00015	0.0004
Carleton Farms Landfill	123,300	250	1,800	0.00026	0.0018
Central Sanitary Landfill	30,100	470	2,500	0.00012	0.0006
Citizen's Disposal Inc.	32,900	180	1,100	0.00005	0.0003
Dafter Sanitary Landfill	16,500	130	680	0.00002	0.0001
Eagle Valley RDF	32,900	170	490	0.00005	0.0001
Glens Sanitary Landfill	3,800	210	770	0.00001	0.00002
Granger Grand River Landfill	64,400	160	240	0.00009	0.0001
Granger Wood Street Landfill	19,200	110	470	0.00002	0.0001
K&W Landfill	17,500	170	830	0.00002	0.0001
Manistee County Landfill	4,700	220	420	0.000009	0.000016
McGill Road Landfill	13,700	170	760	0.00002	0.0001
Michigan Environs Inc. (Menominee)	13,100	100	1,400	0.00001	0.0002
Northern Oaks RDF	12,300	220	1,000	0.00002	0.0001
Oakland Heights Development	17,800	230	780	0.00003	0.0001
Orchard Hill Sanitary Landfill	12,500	110	650	0.00001	0.0001
Ottawa County Farms Landfill	82,200	530	1,800	0.0004	0.0012
People's Landfill	21,900	710	2,500	0.00013	0.0005
Pine Tree Acres RDF	74,000	430	1,800	0.0003	0.001
Pitsch Sanitary Landfill	15,000	260	1,300	0.00003	0.0002
Sauk Trail Hills Landfill	20,500	610	2,800	0.00010	0.0005
SC Holdings	16,000	410	960	0.00005	0.0001
Tri-City RDF	9,600	160	1,200	0.00001	0.0001
Venice Park RDF MH#20/Venice Park RDF MH#21**	32,900	190	910	0.0002	0.0007
		630	1,500		
Vienna Junction Industrial Park Sanitary Landfill	13,700	130	1,300	0.00001	0.0001
Waters Landfill	NONE	230	930	NONE	NONE
Westside RDF	60,800	160	1,300	0.00008	0.0007
Whitefeather Landfill	NONE	550	1,700	NONE	NONE
Woodland Meadows RDF -Van Buren	54,800	510	2,000	0.00023	0.0009
Riverview 003/Riverview 004/Riverview 007**	37,400	270	1,900	0.00004	0.0003
		140	860		
		8.5	38		
South Kent Outfall/South Kent Hauled**	48,000	960	725	0.0002	0.0001
		130	16		
Smith's Creek Landfill**	32,900	120	510	0.00003	0.0001
Minimum	3,800	9	16	0.00001	0.00002
Maximum	123,300	960	3,200	0.00040	0.00260
Geometric Mean	25,501	222	881	0.00005	0.00022

Notes:
1. PFOS = Perfluorooctanesulfonate
2. PFOA = Perfluorooctanoic acid
3. ng/L = nanograms per liter
4. lbs/day = pounds per day
5. MSWLF = municipal solid waste landfill
6. Michigan Study = Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019)
7. RDF = recycling and disposal facility
* = Leachate volume does not include volume disposed of via evaporation.
** = Multiple laboratory results reported, average used for daily mass calculations.

Table 5
1,4-Dioxane Daily Leachate Mass Calculations
North Carolina Collective Study
H&H Job No. NWA-001

Sampling Reference	Average Leachate Volume (gallons/day)	1,4-Dioxane (µg/L)[1]	1,4-Dioxane Daily Mass (lbs/day)[2]
North Carolina Collective Study			
Wake County South Wake MSWLF[3]	9,151	30.0	0.0023
Foothills Environmental Landfill	24,364	99.7	0.0203
BFI-Charlotte Motor Speedway Landfill V	40,027	214	0.0716
Chambers Development MSWLF	17,452	14.8Q[4]	0.0022
Uwharrie Environmental Regional Landfill	31,649	357	0.0944
Great Oak Landfill	9,589	469	0.0376
East Carolina Regional Landfill	41,044	157	0.0538
Upper Piedmont Regional Landfill	31,830	177	0.0471
Sampson County Disposal, LLC*	45,288	184	0.0696
Minimum	9,151	14.8	0.0022
Maximum	45,288	469	0.0944
Geometric Mean	24,152	120	0.0255

Notes:
1. µg/L = micrograms per liter
2. lbs/day = pounds per day
3. MSWLF = municipal solid waste landfill
4. Q = value indicates results of reanalysis outside laboratory holding time
* = Leachate volume is representative of volume disposed at WWTPs.

Table 6
PFOS and PFOA Daily WWTP Mass Calculations
North Carolina Collective Study
H&H Job No. NWA-001

Facility	WWTP[1] Permitted Flow Limit (gallons/day)*	PFOS[2] Concentration (ng/l)[4]	PFOA[3] Concentration (ng/l)	PFOS Daily Mass (lbs/day)[5]	PFOA Daily Mass (lbs/day)
WWTPs that receive leachate from landfills in North Carolina Collective Study					
City of Asheboro WWTP	9,000,000	10.6	19.3	0.0008	0.0014
East Burlington WWTP	12,000,000	49.5	39.6	0.0050	0.0040
Utley Creek Water Reclamation Facility	6,000,000**	10	9.8	0.0005	0.0005
Harnett County Lillington Plant	7,500,000	8.86	20.2	0.0006	0.0013
Michigan Study[6] WWTPs that receive leachate from landfills included in Study					
Menominee	3,200,000	5.6	12	0.0001	0.0003
Clinton River	30,600,000	7.68	4.94	0.0019	0.0013
Genesee Co-Ragnone	25,900,000	5.22	4	0.0012	0.0009
GLWA	650,000,000	7.54	6.02	0.0406	0.0324
Grand Rapids	61,100,000	12.7	5.06	0.0066	0.0026
Holland	12,000,000	3.79	8.93	0.0004	0.0009
Lansing	35,000,000	ND[7]	4.98	ND	0.0014
Sandusky	2,550,000	7.98	12.2	0.0002	0.0003
Three Rivers	2,750,000	7.39	21.44	0.0002	0.0005
Wyoming	22,000,000	6.2 to 26.4	5.08 to 25	0.0048	0.0046
YCUA	51,200,000	4.8 to 7.51	12	0.0032	0.0051
Michigan Study WWTPs that receive leachate from landfills not included in Study					
Bay City	18,000,000	18.2	4.87	0.0027	0.0007
Downriver	125,000,000	22.2	7.2	0.0230	0.0075
Flint	50,000,000	62.4	10.3	0.0258	0.0043
Kalamazoo	53,500,000	ND	ND	ND	ND
Muskegon Co Metro	43,000,000	10.5 to 24.3	11.7 to 36.9	0.0086	0.0131
North Kent S A	8,000,000	31.1	11.2	0.0021	0.0007
Port Huron	20,000,000	19.5	64.6	0.0032	0.0107
S Huron Valley UA (SHUVA)	24,000,000	ND	3.76	ND	0.0007

Notes:
1. WWTP = wastewater treatment plant
2. PFOS = Perfluorooctanesulfonate
3. PFOA = Perfluorooctanoic acid
4. ng/L = nanograms per liter
5. lbs/day = pounds per day
6. Michigan Study = Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019)
7. ND = not detected

* = Permitted flow obtained from Section A.6 of latest National Pollutant Discharge Elimination System permit application retrieved from North Carolina Department of Environmental Quality on-line Laserfiche document repository in December 2019.
** = After receiving an Authorization to Construct, the treatment capacity will increase to 8 millions of gallons per day. The lower value of 6 millions of gallons per day was conservatively used for concentration calculations.
Table only shows facilities for which sampling data are available.

For Michigan sites, daily mass calculations performed using maximum value where multiple data are available. For North Carolina sites, concentrations shown and associated daily mass calculations are based on average values for three sampling events performed between July and September 2019.

Table 7
1,4-Dioxane Daily WWTP Mass Calculations
North Carolina Collective Study
H&H Job No. NWA-001

Facility	WWTP[1] Permitted Flow Limit (gallons/day)*	1,4-Dioxane Concentration (µg/l)[2]	1,4-Dioxane Daily Mass (lbs/day)[3]
WWTPs that receive leachate from landfills in North Carolina Collective Study			
City of Asheboro WWTP	9,000,000	163	12.2927
East Burlington WWTP	12,000,000	18.5	1.8583
Utley Creek Water Reclamation Facility	6,000,000**	7.3	0.3635
Harnett County Lillington Plant	7,500,000	5.95	0.3729

Notes:
1. WWTP = wastewater treatment plant
2. µg/L = micrograms per liter
3. lbs/day = pounds per day

* = Permitted flow obtained from Section A.6 of latest National Pollutant Discharge Elimination System permit application retrieved from North Carolina Department of Environmental Quality on-line Laserfiche document repository in December 2019.
** = After receiving an Authorization to Construct, the treatment capacity will increase to 8 millions of gallons per day. The lower value of 6 millions of gallons per day was conservatively used for concentration calculations.
Concentrations shown and associated daily mass calculations are based on average values for three sampling events performed between July and September 2019.

Table 8
Percent of WWTP Daily Mass Contributed by Landfill Leachate
North Carolina Collective Study
H&H Job No. NWA-001

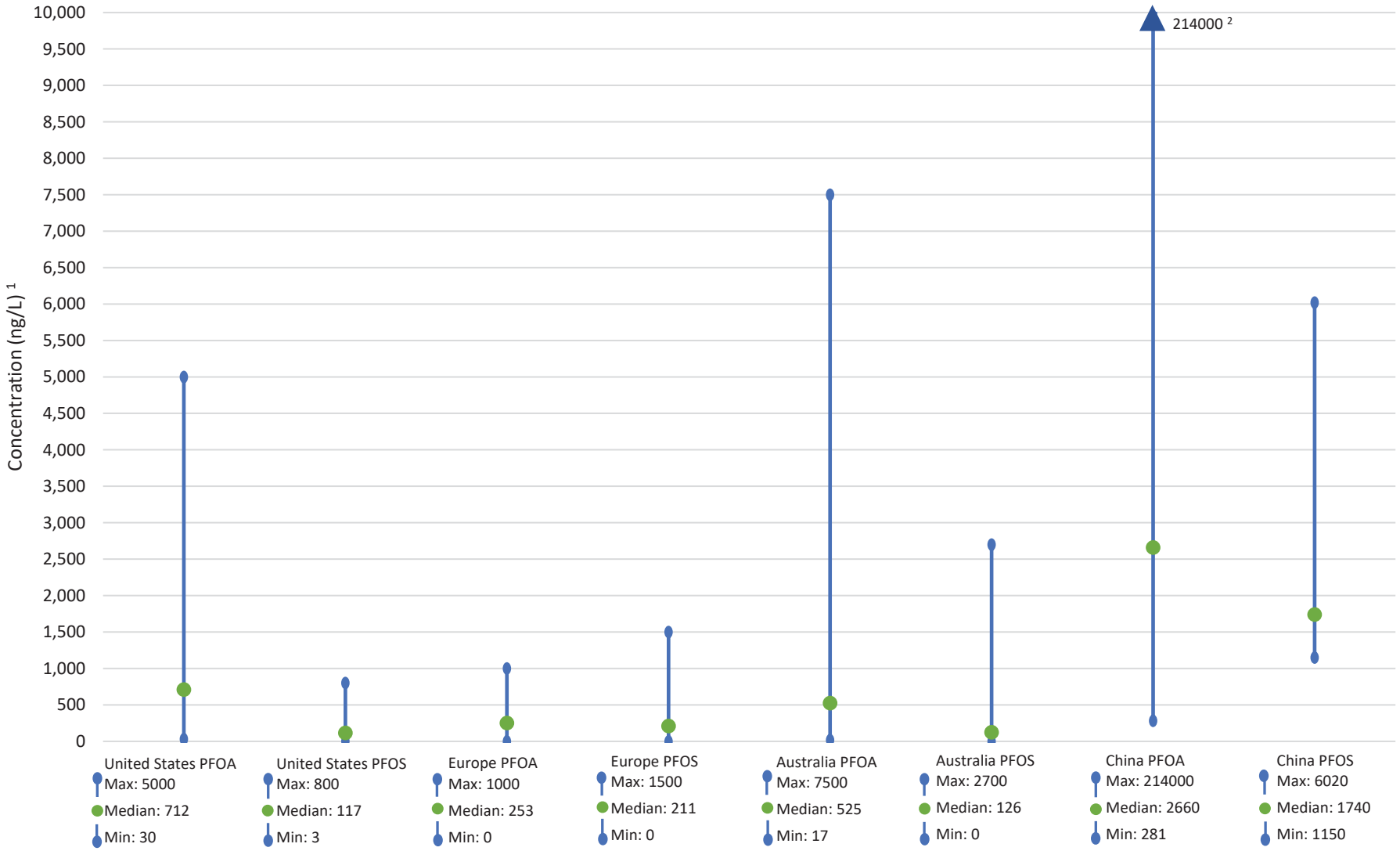
Landfill Name	Average Leachate Volume (gallons/day)	Receiving WWTP[1] Name	WWTP Permitted Flow Limit (gallons per day)*	Constituent	Concentration Data			Daily Mass Data		Percentage of WWTP Influent Daily Mass Associated with Landfill Leachate***
					Concentration Units[2]	Landfill Leachate Concentration	WWTP Influent Concentration	Landfill Leachate Daily Mass (lbs/day)[3]	WWTP Influent Daily Mass (lbs/day)	
Wake County South Wake MSWLF[4]	5,260	Utley Creek Water Reclamation Facility	6,000,000**	PFOS[5]	ng/L	82.3	10	0.00000	0.0005	0.7%
				PFOA[6]	ng/L	803	9.8	0.00004	0.0005	7.2%
				PFOS+PFOA	ng/L	885	20	0.00004	0.0010	3.9%
				1,4-Dioxane	µg/L	30	7.3	0.00132	0.3635	0.4%
	3,890	City of Lumberton WWTP	20,000,000	PFOS	ng/L	82.3	NS[7]	0.00000	NS	NS
				PFOA	ng/L	803	NS	0.00003	NS	NS
				PFOS+PFOA	ng/L	885	NS	0.00003	NS	NS
				1,4-Dioxane	µg/L	30	NS	0.00098	NS	NS
Foothills Environmental Landfill	24,364	Henry Fork WWTP	9,000,000	PFOS	ng/L	296	NS	0.00006	NS	NS
				PFOA	ng/L	1650	NS	0.00034	NS	NS
				PFOS+PFOA	ng/L	1946	NS	0.00040	NS	NS
				1,4-Dioxane	µg/L	99.7	NS	0.02030	NS	NS
BFI-Charlotte Motor Speedway Landfill V	40,027	Rocky River Regional WWTP	26,500,000	PFOS	ng/L	356	NS	0.00012	NS	NS
				PFOA	ng/L	2210	NS	0.00074	NS	NS
				PFOS+PFOA	ng/L	2566	NS	0.00086	NS	NS
				1,4-Dioxane	µg/L	214	NS	0.07157	NS	NS
Chambers Development MSWLF	17,452	Anson County WWTP	3,500,000	PFOS	ng/L	84.2	NS	0.00001	NS	NS
				PFOA	ng/L	345	NS	0.00005	NS	NS
				PFOS+PFOA	ng/L	429	NS	0.00006	NS	NS
				1,4-Dioxane	µg/L	14.8Q[8]	NS	0.00216	NS	NS
Uwharrie Environmental Regional Landfill	31,649	Town of Troy WWTP	1,200,000	PFOS	ng/L	356	NS	0.00009	NS	NS
				PFOA	ng/L	3690	NS	0.00098	NS	NS
				PFOS+PFOA	ng/L	4046	NS	0.00107	NS	NS
				1,4-Dioxane	µg/L	357	NS	0.09441	NS	NS
Great Oak Landfill	9,589	City of Asheboro WWTP	9,000,000	PFOS	ng/L	83.9	10.6	0.00001	0.0008	0.8%
				PFOA	ng/L	108	19.3	0.00001	0.0014	0.6%
				PFOS+PFOA	ng/L	192	29.9	0.00002	0.0022	0.7%
				1,4-Dioxane	µg/L	469	163	0.03758	12.2927	0.3%
East Carolina Regional Landfill	41,044	Tar River Regional WWTP	21,000,000	PFOS	ng/L	402	NS	0.00014	NS	NS
				PFOA	ng/L	1640	NS	0.00056	NS	NS
				PFOS+PFOA	ng/L	2042	NS	0.00070	NS	NS
				1,4-Dioxane	µg/L	157	NS	0.05384	NS	NS
Upper Piedmont Regional Landfill	31,830	East Burlington WWTP	12,000,000	PFOS	ng/L	254	49.5	0.00007	0.0050	1.4%
				PFOA	ng/L	884	39.6	0.00024	0.0040	5.9%
				PFOS+PFOA	ng/L	1138	89.0	0.00030	0.0089	3.4%
				1,4-Dioxane	µg/L	177	18.5	0.04707	1.8583	2.5%
Sampson County Disposal, LLC	8,658	Harnett County Lillington Plant	7,500,000	PFOS	ng/L	222	8.86	0.00002	0.0006	2.9%
				PFOA	ng/L	1790	20.2	0.00013	0.0013	10.2%
				PFOS+PFOA	ng/L	2012	29.0	0.00015	0.0018	8.0%
				1,4-Dioxane	µg/L	184	5.95	0.01331	0.3729	3.6%
				PFPrOPrA[9]	ng/L	10800	NS	0.00078	NS	NS
	16,219	Harnett County South Plant	15,000,000	PFOS	ng/L	222	NS	0.00003	NS	NS
				PFOA	ng/L	1790	NS	0.00024	NS	NS
				PFOS+PFOA	ng/L	2012	NS	0.00027	NS	NS
				1,4-Dioxane	µg/L	184	NS	0.02494	NS	NS
				PFPrOPrA	ng/L	10800	NS	0.00146	NS	NS
	20,411	City of Lumberton WWTP	20,000,000	PFOS	ng/L	222	NS	0.00004	NS	NS
				PFOA	ng/L	1790	NS	0.00031	NS	NS
				PFOS+PFOA	ng/L	2012	NS	0.00034	NS	NS
				1,4-Dioxane	µg/L	184	NS	0.03138	NS	NS
				PFPrOPrA	ng/L	10800	NS	0.00184	NS	NS
	22,137	Evaporation	Not applicable	PFOS	ng/L	222	NA[10]	NA	NA	NA
				PFOA	ng/L	1790	NA	NA	NA	NA
				PFOS+PFOA	ng/L	2012	NA	NA	NA	NA
				1,4-Dioxane	µg/L	184	NA	NA	NA	NA
				PFPrOPrA	ng/L	10800	NA	NA	NA	NA

Notes:
1. WWTP = wastewater treatment plant
2. ng/L = nanograms per liter; µg/L = micrograms per liter
3. lbs/day = pounds per day
4. MSWLF = municipal solid waste landfill
5. PFOS = perfluorooctanesulfonate
6. PFOA = perfluorooctanoic acid
7. NS = no sampling data available
8. Q = value indicates results of reanalysis outside laboratory holding time
9. PFPrOPrA = 2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (trade name GenX)
10. NA = not applicable

* = Permitted flow obtained from Section A.6 of latest National Pollutant Discharge Elimination System permit application retrieved from North Carolina Department of Environmental Quality on-line Laserfiche document repository in December 2019.
** = After receiving an Authorization to Construct, the treatment capacity will increase to 8 millions of gallons per day. The lower value of 6 millions of gallons per day was conservatively used for concentration calculations.
*** = WWTP mass attributed to landfill leachate only includes contributions from landfills covered under the North Carolina Collective Study.

FIGURES

Figure 1
PFOA & PFOS Concentrations in Landfill Leachate Based on Literature Summary



Notes:
1. ng/L = nanograms per liter
2. Concentration is beyond the scale of the graph (>20 times scale of graph)

Source: Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019)

Figure ID	Landfill Name
1	Foothills Environmental Landfill
2	BFI-Charlotte Motor Speedway Landfill V
3	Chambers Development MSWLF [1]
4	Uwharrie Environmental Regional Landfill
5	Great Oak Landfill
6	Upper Piedmont Regional Landfill
7	Wake County South Wake MSWLF
8	Sampson County Disposal, LLC
9	East Carolina Regional Landfill

LEGEND

LANDFILL LOCATION

NOTE:

1. MSWLF = MUNICIPAL SOLID WASTE LANDFILL

LANDFILL LOCATION NUMBERS ARE CODED TO THE TABLE AS SHOWN.

0 40 80

Miles

TITLE: FACILITY LOCATION MAP

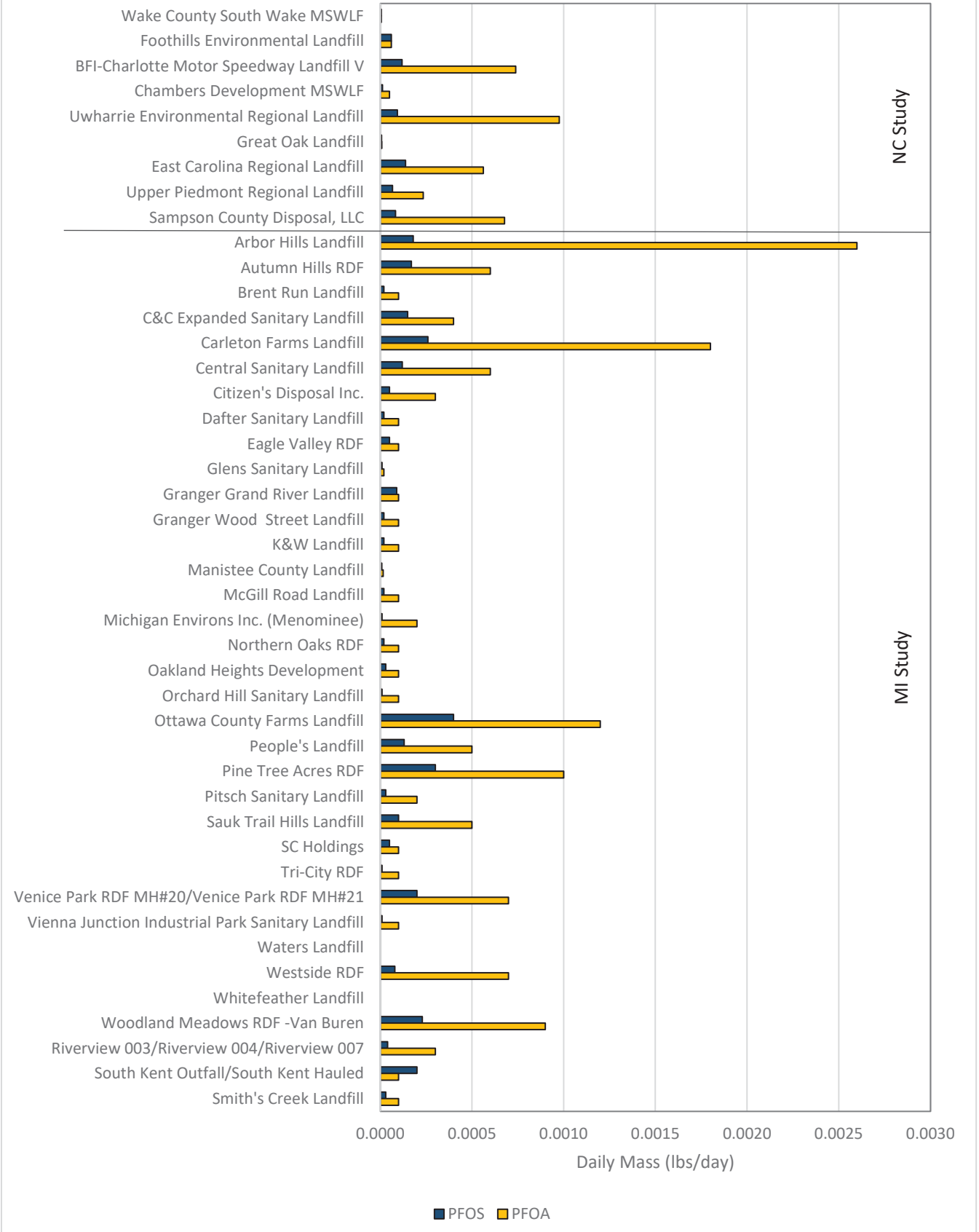
PROJECT: NORTH CAROLINA COLLECTIVE STUDY

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street - Suite 100
Charlotte, North Carolina 28203
704-586-0007 (p) 704-586-0373 (f)
License # C-1269 / # C-245 Geology

DATE: 2-14-20 | REVISION NO: 0

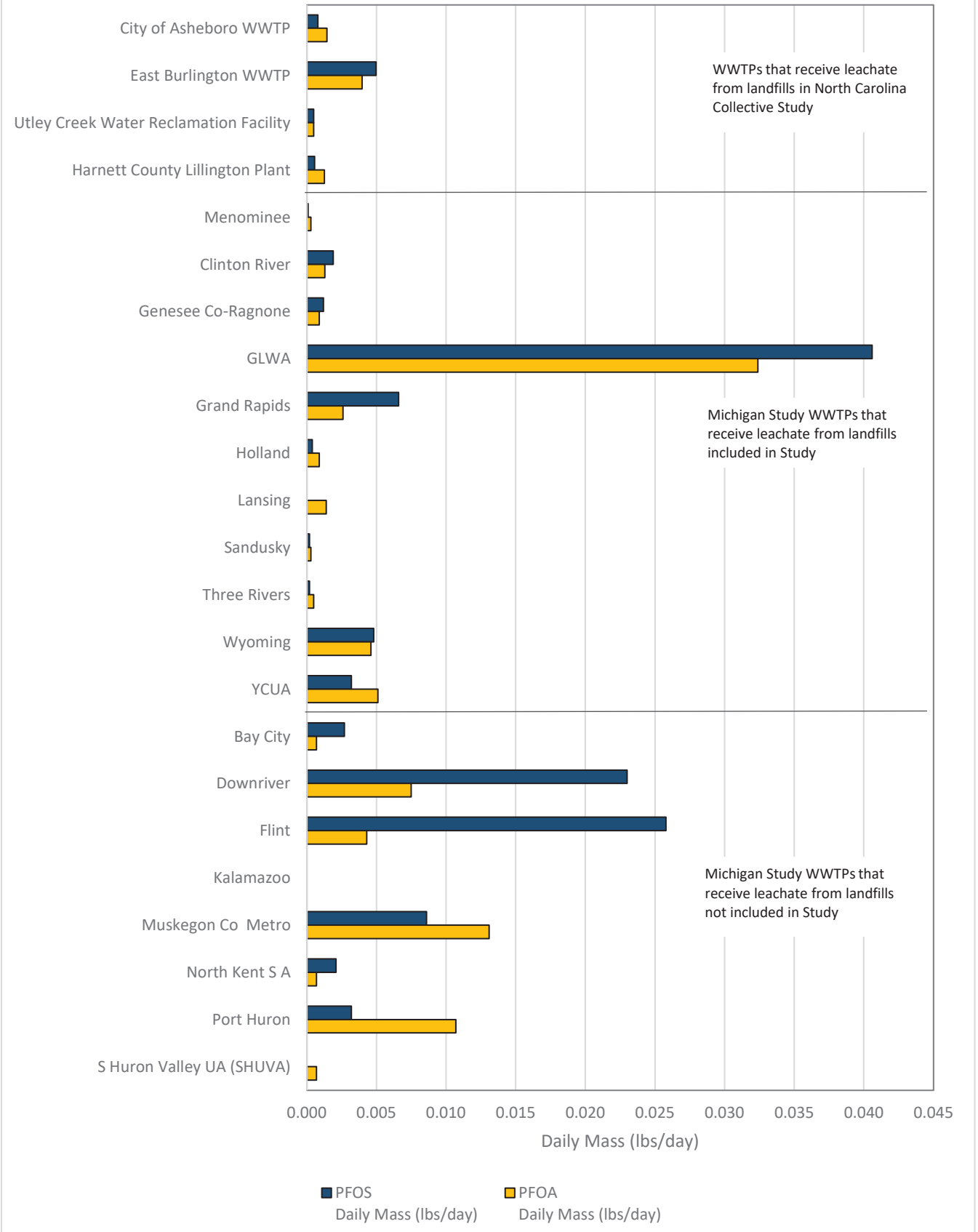
JOB NO: NWA-001 | FIGURE NO: 2

Figure 3 - PFOS and PFOA Daily Leachate Mass Summary



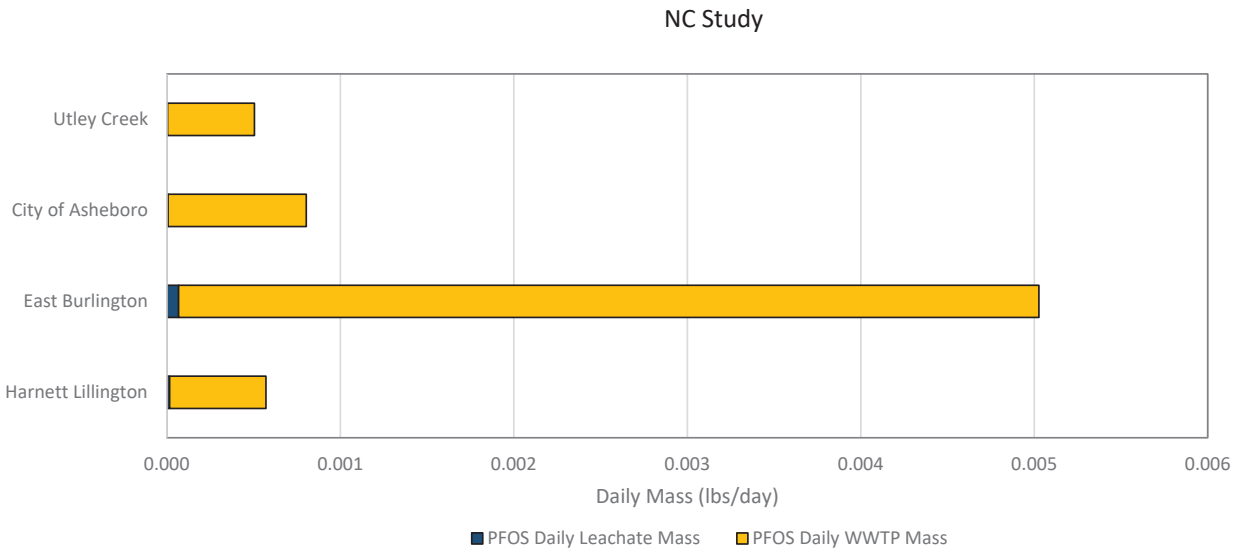
Notes:
1. MI Study = Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019)
2. lbs/day = pounds per day

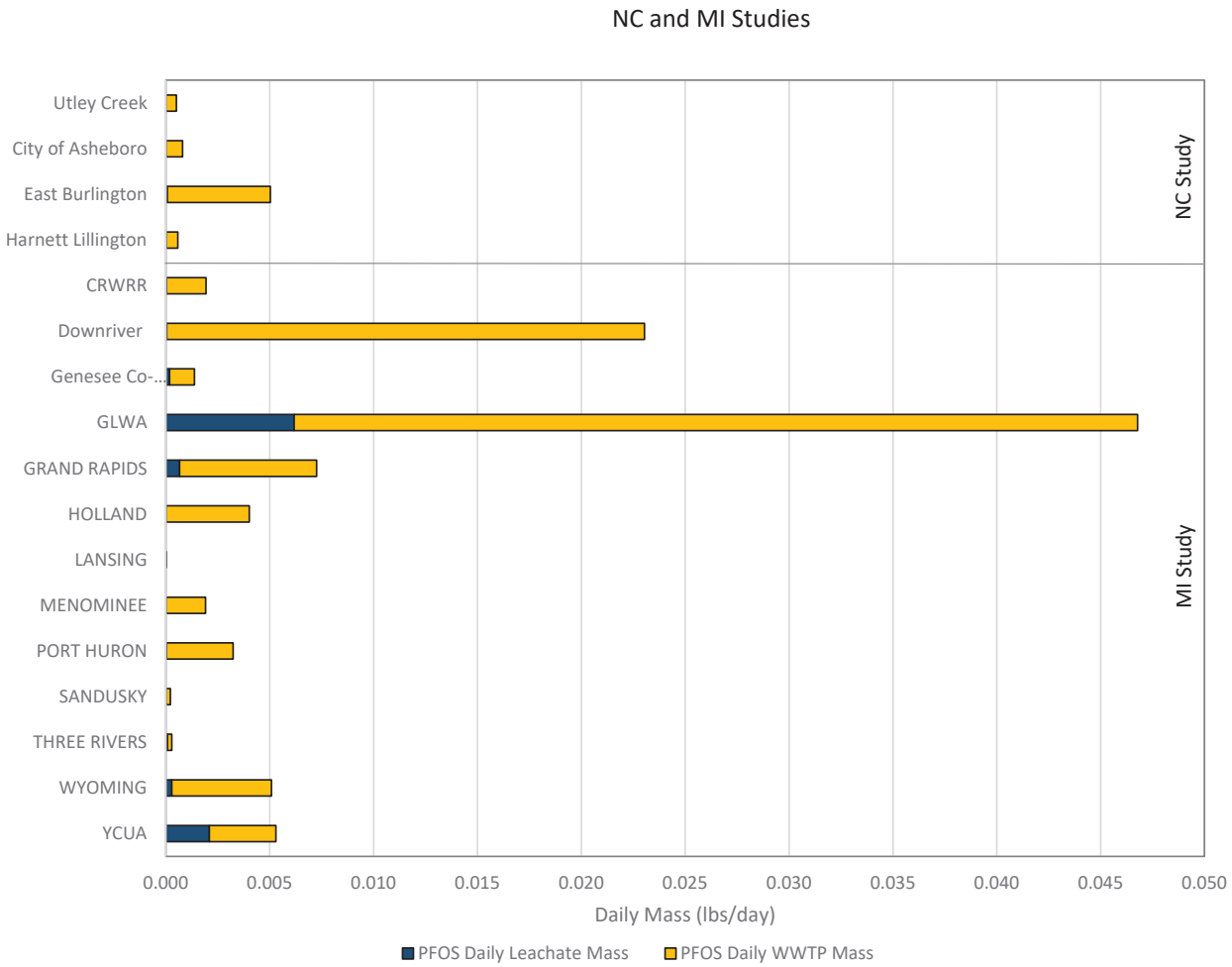
Figure 4 - PFOS and PFOA Daily WWTP Mass Summary



Notes:
1. MI Study = Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019)
2. lbs/day = pounds per day

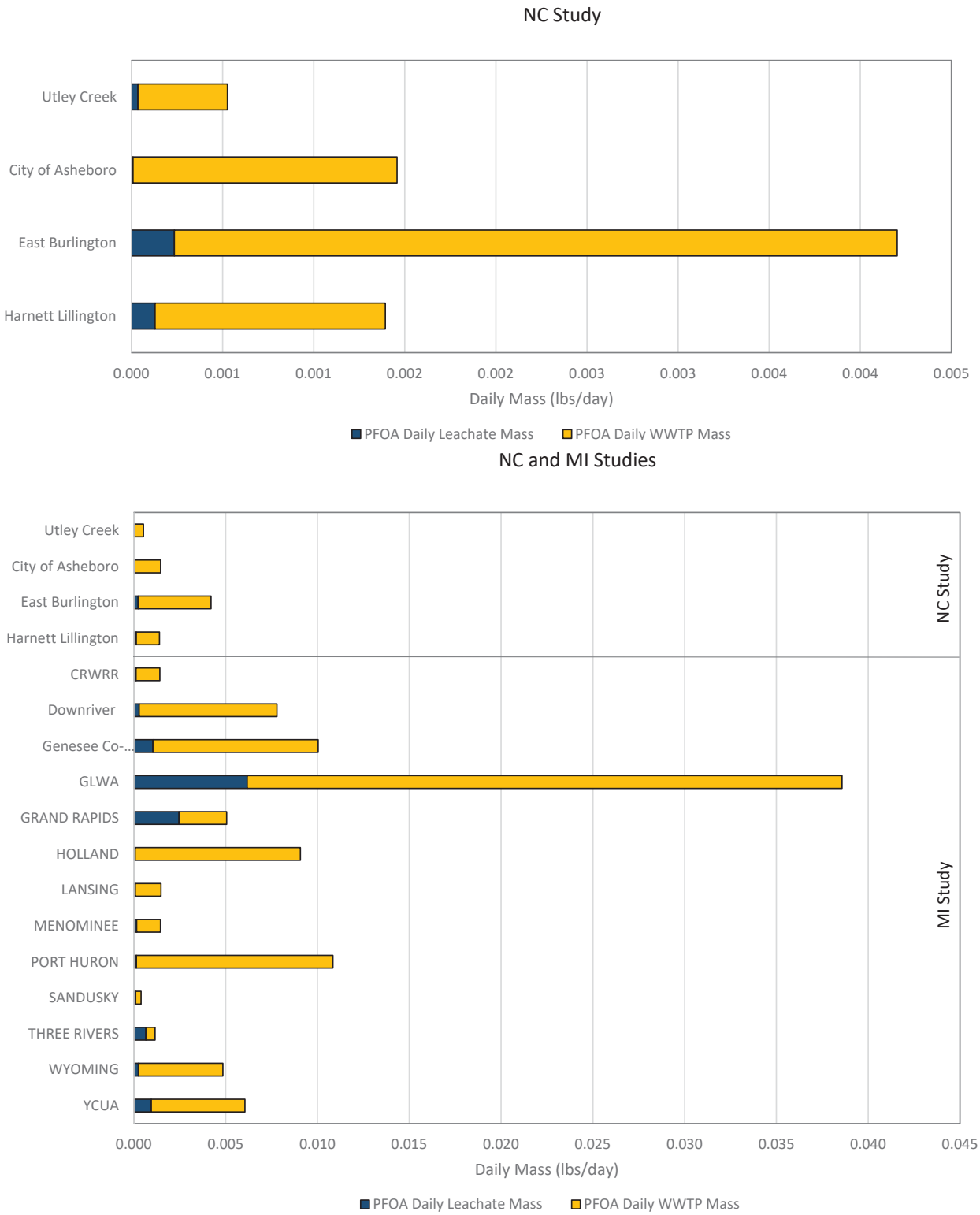
Figure 5 - PFOS Landfill Leachate Contribution to WWTP Daily Mass





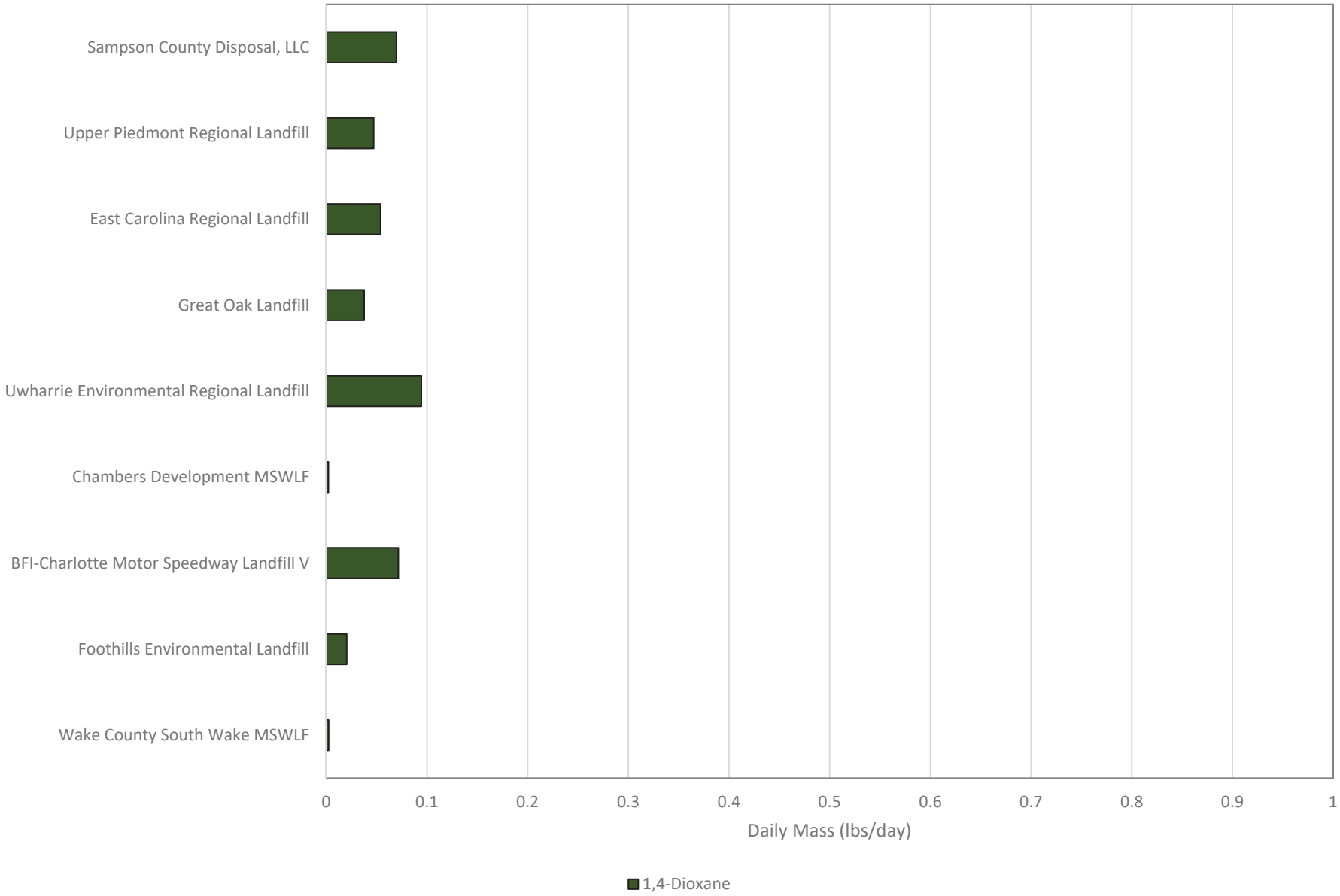
Notes:
1. MI Study = Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019)
2. lbs/day = pounds per day

Figure 6 - PFOA Landfill Leachate Contribution to WWTP Daily Mass



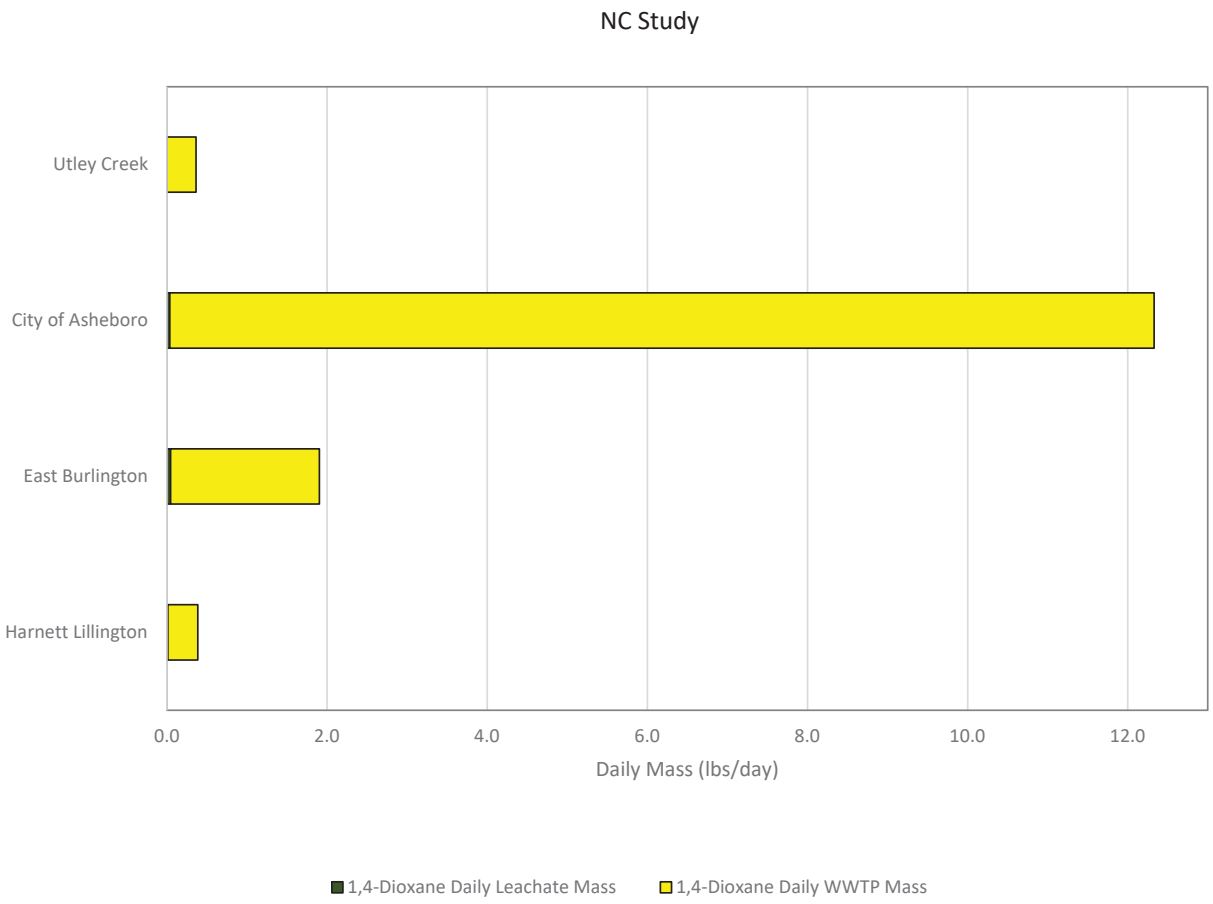
Notes:
1. MI Study = Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent (March 2019)
2. lbs/day = pounds per day

Figure 7 - 1,4-Dioxane Daily Leachate Mass Summary



Note:
1. lbs/day = pounds per day

Figure 8 - 1,4-Dioxane Landfill Leachate Contribution to WWTP Daily Mass



Notes:
1. lbs/day = pounds per day
2. Maximum 1,4-dioxane daily leachate mass is 0.1 lbs/day.

APPENDIX A

LABORATORY ANALYTICAL REPORTS

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for South Wake MSWLF
Work Order: 490673

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490673 GEL Work Order: 490673

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804
Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forSouth Wake MSWLF

Client Sample ID: 9222-1
Sample ID: 490673001
Matrix: Misc Liquid
Collect Date: 18-SEP-19 10:00
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	U	ND	13.2	40.0	ng/L	0.200	1	JLS	10/04/19	1109	1921240	1
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	J	35.8	13.2	40.0	ng/L	0.200	1					
Perfluorobutanesulfonic acid (PFBS)		1420	6.60	17.8	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	U	ND	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)	J	17.3	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)	J	7.40	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	U	ND	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		241	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		237	6.60	18.2	ng/L	0.200	1					
Perfluorohexanoic acid (PFHxA)		2940	6.60	20.0	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)		20.7	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		28.8	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	U	ND	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		82.3	8.00	20.0	ng/L	0.200	1					
Perfluorooctanoic acid (PFOA)		803	7.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		32.3	6.60	18.8	ng/L	0.200	1					
Perfluoropentanoic acid (PFPeA)		577	6.60	20.0	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)	U	ND	6.60	20.0	ng/L	0.200	1					
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	132	384	ng/L	0.200	10	JLS	10/02/19	0622	1921240	2
Perfluorobutyric acid (PFBA)		600	66.0	200	ng/L	0.200	10					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	1320	3760	ng/L	0.200	100	JLS	10/02/19	1016	1921240	3
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100					
Semi-Volatile-GC/MS												

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forSouth Wake MSWLF

Client Sample ID: 9222-1 Project: NWRA00119
Sample ID: 490673001 Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		30.0	10.0	20.0	ug/L	0.200	10	JMB3	09/24/19	1314	1919444	4

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl	PFCs Extraction in Liquid	LM1	09/27/19	0830	1921239
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJW1	09/23/19	1200	1919441

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
4	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	26.2 ug/L	40.0	66*	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490673**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)			
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)			

QC Summary

Workorder: **490673**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490673**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: **490673**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: 490673

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					
Semi-Volatile-GC/MS										
Batch 1919444										
QC1204387349 LCS										
**1,4-Dioxane-d8	4.00			3.55	ug/L		89	(70%-130%)	JMB3	09/24/19 12:24

QC Summary

Workorder: **490673**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1919444											
QC1204387350 LCSD											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)	JMB3	09/24/19	12:49
QC1204387348 MB											
1,4-Dioxane			U	ND	ug/L					09/24/19	11:59
**1,4-Dioxane-d8	4.00			3.05	ug/L		76	(70%-130%)			

Notes:

The Qualifiers in this report are defined as follows:

**	Analyte is a surrogate compound
<	Result is less than value reported
>	Result is greater than value reported
A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
UJ	Compound cannot be extracted

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2040 Savage Road Charleston, SC 29407 - (843) 556-8171 - www.gel.com

QC Summary

Workorder: **490673**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1919444

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1919441

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490673001	9222-1
1204387348	Method Blank (MB)
1204387349	Laboratory Control Sample (LCS)
1204387350	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Surrogate Recoveries
Sample (See Below) did not meet surrogate recovery acceptance criteria. The sample was analyzed at a dilution. As a result, one or more surrogates were diluted out of the acceptance limits.

Sample	Analyte	Value
490673001 (9222-1)	1, 4-Dioxane-d8	66* (70%-130%)

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Technical Information

Sample Dilutions
Sample 490673001 (9222-1) was diluted due to the presence of non-target analytes. The data from the dilution are reported.

LCMSMS-Misc

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490673001	9222-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490673001 (9222-1).

Analyte	490673 001
Fluorotelomer sulfonate 4:2 (4:2 FTS)	100X
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Fluorotelomer sulfonate 8:2 (8:2 FTS)	10X
Perfluorobutyric acid (PFBA)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number (1): NA
PO Number: NA

490673
490886 9/9/23

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Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: South Wake MSWLF Fax # 704-586-0007
Address: Apex, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod	1,4-Dioxane by EPA 8270SIM	<-- Preservative Type (6)
9222-1	09-18-19	1000	N	N	ML			4	X	X	

Comments
Note: extra sample is required for sample specific QC

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1	Patrick H. Davis	09-18-19	1630		9/19/19	0850
2						
3						

TAT Requested: Normal: X Rush: ____ Specify: ____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] Yes [ ] No ***Cooler Temp:*** 1 °C

> ***For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)***

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a - **Y** - for yes the sample was field filtered or - **N** - for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - 3, *6010B/7470A* - 1).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

JH

Client: NWRA

SDG/AR/COC/Work Order: 490673

Received By: AJA

Date Received: 9/19/19

Carrier and Tracking Number

Circle Applicable: FedEx Express FedEx Ground UPS Field Services Courier Other

7762 7563 2308-1°, 7762 7563 3418-1°
7762 7563 2764-1°, 7762 7563 3290-1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: Wet Ice Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 TEMP: 1° Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken Damaged container Leaking container Other (describe) 6204-1 (1 bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?			✓	Circle Applicable: Not relinquished Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VOF Date 9/23/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
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gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for Foothills Environmental Landfill
Work Order: 490860

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490860 GEL Work Order: 490860

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forFoothills Environmental Landfill

Client Sample ID: 1403-1
Sample ID: 490860001
Matrix: Misc Liquid
Collect Date: 16-SEP-19 09:20
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	13.2	37.6	ng/L	0.200	1	JLS	10/02/19	0849	1921240	1
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)		101	13.2	40.0	ng/L	0.200	1					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		257	13.2	40.0	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	U	ND	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)		82.6	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)	U	ND	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	J	6.82	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		571	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		794	6.60	18.2	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		71.4	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	J	7.08	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		296	8.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		50.6	6.60	18.8	ng/L	0.200	1					
Perfluoropentanoic acid (PFPeA)		1070	6.60	20.0	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)	J	7.04	6.60	20.0	ng/L	0.200	1					
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	132	384	ng/L	0.200	10	JLS	10/02/19	0657	1921240	2
Perfluorobutanesulfonic acid (PFBS)		4400	66.0	178	ng/L	0.200	10					
Perfluorobutyric acid (PFBA)		744	66.0	200	ng/L	0.200	10					
Perfluorohexanoic acid (PFHxA)		3920	66.0	200	ng/L	0.200	10					
Perfluorooctanoic acid (PFOA)		1650	70.0	200	ng/L	0.200	10					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100	JLS	10/02/19	1059	1921240	3
Semi-Volatile-GC/MS												

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Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forFoothills Environmental Landfill

Client Sample ID: 1403-1 Project: NWRA00119
Sample ID: 490860001 Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		99.7	2.00	4.00	ug/L	0.200	2	JMB3	09/24/19	1829	1919444	4

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl	PFCs Extraction in Liquid	LM1	09/27/19	0830	1921239
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJW1	09/23/19	1200	1919441

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
4	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	30.0 ug/L	40.0	75	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490860**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)			
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)			

QC Summary

Workorder: **490860**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490860**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: **490860**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: **490860**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					
Semi-Volatile-GC/MS										
Batch 1919444										
QC1204387349 LCS										
**1,4-Dioxane-d8	4.00			3.55	ug/L		89	(70%-130%)	JMB3	09/24/19 12:24

QC Summary

Workorder: **490860**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1919444											
QC1204387350 LCSD											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)	JMB3	09/24/19	12:49
QC1204387348 MB											
1,4-Dioxane			U	ND	ug/L					09/24/19	11:59
**1,4-Dioxane-d8	4.00			3.05	ug/L		76	(70%-130%)			

Notes:

The Qualifiers in this report are defined as follows:

**	Analyte is a surrogate compound
<	Result is less than value reported
>	Result is greater than value reported
A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
UJ	Compound cannot be extracted

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QC Summary

Workorder: **490860**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1919444

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1919441

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490860001	1403-1
1204387348	Method Blank (MB)
1204387349	Laboratory Control Sample (LCS)
1204387350	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Technical Information

Sample Dilutions
Sample 490860001 (1403-1) was diluted due to the presence of one or more over-range target analytes.

LCMSMS-Misc

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490860001	1403-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490860001 (1403-1).

Analyte	490860
	001
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Fluorotelomer sulfonate 8:2 (8:2 FTS)	10X
Perfluorobutanesulfonate (PFBS)	10X
Perfluorobutyric acid (PFBA)	10X
Perfluorohexanoic acid (PFHxA)	10X
Perfluorooctanoic acid (PFOA)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number [1]: NA
PO Number: NA

490860

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Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: Foothills Environmental Landfill Fax # 704-586-0007
Address: Lenoir, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested [5] (Fill in the number of containers for each test)

Sample ID *For composites - indicate start and stop date/time*	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code [2]	Field Filtered [3]	Sample Matrix [4]	Should this sample be considered: Radioactive *Please supply isotopic info.*	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod	1,4-Dioxane by EPA 8270SIM	<-- Preservative Type (6)
1403-1	09-16-19	0920	N	N	ML			4	X	X	

Comments
Note: extra sample is required for sample specific QC

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1	Patrick H. Stevens	09-18-19	1630	[illegible]	9/19/19	0850
2						
3						

TAT Requested: Normal: X Rush: ____ Specify: _____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** ____ °C

> ***For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)***

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: _____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	SDG/AR/COC/Work Order: 490860
Received By: AJA	Date Received: 9/19/19
Carrier and Tracking Number	Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other 7762 7563 2308 -1°, 7762 7563 3418-1° 7762 7563 2764 -1°, 7762 7563 3290-1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: ~~Wet Ice~~ Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken ~~Damaged container~~ Leaking container Other (describe) 6204-1 (1 bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?			✓	Circle Applicable: ~~Not relinquished~~ Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VQ Date 9/25/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for BFI-Charlotte motor Speedway Landfill V
Work Order: 490866

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490866 GEL Work Order: 490866

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forBFI-Charlotte motor Speedway Landfill V

Client Sample ID: 1304-1
Sample ID: 490866001
Matrix: Misc Liquid
Collect Date: 16-SEP-19 12:55
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Fluorotelomer sulfonate 8:2 (8:2 FTS)		39.7	13.2	38.4	ng/L	0.200	1	JLS	10/02/19	0907	1921240	1
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)		87.2	13.2	40.0	ng/L	0.200	1					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		258	13.2	40.0	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	J	6.87	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)		590	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)		63.3	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	J	8.17	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		983	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		925	6.60	18.2	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		269	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	J	11.5	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		356	8.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		73.2	6.60	18.8	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)		30.8	6.60	20.0	ng/L	0.200	1					
Perfluorobutanesulfonic acid (PFBS)		5260	66.0	178	ng/L	0.200	10	JLS	10/02/19	0706	1921240	2
Perfluorobutyric acid (PFBA)		1920	66.0	200	ng/L	0.200	10					
Perfluorohexanoic acid (PFHxA)		3470	66.0	200	ng/L	0.200	10					
Perfluorooctanoic acid (PFOA)		2210	70.0	200	ng/L	0.200	10					
Perfluoropentanoic acid (PFPeA)		2160	66.0	200	ng/L	0.200	10					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	1320	3760	ng/L	0.200	100	JLS	10/02/19	1117	1921240	3
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100					

The following Prep Methods were performed:

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forBFI-Charlotte motor Speedway Landfill V

Client Sample ID:	1304-1	Project:	NWRA00119
Sample ID:	490866001	Client ID:	NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl	PFCs Extraction in Liquid	LM1	09/27/19	0830	1921239

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490866**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)			
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)			

QC Summary

Workorder: **490866**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490866**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: **490866**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: **490866**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					

Notes:

The Qualifiers in this report are defined as follows:

- ** Analyte is a surrogate compound
- < Result is less than value reported
- > Result is greater than value reported

QC Summary

Workorder: **490866**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
UJ	Compound cannot be extracted
X	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
Y	QC Samples were not spiked with this compound
^	RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.
h	Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

LCMSMS-Misc
Technical Case Narrative
NWRA - Carolinas Chapter
SDG #: 490866

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490866001	1304-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490866001 (1304-1).

Analyte	490866 001
Fluorotelomer sulfonate 4:2 (4:2 FTS)	100X
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Perfluorobutanesulfonate (PFBS)	10X
Perfluorobutyric acid (PFBA)	10X
Perfluorohexanoic acid (PFHxA)	10X
Perfluorooctanoic acid (PFOA)	10X
Perfluoropentanoic acid (PFPeA)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number (1): NA
PO Number: NA

490866

GEL Laboratories LLC
gel.com
Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: BFI-Charlotte Motor Speedway Landfill V Fax # 704-586-0007
Address: Concord, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod	1,4-Dioxane by EPA 8270SIM	<-- Preservative Type (6)
1304-1	09-16-19	1255	N	N	ML			4	X	X	

Comments
Note: extra sample is required for sample specific QC

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1	Patricia H. Davis	09-18-19	1630		9/19/19	0850
2						
3						

TAT Requested: Normal: X Rush: ____ Specify: ____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** ____ °C

> ***For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)***

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* **- 3**, *6010B/7470A* **- 1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

JH

Client: NWRA	SDG/AR/COC/Work Order: 490866
Received By: AyA	Date Received: 9/19/19
Carrier and Tracking Number	Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other 7762 7563 2308 -1°, 7762 7563 3418-1° 7762 7563 2764 -1°, 7762 7563 3290-1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: Wet Ice Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 TEMP: 1° Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken Damaged container Leaking container Other (describe) 6204-1 (1bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?			✓	Circle Applicable: ~~Not relinquished~~ Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VQ Date 9/23/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for Chambers Development MSWLF
Work Order: 490872

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490872 GEL Work Order: 490872

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

h Preparation or preservation holding time was exceeded

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forChambers Development MSWLF

Client Sample ID: 0403-1
Sample ID: 490872001
Matrix: Misc Liquid
Collect Date: 16-SEP-19 15:30
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	13.2	38.4	ng/L	0.200	1	JLS	10/02/19	0915	1921240	1
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	J	14.9	13.2	40.0	ng/L	0.200	1					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		50.5	13.2	40.0	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	U	ND	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)		23.6	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)	U	ND	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	U	ND	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		249	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		218	6.60	18.2	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)	J	15.5	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	U	ND	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		84.2	8.00	20.0	ng/L	0.200	1					
Perfluorooctanoic acid (PFOA)		345	7.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		19.6	6.60	18.8	ng/L	0.200	1					
Perfluoropentanoic acid (PFPeA)		780	6.60	20.0	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)	U	ND	6.60	20.0	ng/L	0.200	1					
Fluorotelomer sulfonate 6:2 (6:2 FTS)	J	180	132	380	ng/L	0.200	10	JLS	10/02/19	0714	1921240	2
Perfluorobutanesulfonic acid (PFBS)		6290	66.0	178	ng/L	0.200	10					
Perfluorobutyric acid (PFBA)		831	66.0	200	ng/L	0.200	10					
Perfluorohexanoic acid (PFHxA)		2200	66.0	200	ng/L	0.200	10					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	1320	3760	ng/L	0.200	100	JLS	10/02/19	1125	1921240	3
Semi-Volatile-GC/MS												

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forChambers Development MSWLF

Client Sample ID: 0403-1 Project: NWRA00119
Sample ID: 490872001 Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane	Q	9.22	1.00	2.00	ug/L	0.200	1	JMB3	09/24/19	1854	1919444	4
1,4-Dioxane	h	14.8	1.00	2.00	ug/L	0.200	1	JMB3	10/02/19	1652	1922216	5

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl	PFCs Extraction in Liquid	LM1	09/27/19	0830	1921239
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJ	10/02/19	1000	1922215
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJW1	09/23/19	1200	1919441

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
4	SW846 3535A/8270E SIM	
5	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	24.2 ug/L	40.0	60*	(70%-130%)
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	37.7 ug/L	40.0	94	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490872**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)			
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)			

QC Summary

Workorder: **490872**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490872**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: **490872**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: **490872**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					
Semi-Volatile-GC/MS										
Batch 1919444										
QC1204387349 LCS										
**1,4-Dioxane-d8	4.00			3.55	ug/L		89	(70%-130%)	JMB3	09/24/19 12:24

QC Summary

Workorder: **490872**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1919444											
QC1204387350 LCSD											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)	JMB3	09/24/19	12:49
QC1204387348 MB											
1,4-Dioxane			U	ND	ug/L					09/24/19	11:59
**1,4-Dioxane-d8	4.00			3.05	ug/L		76	(70%-130%)			
Batch 1922216											
QC1204393997 LCS											
**1,4-Dioxane-d8	4.00			4.08	ug/L		102	(70%-130%)	JMB3	10/02/19	15:34
QC1204393998 LCSD											
**1,4-Dioxane-d8	4.00			3.76	ug/L		94	(70%-130%)		10/02/19	16:02
QC1204393996 MB											
1,4-Dioxane			U	ND	ug/L					10/02/19	15:07
**1,4-Dioxane-d8	4.00			3.87	ug/L		97	(70%-130%)			

Notes:

The Qualifiers in this report are defined as follows:

- ** Analyte is a surrogate compound
- < Result is less than value reported
- > Result is greater than value reported
- A The TIC is a suspected aldol-condensation product
- B The target analyte was detected in the associated blank.
- C Analyte has been confirmed by GC/MS analysis
- D Results are reported from a diluted aliquot of the sample
- E Concentration of the target analyte exceeds the instrument calibration range
- H Analytical holding time was exceeded
- J See case narrative for an explanation
- J Value is estimated
- JNX Non Calibrated Compound

QC Summary

Workorder: **490872**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

N Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor

N Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor

N/A RPD or %Recovery limits do not apply.

N1 See case narrative

ND Analyte concentration is not detected above the detection limit

NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

P Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.

Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.

R Sample results are rejected

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

UJ Compound cannot be extracted

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1919444

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1919441

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490872001	0403-1
1204387348	Method Blank (MB)
1204387349	Laboratory Control Sample (LCS)
1204387350	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Surrogate Recoveries
Sample (See Below) did not meet surrogate recovery acceptance criteria. The sample was re-extracted out of holding and met acceptance criteria for all surrogates. Both sets of data results have been reported.

Sample	Analyte	Value
490872001 (0403-1)	1, 4-Dioxane-d8	60* (70%-130%)

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2

Analytical Batch: 1922216

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1922215

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490872001	0403-1
1204393996	Method Blank (MB)
1204393997	Laboratory Control Sample (LCS)
1204393998	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Technical Information

Holding Time Specifications
Sample (See Below) was re-extracted out of holding due to QC failure. The failure did not confirm, so both sets of results are reported and have been qualified accordingly.

Sample	Value
490872001 (0403-1)	Received 19-SEP-19, within holding, prepped 02-OCT-19, out of holding 23-SEP-19

Miscellaneous Information

Manual Integrations
Sample (See Below) required manual integration in order to properly identify one or more peaks and/or to correctly position the baseline as set in the calibration standard injections.

Sample	Analyte	Value
490872001 (0403-1)	Tetrahydrofuran-d8	Result 100ug/L

LCMSMS-Misc

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15

Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490872001	0403-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490872001 (0403-1).

Analyte	490872 001
Fluorotelomer sulfonate 4:2 (4:2 FTS)	100X
Fluorotelomer sulfonate 6:2 (6:2 FTS)	10X
Perfluorobutanesulfonate (PFBS)	10X
Perfluorobutyric acid (PFBA)	10X
Perfluorohexanoic acid (PFHxA)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number (1): NA
PO Number: NA

490872

GEL Laboratories LLC
gel.com
Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: Chambers Development MSWLF Fax # 704-586-0007
Address: Polkton, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID *For composites - indicate start and stop date/time*	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod	1,4-Dioxane by EPA 8270SIM	<-- Preservative Type (6)	Comments
0403-1	09-16-19	1530	N	N	ML			4	X	X		Note: extra sample is required for sample specific QC

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1	Patrick H. Stevens	09-18-19	1630	[signature]	9/19/19	0850
2						
3						

TAT Requested: Normal: X Rush: ____ Specify: ____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** 4 °C

> ***For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)***

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous RCRA metals
Pb = Lead

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	SDG/AR/COC/Work Order: 490872
Received By: AJA	Date Received: 9/19/19
Carrier and Tracking Number	Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other 7762 7563 2308 -1°, 7762 7563 3418-1° 7762 7563 2764 -1°, 7762 7563 3290-1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: ~~Wet Ice~~ Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken ~~Damaged container~~ Leaking container Other (describe) 6204-1 (1bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?			✓	Circle Applicable: ~~Not relinquished~~ Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VOJ Date 9/25/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
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gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for Uwharrie Environmental Regional Landfill
Work Order: 490875

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490875 GEL Work Order: 490875

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forUwharrie Environmental Regional Landfill

Client Sample ID: 6204-1
Sample ID: 490875001
Matrix: Misc Liquid
Collect Date: 17-SEP-19 08:55
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Fluorotelomer sulfonate 8:2 (8:2 FTS)	J	35.8	13.2	38.4	ng/L	0.200	1	JLS	10/02/19	0924	1921240	1
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)		68.0	13.2	40.0	ng/L	0.200	1					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		180	13.2	40.0	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	U	ND	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)		632	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)		184	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	J	9.40	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		1560	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		640	6.60	18.2	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		326	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	U	ND	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		356	8.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		41.4	6.60	18.8	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)		33.0	6.60	20.0	ng/L	0.200	1					
Perfluorobutanesulfonic acid (PFBS)		2870	66.0	178	ng/L	0.200	10	JLS	10/02/19	0731	1921240	2
Perfluorobutyric acid (PFBA)		2400	66.0	200	ng/L	0.200	10					
Perfluorohexanoic acid (PFHxA)		5540	66.0	200	ng/L	0.200	10					
Perfluorooctanoic acid (PFOA)		3690	70.0	200	ng/L	0.200	10					
Perfluoropentanoic acid (PFPeA)		2150	66.0	200	ng/L	0.200	10					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	1320	3760	ng/L	0.200	100	JLS	10/02/19	1134	1921240	3
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100					
Semi-Volatile-GC/MS												

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forUwharrie Environmental Regional Landfill

Client Sample ID: 6204-1 Project: NWRA00119
Sample ID: 490875001 Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		357	10.0	20.0	ug/L	0.200	10	JMB3	09/24/19	1528	1919444	4

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl	PFCs Extraction in Liquid	LM1	09/27/19	0830	1921239
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJW1	09/23/19	1200	1919441

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
4	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	40.4 ug/L	40.0	101	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490875**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)			
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)			

QC Summary

Workorder: 490875

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490875**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: 490875

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: 490875

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					
Semi-Volatile-GC/MS										
Batch 1919444										
QC1204387349 LCS										
**1,4-Dioxane-d8	4.00			3.55	ug/L		89	(70%-130%)	JMB3	09/24/19 12:24

QC Summary

Workorder: 490875

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1919444											
QC1204387350 LCSD											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)	JMB3	09/24/19	12:49
QC1204387348 MB											
1,4-Dioxane			U	ND	ug/L					09/24/19	11:59
**1,4-Dioxane-d8	4.00			3.05	ug/L		76	(70%-130%)			

Notes:

The Qualifiers in this report are defined as follows:

**	Analyte is a surrogate compound
<	Result is less than value reported
>	Result is greater than value reported
A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
UJ	Compound cannot be extracted

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2040 Savage Road Charleston, SC 29407 - (843) 556-8171 - www.gel.com

QC Summary

Workorder: **490875**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1919444

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1919441

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490875001	6204-1
1204387348	Method Blank (MB)
1204387349	Laboratory Control Sample (LCS)
1204387350	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Technical Information

Sample Dilutions
Sample 490875001 (6204-1) was diluted due to the presence of one or more over-range target analytes.

LCMSMS-Misc

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490875001	6204-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490875001 (6204-1).

Analyte	490875 001
Fluorotelomer sulfonate 4:2 (4:2 FTS)	100X
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Perfluorobutanesulfonate (PFBS)	10X
Perfluorobutyric acid (PFBA)	10X
Perfluorohexanoic acid (PFHxA)	10X
Perfluorooctanoic acid (PFOA)	10X
Perfluoropentanoic acid (PFPeA)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number (1): NA
PO Number: NA

490875

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Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: Uwharrie Environmental Regional Landfill Fax # 704-586-0007
Address: Mt Gilead, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod	1,4-Dioxane by EPA 8270SIM	<-- Preservative Type (6)
6204-1	09-17-19	0855	N	N	ML			4	X	X	

Comments
Note: extra sample is required for sample specific QC

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1	Patrick H. Davis	09-18-19	1630	[signature]	9/19/19	0850
2						
3						

TAT Requested: Normal: X Rush: ____ Specify: ____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] Yes [ ] No *Cooler Temp:* 1 °C

> ***For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)***

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	SDG/AR/COC/Work Order: 490875
Received By: AJK	Date Received: 9/19/19
Carrier and Tracking Number	Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other 7762 7563 2308 -1°, 7762 7563 3418-1° 7762 7563 2764 -1°, 7762 7563 3290-1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: ~~Wet Ice~~ Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken ~~Damaged container~~ Leaking container Other (describe) 6204-1 (1bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?			✓	Circle Applicable: ~~Not relinquished~~ Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VQ Date 9/25/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
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gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for Great Oak Landfill
Work Order: 490876

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490876 GEL Work Order: 490876

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804
Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forGreat Oak Landfill

Client Sample ID: 7607-1
Sample ID: 490876001
Matrix: Misc Liquid
Collect Date: 17-SEP-19 13:10
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	J	15.6	13.2	40.0	ng/L	0.200	1	JLS	10/04/19	1052	1921240	1
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		42.4	13.2	40.0	ng/L	0.200	1					
Perfluorobutanesulfonic acid (PFBS)		72.2	6.60	17.8	ng/L	0.200	1					
Perfluorobutyric acid (PFBA)		303	6.60	20.0	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	J	7.10	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)	J	18.5	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)	U	ND	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	U	ND	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		68.4	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		59.1	6.60	18.2	ng/L	0.200	1					
Perfluorohexanoic acid (PFHxA)		449	6.60	20.0	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		32.8	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	J	8.75	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		83.9	8.00	20.0	ng/L	0.200	1					
Perfluorooctanoic acid (PFOA)		108	7.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)	J	10.3	6.60	18.8	ng/L	0.200	1					
Perfluoropentanoic acid (PFPeA)		159	6.60	20.0	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)	J	7.44	6.60	20.0	ng/L	0.200	1					
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	132	384	ng/L	0.200	10	JLS	10/02/19	0740	1921240	2
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	1320	3760	ng/L	0.200	100	JLS	10/02/19	1143	1921240	3
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100					

The following Prep Methods were performed:

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forGreat Oak Landfill

Client Sample ID: 7607-1 Project: NWRA00119
Sample ID: 490876001 Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl PFCs	Extraction in Liquid	LM1	09/27/19	0830	1921239

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804
Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forGreat Oak Landfill

Client Sample ID: 7607-EB
Sample ID: 490876002
Matrix: Misc Liquid
Collect Date: 17-SEP-19 12:40
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	1.15	3.29	ng/L	0.0175	1	JLS	10/02/19	0941	1921240	1
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1.15	3.32	ng/L	0.0175	1					
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	1.15	3.36	ng/L	0.0175	1					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	U	ND	1.15	3.50	ng/L	0.0175	1					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	U	ND	1.15	3.50	ng/L	0.0175	1					
Perfluorobutanesulfonic acid (PFBS)	U	ND	0.577	1.56	ng/L	0.0175	1					
Perfluorobutyric acid (PFBA)	J	1.12	0.577	1.75	ng/L	0.0175	1					
Perfluorodecanesulfonic acid (PFDS)	U	ND	0.577	1.70	ng/L	0.0175	1					
Perfluorodecanoic acid (PFDA)	U	ND	0.682	1.75	ng/L	0.0175	1					
Perfluorododecanoic acid (PFDoA)	U	ND	0.577	1.75	ng/L	0.0175	1					
Perfluoroheptanesulfonic acid (PFHpS)	U	ND	0.577	1.66	ng/L	0.0175	1					
Perfluoroheptanoic acid (PFHpA)	U	ND	0.577	1.75	ng/L	0.0175	1					
Perfluorohexanesulfonic acid (PFHxS)	U	ND	0.577	1.59	ng/L	0.0175	1					
Perfluorohexanoic acid (PFHxA)	U	ND	0.577	1.75	ng/L	0.0175	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	0.612	1.68	ng/L	0.0175	1					
Perfluorononanoic acid (PFNA)	U	ND	0.577	1.75	ng/L	0.0175	1					
Perfluorooctanesulfonamide (PFOSA)	U	ND	0.577	1.63	ng/L	0.0175	1					
Perfluorooctanesulfonic acid (PFOS)	U	ND	0.699	1.75	ng/L	0.0175	1					
Perfluorooctanoic acid (PFOA)	U	ND	0.612	1.75	ng/L	0.0175	1					
Perfluoropentanesulfonic acid (PFPeS)	U	ND	0.577	1.64	ng/L	0.0175	1					
Perfluoropentanoic acid (PFPeA)	U	ND	0.577	1.75	ng/L	0.0175	1					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	0.577	1.75	ng/L	0.0175	1					
Perfluorotridecanoic acid (PFTrDA)	U	ND	0.577	1.75	ng/L	0.0175	1					
Perfluoroundecanoic acid (PFUdA)	U	ND	0.577	1.75	ng/L	0.0175	1					

The following Prep Methods were performed:

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forGreat Oak Landfill

Client Sample ID:	7607-EB	Project:	NWRA00119
Sample ID:	490876002	Client ID:	NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl	PFCs Extraction in Liquid	LM1	09/27/19	0830	1921239

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490876**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)			
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)			

QC Summary

Workorder: **490876**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490876**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: **490876**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: **490876**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					

Notes:

The Qualifiers in this report are defined as follows:

- ** Analyte is a surrogate compound
- < Result is less than value reported
- > Result is greater than value reported

QC Summary

Workorder: **490876**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
UJ	Compound cannot be extracted
X	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
Y	QC Samples were not spiked with this compound
^	RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.
h	Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

LCMSMS-Misc
Technical Case Narrative
NWRA - Carolinas Chapter
SDG #: 490876

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490876001	7607-1
490876002	7607-EB
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range. 490876001 (7607-1).

Analyte	490876 001
Fluorotelomer sulfonate 4:2 (4:2 FTS)	100X
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Fluorotelomer sulfonate 8:2 (8:2 FTS)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002(7607-EB) (7607-EB) due to elevated concentrations of target analytes. PFBA was detected in the following samples above the MDL but less than LOQ. The sample is identified as Field Reagent Blanks (FRB). All samples associated with these blanks contained PFBA concentrations greater than 10 times that found in the blank. 490876002 (7607-EB).

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number (1): NA
PO Number: NA

490876

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Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: Great Oak Landfill Fax # 704-586-0007
Address: Randleman, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID * For composites - indicate start and stop date/time	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod	1,4-Dioxane by EPA 8270SIM
7607-1	09-17-19	1310	N	N	ML			4	X	X
7607-EB	09-17-19	1240	EB	N	ML			4	X	X

<-- Preservative Type (6)

Comments
Note: extra sample is required for sample specific QC

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 Patrick H. Davis	09-18-19	1630	1	9/19/19	0850
2			2		
3			3		

TAT Requested: Normal: X Rush: ____ Specify: ____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** ____ °C

> ***For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)***

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate. If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA

SDG/AR/COC/Work Order: 490876

Received By: AJA

Date Received: 9/19/19

Carrier and Tracking Number

Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other

7762 7563 2308 -1°, 7762 7563 3418-1°
7762 7563 2764 -1°, 7762 7563 3290-1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: ~~Wet Ice~~ Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken ~~Damaged container~~ Leaking container Other (describe) 6204-1 (1 bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?			✓	Circle Applicable: ~~Not relinquished~~ Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VQ Date 9/25/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for East Carolina Reginal Landfill
Work Order: 490877

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 20, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490877 GEL Work Order: 490877

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forEast Carolina Reginal Landfill

Client Sample ID: 0803-1
Sample ID: 490877001
Matrix: Misc Liquid
Collect Date: 19-SEP-19 10:35
Receive Date: 20-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	13.2	37.6	ng/L	0.200	1	JLS	10/02/19	0950	1921240	1
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)		237	13.2	40.0	ng/L	0.200	1					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		230	13.2	40.0	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	U	ND	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)		90.8	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)	U	ND	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	J	9.39	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		689	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		536	6.60	18.2	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		89.0	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	J	17.3	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		402	8.00	20.0	ng/L	0.200	1					
Perfluorooctanoic acid (PFOA)		1640	7.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		54.7	6.60	18.8	ng/L	0.200	1					
Perfluoropentanoic acid (PFPeA)		1220	6.60	20.0	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)	U	ND	6.60	20.0	ng/L	0.200	1					
Perfluorobutanesulfonic acid (PFBS)		3850	66.0	178	ng/L	0.200	10	JLS	10/02/19	0749	1921240	2
Perfluorobutyric acid (PFBA)		650	66.0	200	ng/L	0.200	10					
Perfluorohexanoic acid (PFHxA)		3610	66.0	200	ng/L	0.200	10					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100	JLS	10/02/19	1151	1921240	3
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	1320	3840	ng/L	0.200	100					
Semi-Volatile-GC/MS												

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Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forEast Carolina Reginal Landfill

Client Sample ID: 0803-1 Project: NWRA00119
Sample ID: 490877001 Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		157	4.00	8.00	ug/L	0.200	4	JMB3	09/24/19	1919	1919444	4

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl	PFCs Extraction in Liquid	LM1	09/27/19	0830	1921239
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJW1	09/23/19	1200	1919441

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
4	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	27.3 ug/L	40.0	68*	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490877**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
QC1204391614 LCS										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19 06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)		
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)		
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)		
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)		
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)		
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)		
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)		
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)		
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)		
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)		

QC Summary

Workorder: **490877**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490877**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: 490877

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: 490877

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					
Semi-Volatile-GC/MS										
Batch 1919444										
QC1204387349 LCS										
**1,4-Dioxane-d8	4.00			3.55	ug/L		89	(70%-130%)	JMB3	09/24/19 12:24

QC Summary

Workorder: 490877

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1919444											
QC1204387350 LCSD											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)	JMB3	09/24/19	12:49
QC1204387348 MB											
1,4-Dioxane			U	ND	ug/L					09/24/19	11:59
**1,4-Dioxane-d8	4.00			3.05	ug/L		76	(70%-130%)			

Notes:

The Qualifiers in this report are defined as follows:

**	Analyte is a surrogate compound
<	Result is less than value reported
>	Result is greater than value reported
A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
UJ	Compound cannot be extracted

GEL LABORATORIES LLC
2040 Savage Road Charleston, SC 29407 - (843) 556-8171 - www.gel.com

QC Summary

Workorder: **490877**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1919444

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1919441

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490877001	0803-1
1204387348	Method Blank (MB)
1204387349	Laboratory Control Sample (LCS)
1204387350	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Surrogate Recoveries
Sample (See Below) did not meet surrogate recovery acceptance criteria. The sample was analyzed at a dilution. As a result, one or more surrogates were diluted out of the acceptance limits.

Sample	Analyte	Value
490877001 (0803-1)	1, 4-Dioxane-d8	68* (70%-130%)

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Technical Information

Sample Dilutions
Sample 490877001 (0803-1) was diluted due to the presence of one or more over-range target analytes.

LCMSMS-Misc

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490877001	0803-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490877001 (0803-1).

Analyte	490877 001
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Fluorotelomer sulfonate 8:2 (8:2 FTS)	100X
Perfluorobutanesulfonate (PFBS)	10X
Perfluorobutyric acid (PFBA)	10X
Perfluorohexanoic acid (PFHxA)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project #: 190772 NWRA0019
GEL Quote #: NWRA Quote
COC Number (1): N/A
PO Number: Bill to NWRA

490877

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Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

GEL Work Order Number:
GEL Project Manager: Julie Robinson

Client Name: NWRA c/o Hart & Hickman, P.C. Phone # 919-847-4241
Project/Site Name: East Carolina Regional Landfill Fax #
Address: 1922 Republican Road, Aulander, NC 27805
Collected By: P. Stevens Send Results To: Genna Olson JOlson@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID * For composites - indicate start and stop date/time	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive Please supply isotopic info	(7) Known or possible hazards	Total number of containers	1,4-Dioxane by 8270 SIM (Preservative Type (6): N)	Comments Note: extra sample is required for sample specific QC
0803-1	09-19-19	1035	G	N	ML			2	X	

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time		Received by (signed)	Date	Time
1	[signature]	9-19-19	1700	1	Fedex	9-19-19	1700
2				2	[signature]	9/20/19	8:55
3				3			

TAT Requested: Normal: X Rush: ____ Specify: ________ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** 1 °C

> *For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)*

Sample Collection Time Zone: [ ] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ______

1.) Chain of Custody Number = Client Determined

2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite

3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.

4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - 3, *6010B/7470A* - 1).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) Are there any known or possible hazards associated with these samples?

RCRA Metals
As = Arsenic, Hg = Mercury
Ba = Barium, Se = Selenium
Cd = Cadmium, Ag = Silver
Cr = Chromium, MR = Miscellaneous RCRA metals
Pb = Lead

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW = Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT = Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

Page: 1 of 1
Project #: 190772 NWRA0019
GEL Quote #: NWRA Quote
COC Number [1]: NA
PO Number: Bill to NWRA

GEL Laboratories LLC
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Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics
Chain of Custody and Analytical Request

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

GEL Work Order Number:
GEL Project Manager: Julie Robinson

Client Name: NWRA c/o Hart Hickman, P.C. Phone # 919-847-4241
Project/Site Name: East Carolina Regional Landfill Fax #
Address: 1922 Republican Road, Aulander, NC 27805
Collected By: P. Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested [5] (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	Time Collected (Military) (hhmm)	QC Code [2]	Field Filtered [3]	Sample Matrix [4]	Should this sample be considered: Radioactive (Please supply isotopic info)	(7) Known or possible hazards	Total number of containers	PFAS (21-compound) modified EPA 537										Comments Note: extra sample is required for sample specific QC
<-- Preservative Type (6)									N										
0803-1	09-19-19	1035	G	N	ML			2	X										

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time		Received by (signed)	Date	Time
1	[signature]	9-19-19	1700	1	FedEx	9-19-19	1700
2				2	A. Almen	9/20/19	8:55
3				3			

TAT Requested: Normal: X Rush: ____ Specify: ________ (Subject to Surcharge)
Fax Results: [ ] Yes [X] No
Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4
Additional Remarks:
For Lab Receiving Use Only: Custody Seal Intact? [ ] Yes [ ] No Cooler Temp: 1 °C

> For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)

Sample Collection Time Zone: [ ] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ______

1.) Chain of Custody Number = Client Determined

2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite

3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.

4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. 8260B, 6010B/7470A) and number of containers provided for each (i.e. 8260B - 3, 6010B/7470A - 1).

6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic Hg= Mercury
Ba = Barium Se= Selenium
Cd = Cadmium Ag= Silver
Cr = Chromium MR= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. (i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)

GEL Laboratories LLC

JR

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	SDG/AR/COC/Work Order: 490877
Received By: AJA	Date Received: 9/20/19
Carrier and Tracking Number	Circle Applicable: FedEx Express FedEx Ground UPS Field Services Courier Other 7762 8638 8788 7762 8638 8034

Suspected Hazard Information	Yes	No	
			*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: Wet Ice Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
6	Samples requiring chemical preservation at proper pH?			✓	Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections? AA 9/20	✗		✓	Circle Applicable: Not relinquished Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials KG Date 9/23/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for Upper Piedmont Regional Landfill
Work Order: 490879

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019 and September 20, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490879 GEL Work Order: 490879

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forUpper Piedmont Regional Landfill

Client Sample ID: 7304-1
Sample ID: 490879001
Matrix: Misc Liquid
Collect Date: 17-SEP-19 15:25
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)		48.7	13.2	40.0	ng/L	0.200	1	JLS	10/04/19	1100	1921240	1
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		106	13.2	40.0	ng/L	0.200	1					
Perfluorobutanesulfonic acid (PFBS)		1420	6.60	17.8	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	J	14.9	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)		48.0	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)	U	ND	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	U	ND	6.60	19.0	ng/L	0.200	1					
Perfluoroheptanoic acid (PFHpA)		344	6.60	20.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		190	6.60	18.2	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	J	13.4	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		44.1	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	U	ND	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		254	8.00	20.0	ng/L	0.200	1					
Perfluorooctanoic acid (PFOA)		884	7.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		28.1	6.60	18.8	ng/L	0.200	1					
Perfluoropentanoic acid (PFPeA)		621	6.60	20.0	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)	U	ND	6.60	20.0	ng/L	0.200	1					
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	132	384	ng/L	0.200	10	JLS	10/02/19	0757	1921240	2
Perfluorobutyric acid (PFBA)		743	66.0	200	ng/L	0.200	10					
Perfluorohexanoic acid (PFHxA)		2350	66.0	200	ng/L	0.200	10					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	66.0	200	ng/L	0.200	10					
Perfluorotridecanoic acid (PFTrDA)	U	ND	66.0	200	ng/L	0.200	10					
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	1320	3760	ng/L	0.200	100	JLS	10/02/19	1200	1921240	3
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100					

The following Prep Methods were performed:

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forUpper Piedmont Regional Landfill

Client Sample ID:	7304-1	Project:	NWRA00119
Sample ID:	490879001	Client ID:	NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl PFCs	Extraction in Liquid	LM1	09/27/19	0830	1921239

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forUpper Piedmont Regional Landfill

Client Sample ID:	7304-1	Project:	NWRA00119
Sample ID:	490879002	Client ID:	NWRA001
Matrix:	Misc Liquid		
Collect Date:	17-SEP-19 15:25		
Receive Date:	20-SEP-19		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		177	5.00	10.0	ug/L	0.200	5	JMB3	09/24/19	1945	1919444	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJW1	09/23/19	1200	1919441

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	24.2 ug/L	40.0	61*	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490879**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)			
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)			

QC Summary

Workorder: **490879**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)	JLS	10/02/19 06:05
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluorotridecanoic acid (PFTrDA)	19.5			19.9	ng/L		102	(57%-149%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		10/02/19 06:14
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)		
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		

QC Summary

Workorder: **490879**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)	JLS	10/02/19 06:14
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)		
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		

QC Summary

Workorder: **490879**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)	JLS	10/02/19 06:14
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluorotridecanoic acid (PFTrDA)	18.8			17.7	ng/L	11	94	(0%-35%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L					
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L					

QC Summary

Workorder: **490879**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L				JLS	10/02/19 05:56
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L					
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L					
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L					
Perfluorononanoic acid (PFNA)			U	ND	ng/L					
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L					
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L					
Perfluorooctanoic acid (PFOA)			U	ND	ng/L					
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L					
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L					
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L					
Perfluorotridecanoic acid (PFTrDA)			U	ND	ng/L					
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L					
Semi-Volatile-GC/MS										
Batch 1919444										
QC1204387349 LCS										
**1,4-Dioxane-d8	4.00			3.55	ug/L		89	(70%-130%)	JMB3	09/24/19 12:24

QC Summary

Workorder: **490879**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1919444											
QC1204387350 LCSD											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)	JMB3	09/24/19	12:49
QC1204387348 MB											
1,4-Dioxane			U	ND	ug/L					09/24/19	11:59
**1,4-Dioxane-d8	4.00			3.05	ug/L		76	(70%-130%)			

Notes:

The Qualifiers in this report are defined as follows:

**	Analyte is a surrogate compound
<	Result is less than value reported
>	Result is greater than value reported
A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.
UJ	Compound cannot be extracted

QC Summary

Workorder: **490879**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1919444

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1919441

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490879002	7304-1
1204387348	Method Blank (MB)
1204387349	Laboratory Control Sample (LCS)
1204387350	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Surrogate Recoveries
Sample (See Below) did not meet surrogate recovery acceptance criteria. The sample was analyzed at a dilution. As a result, one or more surrogates were diluted out of the acceptance limits.

Sample	Analyte	Value
490879002 (7304-1)	1, 4-Dioxane-d8	61* (70%-130%)

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Technical Information

Sample Dilutions
Sample 490879002 (7304-1) was diluted due to the presence of one or more over-range target analytes.

LCMSMS-Misc

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490879001	7304-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490879001 (7304-1).

Analyte	490879 001
Fluorotelomer sulfonate 4:2 (4:2 FTS)	100X
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Fluorotelomer sulfonate 8:2 (8:2 FTS)	10X
Perfluorobutyric acid (PFBA)	10X
Perfluorohexanoic acid (PFHxA)	10X
Perfluorotetradecanoic acid (PFTeDA)	10X
Perfluorotridecanoic acid (PFTrDA)	10X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number [1]: NA
PO Number: NA

490879

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Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: Upper Piedmont Regional Landfill Fax # 704-586-0007
Address: Rougemont, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested [5] (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code [2]	Field Filtered [3]	Sample Matrix [4]	Should this sample be considered: Radioactive (Please supply isotopic info.)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod <-- Preservative Type (6)
7304-1	09-17-19	1525	N	N	ML			2	X

Comments
Note: extra sample is required for sample specific QC

Note that you will receive a separate cooler 9/20/19 with bottles for 1,4-dioxane analysis for this site. It is OK to include those in the same lab report as these samples.

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 Patrick H. Stevens	09-18-19	1630	1	9/19/19	0850
2			2		
3			3		

TAT Requested: Normal: X Rush: ____ Specify: ____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] Yes [ ] No *Cooler Temp:* ____ °C

> *For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)*

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

Page: 1 of 1
Project # 190772 NWRA 00119
GEL Quote #: NWRA Quote
COC Number [1]: N/A
PO Number: Bill to NWRA

GEL Laboratories LLC

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Chain of Custody and Analytical Request

GEL Work Order Number:
GEL Project Manager: Julie Robinson

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, P.C. Phone # 919-847-4241
Project/Site Name: Upper Piedmont Regional Landfill Fax #
Address: 9650 Oxford Road, Rougemont, NC 27572
Collected By: P. Stevens Send Results To: Garm Olson golson@harthickman.com

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	(7) Known or possible hazards	Total number of containers	Sample Analysis Requested (5) (Fill in the number of containers for each test): 1,4-Dioxane by EPA 8270 SIM										<-- Preservative Type (6) / Comments Note: extra sample is required for sample specific QC
7304-1	09-17-19	1525	G	N	ML			2	X										

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 [signature]	9-19-19	1700	1 Fedex	9-19-19	1700
2			2 A. Almer	9/20/19	8:55
3			3		

TAT Requested: Normal: X **Rush:** ____ **Specify:** ________ **(Subject to Surcharge)**

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** ____ °C

> For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)

Sample Collection Time Zone: [ ] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ________

1.) Chain of Custody Number = Client Determined

2.) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite

3.) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.

4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - 3, *6010B/7470A* - 1).

6.) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic, Hg = Mercury
Ba = Barium, Se = Selenium
Cd = Cadmium, Ag = Silver
Cr = Chromium, MR = Miscellaneous RCRA metals
Pb = Lead

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW = Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT = Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

JH

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	SDG/AR/COC/Work Order: ~~490859~~ 490879
Received By: AJA	Date Received: 9/19/19
Carrier and Tracking Number	Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other 7762 7563 2306 -1°, 7762 7563 3418-1° 7762 7563 2764 -1°, 7762 7563 3290-1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: ~~Wet Ice~~ Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken ~~Damaged container~~ Leaking container Other (describe) 6204-1 (1 bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?			✓	Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?			✓	Circle Applicable: ~~Not relinquished~~ Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VQ Date 9/23/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

GEL Laboratories LLC

JR

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	**SDG/AR/COC/Work Order:** 490879
Received By: AJA	**Date Received:** 9/20/19
Carrier and Tracking Number	Circle Applicable: (FedEx Express) FedEx Ground UPS Field Services Courier Other 7762 8638 8788 7762 8639 8034

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: (Wet Ice) Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
6	Samples requiring chemical preservation at proper pH?			✓	Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections? AA 9/20	✓		✓	Circle Applicable: (Not relinquished) Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials AG Date 9/23/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

November 08, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for Sampson County Disposal, LLC
Work Order: 490881

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on September 19, 2019 and September 20, 2019. This revised data report has been prepared and reviewed in accordance with GEL's standard operating procedures. This package was revised to include PFPeA and PFOA.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 490881 GEL Work Order: 490881

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

J See case narrative for an explanation

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804
Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forSampson County Disposal, LLC

Client Sample ID: 8202-1
Sample ID: 490881001
Matrix: Misc Liquid
Collect Date: 18-SEP-19 12:20
Receive Date: 19-SEP-19
Collector: Client

Project: NWRA00119
Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Fluorotelomer sulfonate 4:2 (4:2 FTS)	U	ND	13.2	37.6	ng/L	0.200	1	JLS	10/02/19	1007	1921240	1
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)		43.8	13.2	40.0	ng/L	0.200	1					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)		104	13.2	40.0	ng/L	0.200	1					
Perfluorodecanesulfonic acid (PFDS)	U	ND	6.60	19.4	ng/L	0.200	1					
Perfluorodecanoic acid (PFDA)		90.9	7.80	20.0	ng/L	0.200	1					
Perfluorododecanoic acid (PFDoA)	J	9.17	6.60	20.0	ng/L	0.200	1					
Perfluoroheptanesulfonic acid (PFHpS)	U	ND	6.60	19.0	ng/L	0.200	1					
Perfluorohexanesulfonic acid (PFHxS)		424	6.60	18.2	ng/L	0.200	1					
Perfluorononanesulfonic acid (PFNS)	U	ND	7.00	19.2	ng/L	0.200	1					
Perfluorononanoic acid (PFNA)		128	6.60	20.0	ng/L	0.200	1					
Perfluorooctanesulfonamide (PFOSA)	U	ND	6.60	18.6	ng/L	0.200	1					
Perfluorooctanesulfonic acid (PFOS)		222	8.00	20.0	ng/L	0.200	1					
Perfluorooctanoic acid (PFOA)		1790	7.00	20.0	ng/L	0.200	1					
Perfluoropentanesulfonic acid (PFPeS)		61.0	6.60	18.8	ng/L	0.200	1					
Perfluoroundecanoic acid (PFUdA)	J	10.2	6.60	20.0	ng/L	0.200	1					
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA)		10800	330	1000	ng/L	0.200	50	JLS	10/02/19	0806	1921240	2
Fluorotelomer sulfonate 8:2 (8:2 FTS)	U	ND	660	1920	ng/L	0.200	50					
Perfluorobutanesulfonic acid (PFBS)		7530	330	890	ng/L	0.200	50					
Perfluorobutyric acid (PFBA)		4770	330	1000	ng/L	0.200	50					
Perfluoroheptanoic acid (PFHpA)		5520	330	1000	ng/L	0.200	50					
Perfluorohexanoic acid (PFHxA)		6730	330	1000	ng/L	0.200	50					
Perfluorotetradecanoic acid (PFTeDA)	U	ND	330	1000	ng/L	0.200	50					
Perfluorotridecanoic acid (PFTrDA)	U	ND	330	1000	ng/L	0.200	50					
Fluorotelomer sulfonate 6:2 (6:2 FTS)	U	ND	1320	3800	ng/L	0.200	100	JLS	10/02/19	1209	1921240	3

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company : NWRA - Carolinas Chapter
Address : 1550 Crystal Drive, Suite 804

Arlington, Virginia 22202
Contact: Mr. Jim Riley
Project: Analytical forSampson County Disposal, LLC

Client Sample ID: 8202-1 Project: NWRA00119
Sample ID: 490881001 Client ID: NWRA001

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
LCMSMS PFCs												
EPA 537Mod PFCs by LC-MS/MS "As Received"												
Perfluoropentanoic acid (PFPeA)		86400	660	2000	ng/L	0.200	100					

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 537.1 Mod, PFAS, Compl PFCs Extraction in Liquid		LM1	09/27/19	0830	1921239

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
2	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	
3	EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15	

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: November 8, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forSampson County Disposal, LLC

Client Sample ID:	8202-1	Project:	NWRA00119
Sample ID:	490881002	Client ID:	NWRA001
Matrix:	Misc Liquid		
Collect Date:	18-SEP-19 12:20		
Receive Date:	20-SEP-19		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		184	5.00	10.0	ug/L	0.200	5	JMB3	09/24/19	2011	1919444	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJW1	09/23/19	1200	1919441

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	27.7 ug/L	40.0	69*	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

QC Summary

Report Date: November 8, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **490881**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
QC1204391614 LCS											
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA)	19.5			17.1	ng/L		88	(70%-137%)	JLS	10/02/19	06:05
Fluorotelomer sulfonate 4:2 (4:2 FTS)	18.2			15.7	ng/L		86	(60%-145%)			
Fluorotelomer sulfonate 6:2 (6:2 FTS)	18.5			20.4	ng/L		110	(56%-143%)			
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.7			17.5	ng/L		94	(57%-138%)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	19.5			19.3	ng/L		99	(63%-131%)			
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	19.5			21.5	ng/L		111	(62%-133%)			
Perfluorobutanesulfonic acid (PFBS)	17.2			16.6	ng/L		96	(68%-136%)			
Perfluorobutyric acid (PFBA)	19.5			19.7	ng/L		101	(70%-133%)			
Perfluorodecanesulfonic acid (PFDS)	18.8			16.8	ng/L		89	(53%-142%)			
Perfluorodecanoic acid (PFDA)	19.5			18.0	ng/L		93	(62%-135%)			
Perfluorododecanoic acid (PFDoA)	19.5			19.5	ng/L		100	(66%-131%)			
Perfluoroheptanesulfonic acid (PFHpS)	18.5			18.1	ng/L		98	(66%-138%)			
Perfluoroheptanoic acid (PFHpA)	19.5			17.9	ng/L		92	(67%-135%)			

QC Summary

Workorder: **490881**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorohexanesulfonic acid (PFHxS)	17.7			14.5	ng/L		82	(64%-137%)	JLS	10/02/19 06:05
Perfluorohexanoic acid (PFHxA)	19.5			18.9	ng/L		97	(67%-133%)		
Perfluorononanesulfonic acid (PFNS)	18.7			17.5	ng/L		93	(66%-130%)		
Perfluorononanoic acid (PFNA)	19.5			21.1	ng/L		108	(66%-134%)		
Perfluorooctanesulfonamide (PFOSA)	19.5			21.5	ng/L		111	(68%-137%)		
Perfluorooctanesulfonic acid (PFOS)	19.5			19.8	ng/L		102	(61%-131%)		
Perfluorooctanoic acid (PFOA)	19.5			18.8	ng/L		97	(63%-145%)		
Perfluoropentanesulfonic acid (PFPeS)	18.3			16.5	ng/L		90	(62%-139%)		
Perfluoropentanoic acid (PFPeA)	19.5			19.3	ng/L		99	(69%-132%)		
Perfluorotetradecanoic acid (PFTeDA)	19.5			22.5	ng/L		115	(65%-143%)		
Perfluoroundecanoic acid (PFUdA)	19.5			19.1	ng/L		98	(65%-134%)		
QC1204391615 LCSD										
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA)	18.8			18.1	ng/L	5	96	(0%-30%)		10/02/19 06:14
Fluorotelomer sulfonate 4:2 (4:2 FTS)	17.6			20.5	ng/L	26	116	(0%-35%)		
Fluorotelomer sulfonate 6:2 (6:2 FTS)	17.9			17.6	ng/L	14	98	(0%-36%)		
Fluorotelomer sulfonate 8:2 (8:2 FTS)	18.1			19.9	ng/L	13	110	(0%-39%)		

QC Summary

Workorder: **490881**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)	18.8			20.1	ng/L	4	107	(0%-25%)	JLS	10/02/19 06:14
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)	18.8			21.9	ng/L	2	116	(0%-26%)		
Perfluorobutanesulfonic acid (PFBS)	16.7			17.2	ng/L	4	103	(0%-30%)		
Perfluorobutyric acid (PFBA)	18.8			19.3	ng/L	2	102	(0%-30%)		
Perfluorodecanesulfonic acid (PFDS)	18.2			17.2	ng/L	3	95	(0%-28%)		
Perfluorodecanoic acid (PFDA)	18.8			21.1	ng/L	16	112	(0%-29%)		
Perfluorododecanoic acid (PFDoA)	18.8			19.0	ng/L	3	101	(0%-30%)		
Perfluoroheptanesulfonic acid (PFHpS)	17.9			17.7	ng/L	2	99	(0%-30%)		
Perfluoroheptanoic acid (PFHpA)	18.8			19.6	ng/L	9	104	(0%-30%)		
Perfluorohexanesulfonic acid (PFHxS)	17.2			16.8	ng/L	15	98	(0%-30%)		
Perfluorohexanoic acid (PFHxA)	18.8			20.9	ng/L	10	111	(0%-23%)		
Perfluorononanesulfonic acid (PFNS)	18.1			18.2	ng/L	4	101	(0%-27%)		
Perfluorononanoic acid (PFNA)	18.8			18.7	ng/L	12	99	(0%-27%)		
Perfluorooctanesulfonamide (PFOSA)	18.8			20.2	ng/L	6	107	(0%-30%)		
Perfluorooctanesulfonic acid (PFOS)	18.8			19.9	ng/L	1	106	(0%-27%)		

QC Summary

Workorder: **490881**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Perfluorinated Compounds										
Batch 1921240										
Perfluorooctanoic acid (PFOA)	18.8			18.9	ng/L	0	100	(0%-30%)	JLS	10/02/19 06:14
Perfluoropentanesulfonic acid (PFPeS)	17.7			17.3	ng/L	4	98	(0%-29%)		
Perfluoropentanoic acid (PFPeA)	18.8			20.0	ng/L	3	106	(0%-30%)		
Perfluorotetradecanoic acid (PFTeDA)	18.8			20.6	ng/L	9	109	(0%-30%)		
Perfluoroundecanoic acid (PFUdA)	18.8			21.2	ng/L	10	112	(0%-28%)		
QC1204391613 MB										
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA)			U	ND	ng/L					10/02/19 05:56
Fluorotelomer sulfonate 4:2 (4:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 6:2 (6:2 FTS)			U	ND	ng/L					
Fluorotelomer sulfonate 8:2 (8:2 FTS)			U	ND	ng/L					
N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA)			U	ND	ng/L					
N-methylperfluoro-1-octanesulfonamidoacetic acid (N-MeFOSAA)			U	ND	ng/L					
Perfluorobutanesulfonic acid (PFBS)			U	ND	ng/L					
Perfluorobutyric acid (PFBA)			U	ND	ng/L					
Perfluorodecanesulfonic acid (PFDS)			U	ND	ng/L					
Perfluorodecanoic acid (PFDA)			U	ND	ng/L					

QC Summary

Workorder: **490881**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Perfluorinated Compounds											
Batch 1921240											
Perfluorododecanoic acid (PFDoA)			U	ND	ng/L				JLS	10/02/19	05:56
Perfluoroheptanesulfonic acid (PFHpS)			U	ND	ng/L						
Perfluoroheptanoic acid (PFHpA)			U	ND	ng/L						
Perfluorohexanesulfonic acid (PFHxS)			U	ND	ng/L						
Perfluorohexanoic acid (PFHxA)			U	ND	ng/L						
Perfluorononanesulfonic acid (PFNS)			U	ND	ng/L						
Perfluorononanoic acid (PFNA)			U	ND	ng/L						
Perfluorooctanesulfonamide (PFOSA)			U	ND	ng/L						
Perfluorooctanesulfonic acid (PFOS)			U	ND	ng/L						
Perfluorooctanoic acid (PFOA)			U	ND	ng/L						
Perfluoropentanesulfonic acid (PFPeS)			U	ND	ng/L						
Perfluoropentanoic acid (PFPeA)			U	ND	ng/L						
Perfluorotetradecanoic acid (PFTeDA)			U	ND	ng/L						
Perfluoroundecanoic acid (PFUdA)			U	ND	ng/L						

QC Summary

Workorder: **490881**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1919444											
QC1204387349 LCS											
**1,4-Dioxane-d8	4.00			3.55	ug/L		89	(70%-130%)	JMB3	09/24/19	12:24
QC1204387350 LCSD											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)		09/24/19	12:49
QC1204387348 MB											
1,4-Dioxane			U	ND	ug/L					09/24/19	11:59
**1,4-Dioxane-d8	4.00			3.05	ug/L		76	(70%-130%)			

Notes:

The Qualifiers in this report are defined as follows:

**	Analyte is a surrogate compound
<	Result is less than value reported
>	Result is greater than value reported
A	The TIC is a suspected aldol-condensation product
B	The target analyte was detected in the associated blank.
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
E	Concentration of the target analyte exceeds the instrument calibration range
H	Analytical holding time was exceeded
J	See case narrative for an explanation
J	Value is estimated
JNX	Non Calibrated Compound
N	Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N	Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
N/A	RPD or %Recovery limits do not apply.
N1	See case narrative
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
P	Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
Q	One or more quality control criteria have not been met. Refer to the applicable narrative or DER.

QC Summary

Workorder: **490881**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

R Sample results are rejected

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

UJ Compound cannot be extracted

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1919444

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1919441

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490881002	8202-1
1204387348	Method Blank (MB)
1204387349	Laboratory Control Sample (LCS)
1204387350	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Surrogate Recoveries
Sample (See Below) did not meet surrogate recovery acceptance criteria. The sample was analyzed at a dilution. As a result, one or more surrogates were diluted out of the acceptance limits.

Sample	Analyte	Value
490881002 (8202-1)	1, 4-Dioxane-d8	69* (70%-130%)

Laboratory Control Sample Duplicate (LCSD)
An LCSD was used in place of matrix QC due to limited sample volume.

Technical Information

Sample Dilutions
Sample 490881002 (8202-1) was diluted due to the presence of one or more over-range target analytes.

LCMSMS-Misc

Product: **The Extraction and Analysis of Per and Polyfluroalkyl Substances Using LCMSMS**
Analytical Method: EPA 537.1 Mod, PFAS, Compliant with QSM Table B-15
Analytical Procedure: GL-OA-E-076 REV# 7
Analytical Batches: 1921240 and 1921239

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
490881001	8202-1
1204391613	Method Blank (MB)
1204391614	Laboratory Control Sample (LCS)
1204391615	Laboratory Control Sample Duplicate (LCSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Technical Information

Sample Dilutions
The following samples were diluted to bring the over range concentrations within the calibration range and/or due to matrix interference that caused internal standards recoveries to fall outside the acceptance range.
490881001 (8202-1).

Analyte	490881 001
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (PFPrOPrA)	50X
Fluorotelomer sulfonate 6:2 (6:2 FTS)	100X
Fluorotelomer sulfonate 8:2 (8:2 FTS)	50X
Perfluorobutanesulfonate (PFBS)	50X
Perfluorobutyric acid (PFBA)	50X
Perfluoroheptanoic acid (PFHpA)	50X
Perfluorohexanoic acid (PFHxA)	50X
Perfluoropentanoic acid (PFPeA)	100X
Perfluorotetradecanoic acid (PFTeDA)	50X
Perfluorotridecanoic acid (PFTrDA)	50X

Miscellaneous Information

Additional Comments
Additional sample volume was not provided for matrix QC. Also, reduced sample volumes were used for all samples except 490876002 (7607-EB) due to elevated concentrations of target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project # NWA-001
GEL Quote #: NWRA Quote
COC Number (1): NA
PO Number: NA

490881

GEL Laboratories LLC
gel.com
Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Work Order Number: *GEL Project Manager:*

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: Sampson County Disposal, LLC Fax # 704-586-0007
Address: Roseboro, NC
Collected By: Patrick Stevens Send Results To: Genna Olson golson@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	PFAS 21 cmpd list by EPA 537 mod	GenX by EPA 537 mod
8202-1	09-18-19	1220	N	N	ML			2	X	X

<-- Preservative Type (6)

Comments
Note: extra sample is required for sample specific QC

Note that you will receive a separate cooler 9/20/19 with bottles for 1,4-dioxane analysis for this site. It is OK to include those in the same lab report as these samples.

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1	Patrick H. Stevens	09-18-19	1630		9/19/19	0850
2						
3						

TAT Requested: Normal: X Rush: ____ Specify: ____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* *Cooler Temp:* ____ °C

> *For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)*

Sample Collection Time Zone: [X] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a - **Y** - for yes the sample was field filtered or - **N** - for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous RCRA metals
Pb = Lead

TSCA Regulated
PCB = Polychlorinated biphenyls

Page 1 of 1 SDG 490881 Rev1

Page: 1 of 1
Project # 190772 NWRA 0019
GEL Quote #: NWRA Quote
COC Number (1): N/A
PO Number: Bill to NWRA

490881

GEL Laboratories LLC
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Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Work Order Number:

GEL Project Manager: Julie Robinson

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: NWRA c/o Hart & Hickman, P.C. Phone # 919-862-2784
Project/Site Name: Sampson County Disposal, LLC Fax #
Address: 7434 Roseboro Hwy, Roseboro, NC 28382
Collected By: P. Stevens Send Results To: Gemma Olsen jolsen@hearthickman.com

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info)	Should this sample be considered: (7) Known or possible hazards	Total number of containers	Sample Analysis Requested (5) (Fill in the number of containers for each test): 1,4-Dioxane by EPA 8270 SIM	Comments Note: extra sample is required for sample specific QC
8202-1	09-18-19	1220	G	N	ML			2	X	

<-- Preservative Type (6)

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1	[signature]	9-19-19	1700	1 Fedex	9-19-19	1700
2				2 A. Olsen	9/20/19	8:55
3				3		

TAT Requested: Normal: X Rush: ____ Specify: _____ (Subject to Surcharge)

Fax Results: [ ] Yes [X] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] Yes [ ] No ***Cooler Temp:*** 1 °C

> *For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)*

Sample Collection Time Zone: [ ] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: _____

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B**, **6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic **Hg**= Mercury
Ba = Barium **Se**= Selenium
Cd = Cadmium **Ag**= Silver
Cr = Chromium **MR**= Miscellaneous
Pb = Lead RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW= Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT= Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

JH

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	SDG/AR/COC/Work Order: EA10854MQ 490881
Received By: AJA	Date Received: 9/19/19
Carrier and Tracking Number	Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other 7762 7563 2308 -1°, 7762 7563 3418 -1° 7762 7563 2764 -1°, 7762 7563 3290 -1°

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		√	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		√	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		√	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		√	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		√	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	√			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	√			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	√			Preservation Method: ~~Wet Ice~~ Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	√			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?			√	Circle Applicable: Seals broken ~~Damaged container~~ Leaking container Other (describe) 6204-1 (1 bottle) cap received cracked
6	Samples requiring chemical preservation at proper pH?		√		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			√	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	√			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	√			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	√			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	√			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	√			
13	COC form is properly signed in relinquished/received sections?			√	Circle Applicable: ~~Not relinquished~~ Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials VQ Date 9/23/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

GEL Laboratories LLC

JR

SAMPLE RECEIPT & REVIEW FORM

Client: NWRA	SDG/AR/COC/Work Order: 490881
Received By: AJA	Date Received: 9/20/19
Carrier and Tracking Number	Circle Applicable: FedEx Express FedEx Ground UPS Field Services Courier Other 7762 8638 8788 7762 8638 8034

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: (Wet Ice) Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
6	Samples requiring chemical preservation at proper pH?			✓	Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections? AA 9/20	✓		✓	Circle Applicable: (Not relinquished) Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials AG Date 9/23/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 08 November 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171
F 843.766.1178

gel.com

October 14, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for Great Oak Landfill
Work Order: 491597

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on October 01, 2019. This original data report has been prepared and reviewed in accordance with GEL's standard operating procedures.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 491597 GEL Work Order: 491597

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: October 14, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forGreat Oak Landfill

Client Sample ID:	7607-EB	Project:	NWRA00119
Sample ID:	491597001	Client ID:	NWRA001
Matrix:	Misc Liquid		
Collect Date:	30-SEP-19 09:55		
Receive Date:	01-OCT-19		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane	U	ND	0.100	0.400	ug/L	0.020	1	JMB3	10/08/19	1130	1924252	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJ	10/07/19	1230	1924251

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	3.43 ug/L	4.00	86	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: October 14, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forGreat Oak Landfill

Client Sample ID:	7607-2	Project:	NWRA00119
Sample ID:	491597002	Client ID:	NWRA001
Matrix:	Misc Liquid		
Collect Date:	30-SEP-19 10:35		
Receive Date:	01-OCT-19		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		469	20.0	40.0	ug/L	0.200	20	JMB3	10/08/19	1154	1924252	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJ	10/07/19	1230	1924251

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	47.1 ug/L	40.0	118	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

QC Summary

Report Date: October 14, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **491597**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1924252											
QC1204398479 LCS											
**1,4-Dioxane-d8	4.00			3.61	ug/L		90	(70%-130%)	JMB3	10/08/19	11:05
QC1204398478 MB											
1,4-Dioxane			U	ND	ug/L					10/08/19	10:40
**1,4-Dioxane-d8	4.00			4.22	ug/L		105	(70%-130%)			
QC1204398483 491597002 MS											
**1,4-Dioxane-d8	40.0	47.1		42.2	ug/L		106	(70%-130%)		10/08/19	12:19
QC1204398484 491597002 MSD											
**1,4-Dioxane-d8	40.0	47.1		35.1	ug/L		88	(70%-130%)		10/08/19	12:44

Notes:

The Qualifiers in this report are defined as follows:

- ** Analyte is a surrogate compound
- < Result is less than value reported
- > Result is greater than value reported
- A The TIC is a suspected aldol-condensation product
- B The target analyte was detected in the associated blank.
- C Analyte has been confirmed by GC/MS analysis
- D Results are reported from a diluted aliquot of the sample
- E Concentration of the target analyte exceeds the instrument calibration range
- H Analytical holding time was exceeded
- J See case narrative for an explanation
- J Value is estimated
- JNX Non Calibrated Compound
- N Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
- N Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor

QC Summary

Workorder: **491597**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

N/A RPD or %Recovery limits do not apply.

N1 See case narrative

ND Analyte concentration is not detected above the detection limit

NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

P Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.

Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.

R Sample results are rejected

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

UJ Compound cannot be extracted

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile
Technical Case Narrative
NWRA - Carolinas Chapter
SDG #: 491597

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1924252

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1924251

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
491597001	7607-EB
491597002	7607-2
1204398478	Method Blank (MB)
1204398479	Laboratory Control Sample (LCS)
1204398483	491597002(7607-2) Matrix Spike (MS)
1204398484	491597002(7607-2) Matrix Spike Duplicate (MSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Spike Recovery Statement
The MS and MSD (See Below) spike recoveries were not within the acceptance limits. There was a detected presence of 1,4-Dioxane above the reporting limits in the un-spike parent sample that caused a biased calculated spike recovery result in the MS and MSD. The data results have been reported.

Sample	Analyte	Value
1204398483 (7607-2MS)	1, 4-Dioxane	0* (70%-130%)
1204398484 (7607-2MSD)	1, 4-Dioxane	0* (70%-130%)

Technical Information

Sample Dilutions
Samples 1204398483 (7607-2MS), 1204398484 (7607-2MSD) and 491597002 (7607-2) were diluted due to the presence of non-target analytes. The data from the dilutions are reported. Samples 1204398483 (7607-2MS), 1204398484 (7607-2MSD) and 491597002 (7607-2) were diluted due to the presence of one or more over-range

target analytes.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: 1 of 1
Project #: NWA-001
GEL Quote #: NWRA Quote
COC Number (1): N/A
PO Number: N/A

491597

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Chain of Custody and Analytical Request

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

GEL Work Order Number:
GEL Project Manager: Julie Robinson

Client Name: NWRA c/o Hart & Hickman, PC Phone # 919-847-4241
Project/Site Name: Great Oak Landfill Fax #
Address: 3597 Old Cedar Falls Rd, Randleman NC 27317
Collected By: P. Stevens Send Results To: gokon@harthickman.com

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive (Please supply isotopic info.)	(7) Known or possible hazards	Total number of containers	1,4-Dioxane by 8270 SIM (Preservative Type (6): N)									Comments Note: extra sample is required for sample specific QC
7607-EB	09-30-19	955	EB	N	ML			2	X									
7607-2	↓	1035	G	N	ML			2	X									

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
[signature]	9/30/19	1600	1 [signature]	10/01/19	850
			2		
			3		

TAT Requested: Normal: X Rush: ____ Specify: ________ **(Subject to Surcharge)**
Fax Results: [ ] Yes [X] No
Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4
Additional Remarks:
For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** ____ °C

For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)
Sample Collection Time Zone: [ ] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ______

1) Chain of Custody Number = Client Determined
2) QC Codes: N = Normal Sample, TB = Trip Blank, FD = Field Duplicate, EB = Equipment Blank, MS = Matrix Spike Sample, MSD = Matrix Spike Duplicate Sample, G = Grab, C = Composite
3) Field Filtered: For liquid matrices, indicate with a - Y - for yes the sample was field filtered or - N - for sample was not field filtered.
4) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F=Filter, P=Wipe, U=Urine, F=Fecal, N=Nasal
5) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* - 3, *6010B/7470A* - 1).
6) Preservative Type: HA = Hydrochloric Acid, NI = Nitric Acid, SH = Sodium Hydroxide, SA = Sulfuric Acid, AA = Ascorbic Acid, HX = Hexane, ST = Sodium Thiosulfate, If no preservative is added = leave field blank

7) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic, Ba = Barium, Cd = Cadmium, Cr = Chromium, Pb = Lead
Hg = Mercury, Se = Selenium, Ag = Silver, MR = Miscellaneous RCRA metals

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW = Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT = Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

491597

SAMPLE RECEIPT & REVIEW FORM

Client: NLWRA	SDG/AR/COC/Work Order: J.R.
Received By: TYE	Date Received: 10-1-19
Carrier and Tracking Number	Circle Applicable: FedEx Express FedEx Ground UPS Field Services Courier Other 7763 8929 7206

Suspected Hazard Information	Yes	No	
			*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

Sample Receipt Criteria		Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?	✓			Circle Applicable: Client contacted and provided COC COC created upon receipt
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: Wet Ice Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 1°C
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR-18 Secondary Temperature Device Serial # (if Applicable):
5	Sample containers intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?	✓			Circle Applicable: Not relinquished Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials SH Date 10/2/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 14 October 2019

State	Certification
Alaska	17−018
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−28
Vermont	VT87156
Virginia NELAP	460202
Washington	C780

GEL Laboratories LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
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P 843.556.8171
F 843.766.1178

gel.com

December 19, 2019

Mr. Jim Riley
NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia 22202

Re: Analytical for CMS Landfill
Work Order: 498420

Dear Mr. Riley:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on December 05, 2019. This original data report has been prepared and reviewed in accordance with GEL's standard operating procedures.

Test results for NELAP or ISO 17025 accredited tests are verified to meet the requirements of those standards, with any exceptions noted. The results reported relate only to the items tested and to the sample as received by the laboratory. These results may not be reproduced except as full reports without approval by the laboratory. Copies of GEL's accreditations and certifications can be found on our website at www.gel.com.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4289.

Sincerely,

Julie Robinson

Julie Robinson
Project Manager

Purchase Order: GELP19-0905
Enclosures

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 − (843) 556−8171 − www.gel.com

Certificate of Analysis Report
for

NWRA001 NWRA − Carolinas Chapter

Client SDG: 498420 GEL Work Order: 498420

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a Tracer compound

** Analyte is a surrogate compound

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the limit as defined in the 'U' qualifier above.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Julie Robinson.

Reviewed by Julie Robinson

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: December 19, 2019

Company :	NWRA - Carolinas Chapter
Address :	1550 Crystal Drive, Suite 804
	Arlington, Virginia 22202
Contact:	Mr. Jim Riley
Project:	Analytical forCMS Landfill

Client Sample ID:	1, 1A, 2, 2A	Project:	NWRA00119
Sample ID:	498420001	Client ID:	NWRA001
Matrix:	Water		
Collect Date:	04-DEC-19 13:30		
Receive Date:	05-DEC-19		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Semi-Volatile-GC/MS												
SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"												
1,4-Dioxane		214	4.00	8.00	ug/L	0.200	4	JMB3	12/11/19	0925	1947214	1

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3535A	SW8270E SIM Prep 1,4-Dioxane	SJ	12/10/19	0800	1947213

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 3535A/8270E SIM	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,4-Dioxane-d8	SW846 8270 SIM 1,4-Dioxane in Liquid "As Received"	25.3 ug/L	40.0	63*	(70%-130%)

Notes:

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

QC Summary

Report Date: December 19, 2019

NWRA - Carolinas Chapter
1550 Crystal Drive, Suite 804
Arlington, Virginia

Contact: **Mr. Jim Riley**

Workorder: **498420**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Semi-Volatile-GC/MS											
Batch 1947214											
QC1204451621 LCS											
**1,4-Dioxane-d8	4.00			3.18	ug/L		79	(70%-130%)	JMB3	12/10/19	15:57
QC1204451620 MB											
1,4-Dioxane			U	ND	ug/L					12/10/19	15:33
**1,4-Dioxane-d8	4.00			3.48	ug/L		87	(70%-130%)			
QC1204451622 498420001 MS											
**1,4-Dioxane-d8	40.0	25.3		25.0	ug/L		63*	(70%-130%)		12/11/19	09:50
QC1204451623 498420001 MSD											
**1,4-Dioxane-d8	40.0	25.3		28.0	ug/L		70	(70%-130%)		12/11/19	10:13

Notes:

The Qualifiers in this report are defined as follows:

- ** Analyte is a surrogate compound
- < Result is less than value reported
- > Result is greater than value reported
- A The TIC is a suspected aldol-condensation product
- B The target analyte was detected in the associated blank.
- C Analyte has been confirmed by GC/MS analysis
- D Results are reported from a diluted aliquot of the sample
- E Concentration of the target analyte exceeds the instrument calibration range
- H Analytical holding time was exceeded
- J See case narrative for an explanation
- J Value is estimated
- JNX Non Calibrated Compound
- N Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
- N Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor

QC Summary

Workorder: **498420**

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

N/A RPD or %Recovery limits do not apply.

N1 See case narrative

ND Analyte concentration is not detected above the detection limit

NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

P Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.

Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.

R Sample results are rejected

U Analyte was analyzed for, but not detected above the MDL, MDA, MDC or LOD.

UJ Compound cannot be extracted

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

GC/MS Semivolatile
Technical Case Narrative
NWRA - Carolinas Chapter
SDG #: 498420

Product: **Analysis of 1,4-Dioxane in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry**
Analytical Method: SW846 3535A/8270E SIM
Analytical Procedure: GL-OA-E-073 REV# 2
Analytical Batch: 1947214

Preparation Method: SW846 3535A
Preparation Procedure: GL-OA-E-073 REV# 2
Preparation Batch: 1947213

The following samples were analyzed using the above methods and analytical procedure(s).

GEL Sample ID#	Client Sample Identification
498420001	1, 1A, 2, 2A
1204451620	Method Blank (MB)
1204451621	Laboratory Control Sample (LCS)
1204451622	498420001(1, 1A, 2, 2A) Matrix Spike (MS)
1204451623	498420001(1, 1A, 2, 2A) Matrix Spike Duplicate (MSD)

The samples in this SDG were analyzed on an "as received" basis.

Data Summary:

All sample data provided in this report met the acceptance criteria specified in the analytical methods and procedures for initial calibration, continuing calibration, instrument controls and process controls where applicable, with the following exceptions.

Quality Control (QC) Information

Surrogate Recoveries
Samples (See Below) did not meet surrogate recovery acceptance criteria. Since the parent sample and associated MS/MSD pair displayed similar recoveries, the failures were attributed to matrix interference and the data results are reported.

Sample	Analyte	Value
1204451622 (1, 1A, 2, 2AMS)	1, 4-Dioxane-d8	63* (70%-130%)
498420001 (1, 1A, 2, 2A)	1, 4-Dioxane-d8	63* (70%-130%)

Spike Recovery Statement
The MS or MSD (See Below) recovered spiked analytes outside of the established acceptance limits. As similar recoveries were displayed in the MS and MSD, the failures were attributed to sample matrix interference and the data were reported.

Sample	Analyte	Value

1204451622 (1, 1A, 2, 2AMS)	1, 4-Dioxane	0* (70%-130%)
1204451623 (1, 1A, 2, 2AMSD)	1, 4-Dioxane	30* (70%-130%)

Technical Information

Sample Dilutions
Samples 1204451622 (1, 1A, 2, 2AMS), 1204451623 (1, 1A, 2, 2AMSD) and 498420001 (1, 1A, 2, 2A) were diluted due to the presence of one or more over-range target analytes.

Miscellaneous Information

Manual Integrations
Sample (See Below) required manual integration in order to properly identify one or more peaks and/or to correctly position the baseline as set in the calibration standard injections.

Sample	Analyte	Value
498420001 (1, 1A, 2, 2A)	Tetrahydrofuran-d8	Result 400ug/L

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

Page: ______ of ______
Project #: NWRA00119
GEL Quote #:
COC Number [1]:
PO Number:

GEL Laboratories LLC

gel.com

Chemistry | Radiochemistry | Radiobioassay | Specialty Analytics

Chain of Custody and Analytical Request

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

GEL Work Order Number: **GEL Project Manager:** 498420

Client Name: Phone #
Project/Site Name: Fax #
Address:
Collected By: Send Results To:

Sample Analysis Requested [5] (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code [2]	Field Filtered [3]	Sample Matrix [4]	Radioactive (Please supply isotopic info)	(7) Known or possible hazards	Total number of containers	1,4-Dioxane (8270)	Comments (Note: extra sample is required for sample specific QC)
1	12-04-19	13:30						1		
1A	|	|						1		
2	|	|						1		
2A	|	|						1		

<-- Preservative Type (6)

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1			1 R. Almen	12/5/19	8:50
2			2		
3			3		

TAT Requested: Normal: ____ Rush: ____ Specify: ______ **(Subject to Surcharge)**

Fax Results: [ ] Yes [ ] No

Select Deliverable: [ ] C of A [ ] QC Summary [ ] level 1 [ ] Level 2 [ ] Level 3 [ ] Level 4

Additional Remarks:

For Lab Receiving Use Only: *Custody Seal Intact?* [ ] *Yes* [ ] *No* ***Cooler Temp:*** ____ *°C*

> For sample shipping and delivery details, see Sample Receipt & Review form (SRR.)

Sample Collection Time Zone: [ ] Eastern [ ] Pacific [ ] Central [ ] Mountain [ ] Other: ______

1.) Chain of Custody Number = Client Determined

2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite

3.) Field Filtered: For liquid matrices, indicate with a **- Y -** for yes the sample was field filtered or **- N -** for sample was not field filtered.

4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=Nasal

5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B, 6010B/7470A**) and number of containers provided for each (i.e. *8260B* **- 3**, *6010B/7470A* **- 1**).

6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

7.) *Are there any known or possible hazards associated with these samples?*

RCRA Metals
As = Arsenic, Hg = Mercury
Ba = Barium, Se = Selenium
Cd = Cadmium, Ag = Silver
Cr = Chromium, MR = Miscellaneous RCRA metals
Pb = Lead

Characteristic Hazards
FL = Flammable/Ignitable
CO = Corrosive
RE = Reactive

TSCA Regulated
PCB = Polychlorinated biphenyls

Listed Waste
LW = Listed Waste
(F,K,P and U-listed wastes.)
Waste code(s):

Other
OT = Other / Unknown
(i.e.: High/low pH, asbestos, beryllium, irritants, other misc. health hazards, etc.)
Description:

Please provide any additional details below regarding handling and/or disposal concerns. *(i.e.: Origin of sample(s), type of site collected from, odd matrices, etc.)*

GEL Laboratories LLC

JH

SAMPLE RECEIPT & REVIEW FORM 494420

Client: NWHA	**SDG/AR/COC/Work Order:**
Received By: AJA	**Date Received:** 12/5/19
Carrier and Tracking Number	Circle Applicable: ~~FedEx Express~~ FedEx Ground UPS Field Services Courier Other 1223 6338 6830

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
A)Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#: If UN2910, Is the Radioactive Shipment Survey Compliant? Yes___ No___
B) Did the client designate the samples are to be received as radioactive?		✓	COC notation or radioactive stickers on containers equal client designation.
C) Did the RSO classify the samples as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0 CPM / mR/Hr Classified as: Rad 1 Rad 2 Rad 3
D) Did the client designate samples are hazardous?		✓	COC notation or hazard labels on containers equal client designation.
E) Did the RSO identify possible hazards?		✓	If D or E is yes, select Hazards below. PCB's Flammable Foreign Soil RCRA Asbestos Beryllium Other:

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Chain of custody documents included with shipment?			✓	Circle Applicable: Client contacted and provided COC ~~COC created upon receipt~~
3	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: ~~Wet Ice~~ Ice Packs Dry ice None Other: *all temperatures are recorded in Celsius TEMP: 5°
4	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: IR4-16 Secondary Temperature Device Serial # (If Applicable):
5	Sample containers intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
6	Samples requiring chemical preservation at proper pH?		✓		Sample ID's and Containers Affected: If Preservation added, Lot#:
7	Do any samples require Volatile Analysis?			✓	If Yes, are Encores or Soil Kits present for solids? Yes___ No___ NA___(If yes, take to VOA Freezer) Do liquid VOA vials contain acid preservation? Yes___ No___ NA___(If unknown, select No) Are liquid VOA vials free of headspace? Yes___ No___ NA___ Sample ID's and containers affected:
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Circle Applicable: No dates on containers No times on containers COC missing info Other (describe)
11	Number of containers received match number indicated on COC?	✓			Circle Applicable: No container count on COC Other (describe)
12	Are sample containers identifiable as GEL provided?	✓			
13	COC form is properly signed in relinquished/received sections?	✓			Circle Applicable: Not relinquished Other (describe)

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials SH Date 12/6/19 Page 1 of 1

GL-CHL-SR-001 Rev 6

List of current GEL Certifications as of 19 December 2019

State	Certification
Alaska	17−018
Alaska Drinking Water	SC00012
Arkansas	88−0651
CLIA	42D0904046
California	2940
Colorado	SC00012
Connecticut	PH−0169
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330−15−00283, P330−15−00253
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC00012
Idaho	SC00012
Illinois NELAP	200029
Indiana	C−SC−01
Kansas NELAP	E−10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana Drinking Water	LA024
Louisiana NELAP	03046 (AI33904)
Maine	2019020
Maryland	270
Massachusetts	M−SC012
Massachusetts PFAS Approv	Letter
Michigan	9976
Mississippi	SC00012
Nebraska	NE−OS−26−13
Nevada	SC000122020−1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
North Dakota	R−158
Oklahoma	2019−165
Pennsylvania NELAP	68−00485
Puerto Rico	SC00012
S. Carolina Radiochem	10120002
Sanitation Districts of L	9255651
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235−19−15
Utah NELAP	SC000122019−29
Vermont	VT87156
Virginia NELAP	460202
Washington	C780