Naval Facilities Engineering Systems Command Northwest
Silverdale, Washington

Final

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former Naval Arctic Research Laboratory Barrow
Utqiaġvik, Alaska

July 2021

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

Naval Facilities Engineering Systems Command Northwest
Silverdale, Washington

Final

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former Naval Arctic Research Laboratory Barrow
Utqiaġvik, Alaska

July 2021

Prepared for NAVFAC Northwest
by CH2M HILL, Inc.
Seattle, Washington
Contract N62470-16-D-9000
CTO 4117

Executive Summary

Historical use of aqueous film-forming foam (AFFF) at Former Naval Arctic Research Laboratory (NARL) Barrow in Utqiaġvik, Alaska, prompted the Department of the Navy (Navy) to conduct a per- and polyfluoroalkyl substances (PFAS) Site Inspection (SI) at the installation. The United States Environmental Protection Agency (USEPA) has established lifetime health advisories for two PFAS compounds (perfluorooctanoic acid [PFOA] and perfluorooctane sulfonate [PFOS]). A Regional Screening Level is also published for perfluorobutane sulfonate (PFBS).

In 2017, PFOA and PFOS were detected in Imikpuk Lake, a seasonal drinking water source, located adjacent to current Navy property at Former NARL Barrow and downgradient of a known PFAS release at the Airstrip Site (CH2M, 2019b). The combined PFOA and PFOS concentration in the lake exceeded the USEPA lifetime health advisory of 70 parts per trillion (CH2M, 2019b; Alaska DHSS, 2017). In September 2017, an advisory was issued to not use Imikpuk Lake as a source of drinking or cooking water based on this exceedance (Alaska DHSS, 2017). In 2019, a preliminary assessment (PA) of PFAS at Former NARL Barrow was completed (CH2M, 2019a). PA activities included review of existing information regarding the installation, a visual site inspection, and interviews with former installation personnel and others with current or historical ties to the installation to determine potential source areas of PFAS. The PA identified three locations within the Airstrip Site at Former NARL Barrow as potential PFAS source areas recommended for further investigation in an SI: Building 136, Potential Crash Site A, and Potential Crash Site B.

The objectives of the SI were identified in the *Former NARL Barrow Sampling and Analysis Plan, Site Inspection for Per- and Polyfluoroalkyl Substances* (SAP) (CH2M, 2019c). The objectives were as follows:

- Determine if PFAS are present in groundwater and soil, and if present, evaluate whether there is potentially unacceptable risk to human health.
- Evaluate PFAS concentrations in surface water in Imikpuk Lake using current analytical methods.

The SI activities included collection of groundwater, soil, and surface water samples at or near the three potential source areas identified in the PA and Imikpuk Lake, and analysis of the 18 PFAS compounds listed in Method 537.1 via liquid chromatography tandem mass spectrometry compliant with the Department of Defense (DoD) Quality Systems Manual 5.1 Table B-15. The field investigation was initiated in August 2019 and consisted of installation of temporary monitoring wells; groundwater sampling of existing monitoring wells; sampling of surface water in Imikpuk Lake; and surface and subsurface soil sampling via soil borings. Investigations were performed in accordance with the SAP.

Surface water was collected at five locations within Imikpuk Lake and analyzed using current analytical methods. PFOS and PFOA were detected at concentrations similar to those measured in 2017; PFBS was also detected.

At the Airstrip Site, one or more PFAS were detected at concentrations exceeding screening levels in groundwater near two of the potential PFAS source areas: Building 136 and Potential Crash Site A.

Within the Airstrip Site, the three potential PFAS source areas were evaluated individually in a Human Health Risk Screening (HHRS). The purpose of the HHRS was to provide a preliminary indication of potential risks from exposure to PFAS in soil and groundwater and help evaluate whether future unrestricted use of the potential PFAS source areas is acceptable, or if the site requires further evaluation. Results from the HHRS suggest that exposure to PFAS in surface soil or subsurface soil at the three potential PFAS source areas and exposure to PFAS in groundwater downgradient of Potential Crash Site B would not be expected to result in unacceptable human health risks (groundwater was not present at Potential Crash Site B). The HHRS identified potential unacceptable risks associated with PFOA and PFOS in groundwater at Potential Crash Site A and Building 136.

It is recommended that Building 136 and Potential Crash Site A be moved forward as a combined site for further evaluation in a remedial investigation. No further action is recommended for Potential Crash Site B.

Contents

Executive Summary ..... **iii**

Acronyms and Abbreviations ..... **ix**

1 Introduction **1-1**
- 1.1 PFAS Background 1-1
- 1.2 Regulatory Background and History 1-2
  - 1.2.1 PFOA Stewardship Program 1-2
  - 1.2.2 Unregulated Contaminant Monitoring Rule 1-2
  - 1.2.3 USEPA Lifetime Health Advisories 1-2
  - 1.2.4 USEPA Action Plan 1-3
  - 1.2.5 USEPA Guidance, December 20, 2019 1-3
  - 1.2.6 State-specific Action Level 1-3
- 1.3 Report Organization 1-3

2 Site Background and Physical Setting **2-1**
- 2.1 Background 2-1
  - 2.1.1 Former NARL Barrow 2-1
  - 2.1.2 Airstrip Site 2-2
  - 2.1.3 Imikpuk Lake 2-2
- 2.2 Site Setting 2-2
  - 2.2.1 Climate 2-3
  - 2.2.2 Land Use 2-3
  - 2.2.3 Topography and Surface Drainage Features 2-3
  - 2.2.4 Geologic Setting 2-3
  - 2.2.5 Hydrogeologic Setting 2-4
  - 2.2.6 Hydrologic Setting 2-4
  - 2.2.7 Water Use 2-5

3 Field Investigation Methodology **3-1**
- 3.1 Site Preparation and Utility Location 3-1
- 3.2 Temporary Monitoring Well Installation and Development 3-1
  - 3.2.1 Temporary Monitoring Well Installation 3-1
  - 3.2.2 Monitoring Well Development 3-1
- 3.3 Groundwater, Soil, and Surface Water Sampling 3-2
  - 3.3.1 Groundwater Elevation Measurement 3-2
  - 3.3.2 Groundwater Sampling 3-2
  - 3.3.3 Soil Sampling 3-2
  - 3.3.4 Surface Water Sampling 3-3
  - 3.3.5 Quality Assurance and Quality Control 3-3
  - 3.3.6 Sample Packaging and Shipping 3-3
- 3.4 Decontamination Procedures 3-4
- 3.5 Surveying 3-4
- 3.6 Temporary Monitoring Well Abandonment 3-4
- 3.7 Investigation-derived Waste Management 3-4
- 3.8 Laboratory Analysis and Data Usability Assessment 3-5
- 3.9 Deviations from the Sampling and Analysis Plan 3-5

4 Field Investigation Results **4-1**
- 4.1 Analytical Data and Field Observations 4-1
  - 4.1.1 Groundwater 4-1

4.1.2 Surface and Subsurface Soil 4-2
4.1.3 Surface Water 4-3
4.2 PFAS Distribution 4-3

5 Human Health Risk Screening 5-1
5.1 Human Health Risk Screening Methodology 5-1
5.2 Human Health Risk Screening Results 5-3
5.2.1 Building 136 5-3
5.2.2 Potential Crash Site A 5-3
5.2.3 Potential Crash Site B 5-3
5.3 Human Health Risk Screening Findings 5-4

6 Conclusions and Recommendations 6-1
6.1 Conclusions 6-1
6.2 Recommendations 6-1

7 References 7-1

Appendixes

A Field Documentation
B Field Change Requests
C Temporary Monitoring Well Completion Diagrams and Soil Boring Logs
D Temporary Monitoring and Existing Well Development Logs and Groundwater Sampling Sheets
E Field Activity Photo Log
F Survey Report
G Investigation-derived Waste Profiles and Disposal Manifests
H Analytical Data
I Data Quality Assessment Report
J PFAS Characteristics
K ProUCL Output

Tables

3-1 Temporary Monitoring Well Construction Summary
3-2 Groundwater Elevations August 2019
3-3 Water Quality Parameters

4-1 Groundwater Analytical Results
4-2 Surface Soil Analytical Results
4-3 Subsurface Soil Analytical Results
4-4 Surface Water Analytical Results

5-1 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Building 136 – Groundwater
5-1a Risk Ratio Screening, Maximum Detected Concentration – Building 136 - Groundwater
5-1b Risk Ratio Screening, 95 percent UCL Concentration – Building 136 - Groundwater
5-2 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Building 136 - Surface Soil
5-3 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Building 136 - Subsurface Soil
5-4 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Potential Crash Site A - Groundwater
5-4a Risk Ratio Screening, Maximum Detected Concentration – Potential Crash Site A – Groundwater

5-5 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Potential Crash Site A – Subsurface Soil
5-6 Occurrence, Distribution and Selection of Chemicals of Potential Concern – Potential Crash Site B - Groundwater

6-1 Report Recommendations

Figures

2-1 Base Location Map
2-2 Facility Layout Map
2-3 Potential PFAS Source Areas

3-1 Sample Locations
3-2 Potentiometric Surface Map August 2019

4-1 Summary of Detected PFAS in Groundwater at Airstrip Site
4-2 Summary of Detected PFAS in Soil at Airstrip Site
4-3 Summary of Detected PFAS in Surface Water in Imikpuk Lake

Acronyms and Abbreviations

°C	degree Celsius
°F	degree Fahrenheit
µg/kg	microgram per kilogram
µg/L	microgram per liter
ADEC	Alaska Department of Environmental Conservation
AFFF	aqueous film-forming foam
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BUECI	Barrow Utilities and Electric Cooperative, Inc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
COPC	constituent of potential concern
DASN	Deputy Assistant Secretary of the Navy
DI	deionized
DO	dissolved oxygen
DoD	Department of Defense
EtFOSAA	n-ethyl perfluorooctanesulfonamidoacetic acid
HHRS	Human Health Risk Screening
HI	hazard index
HQ	hazard quotient
IDW	investigation-derived waste
J	the analyte is present, value may or may not be accurate or precise
MDC	Maximum Detected Concentration
MeFOSAA	n-methyl perfluorooctanesulfonamidoacetic acid
mg/L	milligram per liter
MS	matrix spike
MSD	matrix spike duplicate
mS/cm	millisiemen per centimeter
mV	millivolt
NAVFAC	Naval Facilities Engineering Systems Command
NARL	Naval Applied Research Laboratories
NAVD	North American Vertical Datum
Navy	Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/L	nanogram per liter
NTU	nephelometric turbidity units
ORP	oxidation-reduction potential
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid

PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnA	perfluoroundecanoic acid
ppt	part per trillion
PVC	polyvinyl chloride
PWS	public water system
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
RfD	reference dose
SAP	Sampling and Analysis Plan
SI	Site Inspection
SL	Screening level
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
UCL	upper confidence limit
UCMR3	Third Unregulated Contaminant Monitoring Rule
UCMR4	Fourth Unregulated Contaminant Monitoring Rule
UCMR5	Fifth Unregulated Contaminant Monitoring Rule
UIC	Ukpeaġvik Iñupiat Corporation
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WQP	water quality parameters

SECTION 1

Introduction

This Site Inspection (SI) Report presents the data and findings obtained from a per- and polyfluoroalkyl substances (PFAS) investigation conducted at Former Naval Arctic Research Laboratory (NARL) Barrow Airstrip Site in Utqiaġvik, Alaska.

The objectives of the SI were defined in the *Final Sampling and Analysis Plan, Site Inspection for Per- and Polyfluoroalkyl Substances, Former Naval Arctic Research Laboratory Barrow, Utqiaġvik, Alaska* (SAP) (CH2M, 2019c). The objectives were as follows:

- Determine if PFAS are present in groundwater and soil, and if present, evaluate whether there is a potentially unacceptable risk to human health.
- Evaluate PFAS concentrations in surface water in Imikpuk Lake using current analytical methods.

This SI Report outlines the approach taken to achieve the listed objectives, results, and conclusions regarding data collected, and recommendations. This report was prepared for the Department of the Navy (Navy), Naval Facilities Engineering Systems Command (NAVFAC) Northwest, under the Comprehensive Long-term Environmental Action—Navy (CLEAN) 9000, Contract N62470-16-D-9000, Contract Task Order 4117.

1.1 PFAS Background

PFAS have been identified by the Department of Defense (DoD) and the United States Environmental Protection Agency (USEPA) as "emerging contaminants"[1]. PFAS are of environmental concern because of their persistence in the environment and in organisms, their migration potential in aqueous systems (for example, groundwater), their historically widespread use in commercial products, and their possible health effects at low levels of exposure. PFAS are anthropogenic compounds with multiple, strong carbon-fluorine bonds.

The chemical properties of PFAS make them useful for many commercial products because they are heat-resistant and can repel oil, grease, and water. PFAS have been manufactured for use in a wide variety of products including firefighting foam, nonstick cookware, fiber and fabric stain protection, food packaging, and personal care products. The pervasive use of PFAS in commercial and industrial products has led to the discovery of PFAS in soil, air, and groundwater worldwide.

PFAS have been used in a variety of military applications, including as a component of aqueous film-forming foam (AFFF). PFAS from AFFF used in firefighting, firefighting training and equipment testing, and fire suppression systems are considered to have the greatest potential for release of PFAS to the environment in terms of mass and concentration at Navy installations. Other potential sources of PFAS to the environment include operations wastes (for example, from chromium electroplating), historical onsite land disposal areas and landfills, and wastewater treatment sludges and effluents.

Additional research is needed to more clearly understand the potential health effects that may be caused by exposure to PFAS compounds. To date, there is limited information on only a few of the thousands of PFAS. Currently, there are no Tier 1 toxicity values for any PFAS. Tier 1 toxicity values are the preferred source for toxicity factors in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) assessments. The United States Environmental Protection Agency (USEPA) Office of Research and Development released "Human Health Toxicity Values for Perfluorobutane Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3)," in April 2021 (USEPA, 2021a). This toxicity assessment provides chronic and subchronic oral reference doses

[1] Per DoDI 4715.18: "As identified by the [Assistant Secretary of Defense for Energy, Installations, and Environment], an emerging contaminant is a contaminant that: has a reasonably possible pathway to enter the environment; presents a potential unacceptable human health or environmental risk; and does not have regulatory standards based on peer-reviewed science, or the regulatory standards are evolving due to new science, detection capabilities, or pathways."

(RfDs) for perfluorobutane sulfonate (PFBS) that are considered Tier 2 noncarcinogenic toxicity values for use in CERCLA investigations. The PFBS oral RfDs are based on thyroid effects (decreased thyroid hormone levels). Due to a lack of information in the current literature on PFBS inhalation toxicity or carcinogenicity, toxicity values for inhalation exposure and cancer endpoints could not be estimated for PFBS (USEPA, 2021a). USEPA Office of Water developed an RfD for perfluorooctanoic acid (PFOA) that is based on a developmental toxicity study using mice (USEPA, 2016d). USEPA Office of Water also determined that PFOA should be classified as "suggestive evidence of carcinogenic potential" and estimated an oral cancer slope factor based on tumor development in rat testes (USEPA, 2016a). USEPA Office of Water estimated an RfD for perfluorooctane sulfonate (PFOS) based on a developmental toxicity study using rats (USEPA, 2016b).

1.2 Regulatory Background and History

1.2.1 PFOA Stewardship Program

In 2006, USEPA initiated the 2010/2015 PFOA Stewardship Program in which eight major companies in the United States committed to reduce facility emissions and product contents of PFOA and related chemicals on a global basis by 95 percent no later than 2010, and to work toward eliminating emissions and product content of these chemicals by 2015. All companies have met the program goals. To meet the program goals, most companies stopped the manufacture and import of long-chained PFAS, and then transitioned to alternative chemicals. On January 21, 2015, USEPA proposed a Significant New Use Rule under the Toxics Substances Control Act, to require manufacturers (including importers) of PFOA- and PFOA-related chemicals to notify USEPA at least 90 days before starting or resuming new uses of these chemicals in any process.

1.2.2 Unregulated Contaminant Monitoring Rule

The USEPA issued the Third Unregulated Contaminant Monitoring Rule (UCMR3) in May 2012. The UCMR3 required monitoring between 2013 and 2015, for 30 substances of all large public water systems (PWSs) serving more than 10,000 people and 800 representative PWSs serving 10,000 or fewer people. Six PFAS compounds were included in the UCMR3 contaminant list (PFOS, PFOA, PFBS, perfluorohexanesulfonic acid (PFHxS), perfluoroheptanoic acid (PFHpA), and perfluorononanoic acid (PFNA)). Of these six PFAS, USEPA issued health advisory levels for only two, PFOA and PFOS. The UCMR3 results found these two chemicals were present above the reference concentration of 70 parts per trillion (ppt) in less than 1 percent of the nearly 5,000 PWSs that sampled under UCMR3 (USEPA, 2017).

In December 2016, USEPA issued the Fourth Unregulated Contaminant Monitoring Rule (UCMR4). UCMR4 requires all large PWSs serving more than 10,000 people and 800 representative PWSs serving 10,000 or fewer people to sample for 30 chemicals between 2018 and 2020. There are no PFAS included on the UCMR4 list of contaminants that require sampling and analysis.

In March 2021, USEPA proposed the Fifth Unregulated Contaminant Monitoring Rule (UCMR5). UCMR5, as proposed, would require sample collection for 30 chemical contaminants, including 29 PFAS, from January 2023 to December 2025 (USEPA, 2021b).

1.2.3 USEPA Lifetime Health Advisories

In May 2016, USEPA Office of Water issued a drinking water lifetime health advisory for PFOA and PFOS (USEPA, 2016a, 2016b). Health advisories are not enforceable regulatory levels; rather, they are levels that would provide Americans, including the most sensitive populations, with a margin of protection from a lifetime of exposure to PFOA and PFOS from drinking water. The health advisory is 0.07 microgram per liter (µg/L) (70 parts per trillion [ppt]) for PFOA and PFOS. When both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS should be compared with the 70 ppt health advisory level.

1.2.4 USEPA Action Plan

In February 2019, the USEPA issued an action plan outlining the steps the agency is taking to take to address PFAS and to protect public health (USEPA, 2019a). The action plan identifies USEPA-led short-term actions, longer-term research, and potential regulatory approaches designed to reduce the risks associated with PFAS in the environment. The action plan notes that USEPA plans to propose a national drinking water regulatory determination for PFOA and PFOS and include PFAS analysis in the next UCMR monitoring cycle. Other steps include further research into improving analytical methods, understanding remediation options, and obtaining more information about the potential toxicity of a broader set of PFAS, along with numerous additional actions. An update to the Action Plan was issued by USEPA in February 2020.

1.2.5 USEPA Guidance, December 20, 2019

In December 2019, the USEPA issued Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS under federal cleanup programs (USEPA, 2019b). The guidance recommends using a screening level of 40 ppt to determine if PFOA and/or PFOS is present at a site and may warrant further attention. The guidance also recommends using USEPA's PFOA and PFOS Lifetime Drinking Water Health Advisory level of 70 ppt as the preliminary remediation goal for contaminated groundwater that is a current or potential source of drinking water, where no state or tribal MCL or other applicable or relevant and appropriate requirements are available or sufficiently protective.

1.2.6 State-specific Action Level

The Defense Environmental Restoration Program requires the Navy to conduct environmental restoration activities in accordance with CERCLA and its regulations, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300 (NCP). DoD restoration actions are subject to § 120(a) of CERCLA, which prohibits federal facilities from utilizing state guidelines, rules, regulations or criteria that are inconsistent with those established by USEPA under CERCLA. See, 42 U.S.C. § 9620(a)(2) and Executive Order 12580. CERCLA and the NCP do not require consideration or application of state standards prior to the Remedial Investigation/Feasibility Study applicable or relevant and appropriate requirements (ARARs) process. The ADEC cleanup levels listed below will be evaluated in the Feasibility Study, if they qualify as ARARs.

The Alaska Department of Environmental Conservation (ADEC) has adopted the USEPA lifetime health advisory as the statewide drinking water action level for PFOS and PFOA (ADEC, 2019a). Specifically, when PFOS and/or PFOA are detected, the sum of the detected concentrations is compared to a summed action level of 0.07 microgram per liter (µg/L) (70 ppt). This action level applies to PFOS and PFOA detected in groundwater and surface water used as drinking water.

ADEC also has published soil and groundwater cleanup levels for PFOS and PFOA (ADEC, 2019b). The lowest soil cleanup values are for the migration to groundwater exposure scenario and are 0.0030 milligram per kilogram (mg/kg) for PFOS and 0.0017 mg/kg for PFOA. Groundwater cleanup values for groundwater used as a drinking water source are 0.40 µg/L for PFOS and 0.40 µg/L for PFOA.

1.3 Report Organization

The SI Report is organized as follows:

- **Section 1** – Introduction
- **Section 2** – Site Background and Physical Setting
- **Section 3** – Field Investigation Methodology
- **Section 4** – Field Investigation Results
- **Section 5** – Human Health Risk Screening
- **Section 6** – Conclusions and Recommendations
- **Section 7** – References

Tables and figures are provided at the end of each respective section. Appendixes are included at the end of the report.

SECTION 2

Site Background and Physical Setting

This section presents background information on Airstrip Site and Imikpuk Lake at Former NARL Barrow including site history, potential sources of PFAS, and relevant information on the physical and hydrogeologic setting at the site.

2.1 Background

2.1.1 Former NARL Barrow

Former NARL Barrow is a former Navy research facility and support camp partially located within the boundary of the City of Utqiaġvik (formerly known as Barrow) on the coastal plain of Alaska's North Slope (**Figure 2-1**). Former NARL Barrow is not actively used by the Navy and no active ranges are present.

The Navy first arrived at the location of Former NARL Barrow in 1944 to support oil exploration activities. At that time, the Navy constructed an airstrip (at the Airstrip Site), a radio antenna array (at the Antenna Field Site), and established Point Barrow Camp[2], a cluster of support buildings along the coast between Middle Salt Lagoon and Imikpuk Lake (**Figure 2-2**) (NAVFAC, 2010).

Former NARL Barrow supported a wide variety of arctic research activities and the laboratory itself was operated by academic institutions (NAVFAC, 2010). Point Barrow Camp was operated by various contractors over its history and supported laboratory and other Navy and Air Force operations (NAVFAC, 2010). It was leased to the Air Force from 1954 until 1971 (NAVFAC, 2010). In 1980, the Navy ended laboratory operations and support of the camp. The United States Geological Survey took over as site caretaker in 1980, and Ukpeaġvik Iñupiat Corporation (UIC) assumed caretaker responsibilities in 1984 (NAVFAC, 2010). In 1986, the Navy, UIC, and Department of Interior signed a land exchange agreement that initiated the transfer of government-owned land at the Former NARL Barrow to UIC (Agreement, 1986). As part of this agreement, the Navy agreed to the following:

- Clean up impacts from past practices to meet state and federal requirements for hazardous waste.
- Transfer ownership of the majority of PLO 2344 Track 1 to UIC including the former Bulk Fuel Tank Farm (also known as the Historical Fuel Farm) and the area formerly known as Point Barrow Camp ("Main Camp Area") located between Imikpuk Lake and Middle Salt Lagoon (**Figure 2-2**). Following the transfer of ownership of the Main Camp Area, this area became known as "UIC-NARL."
- Retain ownership of other property, including the area east of the Middle Salt Lagoon referred to as the Antenna Field Site and the Airstrip Site. The current Navy property boundaries are shown on **Figure 2-2**.

In 1988, the Navy and UIC signed an amendment to the original land exchange agreement that clarified the Navy's environmental cleanup program and property ownership (Amendment to Agreement, 1988).

A preliminary assessment (PA) for PFAS at Former NARL Barrow was conducted to identify all potential or actual PFAS sources at Former NARL Barrow and identify areas requiring further investigation. A PA Report specific to current Navy property at Former NARL Barrow (that is, the Airstrip Site and Antenna Field [**Figure 2-2**]) was finalized in 2019 (CH2M, 2019a). The PA recommended three areas on current Navy property for further evaluation during this SI: Building 136, Potential Crash Site A, and Potential Crash Site B (**Figure 2-3**). All areas are located within the Airstrip Site. The Navy is in the process of revising the PA to include areas formerly owned by the Navy that may require further PFAS investigation.

2 Point Barrow Camp was later renamed NARL, Point Barrow (NAVFAC, 2010) and is now known as UIC-NARL.

2.1.2 Airstrip Site

The Airstrip Site (**Figure 2-2, Figure 2-3**), also known as Site 5, is located adjacent to the Arctic Ocean and includes a former runway and support facilities. The runway was constructed by the Navy in 1944 (NAVFAC, 2010) using pierced steel planking (also known as Marston Mat). The Airstrip Site was the location of three fuel spills identified in the 1983 Initial Assessment Study (NEESA, 1983). These spills are all addressed under one decision document for the Airstrip Site (NARL Cleanup Team, 2002). The PA identified three potential PFAS source areas within the Airstrip Site. Although these areas were evaluated separately in the PA and in this SI, the Airstrip Site is managed as one site (NARL Cleanup Team, 2002). The potential PFAS source areas within the Airstrip Site are:

- **Building 136.** Building 136 (**Figure 2-3**) is a steel-framed, approximately 35,000-square-foot Navy hangar built in 1970 (NAVFAC, 2010). Building 136 does not contain an AFFF fire suppression system but was the site of a 1970 fuel spill where AFFF was applied (NEESA, 1983; CH2M, 2019a). The spill is described as having occurred behind the hangar (southeast of Building 136) (CH2M, 2019a). Based on the recollection of a Navy historical architect, Building 136 was built to replace a previous structure that burned down in the late 1960s or early 1970s (NAVFAC Northwest Historical Architect, pers. comm., 2018). A map from 1966 shows "Building 135 – ARL Hangar" at the approximate location of the current-day Building 136 (or potentially just to the southwest) (NAVFAC, 2010). Although it is not anticipated that this previous hangar contained an AFFF fire suppression system or that AFFF was used during any potential emergency response actions, the location of the previous hangar (just southwest of Building 136) was included in this SI due to its proximity to Building 136.
- **Potential Crash Site A**. Two crashes occurred at the Airstrip Site during the 1970s: a Constellation crash in 1970 and a Twin Otter crash in 1978. In both cases the crashes are believed to have occurred just short of the runway; however, the direction of landing is unknown. One or both of these crashes may have occurred at Potential Crash Site A (**Figure 2-3**). The nature of the accidents and any ensuing emergency response actions are unknown; however, based on the date of the crash, it is possible AFFF may have been used.
- **Potential Crash Site B**. Based on the direction of landing, one or both of the crashes described above may have occurred at Potential Crash Site B (**Figure 2-3**). As with Potential Crash Site A, the nature of the accidents and any ensuing emergency response actions are unknown; however, based on the date of the crash, it is possible AFFF may have been used.

2.1.3 Imikpuk Lake

Imikpuk Lake is located adjacent to the Airstrip Site. In response to Deputy Assistant Secretary of the Navy (DASN) Policy Memo, June 20, 2016, Imikpuk Lake was identified as a drinking water source located within 1 mile downgradient of a known release of AFFF release. The AFFF release occurred at the Airstrip Site in 1970 to address fire risk from a fuel spill near Building 136 (NEESA, 1983). Based on input from community members, Imikpuk Lake has been used as a periodic drinking water source by local elders, fishers, and hunters (CH2M, 2019b). More information on the use of Imikpuk Lake is provided in **Section 2.2.7**. Five surface water samples were collected and analyzed for PFOA, PFOS, and PFBS, in accordance with USEPA Method 537/WS-DW-0004, Rev. 1.1. Laboratory results indicated that these three compounds were present in surface water samples collected from the lake, and the combined concentrations of PFOS and PFOA exceeded the USEPA lifetime health advisory of 70 ppt (Alaska DHSS, 2017; CH2M, 2019b). In September 2017, an advisory was issued to not use Imikpuk Lake as a source of drinking or cooking water based on these exceedances (Alaska DHSS, 2017; CH2M, 2019b).

2.2 Site Setting

This section describes the site setting, including geologic features relevant to this investigation. The local landscape consists of flat tundra with abundant lakes (**Figure 2-2**).

2.2.1 Climate

Former NARL Barrow is located within the Arctic Circle in the northernmost part of Alaska adjacent to the Chukchi Sea (Arctic Ocean) (**Figure 2-1**). Regional climate is impacted by the northern latitude and proximity to the ocean. Winters are long and cold, summers are short and cool, and wind is persistent (USGS, 1994a, 1994b). Average monthly temperatures in Utqiaġvik range from a minimum of -22.7 degrees Fahrenheit (°F) in February to a high of 45.8°F in July (WRCC, 2018). The average total annual precipitation is 4.67 inches, average total annual snowfall is 32.5 inches, and average maximum snow depth is 11 inches (WRCC, 2018).

2.2.2 Land Use

The Airstrip Site at Former NARL Barrow is unoccupied by the Navy with the exception of ongoing remedial efforts, primarily related to petroleum hydrocarbon impacts. Access to Navy property is not restricted. Facilities near UIC-NARL include the Barrow Arctic Research Center, Iḷisaġvik College, permanent and temporary housing, and various staging and storage areas. The community uses the airstrip runway during spring and fall whaling. Additionally, local businesses use the runway for staging during barging operations.

2.2.3 Topography and Surface Drainage Features

The occurrence of surface water runoff at Former NARL Barrow is restricted to warmer months and is primarily observed during the snowmelt period, which lasts approximately 2 weeks and may constitute as much as 90 percent of the annual runoff (USGS, 1995). Drainage patterns during this season are impacted by topography, but temporary alterations to flow paths may occur due to ice- or snow-blocked culverts and other drainage pathways (USGS, 1995). Cracks in the soil (including ice-wedge polygon troughs[3]) and other depressions can also retain water (USGS, 1994b). The Airstrip Site is generally flat and close to sea level. Based on observations from the early 1990s, Building 136 is situated on a surface water drainage divide that bisects the building, with the area southwest of the building draining to Imikpuk Lake and the area northeast draining to North Salt Lagoon (**Figure 2-3**). Two depressions near Building 136 may also impact surface water drainage: the North Depression northeast of Building 136 and the South Depression southeast of Building 136. Surface water near Potential Crash Site A may drain towards either Imikpuk Lake or the Arctic Ocean (CH2M, 2019a). Surface water near Potential Crash Site B may drain towards either North Salt Lagoon or the Arctic Ocean (CH2M, 2019a). Stevenson Road (**Figure 2-3**) creates a slightly elevated barrier between the majority of the Airstrip Site and the Arctic Ocean.

2.2.4 Geologic Setting

Former NARL Barrow is located on a gravel and tundra peninsula on the Arctic Coastal Plain (**Figure 2-2**). The geology at Former NARL Barrow consists of unconsolidated sediments overlying Cretaceous age bedrock (USGS, 1994b). The geologic sequence is composed of (from deepest to shallowest) the Topogorak Formation, a marine-clay shale sequence extending from 450 feet to at least 1,400 feet below ground surface (bgs); the Grandstand Formation, a claystone and sandstone sequence extending from about 50 to 450 feet bgs; and the Gubik Formation, an unconsolidated marine and nonmarine gravel, sand, slit, and clay sequence (URS Greiner, 2000). At Former NARL Barrow, the Gubik Formation extends from the ground surface to about 50 feet bgs (URS Greiner, 2000). Coarse sand and gravel are the predominant soil types and can reach a thickness of approximately 65 feet (URS Greiner, 2000). Overlying the gravel deposits are organics and clay or loam deposits of the tundra meadows. Some finer deposits of silt, clay, and peat occur in drained lake basins and along beach ridges. Where most of buildings have been constructed, the underlying soil consists of coarse-grained deposits. Newer buildings, toward the southeast of the Main Camp Area were constructed on top of sand and gravel fill that was placed over the tundra. The fill deposits are typically 2 to 4 feet thick but may be up to 10 feet thick in places (URS Greiner, 2000).

[3] Ice-wedge polygons are formed as soil cracks in response to low temperatures in a characteristic polygon pattern that covers the tundra. These cracks fill with water during the warmer months. As the water freezes during colder months it forms ice wedges. The cycle of thaw and freeze causes these cracks and ice wedges to become larger over time.

Permafrost is continuous in the region and acts as a confining layer (USGS, 1994a). Soil at Former NARL Barrow is frozen for most of the year. During the summer, between late June and late October, the upper layers of the permafrost slowly thaw, producing what is termed the "active zone." The maximum thawed depth of the active zone is reached by August or September and varies by year. Perturbations to overlying vegetation and organic-rich soil, which are insulating, result in increased thaw depths (NSB, 2015; USGS, 1994b). At Former NARL Barrow, the thaw depth is typically less than about 1.5 feet in undisturbed areas and deeper in unvegetated areas (generally less than 7 feet) (USGS, 1994b, 1995; URS Greiner, 2000). Deeper depths to permafrost ("thaw bulbs") are observed under heated buildings, other artificial structures, and lakes. For example, the depth to permafrost beneath a heated building near Utqiaġvik was measured to be 49 feet and the depth to permafrost beneath Imikpuk Lake is more than 160 feet (USGS, 1994b, 1995). The depth to permafrost is also increased by the chemical composition of groundwater (especially salinity) (USGS, 1994b, 1995). Where the active zone is saturated by saline or a mixture of hydrocarbons and water, the thawed layer may extend up to 11 feet deep (URS Greiner, 2000). Conversely, unheated structures and raised heated structures that block sunlight reduce the depth to permafrost (USGS, 1995). The depth to permafrost depth is also influenced by topography and can be shallower under elevated roads (USGS, 1994a). The permafrost thickness in the Utqiaġvik area has been estimated to be as thick as 670 feet, based on extrapolation of the thermal gradient (NAVFAC, 2009).

2.2.5 Hydrogeologic Setting

Groundwater at the Former NARL Barrow is seasonal and exists above the deeper permafrost during the thaw season, between June and October, when near-surface permafrost thaws to a depth of up to approximately 6 feet bgs (the active zone). Because the active zone is only a few feet thick and remains frozen for most of the year, groundwater is not a viable source of potable water. Isatkoak Lagoon located southwest of Former NARL Barrow (**Figure 2-2**) supplies potable water for the City of Utqiaġvik.

Frozen ground limits infiltration at the time of snowmelt (typically June); therefore, most of the snowmelt becomes surface runoff, with only minimal percolation to the active zone groundwater system. Summer precipitation contributes negligible recharge to the groundwater system at Former NARL Barrow because evapotranspiration typically equals precipitation during the thaw season (USGS, 1994a, 1994b). Because of the confining nature of permafrost, there is also little movement of groundwater from the active zone above the permafrost and groundwater confined beneath the permafrost. As such, there is limited to no recharge from the active zone to confined groundwater beneath the permafrost at Former NARL Barrow. Infiltration of precipitation and runoff is limited to the active zone and is prevented from reaching deeper groundwater (NEESA, 1983). Refreezing of the active zone typically begins by September, progressing from the surface downward.

The direction of groundwater flow in the active zone is highly variable during the thaw season and can change from year to year because of the shallow depth of the active layer, changes to the active layer as the ground thaws, and ice-wedge polygon formation (USGS, 1994b). Due to these dynamic Arctic phenomena, distinct groundwater flow regimes occur at scales ranging from centimeters to tens of meters rather than at regional scales (USGS, 1994b). Groundwater flow directions at Former NARL Barrow (past and current) are not well defined. Generally, the shallow groundwater flow direction within the active zone typically follows topography at the Former NARL Barrow, because, in general, the permafrost surface mimics the land surface (USGS, 1994a, 1994b).

The primary active zone groundwater flow direction at the Airstrip Site is toward Imikpuk Lake and a second, less prominent flow is toward the North Salt Lagoon to the northeast (Wagner et al., 2016, 2018; Sealaska, 2019). A containment berm (ice wall) is present between the Airstrip Site and Imikpuk Lake (**Figure 2-3**). A tracer dye study suggests that some groundwater from the Airstrip Site discharges to Imikpuk Lake either due to groundwater circumnavigating the containment berm or flowing through a potential breach (Wagner et al., 2018).

2.2.6 Hydrologic Setting

In the Utqiaġvik area, permafrost forms a barrier to infiltration of surface water. During snowmelt, the flat topography and lack of infiltration cause seasonal thaw lakes to cover approximately 50 to 90 percent of the

coastal plain. The coastal tundra is largely covered with water following snowmelt (URS Greiner, 2000). Small streams forming on the tundra surface are primarily the result of surface runoff immediately following ice breakup. The streams achieve maximum discharge within a few days of snowmelt (URS Greiner, 2000).

Imikpuk Lake (a freshwater lake) and a series of saltwater lagoons are the main surface water features at Former NARL Barrow. Imikpuk Lake is approximately 70 acres in area with a maximum depth of about 9 feet (Hart Crowser, 1998). The hydrologic interaction between Imikpuk Lake and the groundwater at the Airstrip Site has been assessed previously (USGS, 1994a). In this study, the total annual inflow to Imikpuk Lake was estimated to be approximately 300,000 cubic meters per year, with the primary source of inflow to the lake assumed to be precipitation. The groundwater flux from the Airstrip Site to Imikpuk Lake was estimated to be approximately 173 cubic meters per year, less than 0.1 percent of the estimated annual inflow to Imikpuk Lake (USGS, 1994a). This estimate is anticipated to overestimate the flux to Imikpuk Lake because it does not consider variations in land surface topography at the Airstrip Site, and the potential presence of permafrost ridges beneath buildings and elevated roadways at the site may serve as impediments to groundwater flow (USGS, 1994a).

A formal Federal Emergency Management Agency (FEMA) flood hazard assessment has not been completed for this portion of Alaska (FEMA, 2018), but the area is susceptible to storm surges that may result in flooding and increased erosion (NSB, 2015). The largest storm of record occurred on October 3, 1963 (NSB, 2015). The surge associated with this storm led to flooding of the Main Camp Area at Former NARL Barrow (now UIC-NARL) and areas adjacent to lakes and lagoons (NSB, 2015). Sea water overflowed into Imikpuk Lake, which prompted the use of desalination units to restore the lake (restoration was completed in 1969) (NEESA, 1983).

2.2.7 Water Use

Surface water is the primary source of potable water near Former NARL Barrow, as groundwater is not a viable source of drinking water. Navy-owned property at Former NARL Barrow is no longer in use and there is no regular need for potable water. Nearby, UIC-owned buildings on transferred property are supplied potable water from the City of Utqiaġvik. The City of Utqiaġvik obtains potable water from Isatkoak Lagoon (**Figure 2-2**); this water is treated with micro- and nanofiltration (NSB, 2015). In 2017, the Barrow Utilities and Electric Cooperative, Inc. (BUECI) sampled the Isatkoak Reservoir and the post-treatment water (after filtration) for PFAS. The water from Isatkoak Reservoir tested above the USEPA lifetime health advisory for PFOS and PFOA; no PFOS or PFOA was detected in the post-treated water samples. The results can be obtained from BUECI.

Imikpuk Lake historically provided drinking water for Former NARL Barrow and the community for subsistence and non-subsistence purposes. The lake was a source of drinking water for Former NARL Barrow (CH2M, 2019a) and until 2015 was a source of drinking water for UIC-NARL, which includes the Barrow Arctic Research Center, Iḷisaġvik College, permanent and temporary housing, and various staging and storage areas (NSB, 2020; CH2M, 2019a). The lake was also a source of drinking water for subsistence activities. Iñupiat subsistence hunting, fishing, and whaling traditions remain an integral part of life in Utqiaġvik and are an important aspect of the local culture and economy (NSB, 2015). Many residents of Utqiaġvik hunt or fish for most of their food due to the high cost of transporting food to the city and because it has been a way of life for generations (NSB, 2015). Subsistence use of Imikpuk Lake has included hauling drinking water to cabins at Piqniq (Duck Camp) to the northeast of the Airstrip Site for Spring-Autumn waterfowl hunts, as well as family outings and holidays spent at the camp (NSB, 2020). Water in the form of ice was also hauled from the lake for drinking purposes during spring whaling activities (NSB, 2020).

In September 2017, an advisory was issued to not use Imikpuk Lake as a source of drinking or cooking water based on the detection of PFOS and PFOA exceeding the USEPA lifetime health advisory (Alaska DHSS, 2017; CH2M, 2019b). Ingestion of Imikpuk Lake surface water has been addressed by the following Navy actions: (1) a public meeting to share the results of the 2017 surface water samples with the community, (2) installation of signs around the lake warning the community not to drink or cook with the water, and (3) meetings with local leadership and health officials regarding the PFAS results in the lake.

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\Figure2_1_LocationMap.mxd 3/10/2020 druckc CH2M



LEGEND

- Former NARL Barrow

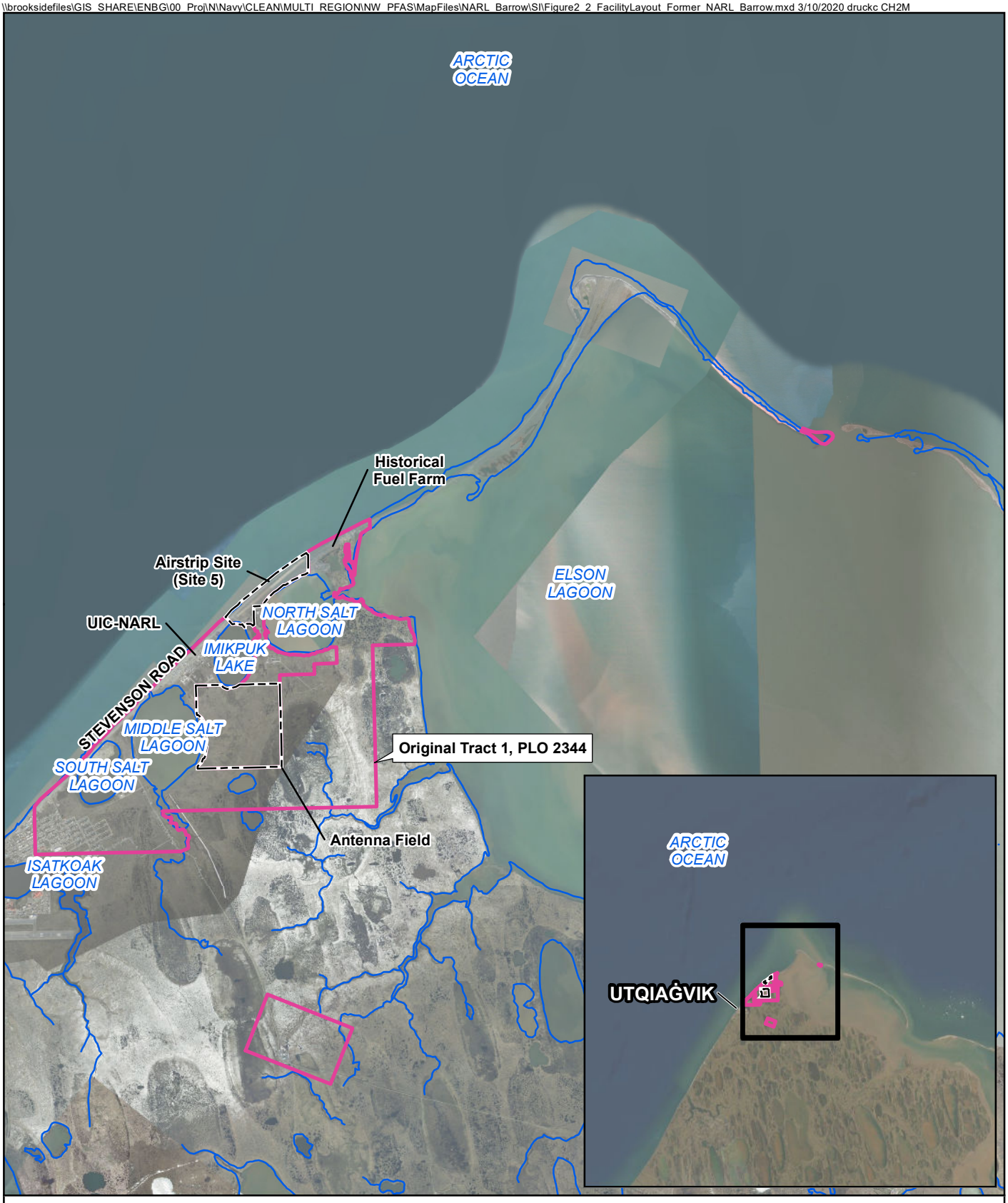
Figure 2-1
Base Location Map
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

0 75 150
Miles
1 inch = 150 mile

N

ch2m.

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\Figure2_2_FacilityLayout_Former_NARL_Barrow.mxd 3/10/2020 druckc CH2M



LEGEND

- Hydrology
- Current Navy Property Boundary
- Historical Installation Boundary

Figure 2-2
Facility Layout Map
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

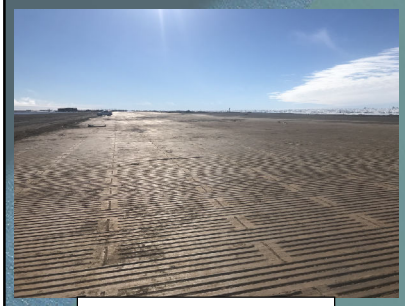
0 0.75 1.5 Miles

1 inch = 1.5 mile

N

ch2m

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\Figure2_3_Potential_PFAS_Source_Areas.mxd 3/10/2020 druckc CH2M



Airstrip
View direction: southwest.
Photo date: 7/10/2018

POTENTIAL CRASH SITE B (LOCATION APPROXIMATE)

ARCTIC OCEAN

AIRSTRIP SITE

Stevenson Road

Surface Water Drainage Divide

North Depression

BUILDING 136

South Depression

NORTH SALT LAGOON

POTENTIAL CRASH SITE A (LOCATION APPROXIMATE)

Navy Treatment Plant

IMIKPUK LAKE

Building 136 - Navy Hangar
View direction: south.
Photo date: 7/10/2018



LEGEND

- Groundwater Flow Direction
- Anticipated Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary

0 500 1,000 Feet

1 inch = 1,000 feet

N

NOTE:
Some features are labeled with only their building number; additional information is provided in the text of this report.

Figure 2-3
Potential PFAS Source Areas
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

ch2m

SECTION 3

Field Investigation Methodology

This section describes the field activities, which were performed in accordance with the SAP (CH2M, 2019c) except where noted. Field activities were conducted in August 2019; field notes are provided in **Appendix A**.

3.1 Site Preparation and Utility Location

Before any intrusive activities began, a third-party utility clearance subcontractor clearly marked subsurface utilities near proposed boring locations. No utilities were marked within 5 feet of any of the proposed boring locations; therefore, no monitoring well locations were moved due to subsurface utilities. However, a major rainstorm occurred in the Utqiaġvik area and one proposed boring location was underwater. Field Change Request #1 (presented in **Appendix B**) was submitted for the adjustment of the boring location and was approved on August 14, 2019. **Figure 3-1** presents the approved soil boring locations.

3.2 Temporary Monitoring Well Installation and Development

Eight temporary (short-term) monitoring wells were constructed at the Airstrip Site. All monitoring wells were installed in accordance with the State of Alaska well construction standards by an Alaska-licensed driller. Borehole advancement and soil logging was conducted using methods described in the SAP (CH2M, 2019c). The locations of all temporary monitoring wells installed are shown on **Figure 3-1**.

3.2.1 Temporary Monitoring Well Installation

Temporary monitoring wells were installed at Building 136, Potential Crash Site A, and Potential Crash Site B. Monitoring well construction information is provided in **Table 3-1**.

All temporary monitoring wells were constructed with a 2-inch-inside-diameter Schedule 40 polyvinyl chloride (PVC) riser connected to a 1-foot or greater, 2-inch-inside-diameter factory slotted 0.010-inch PVC screen with a bottom cap. The screened intervals varied at each well to screen across the full depth of the active groundwater zone, as described in Field Change Request #3 (presented in **Appendix B**). Final screened depths are presented in **Table 3-1**. All drilling and well construction materials were free of fluorine. Well completion diagrams are provided in **Appendix C**.

The annular space between the borehole wall and well screen was backfilled with a sand filter pack placed around the annular space of the well screen from the bottom of the boring and extending to a minimum height of 2 feet above the top of the well screen, if feasible. If the depth to active zone groundwater was too shallow to accommodate a full 2 feet of sand above the top of the screen and still provide for an adequate seal extending to ground surface, the filter pack extended the entire length of the screen. A bentonite seal, at least 1 foot thick, was placed above the top of the sand pack, where feasible.

3.2.2 Monitoring Well Development

After completion of the well installation, each newly installed monitoring well was developed, if possible, by the drilling subcontractor using a combination of surging and pumping throughout the well screen. During monitoring well development, the CH2M field crew measured water quality parameters (WQPs), including pH, temperature, conductivity, and turbidity with a water quality meter. Development continued until turbidity was below 10 nephelometric turbidity units (NTU) or at least three well volumes removed.

Development information, including turbidity, pH, specific conductivity, temperature, and gallons of water removed, were recorded as field notes. In addition, the water quality meter was calibrated daily (at a minimum). Well development logs are provided in **Appendix D**.

Four wells could not be developed because there was no water in the borings on two consecutive days during high tide. These wells were NARL-S05-TW04, NARL-S05-TW05, NARL-S05-TW06, and NARL-S05-TW07 at Potential Crash Sites A and B (**Figure 3-1**).

3.3 Groundwater, Soil, and Surface Water Sampling

Groundwater samples were collected from four newly installed temporary monitoring wells and eight existing monitoring wells. Surface water samples were collected from 5 locations in Imikpuk Lake. Surface and subsurface soil samples were collected from 11 locations. A photo log of the field activities is presented as **Appendix E**.

3.3.1 Groundwater Elevation Measurement

A synoptic groundwater elevation survey was conducted at all newly installed temporary monitoring wells with groundwater present and eight existing monitoring wells using a water level indicator. The survey was conducted at least 24 hours after well installation and development had been completed. Depth to water was measured from the top of the PVC riser and recorded to the nearest 0.01 foot. Groundwater elevations are presented on **Figure 3-2** and **Table 3-2**.

3.3.2 Groundwater Sampling

Groundwater samples were collected from four of the newly installed temporary monitoring wells and eight of the existing monitoring wells near Building 136 (**Figure 3-1**). As described in **Section 3.2.2**, four of the wells could not be developed; as such, no groundwater samples were collected from these wells.

Groundwater samples were collected under low flow/low stress conditions. The pump intake was placed at the middle of the well screen interval. Prior to collecting the sample, a minimum of three well volumes were purged. During purging, depth-to-water readings and WQPs were measured and recorded at regular time intervals of at least 5 minutes. Depth-to-water was measured with a water level indicator, and WQPs were measured using a water quality meter, calibrated daily (at a minimum). The wells were purged at a rate such that drawdown in the well was less than 0.5 foot. Sampling began when three well volumes had been purged and WQPs had stabilized for three consecutive readings, as follows:

- Temperature within 3 percent
- pH within 0.1 pH units
- Conductivity within 3 percent
- Dissolved oxygen (DO) within 10 percent for values greater than 0.5 milligram per liter (mg/L), if 3 DO values were less than 0.5 mg/L, the values were considered stabilized
- Oxidation-reduction potential (ORP) within 10 millivolts (mV)
- Turbidity measurements less than 5 NTU; if 3 turbidity values are less than 5 NTU, the values are considered stabilized
- Depth to water, WQPs, and total well depth measurements were recorded

Groundwater sampling data sheets are provided in **Appendix D** and field parameters are presented in **Table 3-3**.

3.3.3 Soil Sampling

Soil samples were collected at the surface (0 to 6 inches bgs) and top of the capillary fringe in the unsaturated soil at each newly installed temporary monitoring well location (eight) and three soil borings near Building 136 (**Figure 3-1**). Samples were collected using a sampling tube driven to the desired sampling depth using a direct-push technology drill rig, except at the three soil boring locations (NARL-S05-SO09, NARL-S05-SO10, and NARL-S05-SO11) where hand augering methods were used (as proposed and approved in Field Change Request #2, presented in **Appendix B**).

The sampling tube was cut open using a specific knife designed to slice the liners. Soil was collected in the desired sample containers using reusable decontaminated equipment or single-use dedicated equipment. The three soil borings were backfilled with bentonite and the surface was restored. The remaining soil borings were completed as temporary monitoring wells as described in **Section 3.2**.

3.3.4 Surface Water Sampling

Five surface water samples were collected from Imikpuk Lake (**Figure 3-1**). Surface water sampling locations were accessed by foot and samples were collected by submerging the sample bottle into Imikpuk Lake.

3.3.5 Quality Assurance and Quality Control

Field quality assurance/quality control (QA/QC) samples were collected during sampling, in accordance with the SAP (CH2M, 2019c). These samples were obtained to:

- Ensure that disposable and reusable sampling equipment were free of PFAS
- Evaluate field methodology
- Establish ambient field background conditions
- Evaluate whether cross-contamination occurred during sampling and/or shipping

Several types of field QA/QC samples that were collected and analyzed are defined as follows:

- **Equipment Rinsate Blank:** These samples were obtained by running laboratory-grade deionized water over or through sample collection equipment prior to use. These samples, which were collected during groundwater sampling only, were used to determine whether disposable, one-time-use equipment was PFAS-free prior to use.
- **Field Blank:** These samples were collected by pouring the laboratory-provided blank water into an empty sample bottle. The purpose of these samples is to assess the potential for PFAS field contamination.
- **Duplicate Sample:** Duplicate samples were collected at the same time and under identical conditions as their respective associated sample at the frequency of one per 10 field samples of similar matrix. These samples were collected to evaluate the field and laboratory reproducibility of sample results and are one way to evaluate field methodology.

In addition to samples collected to monitor field QC, samples were also collected to monitor quality within the laboratory. These included the following:

- **Matrix Spike (MS):** An aliquot of a matrix (that is, groundwater) was spiked with known quantities of analytes of interest and subjected to the entire analytical procedure. By measuring the recovery of these spiked quantities, the appropriateness of the method for the matrix was demonstrated.
- **Matrix Spike Duplicate (MSD):** These samples were collected as second aliquots of the same matrix as the MS to determine the precision of the method.

One MS sample and one MSD sample were collected for every 20 environmental samples collected (or greater than or equal to 5 percent of the samples collected) per medium including field duplicates.

3.3.6 Sample Packaging and Shipping

Samples were stored in coolers on ice following collection with a corresponding chain-of-custody. Coolers were then shipped as checked luggage from Utqiaġvik to Anchorage without ice to comply with airline requirements. Upon arrival in Anchorage, the samples were inspected; all custody seals were confirmed to be intact and ice was added to the coolers. The samples were then shipped on ice via FedEx to Battelle Norwell Operations, Norwell, Massachusetts, for analysis.

3.4 Decontamination Procedures

All decontamination activities were conducted in accordance with the standard operating procedures (SOPs) provided in the SAP (CH2M, 2019c). In addition, cross-contamination of PFAS was considered during decontamination in accordance with the SOP titled *OPNAV PFC Sampling Policy* provided in the SAP (CH2M, 2019c).

Nondisposable equipment was decontaminated using the following solutions in this order:

1. PFAS-free water and Liquinox solution prepared with reverse osmosis water obtained from UIC and confirmed with laboratory analysis to be PFAS-free.
2. PFAS-free 10 percent isopropanol solution prepared with reverse osmosis water obtained from UIC and confirmed with laboratory analysis to be PFAS-free. Equipment was air-dried following this rinse step.
3. Laboratory-grade deionized water (laboratory-certified PFAS-free, provided by Battelle Norwell Operations, Norwell, Massachusetts).

Water generated during decontamination of sampling equipment was collected and disposed as investigation-derived waste (IDW).

Disposable sampling equipment and personal protective equipment, such as Masterflex tubing and nitrile gloves, were not decontaminated after use and instead were disposed as nonhazardous solid waste.

Reusable heavy equipment, such as drilling rods and augers, were decontaminated before and after the collection of each sample. These fluids were disposed as IDW. All heavy equipment decontamination procedures were conducted in accordance with the Decontamination of Drilling Rigs and Equipment SOP provided in the SAP (CH2M, 2019c).

3.5 Surveying

Monitoring wells and soil sampling locations were horizontally and vertically located by an Alaska-licensed surveyor. The surveyor provided coordinates of all horizontal points X, Y, to the nearest 0.5 foot and vertical point Z to the nearest 0.01 foot (0.1 foot for unpaved ground surface elevations). The survey report is provided as **Appendix F**.

Surface water sample location coordinates were logged by the field team using a handheld Trimble global positioning system (GPS) unit.

3.6 Temporary Monitoring Well Abandonment

Following the completion of groundwater sampling, the temporary monitoring wells were abandoned in accordance with the Monitoring Well and Borehole Abandonment SOP provided in the SAP (CH2M, 2019c). PVC risers and screens were pulled from the ground and the remaining borehole was then sealed with bentonite.

3.7 Investigation-derived Waste Management

IDW generated during the SI included soil cuttings, well development groundwater, groundwater sampling purge-water, and decontamination rinse-water from all nondisposable sampling equipment and heavy equipment. All IDW was containerized in Department of Transportation-approved 55-gallon steel drums (3 wastewater drums and 1 soil drum), which were properly sealed, labeled, and staged within a Navy-owned building adjacent to Building 136.

Upon completion of sampling activities and prior to disposal, CH2M field staff collected waste characterization samples from the drums. Solid and aqueous IDW samples were analyzed for volatile organic compounds, semivolatile organic compounds, pH, Resource Conservation and Recovery Act (RCRA) metals, total petroleum

hydrocarbons, and ignitability. Aqueous IDW samples were also analyzed for PFAS in accordance with Navy policy. PFAS concentrations measured in the aqueous IDW were greater than the USEPA lifetime health advisory. All drums were removed on October 31, 2019 and transported to Waste Management's disposal facility in Arlington, Oregon. Aqueous IDW was solidified prior to disposal.

All IDW management activities were conducted in accordance with the Waste Management Plan and Environmental Protection Plan (appended to the Accident Prevention Plan [CH2M, 2019d]). Tables G-1 and G-2 of **Appendix G** provide an analytical summary for the IDW samples and includes all IDW handling and disposal information.

3.8 Laboratory Analysis and Data Usability Assessment

Groundwater, soil, and surface water samples were submitted to Battelle Norwell Operations, Norwell, Massachusetts, a DoD Environmental Laboratory Accreditation Program accredited laboratory, in accordance with chain-of-custody procedures. Analytical data are provided in **Appendix H**. All samples were analyzed for the 18 PFAS compounds listed in Method 537.1 via liquid chromatography tandem mass spectrometry compliant with Quality Systems Manual 5.1 Table B-15, in accordance with current Navy guidance:

- PFBS
- PFOS
- PFOA
- Perfluorodecanoic Acid (PFDA)
- Perfluorododecanoic Acid (PFDoA)
- PFHpA
- PFHxS
- Perfluorohexanoic Acid (PFHxA)
- PFNA
- Perfluorotetradecanoic Acid (PFTeDA)
- Perfluorotridecanoic Acid (PFTrDA)
- Perfluoroundecanoic Acid (PFUnA)
- 4,8-dioxa-3H-perfluorononanoic acid (ADONA)
- 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)
- 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
- N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)
- N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)
- Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)

After laboratory analysis of samples was complete, data usability was assessed. Data validation was conducted by an independent third-party data validator. Complete validation findings are presented in the data validation reports included in **Appendix I**. Data were then verified and prepared for upload to the Naval Installation Restoration Information Solution database and a Data Quality Assessment was completed. Final, validated data are provided in **Appendix H**, and the Data Quality Assessment is provided in **Appendix I**. Completed ADEC laboratory data review checklists are included in **Appendix I**. The data validation review demonstrated that the analytical systems were generally in control and data results can be used in the project decision making process.

3.9 Deviations from the Sampling and Analysis Plan

The following field procedures deviated from the SAP (CH2M, 2019c):

- Field Change Request #1 was approved on August 14, 2019 proposing a revised boring location due to an originally proposed location being under water during third-party utility location. The approved Field Change Request is provided in **Appendix B**.

- Field Change Request #2 was approved on August 28, 2019 proposing a revision to the soil boring collection method for the stand-alone soil borings. The drilling field schedule was delayed due to unforeseen drilling equipment shipment delays. In order to expedite the soil sample collection, it was proposed that the three stand-alone soil borings be collected with a hand auger. The approved Field Change Request is provided in **Appendix B**.
- Field Change Request #3 was approved on August 28, 2019 proposing the adjustment of the monitoring well screen length from 1 foot to 1 foot or greater to screen across the full depth of the active zone groundwater. The approved Field Change Request is provided in **Appendix B**.

The SAP identified project action levels for groundwater not used as drinking water supply as ADEC groundwater cleanup levels (ADEC, 2019b) and residential tapwater values determined using the USEPA Regional Screening Level (RSL) calculator based on a hazard quotient of 0.1. Data collected during the SI were screened against the screening levels (SLs) as described in **Section 4**. In accordance with CERCLA, should the need for remedial action be established in a future risk assessment, the ADEC cleanup values will be evaluated to determine if they qualify as ARARs during a future feasibility study.

Table 3-1. Temporary Monitoring Well Construction Summary

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Monitoring Well	Installation Date	Top of PVC Casing Elevation (ft msl)	Total Well Depth (ft btoc)	Length of Screen (ft)	Depth of Top of Screen (ft btoc)	Depth of Bottom of Screen (ft btoc)	Elevation of Top of Screen (ft msl)	Elevation of Bottom of Screen (ft msl)	Northing	Easting
NARL- S05-TW01	8/27/2019	14.05	7.5	4.5	3.0	7.5	11.1	6.6	6339180.337	1799050.912
NARL- S05-TW02	8/27/2019	11.95	5.7	3.0	2.7	5.7	9.3	6.3	6339430.165	1798087.069
NARL-S05-TW03	8/27/2019	11.93	5.8	2.8	3.0	5.8	8.9	6.1	6339460.575	1798217.831
NARL-S05-TW04	8/27/2019	13.37	5.5	3.5	2.0	5.5	11.4	7.9	6339601.986	1798129.811
NARL-S05-TW05	8/28/2019	14.19	5.5	2.0	3.5	5.5	10.7	8.7	6342884.667	1802178.511
NARL-S05-TW06	8/28/2019	14.28	6.1	1.5	4.6	6.1	9.7	8.2	6343017.681	1802287.610
NARL-S05-TW07	8/28/2019	14.08	6.7	2.2	4.5	6.7	9.6	7.4	6343015.385	1802178.699
NARL-S05-TW08	8/28/2019	8.80	5.3	3.0	2.3	5.3	6.5	3.5	6342436.166	1802191.758

Notes:

btoc = below top of casing

ft = feet

msl = mean sea level. Vertical elevation references the North American Vertical Datum of 1988 (NAD88)

PVC = polyvinyl chloride

Table 3-2. Groundwater Elevations August 2019

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Monitoring Well	Top of Casing Elevation (ft msl)	Depth to Water[a] (ft btoc)	Groundwater Elevation (ft msl)
NARL- S05-TW01	14.05	6.97	7.08
NARL- S05-TW02	11.95	5.48	6.47
NARL-S05-TW03	11.93	5.38	6.55
NARL-S05-TW04	13.37	NA	NA
NARL-S05-TW05	14.19	NA	NA
NARL-S05-TW06	14.28	NA	NA
NARL-S05-TW07	14.08	NA	NA
NARL-S05-TW08	8.80	3.85	4.95
NARL-S05-WP-16D	7.77	3.05	4.72
NARL-AFAS-WP-20	9.30	2.3	7.00
NARL-S05-WP-18B	9.54	2.54	7.00
NARL-S05-WP-10	8.25	2.81	5.44
NARL-S05-WP-12	8.28	3.5	4.78
NARL-S05-WP-02C	8.24	3.23	5.01
NARL-AFAS-WP-21	10.39	3.22	7.17
NARL-S05-WP-11	11.09	3.21	7.88

Notes:
btoc = below top of casing
ft = feet
msl = mean sea level. Vertical elevation references the North American Vertical Datum of 1988 (NAD88)
NA = not applicable, well was dry
[a]Measurements recorded 24 hours after well development

Table 3-3. Water Quality Parameters

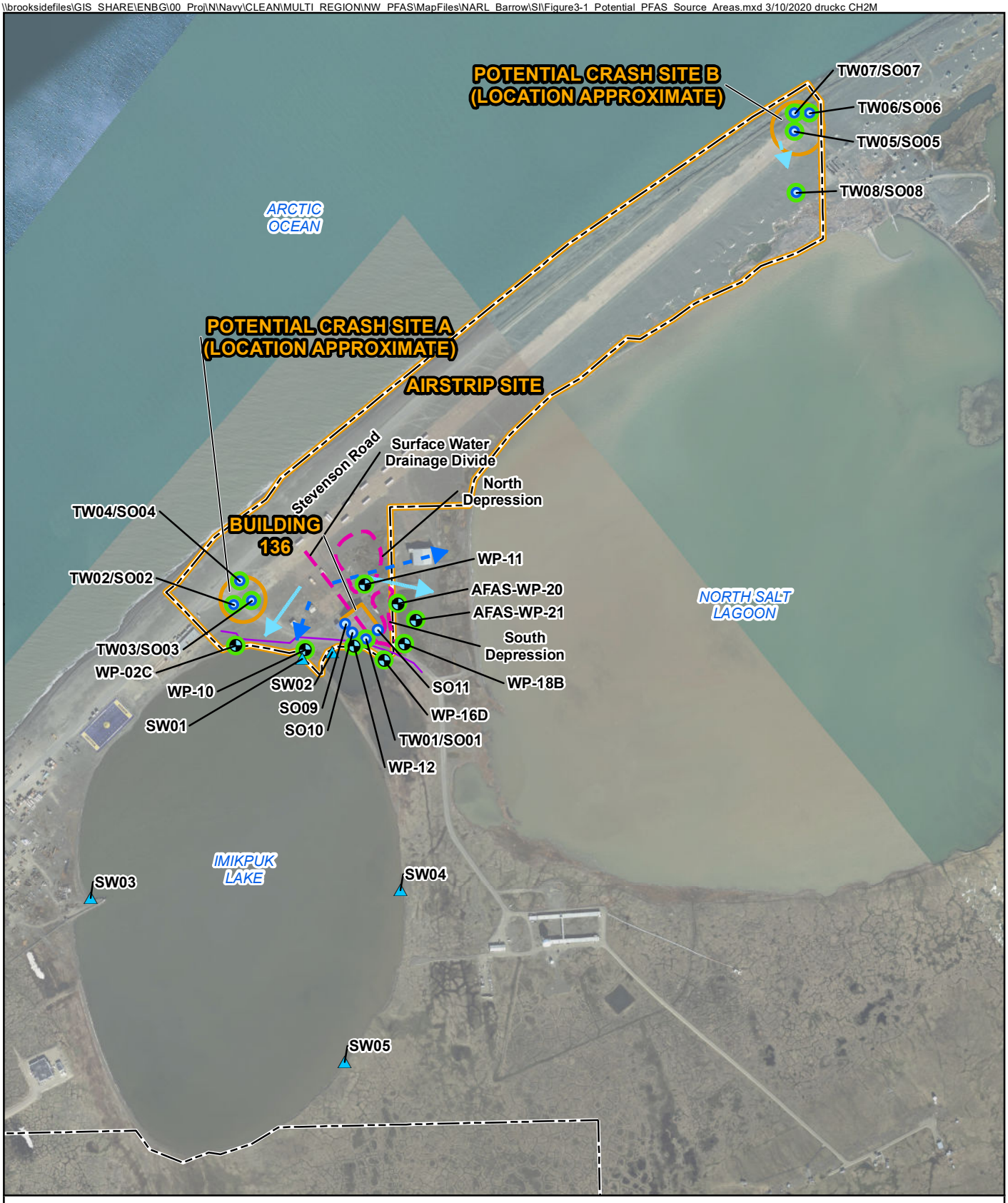
Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Station ID	Sample Date	Sample Time	Depth to Water (ft btoc)	pH	Conductivity (mS/cm)	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Turbidity (NTU)	PID Readings (ppm)	Comments
NARL- S05-TW01	8/29/2019	18:15	6.97	6.98	0.595	1.99	0	-83	15.5	53.9	Fuel like odor, not turbid, clear
NARL- S05-TW02	8/30/2019	16:08	5.48	7.99	4.21	1.75	12.14	91	6.19	0.9	No odor, not turbid, clear
NARL-S05-TW03	8/30/2010	11:04	5.38	7.49	4.09	0.71	11.26	172	4.16	0.1	No odor, not turbid, clear
NARL-S05-TW08	8/30/2019	15:05	3.85	8.12	0.743	5.69	0.80	124	259	NA	No odor, medium turbid, amber
NARL-S05-WP-16D	8/21/2019	15:20	3.05	6.94	0.498	4.98	0	-85	3.99	0	No odor, not turbid, clear
NARL-AFAS-WP-20	8/21/2019	10:52	2.3	6.25	0.480	3.52	0	-40	5.82	9.70	Fuel like odor, low turbid, amber
NARL-S05-WP-18B	8/21/2019	12:32	2.54	7.12	0.704	4.64	0	-117	58.1	NA	No odor, low turbid, amber
NARL-S05-WP-10	8/20/2019	15:30	2.81	6.50	0.631	4.39	0	-116	2.06	NA	Low fuel like odor, low turbid, very pale yellow, sheen observed
NARL-S05-WP-12	8/20/2019	17:00	3.5	6.96	0.353	4.39	3.47	-162	8.77	NA	Fuel like odor, low turbid, slight yellow tint, slight sheen observed
NARL-S05-WP-02C	8/21/2019	15:30	3.23	7.23	3.15	2.53	0	18	2.71	0.2	No odor, not turbid, clear
NARL-AFAS-WP-21	8/21/2019	11:47	3.22	7.10	1.03	4.06	0.64	-143	0.87	0	Low odor, not turbid, clear with some black floaters
NARL-S05-WP-11	8/21/2019	10:33	3.21	6.51	0.757	4.77	0.68	-132	4.51	0.00	Fuel like odor, not turbid, light yellow tint

Notes:
°C = degrees Celsius
btoc = below top of casing
ft = feet
ID = identification
mg/L = milligrams per liter
mS/cm = milliseimens per centimeter
mV = millivolts
NA = not applicable
NTU = nephelometric turbidity units
ppm = parts per million
PID = photo ionization detection

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\Figure3-1_Potential_PFAS_Source_Areas.mxd 3/10/2020 druckc CH2M



LEGEND

- Groundwater Flow Direction
- Anticipated Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary
- Surface Water Sample
- Soil Sample
- Groundwater Sample at Existing Well
- Temporary Monitoring Well & Soil Sample Location

NOTE:
Some features are labeled with only their building number; additional information is provided in the text of this report.

0 500 1,000 Feet

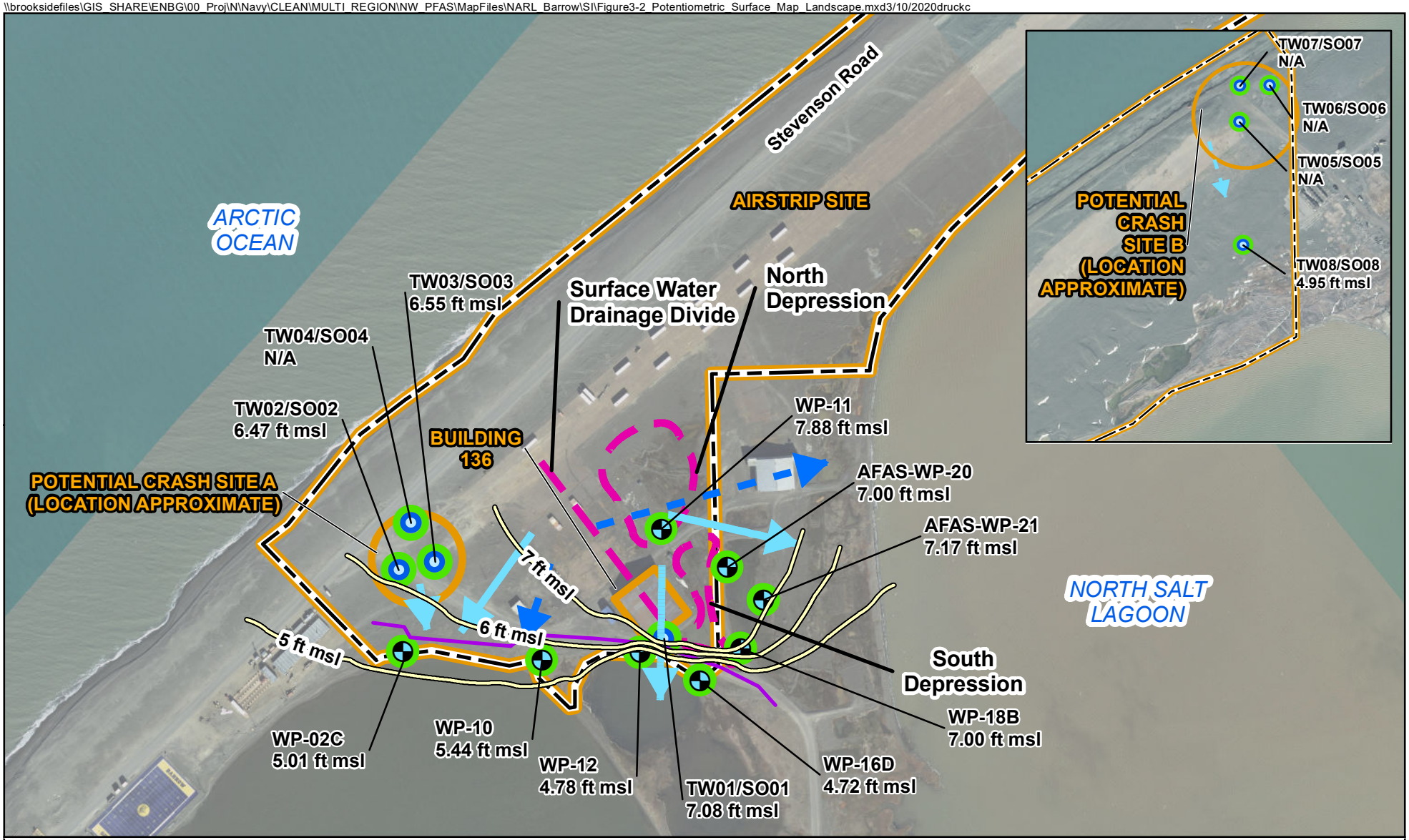
1 inch = 1,000 feet

N

Figure 3-1
Sample Locations
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

ch2m

\\brooksidefiles\GIS_SHARE\ENBG\00_Proj\N\Navy\CLEAN\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\Figure3-2_Potentiometric_Surface_Map_Landscape.mxd3/10/2020druckc



LEGEND

- Groundwater Flow Direction
- Anticipated Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Groundwater Elevation Contours
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary
- Groundwater Sample at Existing Well
- Temporary Monitoring Well & Soil Sample Location

NOTES:
- Some features are labeled with only their building number; additional information is provided in the text of this report.
- ft msl = feet mean sea level
- NA = not applicable, no water in monitoring well

N

0 125 250 500 Feet

1 inch = 500 feet

Figure 3-2
Potentiometric Surface Map August 2019
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake Former NARL Barrow, Utqiaġvik, Alaska

ch2m

SECTION 4

Field Investigation Results

This section presents the results of the field investigation described in **Section 3**.

Groundwater data were screened against the following screening levels:

- Tapwater SLs are based on an HQ of 0.1 and were generated using the USEPA RSL calculator (USEPA, 2019c) as described in DoD technical guidance (DoD, 2019): 0.04 µg/L for PFOS and 0.04 µg/L for PFOA. The SL for PFBS was generated similarly, but the value was updated from that listed in DoD technical guidance (DoD, 2019) to reflect the RfD provided in *Provisional Peer-Reviewed Toxicity Values for PFBS and Related Compound Potassium Perfluorobutane Sulfonate* (USEPA, 2021a)[4]: 0.60 µg/L.

Soil data were screened against the following screening levels:

- Soil SLs are based on an HQ of 0.1 and were generated using the USEPA RSL calculator (USEPA, 2019c) as described in DoD technical guidance (DoD, 2019): 130 µg/kg for PFOA and 130 µg/kg for PFOS. The SL for PFBS was generated similarly, but the value was updated from that listed in in DoD technical guidance (DoD, 2019) to reflect the RfD provided in *Provisional Peer-Reviewed Toxicity Values for PFBS and Related Compound Potassium Perfluorobutane Sulfonate* (USEPA, 2021a)[4]: 1,900 µg/kg.

Analysis was also conducted for PFAS that do not currently have screening levels (PFDA, PFDoA, PFHpA, PFHxS, PFHxA, PFNA, PFTeDA, PFTrDA, PFUnA, ADONA, 9Cl-PF3ONS, 11Cl-PF3OUdS, NEtFOSAA, NMeFOSAA, and HFPO-DA), the results of which may be consulted in the future, if screening levels are established.

The data for surface water collected from Imikpuk Lake was not compared to drinking water screening levels because it is not a current source of drinking water.

4.1 Analytical Data and Field Observations

Laboratory analytical results are presented and compared to screening levels in **Tables 4-1** through **4-4**. **Figures 4-1, 4-2,** and **4-3** summarize the data for detected PFAS at the Airstrip Site and Imikpuk Lake.

4.1.1 Groundwater

Characterization of groundwater included measurement of general groundwater geochemistry and analysis of PFAS concentrations. A summary of the results is presented in the following sections.

Groundwater Geochemistry

Measurements of DO, ORP, pH, temperature, specific conductivity, and turbidity were collected at each monitoring well following purging and immediately prior to sampling. **Table 3-3** shows the groundwater parameters measured at the Airstrip Site.

The DO readings collected from the groundwater samples ranged between 0.0 milligram per liter (mg/L) and 3.47 mg/L, which are indicative of anaerobic conditions. However, DO concentrations in two monitoring wells, NARL-S05-TW02 and NARL-S05-TW03 (**Figure 3-1**), were measured at 12.14 and 11.26 mg/L, respectively, an indication of highly aerobic conditions. The ORP readings in groundwater ranged between -162 mV and 172 mV, indicating that conditions at the site vary from reducing to strongly oxidizing. Temperature readings ranged between 0.71 degrees Celsius (°C) and 5.69°C. pH values were generally neutral, ranging between 6.25 and 8.12. Specific conductivity values, which provide an indication of the concentration of total dissolved solids within groundwater, ranged between 0.353 millisiemens per centimeter (mS/cm) and 4.21 mS/cm, which are indicative of freshwater conditions. Turbidity measurements, which indicate the presence of suspended colloidal matter in water, were generally low (below 20 NTU), with the exception of monitoring wells NARL-S05-TW08 and NARL-S05-WP-18B

4 The PFBS SL may also be read off tables on the USEPA RSL website (USEPA, 2021c).

where turbidity after purging was measured at 259 and 58.1 NTU, respectively. Field observations indicated slight fuel odor at 6 sample locations with sheen observed at NARL-S05-WP-10 and NARL-S05-WP-12.

Overview of Groundwater Analytical Results

Analytical results from groundwater samples are presented in **Table 4-1** and **Figure 4-1**. A summary is presented below. As described in **Section 3.8**, samples were analyzed for the 18 PFAS listed in Method 537.1 via liquid chromatography tandem mass spectrometry compliant with Quality Systems Manual 5.1 Table B-15. The data for PFAS for which no screening levels are established are presented in **Appendix H**.

Analysis of the 12 groundwater samples collected across the Airstrip Site indicate the following:

- **Building 136**. PFOS, PFOA, and PFBS were detected in samples collected at all eight monitoring wells near Building 136 (**Figure 4-1**). Samples from these eight wells exceeded the Tapwater SLs for PFOS and PFOA of 0.04 µg/L, each. The highest concentrations of PFOS (4.2 µg/L) and PFOA (5.7 µg/L) were measured in the sample from NARL-S05-WP-10, which is downgradient of Building 136 near Imikpuk Lake. Concentrations of PFBS did not exceed the Tapwater SLs in any location.
- **Potential Crash Site A**. PFOA and PFBS were detected in all three sampled monitoring wells at and downgradient of Potential Crash Site A; PFOS was detected in two of three sampled monitoring wells at and downgradient of Potential Crash Site A. Groundwater collected from one of two wells sampled at Potential Crash Site A (NARL-S05-TW02) exceeded the Residential Tapwater SL for PFOA (0.04 µg/L) with a concentration of 0.24 µg/L. Groundwater collected from a well downgradient of Potential Crash Site A (NARL-S05-WP-02C) exceeded the Residential Tapwater SL for PFOS (0.04 µg/L) with a concentration of 0.34 µg/L (this well is also downgradient of Building 136).
- **Potential Crash Site B**. No groundwater samples could be collected at Potential Crash Site B, as there was no water in the borings on two consecutive days during high tide. The month leading up to the sampling event was wetter than average, allowing for a greater than usual chance for active zone groundwater recharge[5]. Based on the SI data, it appears that groundwater is not present at Potential Crash Site B. A groundwater sample collected at a monitoring well downgradient of Potential Crash Site B (NARL-S05-TW08) had detections of PFOA, but no exceedances of screening levels. The PFOA concentration at this location was 0.0014 J µg/L (result was J-flagged by the laboratory, indicating that the analyte is present, but the concentration value may or may not be accurate or precise), which is one order of magnitude below the Residential Tapwater SL of 0.04 µg/L. PFOS and PFBS were not detected.

4.1.2 Surface and Subsurface Soil

A summary of the results of the lithology and a discussion of the extent of PFAS in soil are presented in the following sections.

General Lithology

In general, the lithology of the soil borings aligned throughout the site with the following characteristics:

- The surface of the borings down to 1-foot samples consisted of brown moist, loose, sandy gravel with silt.
- Samples collected from 1 to 2.5 feet were classified as blue grey to brownish red fine to medium gravel with sub-rounded to subangular clasts. One boring noted a strong sweet odor in this interval.
- From 2.5 to total depth (up to 6.7 feet) of boring were classified as brown and wet silt to lithe.

Soil boring logs are presented in **Appendix C**.

5 In August 2019 Utqiaġvik received 2.28 inches of rainfall compared to an August average of 1.05 inches (National Weather Service, 2020).

Overview of Soil Analytical Results

Analytical results from soil samples collected are presented in **Tables 4-2** and **4-3** and **Figure 4-2**. A summary is presented below. As described in **Section 3.8**, samples were analyzed for the 18 PFAS listed in Method 537.1 via liquid chromatography tandem mass spectrometry compliant with Quality Systems Manual 5.1 Table B-15. The data for PFAS for which no screening levels are established are presented in **Appendix H**. Analysis of the soil samples collected indicate the following:

- **Building 136**. PFOS was detected at three of four locations near Building 136. These samples did not exceed the Soil SL (130 µg/kg). PFOS was detected in two surface soil samples at concentrations of 1.11 J µg/kg at NARL-S05-SS09 and 1.03 J µg/kg at NARL-S05-SS11. PFOS was detected in two subsurface samples at concentrations of 0.47 J at NARL-S05-SB01 collected from 3.0 to 3.5 feet bgs and 1.32 J µg/kg at NARL-S05-SB11 collected from 3.5 to 4.0 feet bgs. PFOA and PFBS were not detected at any of the four locations.
- **Potential Crash Site A**. PFOS was detected at one of three locations at Potential Crash Site A. The detection was in a subsurface sample at a concentration of 3.35 J µg/kg at NARL-S05-SB04 from 1.8 to 2.3 feet bgs. PFOS was not detected in surface soil. PFOA and PFBS were not detected at any of the three locations.
- **Potential Crash Site B**. PFOS, PFOA, and PFBS were not detected at any of the three locations at Potential Crash Site B or at one location downgradient of the area.

4.1.3 Surface Water

Analytical results from surface water samples collected are presented in **Table 4-4** and **Figure 4-3**. **Figure 4-3** also presents data collected in 2017 (CH2M, 2018) for comparison to 2019 data. A summary is presented below. The data for PFAS for which no screening levels are established are in **Appendix H**.

Analysis of the surface water samples collected indicate the following:

- PFOS, PFOA, and PFBS were detected in all five surface water samples. PFOS concentrations ranged from 0.095 to 0.21 µg/L, PFOA concentrations ranged from 0.067 to 0.089 µg/L, and PFBS concentrations ranged from 0.0053 to 0.0073 µg/L.
- Sample results from this investigation for PFOA, PFOS, and PFBS are of the same magnitude as those detected in the 2017 Imikpuk Lake investigation, confirming the presence of PFAS (CH2M, 2019b).

4.2 PFAS Distribution

The results of the SI have been used to develop an initial understanding of the distribution of PFAS in environmental media (groundwater, soil, and surface water) at the Airstrip Site and Imikpuk Lake. This information can be used in developing a conceptual site model for the site and identifying additional data needs. The characteristics of other PFAS present are discussed in **Appendix J** to further support the conceptual site model.

Concentrations of PFOS and PFOA exceeded Tapwater SLs in groundwater samples collected near Building 136 and Potential Crash Site A, which are both located in the southwestern portion of the Airstrip Site. This was historically an active area within the Airstrip Site containing a higher density of buildings and utilities than other locations. One documented AFFF release has occurred in this area (near Building 136), as well as several fuel spills (CH2M, 2019a). PFOS, PFOA, and PFBS (or a subset of these three PFAS) were detected in all groundwater samples collected at the southwestern Airstrip Site. Groundwater concentrations in the southwestern Airstrip Site (Building 136 and Potential Crash Site A) exceeded the Tapwater SLs in all but one sample collected at Potential Crash Site A. The highest concentration of PFOS, PFOA, and PFBS in groundwater was detected west of Building 136 near Imikpuk Lake (at NARL-S05-WP-10) (**Figure 4-1**). The second highest concentration of PFOS, PFOA, and PFBS was detected southeast of Building 136, also near Imikpuk Lake (at NARL-S05-WP-16) (**Figure 4-1**). Both locations are downgradient of Building 136. PFOS and PFOA concentrations in groundwater collected closer to Building 136 exceeded one or both Tapwater SLs but were lower than those measured downgradient. PFOS and

PFOA also exceeded the Tapwater SLs in a well anticipated to be upgradient of Building 136 (NARL-S05-WP-11). It is unclear why PFOS and PFOA exceeded the Tapwater SLs upgradient of Building 136, but it may be related to small-scale variations in groundwater flow regimes related to the Arctic climate, or possibly a different AFFF release. Similar behavior (transport to an area apparently upgradient) may have been observed during previous tracer dye testing in this area[6] (Wagner et al., 2016). The extent of the PFOS and PFOA in groundwater is not currently delineated based on the samples collected during the SI.

PFOS was detected in soil samples collected near Building 136 and Potential Crash Site B, but did not exceed the Soil SL (**Figure 4-2**). Based on these low concentrations, it appears that soil in the sample locations may not be within a PFAS source zone (although it is recognized that PFAS precursors not measured during this SI may be present in these areas and may contribute to PFOS and PFOA in groundwater).

PFOS, PFOA, and PFBS were not detected in soil at Potential Crash Site B or at a downgradient location (**Figure 4-2**). PFOA was detected in a groundwater sample collected downgradient of Potential Crash Site B, but did not exceed the Tapwater SL (**Figure 4-1**).

The Imikpuk Lake PFAS results (**Figure 4-3**) confirm the presence of PFOS, PFOA, and PFBS at concentrations comparable to the sampling event in 2017 (CH2M, 2018). PFBS was also detected.

6 During tracer dye testing in this area, dye was observed in a well that was anticipated to be upgradient of the dye deployment location. The dye was also observed in background samples, however, making it unclear if the source of the dye was from the deployed dye.

Table 4-1. Groundwater Analytical Results

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site

Former NARL Barrow, Utqiaġvik, Alaska

		Station ID	NARL-AFAS-WP-20	NARL-AFAS-WP-21	NARL-S05-TW01		NARL-S05-TW02	NARL-S05-TW03	NARL-S05-TW08
		Sample ID	NARL-S05-WP-20-0819	NARL-S05-AFAS-WP-21-0819	NARL-S05-TW01-0819	NARL-S05-TW01P-0819	NARL-S05-TW02-0819	NARL-S05-TW03-0819	NARL-S05-TW08-0819
		Sample Date	08/21/19	08/21/19	08/29/19	08/29/19	08/30/19	08/30/19	08/30/19
PFAS Analyte	**Units**	**SL Tapwater (HQ=0.1)**							
PFBS	µg/L	0.60	**0.0153 J**	**0.02314**	**0.00965**	**0.00868**	**0.00473 J**	**0.00194 J**	0.00045 UJ
PFOS	µg/L	0.040	***0.13148***	***0.63524***	***0.25989***	***0.25557***	**0.02552**	0.00355 U	0.00206 U
PFOA	µg/L	0.040	***0.26562***	***0.09967***	**0.02637**	**0.02489**	***0.24087***	**0.00215 J**	**0.00136 J**

Notes:

Bolded text indicates detection

Italicized indicates exceedance of SL Tapwater (HQ=0.1)

J = Analyte present, value may or may not be accurate or precise

U = The material was analyzed for, but not detected

UJ = Analyte not detected, quantitation limit may be inaccurate

µg/L = Micrograms per liter

HQ = hazard quotient

PFAS = Per- and Polyfluoroalkyl Substances

PFBS = Perfluorobutanesulfonic acid

PFOS = Perfluorooctane Sulfonate

PFOA = Perfluorooctanoic acid

SL = Screening Level

Table 4-1. Groundwater Analytical Results

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site

Former NARL Barrow, Utqiaġvik, Alaska

		Station ID	NARL-S05-WP-02C		NARL-S05-WP-10	NARL-S05-WP-11	NARL-S05-WP-12	NARL-S05-WP-16	NARL-S05-WP-18
		Sample ID	NARL-S05-WP-02C-0819	NARL-S05-WP-02CP-0819	NARL-S05-WP-10-0819	NARL-S05-WP-11-0819	NARL-S05-WP-12-0819	NARL-S05-WP-16D-0819	NARL-S05-WP-18B-0819
		Sample Date	08/21/19	08/21/19	08/20/19	08/21/19	08/20/19	08/21/19	08/21/19
PFAS Analyte	**Units**	**SL Tapwater (HQ=0.1)**							
PFBS	µg/L	0.60	**0.00464**	**0.00516**	**0.04858**	**0.0134**	**0.00743**	**0.02481**	**0.01143**
PFOS	µg/L	0.040	***0.29516***	***0.34145***	***4.20351***	***0.37913***	***1.44532***	***2.88116***	***0.85615***
PFOA	µg/L	0.040	**0.02981**	**0.03588**	***5.67898***	***0.23629***	**0.02214**	***0.27321***	***0.24348***

Notes:

Bolded text indicates detection

Italicized indicates exceedance of SL Tapwater (HQ=0.1)

J = Analyte present, value may or may not be accurate or precise

U = The material was analyzed for, but not detected

UJ = Analyte not detected, quantitation limit may be inaccurate

µg/L = Micrograms per liter

HQ = hazard quotient

PFAS = Per- and Polyfluoroalkyl Substances

PFBS = Perfluorobutanesulfonic acid

PFOS = Perfluorooctane Sulfonate

PFOA = Perfluorooctanoic acid

SL = Screening Level

Table 4-2. Surface Soil Analytical Results

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site

Former NARL Barrow, Utqiaġvik, Alaska

		Station ID	NARL-S05-SO01	NARL-S05-SO02	NARL-S05-SO03		NARL-S05-SO04	NARL-S05-SO05	NARL-S05-SO06
		Sample ID	NARL-S05-SS01-0_0-0_5-0819	NARL-S05-SS02-0_0-0_5-0819	NARL-S05-SS03-0_0-0_5-0819	NARL-S05-SS03P-0_0-0_5-0819	NARL-S05-SS04-0_0-0_5-0819	NARL-S05-SS05-0_0-0_5-0819	NARL-S05-SS06-0_0-0_5-0819
		Sample Date	08/27/19	08/27/19	08/27/19	08/27/19	08/27/19	08/28/19	08/28/19
PFAS Analyte	**Units**	**SL Residential Soil (HQ=0.1)**							
PFBS	µg/kg	1900	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
PFOS	µg/kg	130	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
PFOA	µg/kg	130	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U

Notes:

Bolded text indicates detection

Italicized indicates exceedance of SL Residential Soil (HQ=0.1)

J = Analyte present, value may or may not be accurate or precise

U = The material was analyzed for, but not detected

UJ = Analyte not detected, quantitation limit may be inaccurate

µg/kg = Micrograms per kilogram

HQ = hazard quotient

PFAS = Per- and Polyfluoroalkyl Substances

PFBS = Perfluorobutanesulfonic acid

PFOS = Perfluorooctane Sulfonate

PFOA = Perfluorooctanoic acid

SL = Screening Level

Table 4-2. Surface Soil Analytical Results

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site

Former NARL Barrow, Utqiaġvik, Alaska

		Station ID	NARL-S05-SO07	NARL-S05-SO08	NARL-S05-SO09	NARL-S05-SO10		NARL-S05-SO11
		Sample ID	NARL-S05-SS07-0_0-0_5-0819	NARL-S05-SS08-0_0-0_5-0819	NARL-S05-SS09-0_0-0_5-0819	NARL-S05-SS10-0_0-0_5-0819	NARL-S05-SS10P-0_0-0_5-0819	NARL-S05-SS11-0_0-0_5-0819
		Sample Date	08/28/19	08/28/19	08/25/19	08/25/19	08/25/19	08/25/19
PFAS Analyte	**Units**	**SL Residential Soil (HQ=0.1)**						
PFBS	µg/kg	1900	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
PFOS	µg/kg	130	1.12 U	1 U	**1.11 J**	1.06 U	1.05 U	**1.03 J**
PFOA	µg/kg	130	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U

Notes:

Bolded text indicates detection

Italicized indicates exceedance of SL Residential Soil (HQ=0.1)

J = Analyte present, value may or may not be accurate or precise

U = The material was analyzed for, but not detected

UJ = Analyte not detected, quantitation limit may be inaccurate

µg/kg = Micrograms per kilogram

HQ = hazard quotient

PFAS = Per- and Polyfluoroalkyl Substances

PFBS = Perfluorobutanesulfonic acid

PFOS = Perfluorooctane Sulfonate

PFOA = Perfluorooctanoic acid

SL = Screening Level

Table 4-3. Subsurface Soil Analytical Results

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site

Former NARL Barrow, Utqiaġvik, Alaska

		Station ID	NARL-S05-SO01	NARL-S05-SO02	NARL-S05-SO03	NARL-S05-SO04	NARL-S05-SO05		NARL-S05-SO06
		Sample ID	NARL-S05-SB01-3_0-3_5-0819	NARL-S05-SB02-2_0-2_5-0819	NARL-S05-SB03-3_0-3_5-0819	NARL-S05-SB04-1_8-2_3-0819	NARL-S05-SB05-3_5-4_0-0819	NARL-S05-SB05P-3_5-4_0-0819	NARL-S05-SB06-5_0-5_5-0819
		Sample Date	08/27/19	08/27/19	08/27/19	08/27/19	08/28/19	08/28/19	08/28/19
PFAS Analyte	**Units**	**SL Residential Soil (HQ=0.1)**							
PFBS	µg/kg	1900	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
PFOS	µg/kg	130	**0.47 J**	1.05 U	1.06 U	**3.35 J**	1.01 U	0.99 U	1.02 U
PFOA	µg/kg	130	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U

Notes:

Bolded text indicates detection

Italicized indicates exceedance of SL Residential Soil (HQ=0.1)

J = Analyte present, value may or may not be accurate or precise

U = The material was analyzed for, but not detected

UJ = Analyte not detected, quantitation limit may be inaccurate

µg/kg = Micrograms per kilogram

HQ = hazard quotient

PFAS = Per- and Polyfluoroalkyl Substances

PFBS = Perfluorobutanesulfonic acid

PFOS = Perfluorooctane Sulfonate

PFOA = Perfluorooctanoic acid

SL = Screening Level

Table 4-3. Subsurface Soil Analytical Results

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site

Former NARL Barrow, Utqiaġvik, Alaska

		Station ID	NARL-S05-SO07	NARL-S05-SO08	NARL-S05-SO09	NARL-S05-SO10	NARL-S05-SO11
		Sample ID	NARL-S05-SB07-4_2-4_7-0819	NARL-S05-SB08-2_2-2_7-0819	NARL-S05-SB09-3_8-4_2-0819	NARL-S05-SB10-2_5-3_0-0819	NARL-S05-SB11-3_5-4_0-0819
		Sample Date	08/28/19	08/28/19	08/25/19	08/25/19	08/25/19
PFAS Analyte	**Units**	**SL Residential Soil (HQ=0.1)**					
PFBS	µg/kg	1900	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
PFOS	µg/kg	130	0.98 U	1.06 U	1.01 U	1.04 U	**1.32 J**
PFOA	µg/kg	130	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U

Notes:

Bolded text indicates detection

Italicized indicates exceedance of SL Residential Soil (HQ=0.1)

J = Analyte present, value may or may not be accurate or precise

U = The material was analyzed for, but not detected

UJ = Analyte not detected, quantitation limit may be inaccurate

µg/kg = Micrograms per kilogram

HQ = hazard quotient

PFAS = Per- and Polyfluoroalkyl Substances

PFBS = Perfluorobutanesulfonic acid

PFOS = Perfluorooctane Sulfonate

PFOA = Perfluorooctanoic acid

SL = Screening Level

Table 4-4. Surface Water Analytical Results

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

	Station ID	NARL-S05-SW01	NARL-S05-SW02		NARL-S05-SW03	NARL-S05-SW04	NARL-S05-SW05
	Sample ID	NARL-S05-SW01-0819	NARL-S05-SW02-0819	NARL-S05-SW02P-0819	NARL-S05-SW03-0819	NARL-S05-SW04-0819	NARL-S05-SW05-0819
	Sample Date	08/20/19	08/20/19	08/20/19	08/20/19	08/20/19	08/20/19
PFAS Analyte	**Units**						
PFBS	µg/L	**0.00526**	**0.00577**	**0.006 J**	**0.00728**	**0.00614**	**0.006**
PFOS	µg/L	**0.12915**	**0.095**	**0.08168**	**0.12309**	**0.141**	**0.21112**
PFOA	µg/L	**0.0721**	**0.07857**	**0.08905**	**0.07341**	**0.06646**	**0.07767**
PFOS+PFOA	µg/L	0.20125	0.17357	0.17073	0.1965	0.20746	0.28879

Notes:

Bolded text indicates detection

J = Analyte present, value may or may not be accurate or precise

µg/L = Micrograms per liter

PFAS = Per- and Polyfluoroalkyl Substances

PFBS = Perfluorobutanesulfonic acid

PFOS = Perfluorooctane Sulfonate

PFOA = Perfluorooctanoic acid

\\dc1vs01\GISNavyClean\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\Figure4-1_Summary_of_PFAS_Concentrations_Groundwater.mxd4/26/2021DRUCKC

NARL-S05-TW03	
Screen Depth (ft btoc)	3.0-5.8
Sample Date	8/30/2019
PFOS	ND
PFOA	0.0022 J
PFBS	0.0019 J

NARL-S05-WP-11	
Screen Depth (ft btoc)	NA
Sample Date	8/21/2019
PFOS	*0.38*
PFOA	*0.24*
PFBS	0.013

NARL-S05-TW08	
Screen Depth (ft btoc)	2.3-5.3
Sample Date	8/30/2019
PFOS	ND
PFOA	0.0014 J
PFBS	ND

NARL-S05-TW02	
Screen Depth (ft btoc)	2.7-5.7
Sample Date	8/30/2019
PFOS	0.026
PFOA	*0.24*
PFBS	0.0047 J

NARL-AFAS-WP-20	
Screen Depth (ft btoc)	NA
Sample Date	8/21/2019
PFOS	*0.13*
PFOA	*0.27*
PFBS	0.015 J

NARL-S05-WP-02C	
Screen Depth (ft btoc)	NA
Sample Date	8/21/2019
PFOS	*0.34*
PFOA	0.036
PFBS	0.0052

NARL-AFAS-WP-21	
Screen Depth (ft btoc)	NA
Sample Date	8/21/2019
PFOS	*0.64*
PFOA	*0.10*
PFBS	0.023

NARL-S05-WP-10	
Screen Depth (ft btoc)	NA
Sample Date	8/20/2019
PFOS	*4.2*
PFOA	*5.7*
PFBS	0.049

NARL-S05-WP-18	
Screen Depth (ft btoc)	NA
Sample Date	8/21/2019
PFOS	*0.86*
PFOA	*0.24*
PFBS	0.011

NARL-S05-WP-12	
Screen Depth (ft btoc)	NA
Sample Date	8/20/2019
PFOS	*1.4*
PFOA	0.022
PFBS	0.0074

NARL-S05-TW01	
Screen Depth (ft btoc)	3.0-7.0
Sample Date	8/29/2019
PFOS	*0.26*
PFOA	0.026
PFBS	0.0097

NARL-S05-WP-16	
Screen Depth (ft btoc)	NA
Sample Date	8/21/2019
PFOS	*2.9*
PFOA	*0.27*
PFBS	0.025

POTENTIAL CRASH SITE B (LOCATION APPROXIMATE)

POTENTIAL CRASH SITE A (LOCATION APPROXIMATE)

AIRSTRIP SITE

ARCTIC OCEAN

NORTH SALT LAGOON

IMIKPUK LAKE

Stevenson Road

Surface Water Drainage Divide

North Depression

South Depression

136

Notes:

ft btoc = feet below top of casing

HQ = hazard quotient

NA = not available

PFAS = per- and polyfluoroalkyl substances

PFBS = Perfluorobutanesulfonic acid

PFOA = Perfluorooctanoic acid

PFOS = Perfluorooctane Sulfonate

SL = Screening Level

Data Qualifiers:

J = analyte present, value may or may not be accurate or precise

ND = not detected

Italicized indicates exceedance of SL Tapwater (HQ=0.1)

1. Concentrations reported in micrograms per liter (µg/L)
2. Where applicable, the higher concentration between the primary and field duplicate samples is shown

	SL Tapwater (HQ=0.1)
PFOS	0.040
PFOA	0.040
PFBS	0.60

LEGEND

- Anticipated Groundwater Flow Direction
- Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary
- Monitoring Well with SL Exceedance
- Monitoring Well with no Exceedance

NOTE:
Some features are labeled with only their building number; additional information is provided in the text of this report.

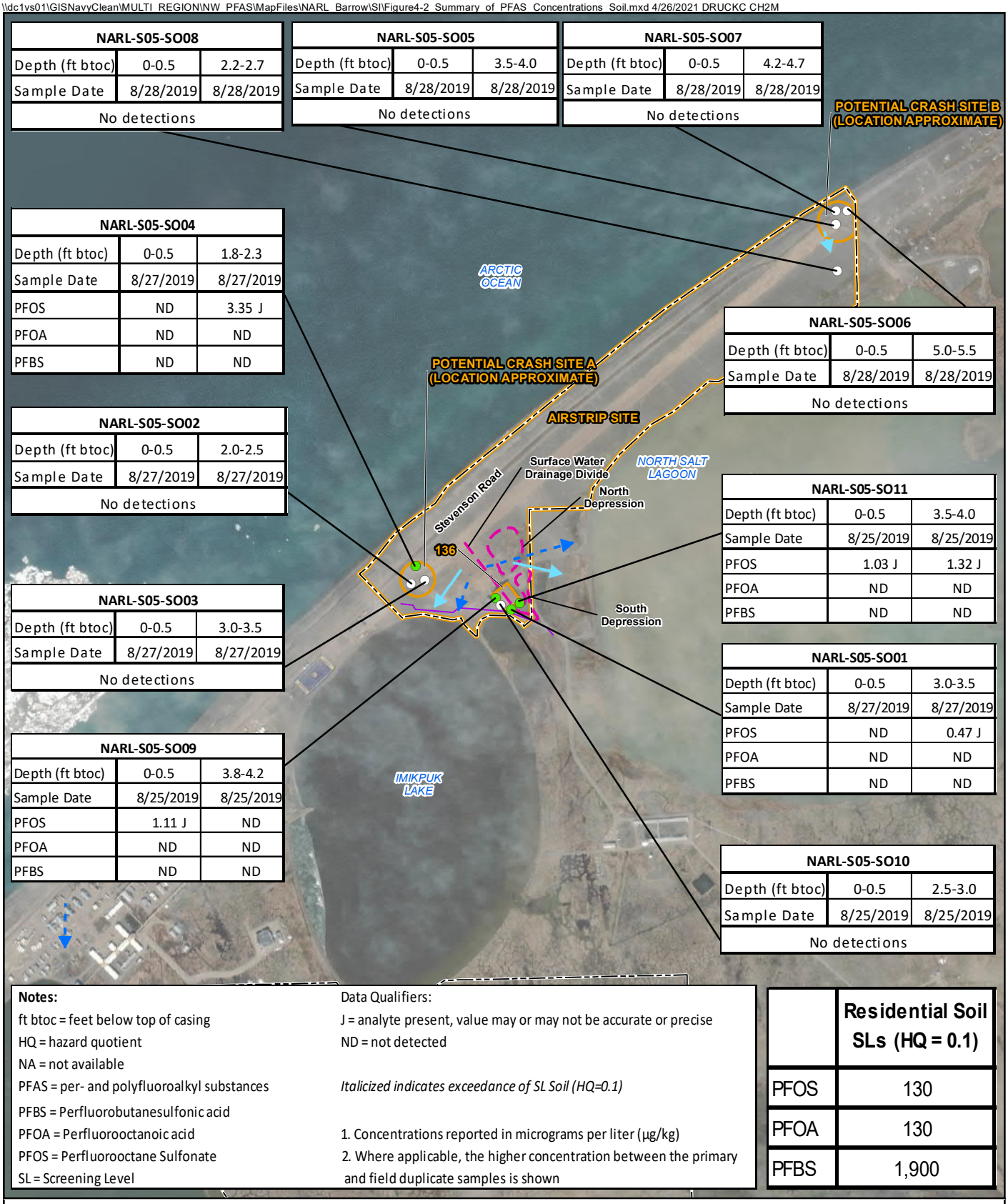
0 500 1,000 Feet

1 inch = 1,000 feet

N

Figure 4-1
Summary of detected PFAS in Groundwater at Airstrip Site
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

ch2m:



NARL-S05-SO08		
Depth (ft btoc)	0-0.5	2.2-2.7
Sample Date	8/28/2019	8/28/2019
No detections		

NARL-S05-SO05		
Depth (ft btoc)	0-0.5	3.5-4.0
Sample Date	8/28/2019	8/28/2019
No detections		

NARL-S05-SO07		
Depth (ft btoc)	0-0.5	4.2-4.7
Sample Date	8/28/2019	8/28/2019
No detections		

NARL-S05-SO04		
Depth (ft btoc)	0-0.5	1.8-2.3
Sample Date	8/27/2019	8/27/2019
PFOS	ND	3.35 J
PFOA	ND	ND
PFBS	ND	ND

NARL-S05-SO06		
Depth (ft btoc)	0-0.5	5.0-5.5
Sample Date	8/28/2019	8/28/2019
No detections		

NARL-S05-SO02		
Depth (ft btoc)	0-0.5	2.0-2.5
Sample Date	8/27/2019	8/27/2019
No detections		

NARL-S05-SO11		
Depth (ft btoc)	0-0.5	3.5-4.0
Sample Date	8/25/2019	8/25/2019
PFOS	1.03 J	1.32 J
PFOA	ND	ND
PFBS	ND	ND

NARL-S05-SO03		
Depth (ft btoc)	0-0.5	3.0-3.5
Sample Date	8/27/2019	8/27/2019
No detections		

NARL-S05-SO01		
Depth (ft btoc)	0-0.5	3.0-3.5
Sample Date	8/27/2019	8/27/2019
PFOS	ND	0.47 J
PFOA	ND	ND
PFBS	ND	ND

NARL-S05-SO09		
Depth (ft btoc)	0-0.5	3.8-4.2
Sample Date	8/25/2019	8/25/2019
PFOS	1.11 J	ND
PFOA	ND	ND
PFBS	ND	ND

NARL-S05-SO10		
Depth (ft btoc)	0-0.5	2.5-3.0
Sample Date	8/25/2019	8/25/2019
No detections		

Notes:

ft btoc = feet below top of casing

HQ = hazard quotient

NA = not available

PFAS = per- and polyfluoroalkyl substances

PFBS = Perfluorobutanesulfonic acid

PFOA = Perfluorooctanoic acid

PFOS = Perfluorooctane Sulfonate

SL = Screening Level

Data Qualifiers:

J = analyte present, value may or may not be accurate or precise

ND = not detected

Italicized indicates exceedance of SL Soil (HQ=0.1)

1. Concentrations reported in micrograms per liter (µg/kg)
2. Where applicable, the higher concentration between the primary and field duplicate samples is shown

	Residential Soil SLs (HQ = 0.1)
PFOS	130
PFOA	130
PFBS	1,900

LEGEND

- Anticipated Groundwater Flow Direction
- Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary
- Sample Location with no Exceedance
- No detections of PFOA, PFOS, or PFBS

NOTE:
Some features are labeled with only their building number; additional information is provided in the text of this report.

0 0.125 0.25 Miles

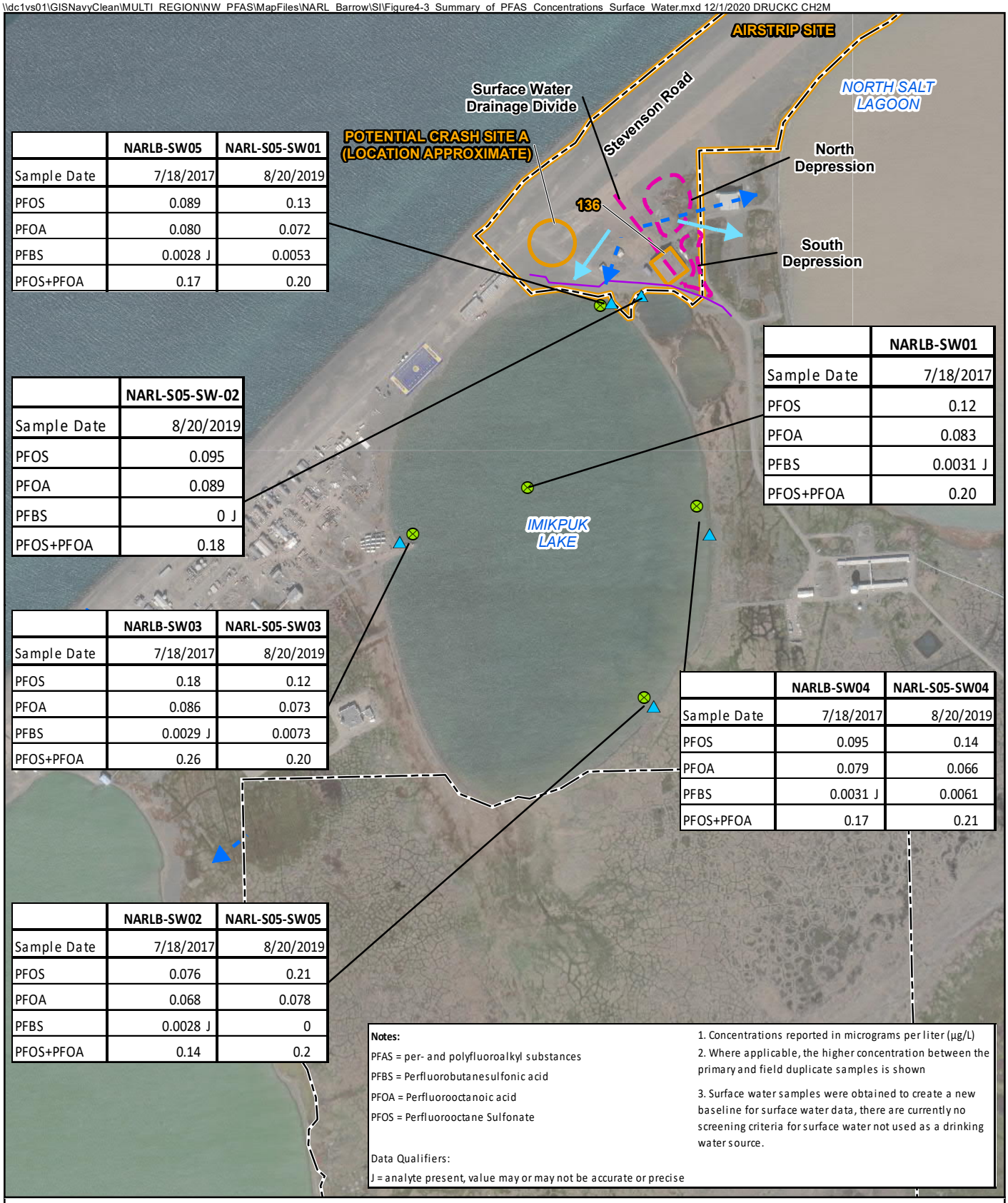
1 inch = 0.25 mile

N

Figure 4-2
Summary of Detected PFAS in Soil at Airstrip Site
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

ch2m

\\dc1vs01\GISNavyClean\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\Figure4-3_Summary_of_PFAS_Concentrations_Surface_Water.mxd 12/1/2020 DRUCKC CH2M



	NARLB-SW05	NARL-S05-SW01
Sample Date	7/18/2017	8/20/2019
PFOS	0.089	0.13
PFOA	0.080	0.072
PFBS	0.0028 J	0.0053
PFOS+PFOA	0.17	0.20

	NARL-S05-SW-02
Sample Date	8/20/2019
PFOS	0.095
PFOA	0.089
PFBS	0 J
PFOS+PFOA	0.18

	NARLB-SW01
Sample Date	7/18/2017
PFOS	0.12
PFOA	0.083
PFBS	0.0031 J
PFOS+PFOA	0.20

	NARLB-SW03	NARL-S05-SW03
Sample Date	7/18/2017	8/20/2019
PFOS	0.18	0.12
PFOA	0.086	0.073
PFBS	0.0029 J	0.0073
PFOS+PFOA	0.26	0.20

	NARLB-SW04	NARL-S05-SW04
Sample Date	7/18/2017	8/20/2019
PFOS	0.095	0.14
PFOA	0.079	0.066
PFBS	0.0031 J	0.0061
PFOS+PFOA	0.17	0.21

	NARLB-SW02	NARL-S05-SW05
Sample Date	7/18/2017	8/20/2019
PFOS	0.076	0.21
PFOA	0.068	0.078
PFBS	0.0028 J	0
PFOS+PFOA	0.14	0.2

Notes:

PFAS = per- and polyfluoroalkyl substances

PFBS = Perfluorobutanesulfonic acid

PFOA = Perfluorooctanoic acid

PFOS = Perfluorooctane Sulfonate

Data Qualifiers:

J = analyte present, value may or may not be accurate or precise

1. Concentrations reported in micrograms per liter (µg/L)
2. Where applicable, the higher concentration between the primary and field duplicate samples is shown
3. Surface water samples were obtained to create a new baseline for surface water data, there are currently no screening criteria for surface water not used as a drinking water source.

LEGEND

- Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary
- 2019 Surface Water Samples
- 2017 Surface Water Samples

NOTE:
Some features are labeled with only their building number; additional information is provided in the text of this report.

0 500 1,000 Feet

1 inch = 1,000 feet

N

Figure 4-3
Summary of Detected PFAS in Surface Water in Imikpuk Lake
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

ch2m

SECTION 5

Human Health Risk Screening

A human health risk screening (HHRS) was performed to assess potential human health risks associated with exposure to PFAS in soil and groundwater at the Airstrip Site at Former NARL Barrow. Potential risks associated with PFBS, PFOA, and PFOS, the only PFAS with available toxicity values, were quantified in the HHRS. As discussed in previous sections of the SI, additional PFAS were also analyzed by the laboratory in the samples, however, as there are no current toxicity or screening values for these PFAS they were not quantitatively evaluated in the HHRS. They were analyzed by the laboratory for comparison to screening levels that may be developed in the future. The surface water samples collected from Imikpuk Lake were not evaluated in the HHRS (the SI objective with respect to Imikpuk Lake was to evaluate PFAS concentrations in surface water in Imikpuk Lake using current analytical methods).

The results of the HHRS provide a preliminary indication of potential risks from exposure to PFAS in soil and groundwater and are used to help evaluate whether future unrestricted use of the site is acceptable, or if the site requires further evaluation. Although the groundwater is not used as a potable water supply, and it is unlikely to be used as a future water supply because it is not a viable source of drinking water, human health risk-based levels for potable use were used for the screening evaluation for the groundwater as screening criteria for other exposure scenarios have not been developed. Additionally, although the site is not a residential site, human health risk-based levels for residential exposure were used for the screening evaluation for soil.

The groundwater, surface soil, and subsurface soil samples collected at each of the potential PFAS source areas were assessed separately in the HHRS. The following three areas were evaluated in the HHRS:

- Building 136
- Potential Crash Site A
- Potential Crash Site B

The soil and groundwater PFAS data evaluated in the HHRS were validated. Validation of the data identified the following criteria for data usability:

- Estimated values flagged with a J qualifier were treated as unqualified detected concentrations.
- Values flagged with a U or UJ qualifier indicate an analyte was not detected and the UJ qualifier indicates the quantitation limit was estimated.
- For duplicate samples, the maximum concentration between the two samples was used as the sample concentration. If the analyte was only detected in one of the samples, the detected concentration was used as the sample concentration. If the analyte was not detected in either of the samples, the higher detection limit was used as the sample detection limit.

5.1 Human Health Risk Screening Methodology

The HHRS was conducted in three steps using the risk ratio technique described in *Overview of Screening, Risk Ratio, and Toxicological Evaluation. Procedures for Northern Division Human Health Risk Assessments* (Navy, 2000). If constituents of potential concern (COPCs) were identified after Step 1, they were evaluated in Step 2. If COPCs were identified after Step 2, the COPCs were evaluated in Step 3. The three-step screening process is described below.

Step 1

The maximum detected PFAS concentrations in soil (surface soil and subsurface soil were evaluated separately) and groundwater within each of the three areas were compared to the Residential Soil SLs and Tapwater SLs, respectively. SLs based on noncarcinogenic effects were based on an HQ of 0.1. SLs based on carcinogenic endpoints were based on a carcinogenic risk of 1×10^{-6}. SLs for PFOS and PFOA were generated using the USEPA

RSL calculator (USEPA, 2019c), as described in DoD technical guidance (DoD, 2019). SLs for PFBS were generated similarly, but values were updated from those listed in DoD technical guidance (DoD, 2019) to reflect RfDs provided in *Provisional Peer-Reviewed Toxicity Values for PFBS and Related Compound Potassium Perfluorobutane Sulfonate* (USEPA, 2021a).[7] PFOA, PFOS, and PFBS are the only PFAS with available toxicity values.

If the maximum detected concentration (MDC) exceeded the SL, the constituent was identified as a Step 1 COPC and carried forward to Step 2.

Step 2

Step 2 was only performed for groundwater. Step 2 was not performed for soil because Step 1 COPCs were not identified for surface soil or subsurface soil at any of the potential PFAS source areas. A risk level was calculated for the constituents identified as COPCs in Step 1 following the approach discussed in *Overview of Screening, Risk Ratio, and Toxicological Evaluation. Procedures for Northern Division Human Health Risk Assessments* (Navy, 2000):

For carcinogenic chemicals identified as COPCs in Step 1, carcinogenic risk was calculated using the following equation:

$$\textit{Carcinogenic risk} = \frac{\textit{MDC x acceptable risk level}}{\textit{SL}}$$

Where:

MDC = Maximum detected concentration (microgram per liter [µg/L])
acceptable risk level = $1x10^{-6}$ (unitless)
SL = Screening Level based on carcinogenic risk of 1×10^{-6} (µg/L)

For noncarcinogenic chemicals identified as COPCs in Step 1, a hazard index (HI) was calculated using the following equation:

$$\textit{HI} = \frac{\textit{MDC x acceptable HI}}{\textit{SL}}$$

Where:

MDC = Maximum detected concentration (µg/L)
acceptable HI = 1 (unitless)
SL = Screening Level based on HI of 1 (µg/L)

Both the carcinogenic risk and the HI were calculated for COPCs that act through carcinogenic and noncarcinogenic effects. The carcinogenic risks for each COPC within an area were summed to calculate the cumulative carcinogenic risk, and the HIs for each area were summed to calculate the cumulative HI. A cumulative HI was also calculated for each target organ/effect. If the cumulative HI for a target organ/effect was greater than 0.5, or the cumulative carcinogenic risk was greater than 5×10^{-5} (the target hazard and risk levels presented in the Navy risk ratio guidance document [Navy, 2000]), the chemicals contributing to these values were identified as COPCs. If an analyte was identified as a Step 2 COPC, it was carried forward to Step 3.

Step 3

Step 3 was performed for groundwater at Building 136, since COPCs (PFOS and PFOA) were identified in Step 2. Step 3 was not performed for groundwater at Potential Crash Site A even though PFOS and PFOA were identified as COPCs in Step 2 because only three samples were available for Potential Crash Site A groundwater. Three samples are not enough samples for ProUCL to compute meaningful or reliable statistics.

Carcinogenic risks and HIs were calculated as discussed above for Step 2; however, the 95 percent upper confidence limit (UCL) was used as the concentration instead of the MDC. ProUCL Version 5.1.002 (USEPA, 2016c)

[7] The PFBS SL may also be read off tables on the USEPA RSL website (USEPA, 2021c).

was used to calculate the 95 percent UCL. The ProUCL output file for Building 136 groundwater is included as **Appendix K**. If the cumulative HI by target organ/effect is greater than 0.5, or the cumulative carcinogenic risk is greater than 5×10^{-5}, the chemicals contributing to these values are considered COPCs.

5.2 Human Health Risk Screening Results

The HHRS results are presented in this section for each area.

5.2.1 Building 136

Groundwater, surface soil, and subsurface soil samples were collected at Building 136.

Tables 5-1 through **5-1b** present the HHRS for groundwater. The MDC of PFOS and PFOA exceeded the Tapwater SL; therefore, PFOS and PFOA were evaluated in Step 2. The MDC of PFBS was below the USEPA Tapwater SL. Based on Step 2, PFOS and PFOA were identified as COPCs and were carried forward to Step 3. Based on Step 3, PFOS and PFOA were retained as COPCs.

Table 5-2 presents the HHRS for surface soil. The MDC of PFOS, the only detected chemical, was below the Soil SL.

Table 5-3 presents the HHRS for subsurface soil. The MDC of PFOS, the only detected chemical, was below the Soil SL.

Potable use of groundwater at Building 136 area may result in potential unacceptable human health risks associated with PFOA and PFOS. It is noted that groundwater at Former NARL Barrow is not a viable source of potable water, but this exposure scenario was used because screening criteria for other exposure scenarios have not been developed. Groundwater at Former NARL Barrow is also hydraulically connected to Imikpuk Lake, which was historically a seasonal drinking water source. Exposure to PFAS in surface soil or subsurface soil would not be expected to result in unacceptable health risks.

5.2.2 Potential Crash Site A

Groundwater, surface soil, and subsurface soil samples were collected at Potential Crash Site A.

Tables 5-4 and **5-4a** present the HHRS for groundwater. The MDC of PFOS and PFOA exceeded the Tapwater SL, therefore, PFOS and PFOA were evaluated in Step 2. The MDC of PFBS did not exceed the Tapwater SL. Based on Step 2, PFOS and PFOA were identified as COPCs. Step 3 was not performed because only three groundwater samples were available from the Potential Crash Site A area, which is not enough for ProUCL to compute meaningful or reliable statistics.

There were no PFAS detected in surface soil at Potential Crash Site A.

Table 5-5 presents the HHRS for subsurface soil. The MDC of PFOS, the only detected chemical, was below the Residential Soil SL.

Potable use of groundwater at Potential Crash Site A may result in potential unacceptable human health risks associated with PFOA and PFOS. It is noted that groundwater at Former NARL Barrow is not a viable source of potable water, but this exposure scenario was used because screening criteria for other exposure scenarios have not been developed. Groundwater at Former NARL Barrow is also hydraulically connected to Imikpuk, which was historically a seasonal drinking water source. Exposure to PFAS in surface soil or subsurface soil would not be expected to result in unacceptable health risks.

5.2.3 Potential Crash Site B

Groundwater was not present at Potential Crash Site B; a groundwater sample collected downgradient was used in the HHRS. Surface soil and subsurface soil samples were collected at and downgradient of Potential Crash Site B.

Table 5-6 presents the HHRS for groundwater. The MDC of PFOA, the only detected chemical with a screening level, was below the Tapwater SL.

There were no PFAS detected in surface soil or subsurface soil at Potential Crash Site B.

Based on the results of this SI, groundwater is not present at Potential Crash Site B. Potable use of groundwater downgradient of Potential Crash Site B would not be expected to result in unacceptable human health risks. Exposure to PFAS in surface soil or subsurface soil would not be expected to result in unacceptable health risks.

5.3 Human Health Risk Screening Findings

Exposure to PFAS in surface soil or subsurface soil at all the three potential PFAS areas and exposure to PFAS in groundwater downgradient of Potential Crash Site B would not be expected to result in unacceptable human health risks.

The HHRS identified potential unacceptable risks associated with PFOA and PFOS in groundwater at Building 136 and Potential Crash Site A if groundwater is used as a drinking water supply. As indicated above, groundwater at Former NARL Barrow is not a viable source of potable water. However, screening criteria for other groundwater exposure scenarios have not been developed. Groundwater at the Airstrip Site is hydraulically connected to Imikpuk Lake.

Table 5-1. Occurrence, Distribution and Selection of Chemicals of Potential Concern - Building 136 - Groundwater
Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background Value [3]	Screening Toxcity Value [4]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
	1763-23-1	**Perfluorooctane Sulfonate (PFOS)**	**1.3E-01**	**4.2E+00**	**µg/L**	**NARL-S05-WP-10-0819**	**8/8**	**0.00086 - 0.00096**	**4.2E+00**	**N/A**	**4.0E-02 N**	**N/A**	**N/A**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**2.2E-02**	**5.7E+00**	**µg/L**	**NARL-S05-WP-10-0819**	**8/8**	**0.00086 - 0.00096**	**5.7E+00**	**N/A**	**4.0E-02 N**	**N/A**	**N/A**	**YES**	**ASL**
	375-73-5	Perfluorobutanesulfonic acid (PFBS)	7.4E-03	4.9E-02	µg/L	NARL-S05-WP-10-0819	8/8	0.00045 - 0.00048	4.9E-02	N/A	6.0E-01 N	N/A	N/A	NO	BSL

Notes
[1] Minimum/Maximum detected concentrations (samples NARL-S05-TW01-0819, NARL-S05-TW01P-0819, NARL-S05-WP-20-0819, NARL-S05-AFAS-WP-21-0819, NARL-S05-WP-10-0819, NARL-S05-WP-11-0819, NARL-S05-WP-12-0819, NARL-S05-WP-16D-0819, and NARL-S05-WP-18B-0819).
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Screening Levels (SLs) for PFOA and PFOS are based on an HQ of 0.1 and were generated using the USEPA RSL Calculator as described in DoD, 2019. SL for PFBS was generated similarly, but value was updated from DoD, 2019 to reflect reference doses provided in Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonic Acid (PFBS) and Related Compound Potassium Perfluorobutane Sulfonate (USEPA, 2021a). The PFBS SL may also be read off tables on the USEPA RSL website (USEPA, 2021c).
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
µg/L = Micrograms per liter
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
C = Carcinogenic
COPC = Chemical of Potential Concern
J = Analyte present, value may or may not be accurate or precise
N = Noncarcinogenic
N/A = Not available
NTX = no toxicity value

Table 5-1a. Risk Ratio Screening, Maximum Detected Concentration - Building 136 - Groundwater

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (µg/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water SL (µg/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water SL (µg/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ
Perfluorooctane Sulfonate (PFOS)	**8 / 8**	**4.2E+00**	**NARL-S05-WP-10-0819**	**N/A**			**4.0E-01**	**1**	**11**	**Developmental**
Perfluorooctanoic acid (PFOA)	**8 / 8**	**5.7E+00**	**NARL-S05-WP-10-0819**	**1.1E+00**	**1E-06**	**5E-06**	**4.0E-01**	**1**	**14**	**Developmental**
Cumulative Hazard Index[c]									**25**	
Cumulative Cancer Risk[d]						**5E-06**				

Notes: Total Developmental HI = 25

[a] Cancer Risk equals maximum detected concentration divided by the SL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the SL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05.

Constituents selected as COPCs are indicated by bold and shading.

µg/L = Micrograms per liter

COPC = Constituent of Potential Concern

HI = Hazard Index

N/A = Not available/not applicable

SL = Screening Level

Table 5-1b. Risk Ratio Screening, 95% UCL Concentration - Building 136 - Groundwater

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Analyte	Detection Frequency	95% UCL	95% UCL Rationale	Carcinogenic Tap Water SL (µg/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water SL (µg/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ
Perfluorooctane Sulfonate (PFOS)	**8 / 8**	**2.3E+00 1,2,3**	**95% Student's-t UCL**	**N/A**			**4.0E-01**	**1**	**6**	**Developmental**
Perfluorooctanoic acid (PFOA)	**8 / 8**	**5.7E+00 1**	**Maximum Detected Concentration**	**1.1E+00**	**1E-06**	**5E-06**	**4.0E-01**	**1**	**14**	**Developmental**
Cumulative Hazard Index[c]									**20**	
Cumulative Cancer Risk[d]						**5E-06**				
								Total Developmental HI =	20	

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the SL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the SL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05.

Constituents selected as COPCs are indicated by bold and shading.

µg/L = Micrograms per liter

COPC = Constituent of Potential Concern

HI = Hazard Index

N/A = Not available/not applicable

SL = Screening Level

UCL = Upper Confidence Limit

ProUCL, Version 5.1.002 used to determine distribution of data. ProUCL used to calculate exposure point concentration, following recommendations based on distribution and standard deviation in User's Guide (USEPA. May, 2016. Prepared by Lockheed Martin Environmental Services).

Upper Confidence Limit (UCL) Rationale:

(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.

(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.

(3) Anderson-Darling and/or Kolmogorov-Smirnov Tests indicate data are gamma distributed.

(4) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).

(5) Recommended 95% UCL is greater than the maximum detected concentration. Maximum detected concentration is used as the exposure point concentration.

Table 5-2. Occurrence, Distribution and Selection of Chemicals of Potential Concern - Building 136 - Surface Soil

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background Value [3]	Screening Toxcity Value [4]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Building 136	1763-23-1	Perfluorooctane Sulfonate (PFOS)	1.0E+00 J	1.1E+00 J	µg/kg	NARL-S05-SS09-0_0-0_5-0819	2/4	1.04 - 1.08	1.1E+00	N/A	1.3E+02	N/A	N/A	NO	BSL

Notes:
[1] Minimum/Maximum detected concentrations (samples NARL-S05-SS01-0_0-0_5-0819, NARL-S05-SS09-0_0-0_5-0819, NARL-S05-SS10-0_0-0_5-0819, NARL-S05-SS10P-0_0-0_5-0819, NARL-S05-SS11-0_0-0_5-0819).
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Screening Level (SL) for PFOS based on an HQ of 0.1 and generated using the USEPA RSL Calculator as described in DoD, 2019.
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
µg/kg = Micrograms per kilogram
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogenic
COPC = Chemical of Potential Concern
J = Analyte present, value may or may not be accurate or precise
N = Noncarcinogenic
N/A = Not available
NTX = no toxicity value

Table 5-3. Occurrence, Distribution and Selection of Chemicals of Potential Concern - Building 136 - Subsurface Soil

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background Value [3]	Screening Toxcity Value [4]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Building 136	1763-23-1	Perfluorooctane Sulfonate (PFOS)	4.7E-01 J	1.3E+00 J	µg/kg	NARL-S05-SB11-3_5-4_0-0819	2/4	1.01 - 1.04	1.3E+00	N/A	1.3E+02	N/A	N/A	NO	BSL

Notes:
[1] Minimum/Maximum detected concentrations (samples NARL-S05-SB01-3_0-3_5-0819, NARL-S05-SB09-3_8-4_2-0819, NARL-S05-SB10-2_5-3_0-0819, and NARL-S05-SB11-3_5-4_0-0819).
[2] Maximum de
[3] Background values not available
[4] Screening Level (SL) for PFOS based on an HQ of 0.1 and generated using the USEPA RSL Calculator as described in DoD, 2019.
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
µg/kg = Micrograms per kilogram
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogenic
COPC = Chemical of Potential Concern
J = Analyte present, value may or may not be accurate or precise
N = Noncarcinogenic
N/A = Not available
NTX = no toxicity value

Table 5-4. Occurrence, Distribution and Selection of Chemicals of Potential Concern - Potential Crash Site A - Groundwater

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background Value [3]	Screening Toxcity Value [4]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Potential Crash Site A	**1763-23-1**	**Perfluorooctane Sulfonate (PFOS)**	**2.6E-02**	**3.4E-01**	**µg/L**	**NARL-S05-WP-02CP-0819**	**2/3**	0.0035 - 0.0035	**3.4E-01**	**N/A**	**4.0E-02 N**	**N/A**	**N/A**	**YES**	**ASL**
	335-67-1	**Perfluorooctanoic acid (PFOA)**	**2.2E-03 J**	**2.4E-01**	**µg/L**	**NARL-S05-TW02-0819**	**3/3**	0.00175 - 0.00182	**2.4E-01**	**N/A**	**4.0E-02 N**	**N/A**	**N/A**	**YES**	**ASL**
	375-73-5	Perfluorobutanesulfonic acid (PFBS)	1.9E-03 J	5.2E-03	µg/L	NARL-S05-WP-02CP-0819	3/3	0.00044 - 0.00045	5.2E-03	N/A	6.0E-01 N	N/A	N/A	NO	BSL

Notes:
[1] Minimum/Maximum detected concentrations (samples NARL-S05-TW02-0819, NARL-S05-TW03-0819, NARL-S05-WP-02C-0819, and NARL-S05-WP-02CP-0819).
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Screening Levels (SLs) for PFOA and PFOS are based on an HQ of 0.1 and were generated using the USEPA RSL Calculator as described in DoD, 2019. SL for PFBS was generated similarly, but value was updated from DoD, 2019 to reflect reference doses provided in Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonic Acid (PFBS) and Related Compound Potassium Perfluorobutane Sulfonate (USEPA, 2021a). The PFBS SL may also be read off tables on the USEPA RSL website (USEPA, 2021c).
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
µg/L = Micrograms per liter
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogenic
COPC = Chemical of Potential Concern
J = Analyte present, value may or may not be accurate or precise
N = Noncarcinogenic
N/A = Not available
NTX = no toxicity value

Table 5-4a. Risk Ratio Screening, Maximum Detected Concentration - Potential Crash Site A - Groundwater

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier) (µg/L)	Sample Location of Maximum Detected Concentration	Carcinogenic Tap Water SL (µg/L)	Acceptable Risk Level	Cancer Risk[a]	Non-carcinogenic Tap Water SL (µg/L)	Acceptable Hazard Level	Hazard Index[b]	Target Organ
Perfluorooctane Sulfonate (PFOS)	**2 / 3**	**3.4E-01**	**NARL-S05-WP-02CP-0819**	**N/A**			**4.0E-01**	**1**	**0.9**	**Developmental**
Perfluorooctanoic acid (PFOA)	**3 / 3**	**2.4E-01**	**NARL-S05-TW02-0819**	**1.1E+00**	**1E-06**	**2E-07**	**4.0E-01**	**1**	**0.6**	**Developmental**
Cumulative Hazard Index[c]									**1**	
Cumulative Cancer Risk[d]						**2E-07**				
								Total Developmental HI =		1

Notes:

[a] Cancer Risk equals maximum detected concentration divided by the SL divided by the acceptable risk level.

[b] Hazard Index equals maximum detected concentration divided by the SL divided by the acceptable hazard level.

[c] Cumulative Hazard Index equals sum of Hazard Indices for each constituent.

[d] Cumulative Cancer Risk equals sum of Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Cancer Risk greater than 5E-05.

Constituents selected as COPCs are indicated by bold and shading.

µg/L = Micrograms per liter

COPC = Constituent of Potential Concern

HI = Hazard Index

N/A = Not available/not applicable

SL = Screening Level

Table 5-5. Occurrence, Distribution and Selection of Chemicals of Potential Concern - Potential Crash Site A - Subsurface Soil
Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background Value [3]	Screening Toxcity Value [4]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Potential Crash Site A	1763-23-1	Perfluorooctane Sulfonate (PFOS)	3.4E+00 J	3.4E+00 J	µg/kg	NARL-S05-SB04-1_8-2_3-0819	1/3	0.99 - 1.06	3.4E+00	N/A	1.3E+02	N/A	N/A	NO	BSL

Notes:
[1] Minimum/Maximum detected concentrations (samples NARL-S05-SB02-2_0-2_5-0819, NARL-S05-SB03-3_0-3_5-0819, and NARL-S05-SB04-1_8-2_3-0819).
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Screening Level (SL) for PFOS based on an HQ of 0.1 and generated using the USEPA RSL Calculator as described in DoD, 2019.
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
µg/kg = Micrograms per kilogram
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogenic
COPC = Chemical of Potential Concern
HA = USEPA Lifetime Health Advisory (May 2016)
J = Analyte present, value may or may not be accurate or precise
N = Noncarcinogenic
N/A = Not available
NTX = no toxicity value

Table 5-6. Occurrence, Distribution and Selection of Chemicals of Potential Concern - Potential Crash Site B - Groundwater

Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake

Former NARL Barrow, Utqiaġvik, Alaska

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background Value [3]	Screening Toxcity Value [4]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
Potential Crash Site B	335-67-1	Perfluorooctanoic acid (PFOA)	1.4E-03 J	1.4E-03 J	µg/L	NARL-S05-TW08-0819	1/1	N/A	1.4E-03	N/A	4.0E-02 N	N/A	N/A	NO	BSL
	375-73-5	Perfluorobutanesulfonic acid (PFBS)	ND	ND	µg/L			0.00206 - 0.00206	2.1E-03	N/A	6.0E-01 N	N/A	N/A	NO	BSL

Notes:
[1] Minimum/Maximum detected concentrations.
[2] Maximum detected concentration is used for screening.
[3] Background values not available
[4] Screening Levels (SLs) for PFOA and PFOS are based on an HQ of 0.1 and were generated using the USEPA RSL Calculator as described in DoD, 2019. SL for PFBS was generated similarly, but value was updated from DoD, 2019 to reflect reference doses provided in Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonic Acid (PFBS) and Related Compound Potassiun Perfluorobutane Sulfonate (USEPA, 2021a). The PFBS SL may also be read off tables on the USEPA RSL website (USEPA, 2021c)
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
µg/L = Micrograms per liter
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogenic
COPC = Chemical of Potential Concern
J = Analyte present, value may or may not be accurate or precise
N = Noncarcinogenic
N/A = Not available
NTX = no toxicity value

SECTION 6

Conclusions and Recommendations

This section summarizes the conclusions of the PFAS SI conducted at Airstrip Site and Imikpuk Lake at Former NARL Barrow. It also presents recommendations for further investigation to delineate the extent of PFAS impacts.

6.1 Conclusions

PFOS and PFOA were detected above Tapwater SLs in groundwater collected in portions of the Airstrip Site. PFBS did not exceed the Tapwater SL. The area of greatest impact is the southwestern portion of the Airstrip Site near Building 136 and Potential Crash Site A (**Figure 4-1**). The highest concentrations were measured in samples collected downgradient of Building 136, although groundwater collected upgradient of Building 136 also exceeded the Tapwater SLs for PFOS and PFOA. Groundwater was not present at Potential Crash Site B; a groundwater sample collected downgradient of Potential Crash Site B did not exceed the Tapwater SLs for PFOS, PFOA, or PFBS.

No soil samples exceeded Soil SLs for PFOS, PFOA or PFBS. Based on the low concentrations measured in soil, no area could be identified as a source zone (although it is recognized that PFAS precursors not measured during this SI may be present in soil at the sample locations and could contribute to PFOS and PFOA detected in groundwater).

An HHRS was performed to evaluate potential human health risks associated with exposure to PFOS, PFOA, and PFBS in groundwater and soil. The HHRS identified potential unacceptable risks associated with PFOS and PFOA in groundwater at Building 136 and Potential Crash Site A if groundwater is used as a potable water supply (based on the Tapwater SLs). However, active zone groundwater at the Airstrip Site and surrounding area is not a viable source of potable water. The HHRS also indicated that exposure to groundwater downgradient of Potential Crash Site B would not be expected to result in unacceptable human health risks nor would exposure to PFOS, PFOA, or PFBS in surface soil or subsurface soil at any of the three potential PFAS source areas at the Airstrip Site (Building 136, Potential Crash Site A, and Potential Crash Site B).

In addition to SI activities at the Airstrip Site, PFAS concentrations were evaluated in surface water at Imikpuk Lake using current analytical methods. These samples contained similar concentrations of PFOS, PFOA, and PFBS as measured previously (CH2M, 2019b) and provided data for additional PFAS. The proportions of PFOS and PFOA measured in Imikpuk Lake samples were similar to those measured in groundwater at the Airstrip Site (**Appendix J**).

6.2 Recommendations

Based on the results of the SI, it is recommended that Building 136 and Potential Crash Site A be carried forward to a remedial investigation. No further action is recommended for Potential Crash Site B. Recommendations and rationales are presented in **Table 6-1**.

Table 6-1. Site Inspection Summary and Recommendations
Site Inspection Report for Per- and Polyfluoroalkyl Substances at Airstrip Site and Imikpuk Lake Former NARL Barrow, Utqiaġvik, Alaska

Potential PFAS Source Area	Rationale	Recommendation
Airstrip Site: Building 136	• PFOA and PFOA were detected at concentrations exceeding the Tapwater SLs in groundwater. The extent of the exceedances is not delineated. PFBS did not exceed the Tapwater SL. • Groundwater near Building 136 is hydraulically connected to Imikpuk Lake. • Exposure to PFOS and PFOA in groundwater at Building 136 was identified as a potential unacceptable risk to human health[a] (exposure to soil would not be expected to result in unacceptable human health risks).[b]	Initiate Remedial Investigation • Investigate the areas around Building 136 and Potential Crash Site A as one area due to proximity. • Install and sample additional active zone groundwater monitoring wells to delineate the nature and extent of PFOS and PFOA (including precursors) in groundwater and characterize geochemistry. • Collect additional soil samples in the southwestern portion of the Airstrip Site to delineate the nature and extent of PFOS and PFOA (including precursors) in soil and characterize geochemistry. Include the area along the southern border of the Airstrip Site near Imikpuk Lake, where high concentrations of PFOA and PFOA were measured in groundwater to help determine if a PFOS and PFOA source zone is present in this area. • Develop an updated conceptual site model based on the data collected.
Airstrip Site: Potential Crash Site A	• PFOS and PFOA were detected at concentrations exceeding the SLs in groundwater and soil. The extent of the exceedances is not delineated. PFBS did not exceed the Tapwater SL. • Groundwater near Potential Crash Site A is hydraulically connected to Imikpuk Lake. • Exposure to PFOS and PFOA in groundwater at Potential Crash Site A was identified as a potential unacceptable risk to human health[a] (exposure to soil would not be expected to result in unacceptable human health risks).[b]	
Airstrip Site: Potential Crash Site B	• PFOS, PFOA and PFBS were not detected in surface or subsurface soil at this area or downgradient. Groundwater was not present at Potential Crash Site B. PFOS, PFOA, and PFBS were not detected or did not exceed SLs in downgradient groundwater (PFOS and PFBS were not detected; PFOA was detected at a concentration approximately one order of magnitude lower than the SL). • No unacceptable human health risks were identified.	No Further Action

Notes:

[a] Active zone groundwater at Former NARL Barrow is not a viable source of potable water. It is not known whether other exposure scenarios (such as dermal exposure) would or would not be expected to result in unacceptable health risks because screening values have not been developed.

[b] Promulgated screening values for ecological receptors have not yet been released by the USEPA; therefore, an ecological risk screening has not been completed.

SECTION 7

References

ADEC. 2019a. Technical Memorandum Action Levels for PFAS in Water and Guidance on Sampling Groundwater and Drinking Water. October.

ADEC. 2019b. 18 AAC 75 Oil and Other Hazardous Substances Pollution Control. As amended through October 27, 2018. January

Alaska Department of Health and Social Services (Alaska DHSS). 2017. Perfluoroalkyl Substances – Imikpuk Lake in Utqiaġvik, Alaska. August 31.

Agreement Between the United States of America and Ukpeagvik Inupiat Corporation (Agreement). 1986. February 7.

Amendment to Agreement between the United States of America and Ukpeagvik Inupiat Corporation (Amendment to Agreement). 1988. December 8.

CH2M HILL, Inc. (CH2M). 2019a. Preliminary Assessment for Per- and Polyfluoroalkyl Substances at Former Naval Arctic Research Laboratory Barrow and Associated Special Areas, Utqiaġvik, Alaska. April.

CH2M. 2019b. Results of Investigation of Per- and Polyfluoroalkyl Substances in Drinking Water, Former Naval Arctic Research Laboratory Utqiaġvik (Barrow), Alaska. May.

CH2M. 2019c. Sampling and Analysis Plan Site Inspection for Per- and Polyfluoroalkyl Substances Former Naval Arctic Research Laboratory Barrow, Utqiaġvik, Alaska. August.

CH2M. 2019d. Accident Prevention Plan Monitoring Well Installation, Soil, Groundwater, and Surface Water Sampling Site Investigation for Per- and Polyfluoroalkyl Substance Former Naval Arctic Research Laboratory Barrow Utqiaġvik, Alaska. August.

Department of Defense (DoD). 2018. United States Department of Defense General Data Validation Guidelines. February.

DoD. 2019. Memo: Investigating Per-and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October 15.

Department of the Navy (Navy). 2000. *Overview of Screening, Risk Ratio, and Toxicological Evaluation*. Procedures for Northern Division Human Health Risk Assessments. May.

Federal Emergency Management Agency (FEMA). 2018. Flood Map Service Center. https://msc.fema.gov/portal/home. Accessed October 5.

Google Earth. 2018. “Imikpuk Lake.” 71°19'39.01"N and 156°39'31.69"W. Accessed September 28.

Hart Crowser. 1998. Final Sampling and Analysis Plan, Airstrip Site, Former Naval Arctic Research Laboratory, Point Barrow, Alaska. July 6.

National Weather Service. 2020. Preliminary Local Climatological Data, Utqiaġvik (Barrow) AK, August 2019. https://w2.weather.gov/climate/getclimate.php?date=&wfo=pafg&sid=BRW&pil=CF6&recent=&specdate=2019-08-31+11%3A11%3A11. Accessed August 24, 2020.

Naval Arctic Research Laboratory (NARL) Cleanup Team. 2002. Decision Document for the Navy Arctic Research Laboratory Airstrip Site Barrow Alaska. June.

Naval Energy and Environmental Support Activity (NEESA). 1983. Navy Assessment and Control of Installation Pollutants: Initial Assessment Study of Naval Arctic Research Laboratory (NARL) Point Barrow, Alaska. NEESA 13-026. May.

Naval Facilities Engineering Command (NAVFAC). 2009. Environmental Condition of Property, Naval Arctic Research Laboratory, Antenna Field, Barrow, AK. September.

NAVFAC. 2010. Naval Arctic Research Laboratory Historic Property Inventory and Evaluation Naval Arctic Research Laboratory (NARL) Point Barrow and NARL Point Barrow Airstrip Point Barrow, Alaska. August.

NAVFAC Northwest Historical Architect. 2018. Personal communications (emails) with CH2M HILL, Inc. August.

North Slope Borough (NSB) Department of Planning & Community Services. 2015. Soaring to the Future Barrow Comprehensive Plan 2015-2035. Adopted March 3.

NSB. 2020. Letter to Kendra Clubb/NAVFAC Northwest. October 6.

Sealaska Environmental Services, LLC (Sealaska). 2019. 2018 Annual Monitoring Report for the Airstrip, Powerhouse, and Former Bulk Fuel Tank Farm Sites, Formal Naval Arctic Research Laboratory, Utqiagvik, Alaska. Prepared by Sealaska Environmental Services, LLC. April.

United Stated Environmental Protection Agency (USEPA). 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. EPA/240/B-06/001. February.

USEPA. 2016a. Drinking Water Health Advisory for PFOA. EPA-822-R-16-005. May.

USEPA. 2016b. Drinking Water Health Advisory for PFOS. EPA-822-R-16-004. May.

USEPA. 2016c. ProUCL, Version 5.1. Prepared by Lockheed Martin Environmental Services. October.

USEPA. 2016d. Fact Sheet: PFOA and PFOS Drinking Water Health Advisories. EPA 800-F-16-003. November.

USEPA. 2017. The Third Unregulated Contaminant Monitoring Rule (UCMR 3) Data Summary. January.

USEPA. 2018. *Regional Screening Levels for Chemicals at Superfund Sites*. May.

USEPA. 2019a. EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan. February.

USEPA. 2019b. Interim Recommendations to Address Groundwater Contaminated with Perfluorooctanoic Acid and Perfluorooctanesulfonate. December.

USEPA. 2019c. *Regional Screening Levels for Chemicals at Superfund Sites*. November.

USEPA. 2021a. Provisional Peer-Reviewed Toxicity Values for Perfluorobutane Sulfonic Acid (PFBS) and Related Compound Potassium Perfluorobutane Sulfonate. U.S. Environmental Protection Agency, Washington, DC, EPA/690/R-21/001F, April.

USEPA. 2021b. The Fifth Unregulated Contaminant Monitoring Rule (UCMR 5) Summary. March.

USEPA. 2021c. Regional Screening Levels (RSLs) - Generic Tables. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. Accessed May 11.

United States Geological Survey (USGS). 1994a. Assessment of the Hydrologic Interaction Between Imikpuk Lake and the Adjacent Airstrip Site Near Barrow, Alaska, 1993. Open File Report 94-367.

USGS. 1994b. Overview of Environmental and Hydrogeologic Conditions at Barrow, Alaska. Open-File Report 94-322.

USGS. 1995. Assessment of the Subsurface Hydrogeology of the UIC-NARL Main Camp, Near Barrow, Alaska, 1993-94. July.

URS Greiner, Inc. (URS Greiner). 2000. Final NARL Environmental Site Status Report, Former Naval Arctic Research Laboratory Barrow, Alaska. July.

Wagner, Anna; Arthur Gelvin; Keven Bjella; Ann Staples. 2016. 2015 NARL Airstrip and Powerhouse Sites Hydrological Study. U.S. Army Corps of Engineers, US Army Cold Regions Research and Engineering Laboratory, Fort Wainwright, AK. March.

Wagner, Anna; Arthur Gelvin; Ann Staples; Stephanie Saari; Kevin Bjella. 2018. 2016 NARL Airstrip and Powerhouse Sites Tracer Dye Study, Barrow, Alaska. U.S. Army Corps of Engineers, US Army Cold Regions Research and Engineering Laboratory, Fort Wainwright, AK. February.

Western Regional Climate Center (WRCC). 2018. Barrow Post Rogers AP, Alaska (500546). https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak0546. Accessed October 15.

Appendix A
Field Documentation

Former NARL Barrow – Daily Reports

Monday 12th of August

Staff:
CH2M:
Paige Molzahn

GeoTek:
Jared Stultz (Utility Locates)

UIC
Michael Thomas and Wilbur Leavitt (Bear Guards) – only one bear guard required, Michael

Health and Safety Meeting

Met onsite at 0830 at BARC, connected with Martin, Stephanie, and Nagruk to go over general plan. Health and safety meeting held with bear guard and locator. Covered PTSP, AHAs, SSHP and StepBack. Specific tasks talked through, methods of communication determined, and polar bear awareness reiterated.

Utility Locate

Began locates at potential crash site B, completed all 4 with no deviations from proposed locations. See photos and maps below.

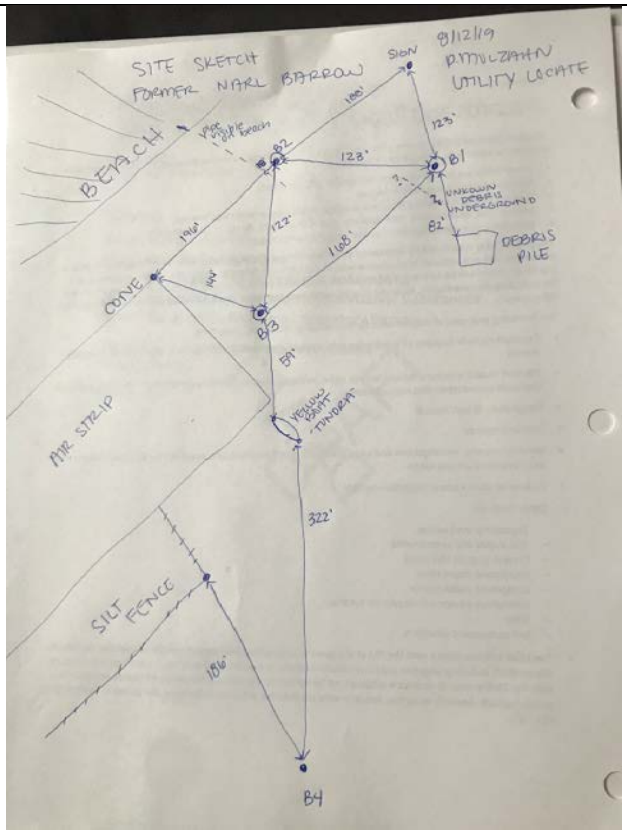
Lunch break for 30 minutes.

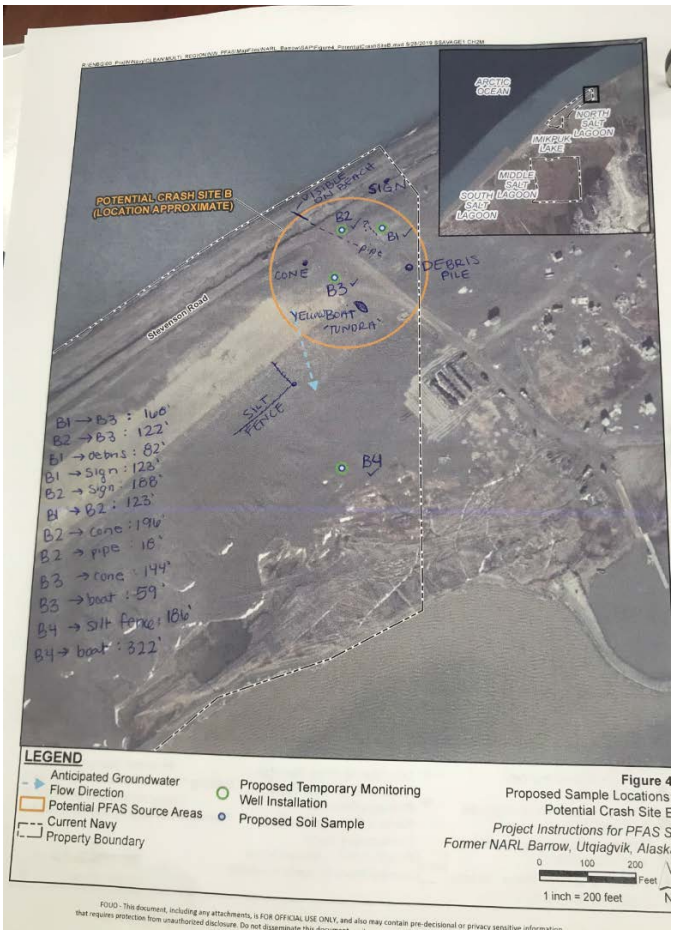
Continued locating the four sample locations around Building 136. The two points to the west of the building remained as proposed. The two locations SE of the building needed to be adjusted to avoid large pond of standing water and utilities that lined the building. Repositioning approved by Ali. See photos and maps below.

Marked out the locations for Potential Crash Site A to start tomorrow AM.

Other:

Chris (unknown) approached at the end of the day, working on a project for UIC nearby potential crash site A. He asked for us to attend their safety meeting tomorrow at 730AM to explain our schedule.





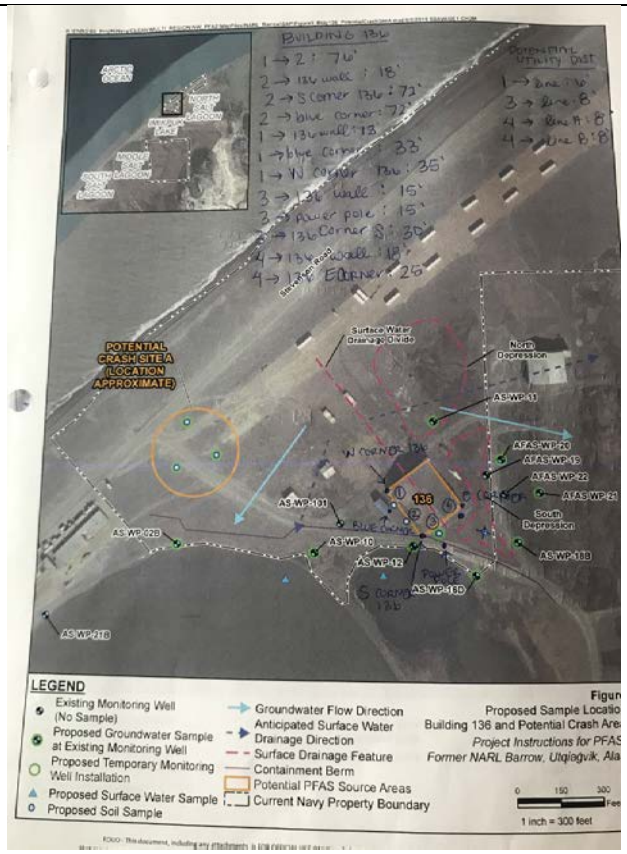
Potential Crash Site B Locations maps and photos

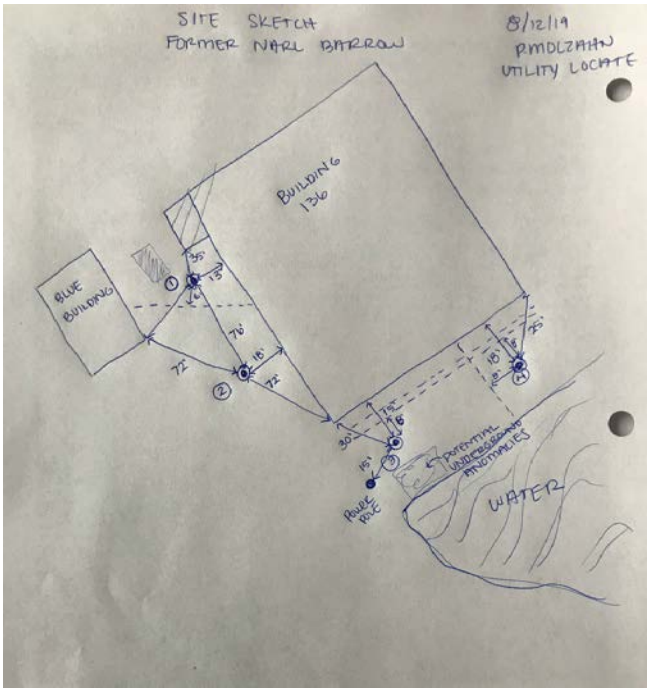












Sketch and photos of Building 136 locations.









Health and Safety Signed Documents

ch2m:

ACTIVITY HAZARD ANALYSIS

	PRINT NAME	SIGNATURE	Date/Time:
Supervisor Name:	PAIGE MOLZAHN	Paige Molzahn	8/11/19 1700
SC/SSHO Name:	PAIGE MOLZAHN	Paige Molzahn	8/11/19 1700
Employee Names:	Michael Thomas	Michael Thomas	08/12/19 9:30
	Wilbur Leavitt	Wilbur Leavitt	08/12/19 9:31
	JARED STULTZ	Jared Stultz	08/12/19
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:

DRAFT

ch2m:

EMPLOYEE SIGNOFF FORM
APP and SSHP

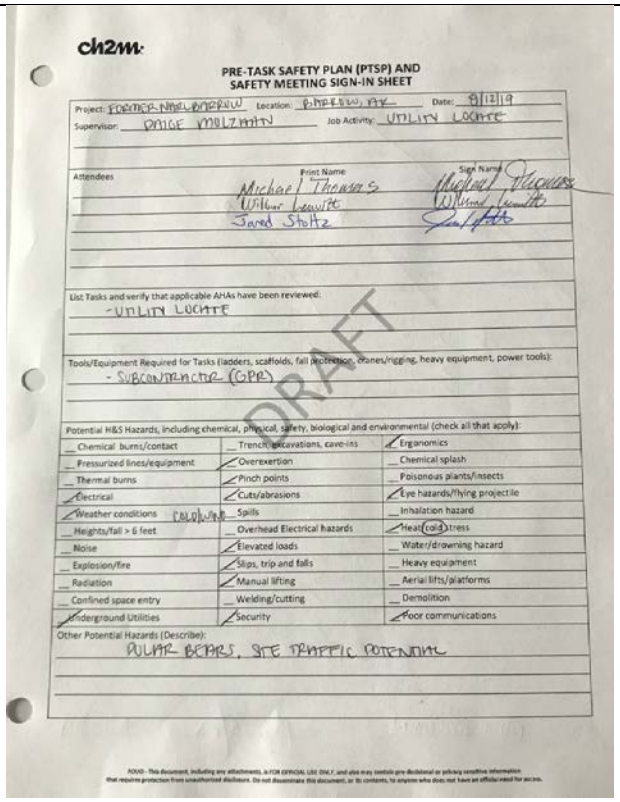
The CH2M project employees and subcontractors listed below have been provided with a copy of this APP/SSHP, have read and understood it, and agree to abide by its provisions.

Project Name: NARL BARROW Project Number:

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE
PAIGE MOLZAHN	Paige Molzahn	JACOBS	8-11-19
Michael Thomas	Michael Thomas	UICS	8/12/2019
Wilbur Leavitt	Wilbur Leavitt	UICS	8/12/2019
JARED STULTZ	Jared Stultz	GeoTek	8/12/2019

DRAFT

FOUO - This document, including any attachments, is FOR OFFICIAL USE ONLY, and also may contain pre-decisional or privacy sensitive information that requires protection from unauthorized disclosure. Do not disseminate this document, or its contents, to anyone who does not have an official need for access.



ch2m·

PRE-TASK SAFETY PLAN (PTSP) AND SAFETY MEETING SIGN-IN SHEET

Project: FORMER NIKE BARROW Location: BARROW, AK Date: 8/12/19

Supervisor: PAIGE MOLZAHN Job Activity: UTILITY LOCATE

Attendees	Print Name	Sign Name
	Michael Thomas	
	William Leavitt	
	Jared Stoltz	

List Tasks and verify that applicable AHAs have been reviewed:

- UTILITY LOCATE

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

- SUBCONTRACTOR (GPR)

Potential H&S Hazards, including chemical, physical, safety, biological and environmental (check all that apply):

__ Chemical burns/contact	__ Trench, excavations, cave-ins	✓ Ergonomics
__ Pressurized lines/equipment	✓ Overexertion	__ Chemical splash
__ Thermal burns	✓ Pinch points	__ Poisonous plants/insects
✓ Electrical	✓ Cuts/abrasions	✓ Eye hazards/flying projectile
✓ Weather conditions COLD/WIND	__ Spills	__ Inhalation hazard
__ Heights/fall > 6 feet	__ Overhead Electrical hazards	✓ Heat/cold stress
__ Noise	✓ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	✓ Slips, trip and falls	__ Heavy equipment
__ Radiation	✓ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__ Welding/cutting	__ Demolition
✓ Underground Utilities	✓ Security	✓ Poor communications

Other Potential Hazards (Describe):

- POLAR BEARS, SITE TRAFFIC POTENTIAL

DRAFT

FOUO - This document, including any attachments, is FOR OFFICIAL USE ONLY, and also may contain pre-decisional or privacy sensitive information that requires protection from unauthorized disclosure. Do not disseminate this document, or its contents, to anyone who does not have an official need for access.



ch2m·

Hazard Control Measures (Check All That Apply):

PPE	Protective Systems	Fire Protection	Electrical
__ Thermal/lined	__ Sloping	✓ Fire extinguishers	__ Lockout/tagout
✓ Eye ✓ STEEL TOES	__ Shoring	__ Fire watch	__ Grounded
✓ Dermal/hand	__ Trench box	__ Non-spark tools	__ Panels covered
__ Hearing	__ Barricades	__ Grounding/bonding	__ GFCI/extension cords
✓ Respiratory	__ Competent person	✓ Intrinsically safe equipment	__ Power tools/cord inspected
__ Reflective vests	__ Locate buried utilities		__ Overhead line clearance
__ Flotation device	__ Daily inspections		✓ Underground utils ID'd
✓ Hard Hat	✓ Entry Permits/notification		

Fall Protection	Air Monitoring	Proper Equipment	Welding & Cutting
__ Harness/lanyards	__ PID/FID	__ Aerial lift/ladders/ scaffolds	__ Cylinders secured/capped
__ Adequate anchorage	__ Detector tubes	__ Forklift/heavy equipment	__ Cylinders separated/upright
__ Guardrail system	__ Radiation	__ Backup alarms	__ Flash-back arrestors
__ Covered opening	__ Personnel sampling	__ Hand/power tools	__ No cylinders in CSE
__ Fixed barricades	__ LEL/O2	__ Crane with current inspection	__ Flame retardant clothing
__ Warning system	__ No visible dust	✓ Proper rigging	__ Appropriate goggles
	__ Other	__ Operator qualified	

Confined Space Entry	Medical/ER	Heat/Cold Stress	Vehicle/Traffic
__ Isolation	✓ First-aid kit	✓ Work/rest regime	✓ Traffic control
__ Air monitoring	✓ Eye wash	✓ Rest area	__ Barricades
__ Trained personnel	✓ FA-CPR trained personnel	✓ Liquids available	__ Flags
__ Permit completed	✓ Route to hospital	✓ Monitoring	__ Signs
✓ Rescue		✓ Training	

Permits	Demolition	Inspections:	Training:
__ Hot work	__ Pre-demolition survey	__ Ladders/aerial lifts	✓ Hazwaste (current)
__ Confined space	__ Structure condition	__ Lanyards/harness	__ Construction
__ Lockout/tagout	__ Isolate area/utilities	__ Scaffolds	✓ Competent person
__ Excavation	__ Competent person	__ Heavy equipment	✓ Task-specific
__ Demolition	__ Hazmat present	__ Drill rigs/geoprobe rigs	✓ FA/CPR
__ Energized work		__ Cranes and rigging	__ Confined Space
		✓ Utilities marked	__ Hazcom

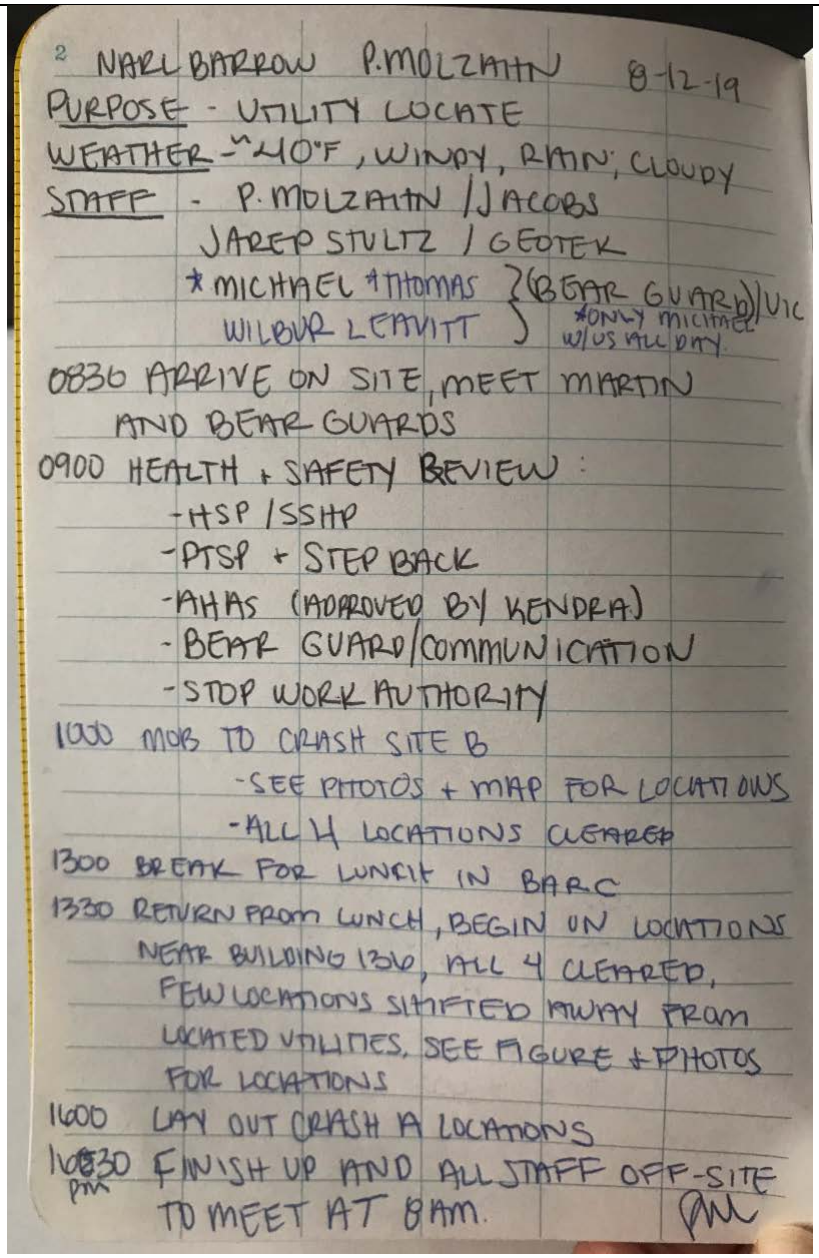
Underground Utilities	Incident Communications	AHA's
__ Dig alert called TBD	✓ Work stops until cleared by TM/CM	✓ reviewed and approved by HSM
✓ 3rd Party locater	✓ Immediate calls to TM/CM	✓ on site and current
✓ As-builts reviewed	✓ Client notification	✓ applicable for this day's work
✓ Interview site staff	✓ 24 hour notification setup	✓ Communication and incident processes included?
✓ Client review	✓ Clear communications	Step Back
__ soft locate necessary?		✓ Identify, evaluate, act – conduct at any time

Field Notes (including observations from prior day, etc.):

Name (Print): PAIGE MOLZAHN Signature: Paige Molzahn Date: 8/12/19

DRAFT

FOUO - This document, including any attachments, is FOR OFFICIAL USE ONLY, and also may contain pre-decisional or privacy sensitive information that requires protection from unauthorized disclosure. Do not disseminate this document, or its contents, to anyone who does not have an official need for access.



2 NARL BARROW P. MOLZAHN 8-12-19
PURPOSE - UTILITY LOCATE
WEATHER - ~40°F, WINDY, RAIN, CLOUDY
STAFF - P. MOLZAHN / JACOBS
JAREP STULTZ / GEOTEK
* MICHAEL * THOMAS } (BEAR GUARD) / VIC
WILBUR LEAVITT } *ONLY MICHAEL W/US ALL DAY.
0836 ARRIVE ON SITE, MEET MARTIN AND BEAR GUARDS
0900 HEALTH + SAFETY REVIEW:
- HSP / SSHP
- PTSP + STEP BACK
- AHAS (APPROVED BY KENDRA)
- BEAR GUARD / COMMUNICATION
- STOP WORK AUTHORITY
1000 MOB TO CRASH SITE B
- SEE PHOTOS + MAP FOR LOCATIONS
- ALL 4 LOCATIONS CLEARED
1300 BREAK FOR LUNCH IN BARC
1330 RETURN FROM LUNCH, BEGIN ON LOCATIONS NEAR BUILDING 136, ALL 4 CLEARED, FEW LOCATIONS SHIFTED AWAY FROM LOCATED UTILITIES. SEE FIGURE + PHOTOS FOR LOCATIONS
1600 LAY OUT CRASH A LOCATIONS
1630 PM FINISH UP AND ALL STAFF OFF-SITE TO MEET AT 8AM.

Former NARL Barrow – Daily Reports

Tuesday 13th of August

Staff:
CH2M:
Paige Molzahn
GeoTek:
Jared Stultz (Utility Locates)
UIC
Michael Thomas

Health and Safety Meeting

Paige Molzahn attended the safety meeting for the other remediation project at 0730. Both teams have plans to work in the same vicinity, however no immediate overlap is predicted. NOTE: for future work include emphasis on traffic safety and communication with teams working nearby.

Met at 0800 at BARC, health and safety meeting held with bear guard and locator. Covered PTSP and StepBack. Specific tasks talked through, methods of communication determined, and polar bear awareness reiterated.

Utility Locate

Began locates at potential crash site A, completed all 3 with no deviations from proposed locations. See photos and maps below. Double checked all locations stakes, flags, and pins were still in place. Packed up equipment, completed paperwork and left the site.

Other

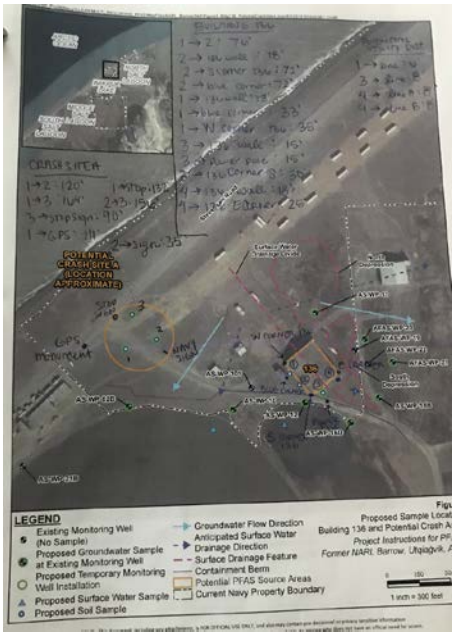
Charlie (Navy) was onsite nearby around 1000. Showed us the blue shed, and allowed us to leave the first aid kit, eye wash, fire extinguisher, and tape measure in the office area for the work being conducted next week. We discussed the project schedule and plans for the coming week.

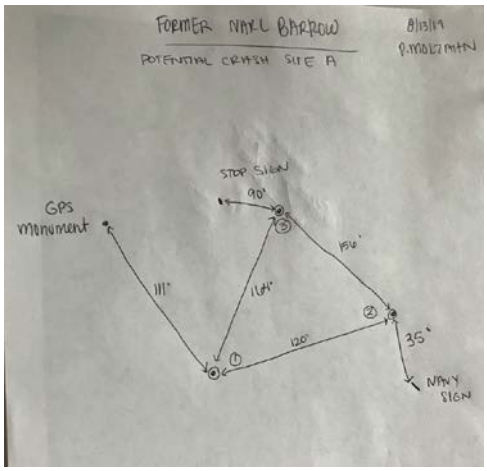


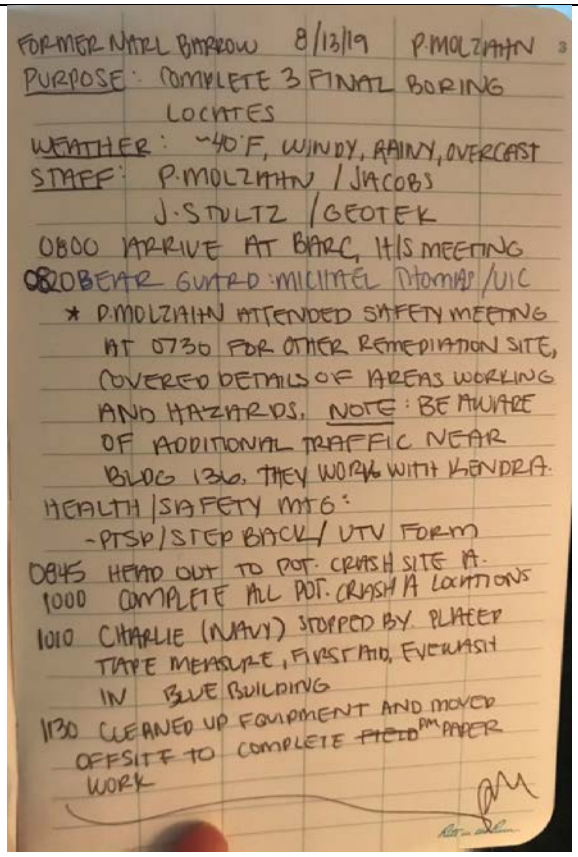


Potential Crash Site A Locations maps and photos




POTENTIAL CRASH SITE A LOCATION APPROXIMATE
GPS Monument
LEGEND
Existing Monitoring Well (No Sample)
Proposed Groundwater Sample at Existing Monitoring Well
Proposed Temporary Monitoring Well Installation
Proposed Surface Water Sample
Proposed Soil Sample
Groundwater Flow Direction
Anticipated Surface Water Drainage Direction
Surface Drainage Feature
Containment Berm
Potential PFAS Source Areas
Current Navy Property Boundary
1 inch = 300 feet


FORMER NAVL BARROW
POTENTIAL CRASH SITE A
8/13/19
STOP SIGN
90°
GPS monument
111°
164°
156°
120°
35°
NAVY SIGN



FORMER NAVL BARROW 8/13/19 P.MOLZAHN
PURPOSE: COMPLETE 3 FINAL BORING LOCATES
WEATHER: ~40°F, WINDY, RAINY, OVERCAST
STAFF: P.MOLZAHN / JACOBS
J.STULTZ / GEOTEK
0800 ARRIVE AT BARC, H/S MEETING
0820 BEAR GUARD: MICHAEL THOMAS / UIC
* P.MOLZAHN ATTENDED SAFETY MEETING AT 0730 FOR OTHER REMEDIATION SITE, COVERED DETAILS OF AREAS WORKING AND HAZARDS. NOTE: BE AWARE OF ADDITIONAL TRAFFIC NEAR BLDG 1360. THEY WORK WITH KENDRA.
HEALTH/SAFETY MTG:
-PTSP/STEP BACK/UTV FORM
0845 HEAD OUT TO POT. CRASH SITE A.
1000 COMPLETE ALL POT. CRASH A LOCATIONS
1010 CHARLIE (NAVY) STOPPED BY. PLACED TAPE MEASURE, FIRST AID, EYEWASH IN BLUE BUILDING
1130 CLEANED UP EQUIPMENT AND MOVED OFFSITE TO COMPLETE ~~FIELD~~ PM PAPER WORK

Former NARL Barrow – Daily Reports

Monday 19th of August

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (Project Manager [PM])

Geotek Drilling:
None

UIC:
Michael Thomas (Bear Guard)

Health and Safety Meeting

Arrived in Barrow at 1050, then went for an early lunch and reviewed the HSP and signed relevant sections. Then went over to BARC to review with the bear guard but discovered that he had already reviewed the material with Paige so proceeded to site walkover.

Site walkover

Conducted a site walkover of all the proposed boring locations. All appeared to be in place except one at the far end of the runway that will need to be re-staked using GPS along with measurements and photos taken during the third-party utility locate. Moved the sampling equipment and coolers into shed adjacent to Building 136 all equipment appeared to be in good working order.

Other:

Traveled from anchorage to Barrow

Collected sampling equipment from Alaska Air Cargo

Former NARL Barrow – Daily Reports

Monday 20th of August

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (Project Manager [PM])

Geotek Drilling:
None

UIC:
Michael Thomas (Bear Guard)

Surface water collection

Arrived at site 0800 conducted safety tailgate then Maggie and Nicole went with bear guard to collect surface water samples, in this time Tom picked up misc field supplies and calibrated and prepared groundwater sampling equipment inside so no bear guard was necessary. All surface water samples were successfully collected.

Groundwater collection

This afternoon we collect two groundwater samples at existing wells AS-WP-10 and AS-WP-12 (2 of 8 existing wells sampled).

Other:

Both wells sampled exhibited a sheen and had a fuel odor

Received news that the drill rig is delayed at its last job and will likely not be in Barrow until Saturday or Sunday

	Surface water collection

Former NARL Barrow – Daily Reports

Monday 21th of August

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (Project Manager [PM])

Geotek Drilling:
None

UIC:
Michael Thomas (Bear Guard)

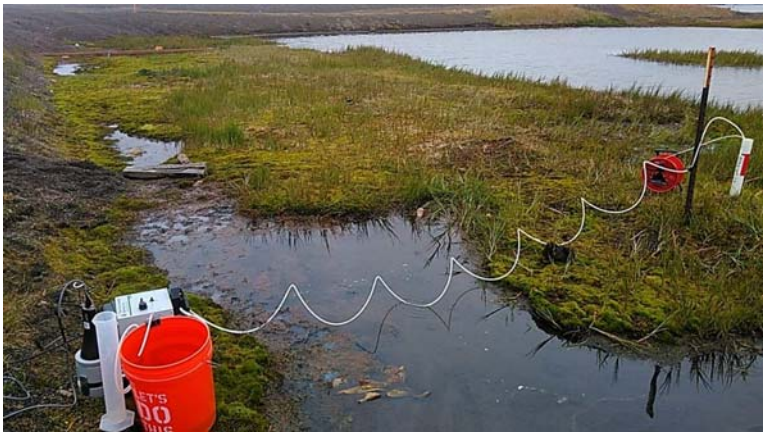
Groundwater collection

Arrived at site 0840 conducted safety tailgate and calibrated equipment, then proceeded to split into two teams and sample remaining existing groundwater monitoring wells (8 of 8 existing wells sampled) a duplicate and an MS/MSD were collected at the wells listed in the PI. A trip blank and 2 equipment blanks (one from each lot of tubing) were also collected.

Other:

Maggie departed site this evening to return on Monday for the planned start of drilling.

A cooler with all the water samples was taken by Maggie for shipping.

	Groundwater setup at MW AFAS-WP-20

Former NARL Barrow – Daily Reports

Monday 22th of August

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO])

Geotek Drilling:
None

UIC:
Michael Thomas (Bear Guard)

Groundwater collection

This morning we conducted the morning tailgate meeting and inspected the soil boring and MW install locations then re staked a missing proposed monitoring well location (B 3) at the far end of the runway. Once this was complete all work that could be done without the drill crew has been completed and we are now on standby until the driller arrives on Saturday and we can begin hand auguring the soil boring locations.

Other:

Labeled up the purge water buckets on site

	Staked location at B-3
	Warning sign

Former NARL Barrow – Daily Reports

Sunday 25th of August

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO])

Geotek Drilling:
Thomas Belli

UIC:
Michael Thomas (Bear Guard)

Hand Auguring:
This afternoon we hand augered the 3 Soil boring located near hangar 136 and collected two primary samples at each location and a duplicate at SS10, once the soil borings were complete the holes were filled back in using hole plug. We also hand cleared around the Temp well located near Hangar 136.

Other:

Thomas (drill helper) and the rig arrived last night

Thomas set up the rig at the airport

We moved the rig over to the site

We also ran though health and safety paperwork with Thomas

	SB09 Soil picture

	Image of hand auguring during clearance
	3 clearance locations around Temp well location
	Clearance locations covered by cones as specified in PI

Former NARL Barrow – Daily Reports

Monday 26th of August

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (PM).

Geotek Drilling:
Thomas Belli (Helper), Travis Drewry (Driller)

UIC:
Michael Thomas (Bear Guard)

Misc Tasks:

Maggie and Travis arrived today on the morning flight
We picked up and transported to site all the various cargo shipments Geotek had sent and prepared to begin drilling
However, a piece required to pull out the drill casings did not get shipped by Geotek and we were unable to drill today. The required pieces are being Gold Steaked and should arrive on Tuesday's morning flight.

	Drill rig staged and ready to drill near hangar 136

Former NARL Barrow – Daily Reports

Tuesday 27th of August

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (PM).

Geotek Drilling:
Thomas Belli (Helper), Travis Drewry (Driller), Logan Hermanns (Driller)

UIC:
Michael Thomas (Bear Guard)

Soil Borings/Temp Well Install:

We could not get started today until the parts needed for the drill rig arrived at Alaska air cargo and we could get them. Once the parts did arrive this afternoon we drilled NARL-SO5-TW01 through NARL-SO5-TW04. These wells are the one near Building 136 and the three wells at the southwestern end of the runway. Two primary samples were collected at each location and a duplicate was collected at SS03 and a MS/MSD was collected at SS02.

Misc Tasks:

Flush mount covers were installed on the 3 wells installed at the southwestern end of the runway.
Travis will leave tomorrow. His replacement Logan arrived today at the very end of the day and he received the health and safety orientation.
An equipment blank that was collected from the core liner and a decontaminated sample barrel.

Former NARL Barrow – Daily Reports

Wednesday 28th of August 2019

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (PM).

Geotek Drilling:
Thomas Belli (Helper), Logan Hermanns (Driller)

UIC:
Michael Thomas (Bear Guard)

Soil Borings/Temp Well development:
This morning we completed the boring of the remaining 4 Temp wells located at the Eastern end of the runway. With their completion all planned well locations have been collected and all soil samples as stated in the workplan. This afternoon we began development of the wells completed yesterday afternoon. TW02 and TW04 were both dry and the water column at TW03 was 0.25 ft . TW01 had over a foot of water. TW01 and TW03 were successfully developed and can be sampled tomorrow afternoon.

Misc Tasks:

- We collected an equipment blank on the drilling equipment
- We collected an equipment blank on the development pump
- The stake for TW07 had been washed away and so the location had to be restaked before drilling
- This morning while parked one of the rental trucks tires blew out, it was repaired by the afternoon

	Drilling at TW07

Former NARL Barrow – Daily Reports

Thursday 29th of August 2019

Staff:
CH2M/Jacobs:
Tomos Davies (Field Team Lead [FTL]); Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (PM).

Geotek Drilling:
Thomas Belli (Helper), Logan Hermanns (Driller)

UMIAQ Survey:
AJ and Chris

UIC:
Michael Thomas (Bear Guard)

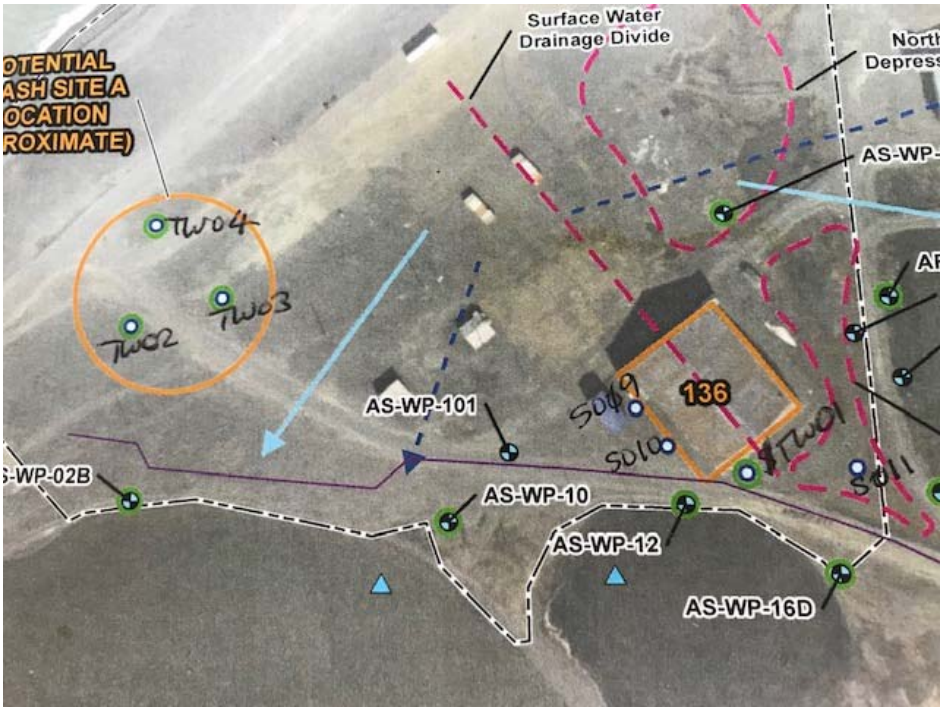
Soil Borings/Temp Well development:

Today was a gorgeous day!

All wells installed at the northern end of the runway were in good condition. This morning we gauged wells that were installed 8/28/19, TW05, TW06, and TW07 were dry and TW08 had water. As discussed with Katie Tippin on the morning of 8/29/19 the team planned to re-gauge all dry wells (TW02, TW04, TW05, TW06, and TW07) at high tide, approximately 13:45. The team did IDW management, collected the soil IDW sample, and prepared samples for shipment with Tomos on the 19:25 flight. The team developed TW08 that was installed on 8/28/19. All dry wells were re-gauged from 13:42 – 14:00 and TW03, TW05, TW06, and TW07 were dry and TW02 had approximately 0.05 inches of water column. The team developed TW02 successfully. TW01 was sampled. The drillers abandoned dry wells TW04, TW05, TW06, and TW07. The surveyors completed surveying all newly installed wells and all existing wells that were sampled.

Misc Tasks:

- We collected an equipment blank on the development pump
- We collected an equipment blank on the peristaltic pump tubing (new batch)
- Tomos demobilized with all soil samples and equipment blanks

	Gauging TW07
	Southern end location figure

	Northern end location figure

Former NARL Barrow – Daily Reports

Friday 30th of August 2019

Staff:
CH2M/Jacobs:
Nicole Badon (Site Safety Health Officer [SSHO]), Maggie Radford (PM/Field Team Lead [FTL]).

Geotek Drilling:
Thomas Belli (Helper), Logan Hermanns (Driller)

UIC:
Michael Thomas (Bear Guard)

Temporary Well Sampling and Demobilization:
The team gauged all existing wells sampled and new wells this morning. We collected the remaining groundwater samples from TW02, TW03, and TW08. The drillers removed these wells following sampling. The aqueous IDW sample was collected. The samples collected 8/29 and 8/30 were packed up for travel tomorrow with Maggie to Anchorage. All equipment was packed up and will be shipped tomorrow morning. The drilling equipment and drill rig were demobilized and taken to NAC.

There are 3 aqueous and 1 soil drums labeled and staged in the treatment building. We left one box of supplies labeled and on the bench in the treatment building, these will stay onsite through IDW mobilization. We still have a key for the treatment building and are planning to keep this until IDW is demobilized, per discussion with Charlie. We can coordinate return of this key sooner if needed.

Maggie and the drillers to demobilize tomorrow morning. We will be onsite to load equipment and ship via Alaska Air Cargo first thing in the morning with Thomas.

Former NARL Barrow PFAS SI 8/19/19

Team: Nicole Badon / Jacobs
Maggie Radford / Jacobs
Tomos Davies / Jacobs
Michael Tomas / UIC - bear guard
Charlie Escola / Navy - NTR

Weather: Overcast, occasional rain sprinkles temps in the 40's °F

Task: Arrive in Barrow, review health + Safety, meet bear guard, visit site, ready shipped supplies

1050 Jacobs team arrives in Barrow. Pick up rental vehicle, go to lunch and review and sign health and safety plan

1330 Pick up supply shipment from Alaska Air Cargo

1400 Arrive at BARC to meet bear guard and Navy Technical Representative. Discuss bear Safety then go to tour site and planned field work locations

1520 Unload field equipment and organize for field work. into the treatment building

1610 Finish up activities for the day. Ready to begin field work tomorrow

5/19/19

Page
blank

8/20/19

Page
blank

8/20/19

Former NARL Barrow PFAS SI 8/20/19

Team: Nicole Baden
Maggie Radford
Tomas Davies
Michael Tomas

Weather: 40's, overcast, light wind, occasional sprinkles (rain)

Task: Surface water sampling and groundwater sampling

0800 Health and Safety tailgate with team
0815 load up and get ready for surface water sampling
0905 Go out to the lake to sample. Disturbed sediment is bubbling up and smells of sulfur will let settle before coming back to sample
0926 collect coordinates for SW01: 71°19'59.115"N, 156°39'02.762"W
0935 Collect NARL-SOS-SW01-0819 | NARL-SOS-SW01-0819-MS, NARL-SOS-SW01-0819-SD
go inside and prepare labels for next set
1015 collect NARL-SOS-SW02-0819 and
1025 NARL-SOS-SW02R-0819
coordinates: 71°19'59.571"N, 156°38'56.039"W
1030 Label samples at staging area in treatment plant
Prepare for next sample set

Nicole Baden 8/20/19

Former NARL Barrow PFAS SI 8/20/19

1050 - Collect NARL-SOS-SW03-0819
COORDINATES: 71°19'42.30"N
156°39'51.460"W
1125 Go to airforce property to check in for accessing the side of the lake on AF. property with the bear guard and his gun. Check procedures for required for the gun
1138 Mob to sample locations on lake
1150 Collect NARL-SOS-SW04-0819
Coordinates: 71°19'43.369"N
156°38'41.990"W
1204 Arrive at SW05
1210 collect NARL-SOS-SW05-0819
COORDINATES: 71°19'30.154"N
156°38'55.254"W
1218 Complete surface water sampling; label and place samples on ice

Calibration Log for GW equipment

Horiba 44542 + 18804

	pH	cond (ms/cm)	turb (NTU)	DO (mg/L)
Precal	4.31	5.10	0	14.98
Post-cal	4.0	4.54	0	12.96

Cal solution Lot # 18397435
temp 10.12°C

TD 8/20/19

Former NARL Barrow PFAS SI 8/20/19

Horiba 21301 - 21995

	pH	cond (ms/cm)	turb (NTU)	DO (mg/L)
Pre-Cal	4.46	5.37	0	13
Post-Cal	4.00	4.54	0	12.20

cal solution Lot # 1839435

temp 10.12°C

multi Rae 43639

fresh air 20.9 O2 - pass

multi gases O_2 - 18 % - pass

CO - 50 ppm gas Lot # 19-6914

VOC 100.2 - pass Lot # 19-6791

12:40 Lunch

1325 Back on site, prep for groundwater sampling

1429 Set up at AS-WP-10

1528 Set up at AS-WP-12, ~~TD~~ TD = 2.13' bgs, screen 1.7' length

TD: 4.23' TOC Screen at 2.53' TOC

1530 Sampled AS-WP-10 one primary sample collected NARL-SOS-WP-10-0819

final parameters at 15:28:

WL (drawdown)	P(L)	pH	Cond (ms/cm)	Turb (NTU)	DO	Temp	ORP
2.95	6	6.5	0.631	2.06	0	4.34	-116

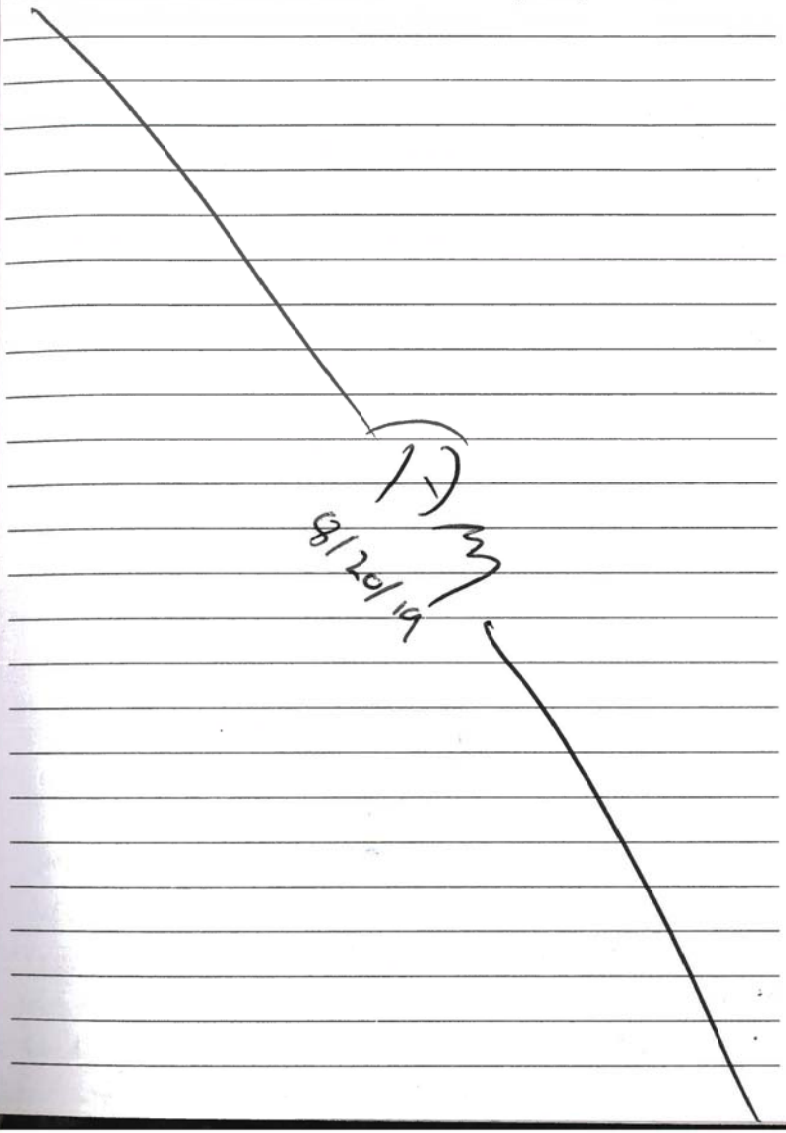
1700 Sample AS-WP-12 one primary sample collected NARL-SOS-WP-12-0819

final parameters 1651:

WL	pH	Cond	Turb	DO	Temp	ORP
3.57	6.96	0.353	8.77	3.47	4.39	-162

Former NARL Barrow PFAS SI 8/20/19

17:40 leave site Done end of Day



Former NARL Barrow AFAS SI 8/21/19

Team: Nicole Baldon / Jacobs
Maggie Rochford / Jacobs
Temos Davies / Jacobs
Michael Tomas / UIC - bear guard

Weather: 40°F, overcast, occasional drizzle

Task: Groundwater Sampling

08:30 Arrive on site at treatment plant staging area. Calibrate equipment

0900 Health and Safety meeting

Calibration info MultiRae SN: 043639

MULTIGAS & ISO INFO SEE 8/20/19 NOTES.

0910 Conduct fresh air calibration

H_2S: 0.0 CH_4: 0.0
CO: 0.0 VOC: 0.0
O_2: 20.9

MULTI-SPAN; ALL PARAMETERS PASS

0924 Load up equipment for sampling

Horiba cal info

# 21361 / 21995	pH	Turb	EC	DO
Precal	4.01	0.2	4.25	12.59
Post cal	4.0	0	4.56	12.36
# 18804 / 44542				
Pre cal	4.05	0	4.48	13.35
post cal	4.0	0	4.55	12.65

Cal solution lot # 18397435 temp 9°C

FORMER NARL PFAS SI 8/21/19

0950 - N. BAODN AND M. RADFORD SET-UP AT AS-WP-11.

0955 - START PUMPING

1000 - T. DAVIES AND M. RADFORD SET-UP AT AFAS-WP-20.

1015 - START PUMPING

1020 - FUEL LIKE ODOR NOTED AT AFAS-WP-20, PID=9.7 PPM, AMBER COLOR
BREATHING ZONE = 0.0 PPM

1025 - FUEL LIKE ODOR NOTED AT AS-WP-11, LIGHT YELLOW COLOR, PID=0.0 PPM (LEADSPACE)

1033: COLLECT NARL-SOS-WP-11-0819
DTW: 3.56' BTOC TURB: 4.51 NTU
VOL: ~2 GAL DO: 0.68 mg/L
pH: 6.51 SU TEMP: 4.77°C
COND: 6.51 mS/cm ORP: -132 mV

1052: COLLECT NARL-AFAS-WP-20-0819
DTW: 2.39' BTOC TURB: 552 NTU
VOL: 6.8 L ~ 2 GAL DO: 0
pH: 6.25 TEMP: 3.52°C
COND: 0.980 mS/cm ORP: -40 mV

1115: N. BAODN SET-UP AT AFAS-WP-21

1122: START PUMPING

1130: T. DAVIES SET-UP AT SOS-WP-18B

FORMER NARL BARROW PFAS SI 8/21/19

1148: COLLECT ~~NARL-SOS~~ MR (ML)

NARL-AFAS-WP-21-0819

DTW: 3.24' BTOC TURB: 0.87 NTU

VOL: 22 GAL DO: 0.64 mg/L

pH: 7.10 SU TEMP: 4.06°C

COND: 1.03 mS/cm ORP: -143 mV

1148: START PUMPING AT AS-WP-18B

1232: COLLECT NARL-SOS-WP-18B-0819

DTW: 2.57' BTOC TURB: 58.1 NTU

VOL: 11L 2.3 GAL DO: 0

pH: 7.12 SU TEMP: 4.64°C

COND: 0.704 mS/cm ORP: -117

1245: TO TREATMENT BUILDING TO LABEL SAMPLE AND PLACE ON ICE

1300: OFFSITE FOR LUNCH

1400: ONSITE

1430: SET-UP AT AS-WP-16D (T. DAVIES & M. RADFORD)

1445: START PUMPING

*1435: N. BADON SET-UP AT AS-WP-2C (SAMP LOC CONFIRMED AS 2B)

1456: START PUMPING AS-WP-2C

1520: COLLECT NARL-SOS-FB01-0819

- IN CENTRAL LOCATION NEAR BLDG 856

FORMER NARL BARROW PFAS SI 8/21/19

1530: COLLECT NARL-SOS-EB01-0819

- FROM DI OF REVERSE OSMOSIS WATER - USED FOR FINAL DECON RINSE.

*1520: COLLECT NARL-SOS-WP-16D-0819
NARL-SOS-WP-16D-0819-MS
NARL-SOS-WP-16D-0819-SD

1555: COLLECT NARL-SOS-FB02-0819

- T. DAVIES 8/21 & N. BADON 8/20

SET-UP

HDPE FROM CHEM WAREHOUSE AND MASTER FLEX LOT # 0624-15

MANF. DATE: 1/16/2019

→ FINAL PARAMETERS

DTW: 3.06' BTOC TURB: 3.99 NTU

VOL: 2L DO: 0 mg/L

pH: 8.94 SU TEMP: 4.98°C

COND: 0.498 mS/cm ORP: -85 mV

*1530: COLLECT NARL-SOS-WP-02C-0819

DTW: 3.24' BTOC TURB: 2.71 NTU

VOL: ~1.5 GAL DO: 0 mg/L

pH: 7.23 SU TEMP: 2.53°C

COND: 3.15 mS/cm ORP: 18 mV

1535: COLLECT NARL-SOS-WP-02CP-0819

FORMER NAVAL BARROW PFAS SI 8/21/19

1610 COLLECT NAVL-SOS-EB03-0819

LOT # (MASTER FLEX): 24595912

MANUFAC. DATE: 1/16/2019

N. BADON 8/21 & T. DAVIES 8/20

1630 leave treatment plant to bring M. Radford to the airport with the samples

1700 Drop off samples at airport to fly w/ Maggie to Anchorage. End of day

8/21/19

FORMER NARL BARROW PFAS SI 8/22/19

Team: Nicole Badon / Jacobs

Tomos Davies / Jacobs

Michael Thomas / UIC - bear guard

Weather: 40's, cloudy, occasional rain

Task: Relocate missing sample locations that have been run over

0805 Arrive on site

0810 Health and Safety Meeting with team.

0835 Get ready for the day's task

0900 Locate missing well area, re-stake location

1000 End of day until drillers arrive on site in a few days

8/22/19

Former NARL Barrow PFAS SI 8/25/19

Team: Nicole Baden / Jacobs - CH2M
Tomas Davies / Jacobs
Thomas Belli / GeoTek
Michael Thomas / UIC - bearguard

Weather: 40's, sunny w/ some clouds

Task: Brief T. Belli (GeoTek) on health and safety. Hand auger three soil sampling locations. Hand clear 1 monitoring well location for utilities

1025 Meet with T. Belli @ Hotel
1030 Exit drill rig from near airport (T. Belli has assembled earlier this morning
1040 Drive drill rig to the site via remote control
1215 Arrive at site (Geoprobe track rig 6620 DT)
1230 Health and safety plan overview
1300 Leave site for lunch break. GeoTek off site to grab equipment from Alaska Air Cargo
1350 Head back to the site
1359 Arrive back on site, meet GeoTek w/ more of their equipment
1420 Calibrate multi. gas for methane: O_2: 20.9 LEL: 0 (CO_2) VOC 0 (H_2S) multi gas: pass
VOC cal gas: pass

Nicole Baden 8/25/19

Former NARL Barrow PFAS SI 8/25/19

1445 Set up at soil boring location NARL-SOS-SO01
1450 Collect sample NARL-SOS-SS09-0.0-0.5-0819 0 to 0.5'
1500 Slow progress with hand auger
1615 Collect sample NARL-SOS-SB09-3.8-4.2-0819 from 3.8' to 4.2' bgs. Fuel-like odor.
1635 Collect sample NARL-SOS-SS10-0.0-0.5-0819
1640 and field duplicate NARL-SOS-SS10-0.0-0.5-0819
1645 Collect sample NARL-SOS-SB10-2.5-3-0819 from 2.5 ft to 3ft. PID = 0.4 ppm. Solvent odor.
1700 Collect sample NARL-SOS-SS11-0.0-0.5-0819 from 0' to 0.5'
1715 Collect NARL-SOS-SB11-3.5-4-0819 from 3.5 ft to 4 Ft
1720 Collect NARL-SOS-EB04-082519 on decon'ed hand auger
1725 Start hand clearing pilot holes near NARL-SOS-SO01 with hand auger
1830 Finish clearing pilot holes at SO01. Put away supplies and place samples on ice. GeoTek off site
1912 N. Baden and T. Davies off site. End of day

Nicole Baden 8/25/19

Former NARL Barrow PFAS SI 8/26/19

Team: Nicole Buckon/CH2M-Jacobs
Maggie Radford/CH2M-Jacobs
Temos Davies/Jacobs
Thomas Belli/GeoTek
Travis Drewry/GeoTek
Michael Thomas/LHC - Bear guard

Weather: 43°F, rain, light wind

Task: Drill with direct push, soil sampling, install temporary monitoring wells

1030 Head to airport to pick up Maggie and Travis and for drillers to receive their equipment and supplies from air cargo

1130 Arrive at NARL groundwater treatment plant building (meeting spot) to review health and safety w/ travis and sign AHAS

1200 Drillers go back to airport to get more supplies and lunch break

1215: CALIBRATE MULTIRAE 436:39
FRESH AIR ALL PARAMETERS PASS
MULTISENSOR: H_2S, CO, CH_4, O_2
LOT #: 19-6914
ALL SENSORS PASS
VOC: ISO-100 PPM LOT # 19-6791
EXP: 5/9/2023

1420 Drillers back on site. Set up for drilling

8/26/19

Former NARL Barrow PFAS SI 8/26/19

1440 Drillers discover that they weren't sent a tool that they need to pull their rods up after driving them down. Cannot drill and install temporary wells without it. They will have to ship overnight on Goldstreak to arrive on tomorrow's flight

1515 finished organizing equipment and getting ready to drill when part is expected to arrive tomorrow

1550 off site, End of day.

8/26/19

Former NARL Barrow PFAS SI 8/27/19

Team: Tomas Davies / Jacobs
Nicole Bodon / CH2M - Jacobs
Maggie Radford / CH2M - Jacobs
Travis Drewry / Geotek
Thomas Belli / Geotek
Michael Tomas / Bear Guard - AIC

weather: 40° F, Cloudy, windy

Task: Drill all Soil borings and install Temp wells

1230 Arrive on Site begin setup and calibration of equipment.

1240: CALIBRATE MULTIRAE 436354

FRESH AIR: O_2, VOC, CH_4, CO, H_2S: PASS

MULTISPAN - LOT-19-6914, EXP: 7/8/21, FILL: 7/8/19

O_2, CH_4, CO, H_2S: PASS

VOC: LOT - 19-6791, EXP: 5/7/23, FILL: 7/5/19

VOC (100 PPM): PASS

1245: ~~HRS~~ CHARTBRIDGE / DAILY MEETING

1300 Mob to first drilling location

NARL-SOS-TW01 BEHIND BUILDING

1330 Collect | NARL-SOS-SS01-0.0-0.5-08[illegible] | at 0.0 to 0.5 ft

1333 Collect | NARL-SOS-SB01-3.0-3.5-08[illegible] | at 3-3.5 ft BGS First above saturated zone

8/27/19

1350 Begin install of NARL-SOS-TW01

1402 installation complete Begin move to TW02

1432 Begin soil boring at NARL-SOS-TW02

1440 collect | NARL-SOS-SS02-0.0-0.5-08[illegible] | NARL-SOS-SS02-0.0-0.5-08[illegible]-MS | NARL-SOS-SS02-0.0-0.5-08[illegible]-SD

1446 collect | NARL-SOS-SB02-2.0-2.5-08[illegible] | at 2-2.5 ft BGS

1457 Begin well install of NARL-SOS-TW02

1520 complete install of TW02 Begin move to TW03

1540 Begin Soil Boring at NARL-SOS-TW03

1550 collect. Soil Sample | NARL-SOS-SS03-0.0-0.5-08[illegible]

1552 collect Duplicate | NARL-SOS-SS03D-0.0-0.5-08[illegible]

1558 collect | NARL-SOS-SB03-3.0-3.5-08[illegible] | at 3-3.5 ft BGS

1605 Begin well install of NARL-SOS-TW03

1617 Complete well install NARL-SOS-TW03

1657 Begin Soil Boring at NARL-SOS-TW04

1705 collect | NARL-SOS-SS04-0.0-0.5-08[illegible]

1716 collect | NARL-SOS-SB04-1.8-2.3-08[illegible] | at 1.8-2.3 ft BGS

1720 begin well install of NARL-SOS-TW04 install failed moved 1 ft North Re-drilled and begin install process hole collapsed and caved

1835 complete install of NARL-SOS-TW04 all wells installed

NARL PFAS SI 8/27/19

18:50 Begin flush mount completion on 3 wells at end of runway that have been completed

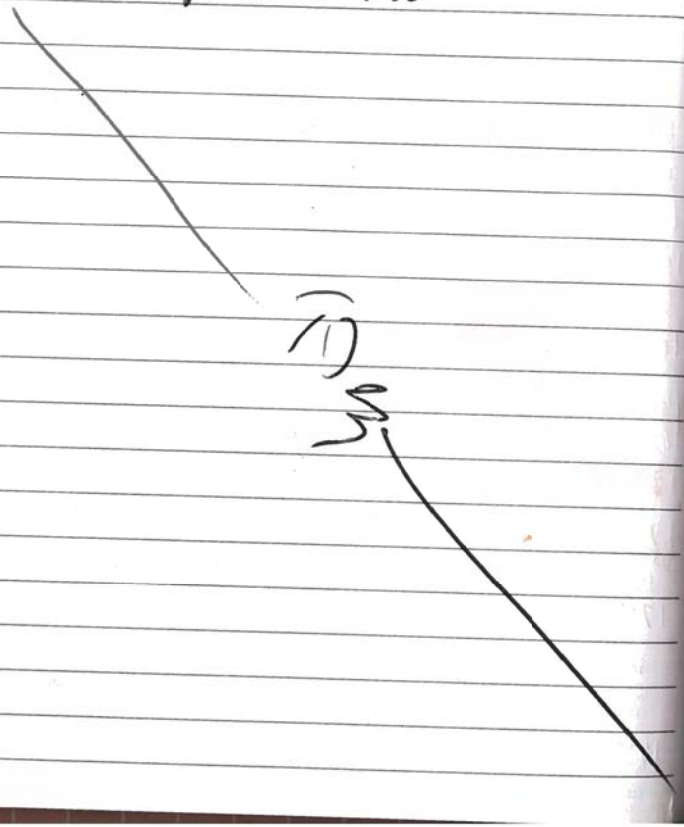
19:05 flush mounts complete Begin travel from site

19:35 Drilling moved to far end of the runway

20:00 collected Equipment Blank on Rod and liner

ID: NARL-SOS-EBOS-082719

20:20 end of Day leave site



Former NARL Barrow PFAS SI 8/28/19

Team: Tomas Davies / Jacobs
Nicole Badon / ch2m-Jacobs
Maggie Radford / ch2m-Jacobs
Thomas Balli / Ukpeagvik
Travis Drewry / Ukpeagvik
Logan Hermanns / Ukpeagvik
Michael Thomas / UIC (Dew Line)

weather: 38°F, cloudy light rain + wind

Task: Complete drilling and Begin development of wells

8:00 Meet at site and Conduct Morning Safety briefing

8:20 Mobilize to east of runway and begin setup at NARL-SOS-TWO5

8:25 CALIBRATE MULTIRAE 4360SG

SEE 5/27 FOR STANDARD DETAILS

FRESH AIR: ALL PASS

MULTI: ALL PASS

VOC (100 ppm): ALL PASS

8:48 Begin drilling at NARL-SOS-TWO5

8:58 collect NARL-SOS-SSOS-00-0.5-0819

9:00 collect NARL-SOS-~~TO~~ SBOS-35-40-0819

9:05 Collect Duplicate NARL-SOS-SBOSP-35-40-0819

9:06 Begin install of temp well at NARL-SOS-TWO5

9:20 Complete install with flush mount at TWO5 Begin move to TWO6

NARL BARROW PFAS SI 8/28/19

9:35 Begin Drilling at NARL-SOS-TW06
9:45 Collect | NARL-SOS-SS06-0.0-0.5-0819 |
9:56 Collect | NARL-SOS-SB06-5.0-5.3-0819 |
at 5-5.3 ft BGS.
10:00 Begin well install of NARL-SOS-TW06
10:15 Complete well install at TW06 Begin setup at TW07, reattach bracket on bike number away from bike
1020 Drillers leave to drop off T. Drewry at the airport
1140 Drillers return to site
12:00 Begin Drilling NARL-SOS-TW07
12:06 Collect | NARL-SOS-SS07-0.0-0.5-0819 |
12:10 Collect | NARL-SOS-SB07-4.2-4.7-0819 |
12:15 Begin well install at NARL-SOS-TW07
13:09 Begin soil Boring at NARL-SOS-TW08
1328 Collect | NARL-SOS-SS08-0.0-0.5-0819 |
13:30 Collect MS/MSD | NARL-SOS-SB08-2.2-2.7-0819 |
| NARL-SOS-SB08-2.2-2.7-0819-MS |
| NARL-SOS-SB08-2.2-2.7-0819-SD |
13:20 Begin install of MW-08
13:39 Complete well install of NARL-SOS-TW08
14:00 Lunch
15:00 Return to site
15:20 Complete Equipment Blank | NARL-SOS-EB06-082819 |

NARL BARROW PFAS SI 8/28/19

Calibrate Horiba 18804 / 445542

Post cal readings pH 4.0, mS/cm 4.54, NTU 0, mg/L DO 12.47

Calibration complete begin setup at TW03

1600 Begin TD Development of TW01

1730: STOP DEVELOPMENT, APPROX. 30 WELL VOLUMES (15.75 GAL) AND TURB. STABILIZED @ 1300 NTU. WELL PUMPED DRY 11 TIMES

1735: DECON PUMP AND EQUIPMENT AND MOBILIZE TO NARL-SOS-TW03 0.25 FT WATER IN SCREEN. GAUGED NARL-SOI-TW02 AND NARL-SOI-TW04. NO WATER IN WELL, UNABLE TO BAIL + DEVELOP.

1745: BAILED 0.5 GALLONS FROM NARL-SOS-TW05, WELL DID NOT GO DRY. ATTEMPT PURGE/DEV. W/ DEVELOPMENT PUMP. TO LITTLE VOLUME TO DEVELOP W/ PUMP. SET-UP PERI-PUMP AT MAX FLOW. BAILED W/ STAINLESS BAILER

1811 - START DEVELOPING W/ PERI-PUMP PURGED @ 2.14 GAL/MIN

1858: STOP DEVELOPING, TURB. STABILIZED @ 100 NTU, 7 GAL PURGED (~175 WELL VOL's).

NARL BARROW PFAS SI 8/28/19

1910: PACK UP EQUIPMENT AND GO TO TREATMENT BUILDING

1930: COLLECT NARL-SOS-EB07-082819 FROM DEVELOPMENT PUMP AFTER DECON AND 3/8" HOPE / MASTER FLEX (LOT #)

1940: SURVEYORS OFF SITE

1945: ENTIRE TEAM OFF-SITE

0800: SURVEYORS ONSITE, H&S CHATTERING AND SIGN APP/ SSHP.

8/28/19

NARL Barrow PFAS SI 8/29/19

Team: Tomas Davies / Jacobs
Nicole Bedon / CH2M-Jacobs
Maggie Radford / CH2M-Jacobs
Thomas Delli / Geobel
Logan Hermans / Geobel
michaeal Thomas / GTC (Beargrund)

weather: 39°F Cloudy, medium winds

Task: Develop remaining wells + Sample three developed yesterday

8:00 meet onsite conduct safety tailgate

8:30 begin calibration of equipment for TD Development of wells

Horiba TD 188 04/44 542

	PH	Ec	NTU	DO
Pre calibration	4.0	4.24	4.1	12.72
Post calibration	4.0	4.56	0.5	12.95

Calibration complete

multi Rae 43639

Fresh air cal - pass
Multi gas - pass
VOC cal - pass

0900 Head out to check wells installed yesterday for groundwater

0912 Check NARL-SOS-TW05, DRY

0915 Check NARL-SOS-TW06, DRY

8/29/19

FORMER NARL BARROW PFAS SI 8/29/19

0918 NARL-SOS-TW07, DRY, NO water

0922 Check NARL-SOS-TW08, DTW = 3.76' TOC

1015 Collect soil core from IDW barrel for IDW sampling. TWO jars for SVOC, NWTPH-DX, Metals, Mercury, pH, ignitability, flash; 2 VOAs for VOCs, NWTPH-Gx;

NARL-SOS-WSOIL-082919 @ 1015

13:50 Begin Development of TW08

14:38 Begin TD complete Development of TW08 upon stability

107 well volumes final Parameters

PH	Cond	Turb	Do	Temp	ORP
7.95	6.840	273	1.23	1.12	137

1456 Begin well development at NARL-SOS-TW02 0.07' of water in well; develop w/ peristaltic pump.

1520 finish developing NARL-SOS-TW02 removed ~2.5 gallons. Final turbidity reading = 8.60 NTU

1535 Go to prepare existing Samples for evening flight to Anchorage

1625 - COLLECT NARL-SOS-EB08-082919 FROM TUBING LOT # MASTER PLUS: 24595912 USED IN 8/29 + 8/30 SAMPLE COLLECTION

1634 - COLLECT NARL-SOS-EB09-082919 DEDICATED PUMP DECON

NARL BARROW PFAS SI 8/29/19

1700 - T. DAVIES + N. BADON OFFSITE TO TAKE T. DAVIES TO AIRPORT

* 1500 - SURVEYORS OFFSITE, ALL NEW WELLS AND EXISTING WELLS SURVEY + SOIL SAMPLE LOCATIONS.

1718 - SET-UP AT NARL-SOS-TW01

*NOTE: Checked dry wells again at high tide 13:45

13:52 NARL-SOS-TW07 = DRY, ~~1345 NARL-SOS-TW08~~

13:55 NARL-SOS-TW06 = DRY, 1341 NARL-SOS-TW04 = DRY

1357 NARL-SOS-TW05 = DRY

* 1700-1745 Drillers abandoned by removal TW05, TW06, TW07, TW04

1815 Collect NARL-SOS-TW01-0819

1820 Collect NARL-SOS-TW01P-0819 field duplicate

1823 Complete sampling at TW01

1835 MOBILIZE BACK TO TREATMENT BUILDING + DECON EQUIPMENT

900 - N BADON, M. RADFORD, + M. THOMAS OFFSITE

8/29/19

NARL BARROW PFAS S1 8/30/19

SHAFF, THOMAS BELL / GTA

LOGAN HERMANN / GTA

NICOLE BADON / CH2M

MAGGIE RADFORD / CH2M

MICHAEL THOMAS / UIC SCIENCE

WEATHER: 32°F, CLOUDY, LIGHT WINDS

TASK: GW SAMPLING, IDW SAMPLING, DECON, DEMOBILIZATION, GW GAUGING

0800: ONSITE, PTSP / H+S MTG

0820: CALIBRATE MULTIRAE: 435639

fresh air calibration = PASS for all meters

O_2 = pass, 18.9 CO = pass, 74 (bump reading)

LEL = pass, 50 H_2S = pass, 9.3 ppm

VOC = pass 100 ppm

0910: SITEWIDE GAUGING (DTW, BTOC, FT)

	DTW	VOC
TW08	3.83'	0.0 PPM
TW03	5.38'	0.1 PPM
TW02	5.49'	0.1 PPM
AS-WP-02C	3.27'	0.1 PPM
AS-WP-10	3.00'	0.0 PPM
AS-WP-12	3.75'	1.7 PPM
TW01	6.99'	15.3 PPM
AS-WP-16D	3.25'	0.0 PPM

NARL BARROW PFAS S1 8/30/19

	DTW	VOC
AS-WP-18B	2.63'	0.1 PPM
AFAS-WP-20	2.32'	0.4% >100% LEL
AFAS-WP-21	3.31'	0.0 PPM O_2: 15%
AS-WP-11	-	17.7 PPM O_2: 20.3%

10:09 - STOP GAUGING, BACK AT TREATMENT BUILDING TO START SAMPLING

1015: CALIBRATE HORIBA U-52 - 18804

AUTO CAL EXP: 7/2020 LOT # 1915J080

pH: 4.0, 4.49 MS/CM, 0 NTU

pH: 4.0 SU

COND: 4.66 MS/CM

DO: 13.16 MG/L

TURB: 0.0 NTU

1025 - MOBILIZE TO TW03 TO SAMPLE

1042 - START PURGING

1104 - COLLECT NARL-SOIL-TW03-0819

DTW 5.39' BTOC TURB: 4.16 NTU

ORP: 1.4 MV DO: 11.20 MG/L

pH: 7.49 SU TEMP: 0.71 °C

COND: 4.09 MS/CM ORP: 172 MV

1114 - BACK TO TREATMENT BLDG, DECON BUCKETS AND ACETATE LINERS

1220 - OFF SITE FOR LUNCH, SUPPLIES, GAS TRUCK

NARL BARROW PFAS SI 8/30/19

1345 - ONSITE, SET-UP FOR IDW SAMPLING

1420 - COLLECT NARL-505-MW01-083019 - IDW, AQUEOUS SAMPLE

1430 - SET-UP AT NARL-505-TW08

1438 - START PURGING

1505 - COLLECT NARL-505-TW08-0819

DTW: 3.88' TURB - 259 NTU

VOL: 1.6 GAL DO - 0.80 mg/L

pH - 8.12 SU TEMP: 5.69°C

COND - .743 mS/cm ORP - 124 mV

1520 - MOBILIZE TO TW02

1527 - SET-UP AT TW02

1536 - START PURGING

1608 - COLLECT NARL-505-TW02-0819

DTW: 5.51' TURB: 6.19 NTU

VOL: 2.5 GAL DO: 12.14 mg/L

pH: 7.99 SU TEMP: 1.75°C

COND: 4.21 mS/cm ORP: 91 mV

1616 - COLLECT NARL-505-MW01-083019

ANALYSIS: PFAS

1620 - DRILLERS ABANDON ALL REMAINING WELLS

1625 - AT TREATMENT BLDG TO PACK-UP

1700 - DRILLERS DEMOB W/ DRILL RIG

NARL BARROW PFAS SI 8/30/19

1720 - OFF-SITE, N. BARROW TO AIRPORT

1995 - ONSITE, AIR CARGO UNABLE TO TAKE EQUIPMENT UNTIL MORNING OF 8/31/19. MEET M. THOMAS/UIC TO UNLOAD EQUIPMENT.

2000 - OFF-SITE.

8/30/19

NAVY BARROWS PFAS SI 8/31/19

STAFF: MICHAEL THOMAS/UIC

MAGGIE RADFORD / CHEM

WEATHER: 39°C, CLOUDY, WINDY

TASK: DEMOBILIZATION, SHIP SUPPLIES AND EQUIPMENT

0745- ONSITE (M. RADFORD) TO MEET M. THOMAS, H&S MOMENT: LIFTING SHEET

0800- OFFSITE TO SHIP + DEMOBILIZE

8/31/19

Appendix B
Field Change Requests

FIELD CHANGE REQUEST 01
FORMER NARL BARROW, UTQIAĠVIK, ALASKA

ch2m.	**FIELD CHANGE REQUEST 01 CTO No. 4117 Former NARL Barrow, Utqiaġvik, Alaska Contract: N62470-16-D-9000**		**SAP DOC ID (NIRIS ID): Not yet assigned**
TABLE, FIGURES OF TEXT SECTION	**REV NO.**	**ITEMIZED CHANGES**	**PREPARED BY/DATE**
Figure 3	1	Revised soil boring location	CH2M HILL Inc. (CH2M) August 14, 2019

REFERENCE DOCUMENTS (Associated Work Plan and SAP/QAPP)

Sampling and Analysis Plan Site Inspection for Per- and Polyfluoroalkyl Substances Former Naval Arctic Research Laboratory Barrow Utqiaġvik, Alaska

Contract Number: N62470-16-D-9000

Prepared by CH2M HILL Inc. (CH2M), Contract Task Order 4117

August 2019

EXISTING CONDITION

Initial site reconnaissance and third-party utility locate verification have been performed.

REASON FOR CHANGE

Since completing the SAP and prior to soil boring collection, a major rain storm occurred in the Utqiaġvik area. One proposed soil boring location shown in Figure 3 of the SAP is now under water and a boring cannot be collected.

DESCRIPTION OF CHANGE (items involved, submit sketch, if applicable)

(1) Figure 3 of the SAP shows a proposed soil boring location within the southern portion of the South Depression located east of Building 136 (Navy Hangar). This location was under water during third party utility locate verification. It is proposed that this soil boring location be moved northwest of its current location to just southeast Building 136 (see attached figure markup).

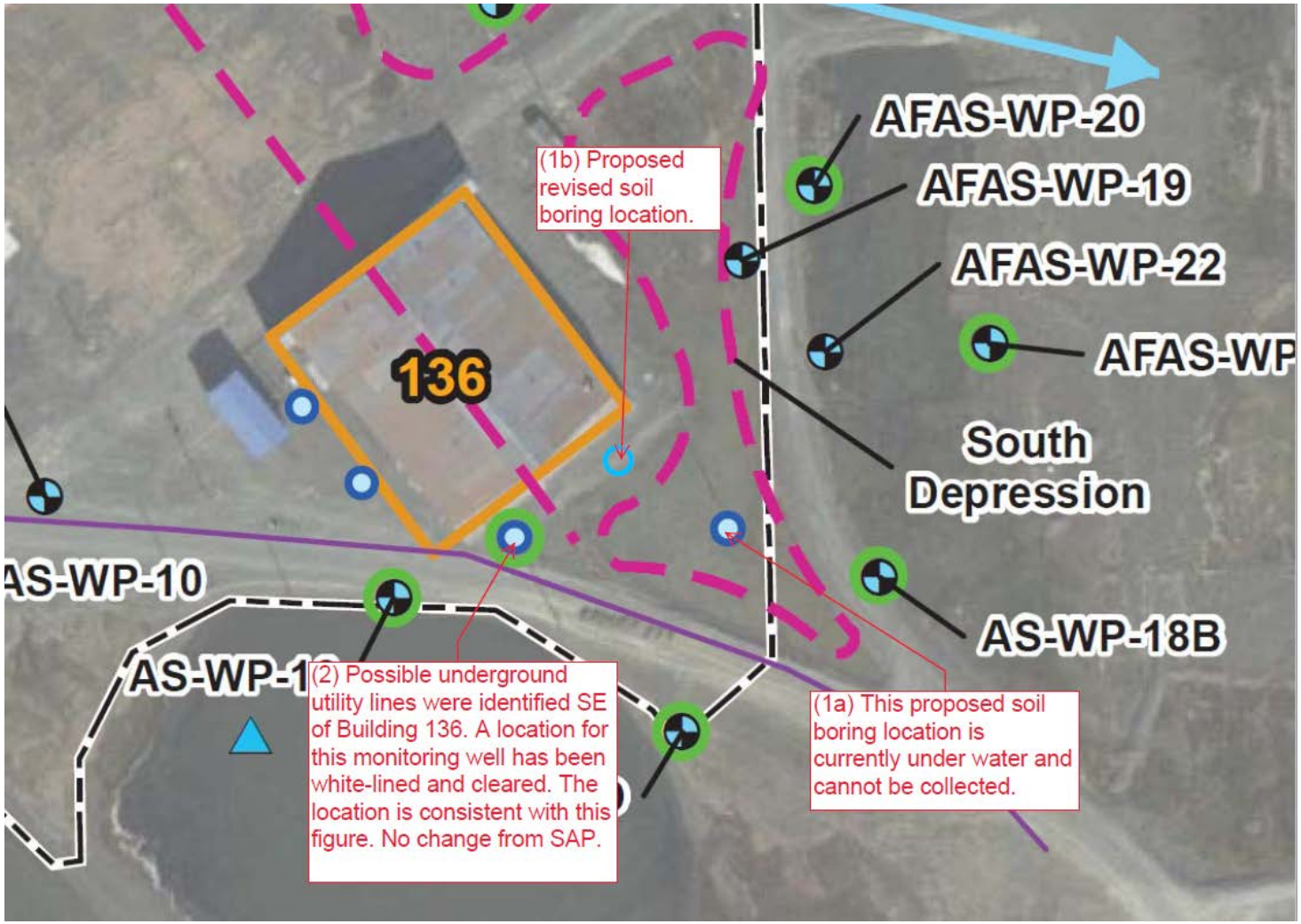
(2) Daily reports from the third part utility locate oversight mention that 2 proposed locations were repositioned. The second location referred to is a monitoring well and soil boring location just off the southwest corner of Building 136 (see attached figure markup). The field team initially “white lined” a location approximately 5 feet sway from Building 136 but potential underground utility lines were identified adjacent to that location. The team then stepped out to 15 feet from Building 136 in order to be clear of the utility. The ultimate white-lined location is consistent with Figure 3 of the SAP. CH2M does not consider this to be a variation from the planned location.

APPROVALS

(Signature) Date:	**(Signature) Date:**
CH2M Project Manager	**Navy Remedial Project Manager**
Name: Maggie Radford	**Name: Kendra Leibman**

FIELD CHANGE REQUEST 01
FORMER NARL BARROW, UTQIAĠVIK, ALASKA

Figure 3 Markup (zoomed in)



FIELD CHANGE REQUEST 02
FORMER NARL BARROW, UTQIAĠVIK, ALASKA

ch2m.	**FIELD CHANGE REQUEST 02 CTO No. 4117 Former NARL Barrow, Utqiaġvik, Alaska Contract: N62470-16-D-9000**		**SAP DOC ID (NIRIS ID):** 3905
TABLE, FIGURES OF TEXT SECTION	**REV NO.**	**ITEMIZED CHANGES**	**PREPARED BY/DATE**
Worksheet #14	1	Revised soil boring collection method – stand-alone soil borings.	CH2M HILL Inc. (CH2M) August 21, 2019

REFERENCE DOCUMENTS (Associated Work Plan and SAP/QAPP)

Sampling and Analysis Plan Site Inspection for Per- and Polyfluoroalkyl Substances Former Naval Arctic Research Laboratory Barrow Utqiaġvik, Alaska

Contract Number: N62470-16-D-9000

Prepared by CH2M HILL Inc. (CH2M), Contract Task Order 4117

August 2019

EXISTING CONDITION

Surface water samples and some groundwater samples at existing wells have been collected. Remaining groundwater sample collection at existing wells is anticipated to be completed on August 21, 2019. Drilling has not yet begun.

REASON FOR CHANGE

The drilling field schedule has been delayed due to unscheduled air carrier plane maintenance. Groundwater sampling and soil sample collection must occur before weather conditions cause the active zone to freeze.

DESCRIPTION OF CHANGE (items involved, submit sketch, if applicable)

Worksheet #14 describes soil samples being collected as follows, "Soil samples will be collected using a sampling tube driven to the desired sampling depth using a truck-mounted hydraulic percussion hammer." In order to expedite soil sample collection, it is proposed that the three (3) stand-alone soil borings be collected with hand augering methods instead. This method is consistent with the soil sampling SOP ("Soil Sampling for Per- and Polyfluoroalkyl Substances") and the objective to "Determine if PFAS are present in groundwater and soil, and if present, evaluate whether there is a potentially unacceptable risk to human health." Soil samples at proposed new well locations will be collected as described in the SAP. An excerpt of Worksheet #14 with the change is attached.

APPROVALS	**APPROVALS**
(Signature) **Date:**	**(Signature)** **Date:**
CH2M Project Manager **Name: Maggie Radford**	**CH2M Program Chemist** **Name: Anita Dodson**
(Signature)	**(Signature)** **Date:**
Navy Remedial Project Manager **Name: Kendra Leibman**	**Navy Quality Assurance Officer** **Name:**

FIELD CHANGE REQUEST 02
FORMER NARL BARROW, UTQIAĠVIK, ALASKA

SAP Worksheet #14—Summary of Project Tasks (continued)

Soil Sampling

Soil samples will be collected at the surface (0 to 6 inches bgs) and top of the capillary fringe in the unsaturated soil (to be determined in the field) at each newly installed temporary monitoring well location (eight) and three standalone soil borings near Building 136 (**Figures 3 and 4**) in accordance with **Worksheet #18** and with the SOPs listed in **Worksheet #21** and provided in **Appendix A**.

Soil samples will be collected using a sampling tube driven to the desired sampling depth using a truck-mounted hydraulic percussion hammer at well locations and by hand augering at soil-boring only locations. The sampling tube will be cut open using a specific knife designed to slice the acetate liners. Soil will be collected in the desired sample containers using reusable decontaminated equipment or single-use dedicated equipment. Decontamination will occur is accordance with the SOPs listed in **Worksheet #21** and provided in **Appendix A**. The three standalone soil borings will be backfilled with grout or bentonite and the surface will be repaired as required.

FIELD CHANGE REQUEST 03
FORMER NARL BARROW, UTQIAĠVIK, ALASKA

ch2m.	**FIELD CHANGE REQUEST 02** **CTO No. 4117** **Former NARL Barrow, Utqiaġvik, Alaska** **Contract: N62470-16-D-9000**		**SAP DOC ID (NIRIS ID):** 3905
TABLE, FIGURES OF TEXT SECTION	**REV NO.**	**ITEMIZED CHANGES**	**PREPARED BY/DATE**
Worksheets #14, #21	2	Increase monitoring well screen length from 1 foot to 1 foot or greater.	CH2M HILL Inc. (CH2M) August 28, 2019

REFERENCE DOCUMENTS (Associated Work Plan and SAP/QAPP)

Sampling and Analysis Plan Site Inspection for Per- and Polyfluoroalkyl Substances Former Naval Arctic Research Laboratory Barrow Utqiaġvik, Alaska

Contract Number: N62470-16-D-9000

Prepared by CH2M HILL Inc. (CH2M), Contract Task Order 4117

August 2019

EXISTING CONDITION

4 of 8 monitoring well have been installed. Installation of remaining well is underway.

REASON FOR CHANGE

During monitoring well installation it was noted that active zone groundwater is currently about 3 feet thick at some well locations.

DESCRIPTION OF CHANGE (items involved, submit sketch, if applicable)

Worksheet #14 describes using well screens that are 1-foot in length. Based on the current thickness of active zone groundwater, screening across the full depth of active zone groundwater (just above the top of the water to the permafrost) will better meet the objectives of the SAP. It is proposed that the description of the well screen length be modified to allow flexibility based on field conditions. Excerpts showing the proposed changes to Worksheet #14 and Worksheet #21 are attached.

APPROVALS	**APPROVALS**
(Signature) **Date:**	**(Signature)** **Date:**
CH2M Project Manager **Name: Maggie Radford**	**CH2M Program Chemist** **Name: Anita Dodson**
(Signature)	**(Signature)** **Date:**
Navy Remedial Project Manager **Name: Kendra Leibman**	**Navy Quality Assurance Officer** **Name:**

FIELD CHANGE REQUEST 03
FORMER NARL BARROW, UTQIAĠVIK, ALASKA

SAP Worksheet #14—Summary of Project Tasks

Temporary Monitoring Well Installation

All temporary monitoring wells will be installed in accordance with the State of Alaska well construction standards by an Alaska-licensed driller. Temporary monitoring wells will be installed using direct push technology drilling techniques in accordance with the SOP listed in **Worksheet #21** and provided in **Appendix A**.

Eight temporary monitoring wells will be constructed with a 2-inch inside-diameter Schedule 40 polyvinyl chloride (PVC) riser connected to a 2-inch inside-diameter factory slotted (0.010-inch or 10 slot), PVC screen with a bottom cap. All drilling and well construction materials will be free of fluorine. No fluorine-containing greases, bentonite, or other materials will be used.

The temporary monitoring wells will be screened across first encountered groundwater. The top of the ~~1-foot~~ screen (1-foot or greater in length) will be set just above the water table. A sand filter pack (native sands) will be placed around the annular space of the well screen from the bottom of the boring and extend to a minimum height of 2 feet above the top of the well screen, if feasible. If the depth to active zone groundwater is too shallow to accommodate a full 2 feet of sand above the top of the screen and still provide for an adequate seal extending to ground surface (i.e., if the well is less than 5 feet in total depth), the filter pack will extend to a minimum of 1 to 2 inches above the of the well screen after settling. A bentonite seal, at least 1 foot thick, if feasible, will be placed above the top of the sand pack. The locations of the proposed temporary monitoring wells are provided on **Figures 3 and 4**.

FIELD CHANGE REQUEST 03
FORMER NARL BARROW, UTQIAĠVIK, ALASKA

SAP Worksheet #21—Project Sampling SOP References Table (continued)

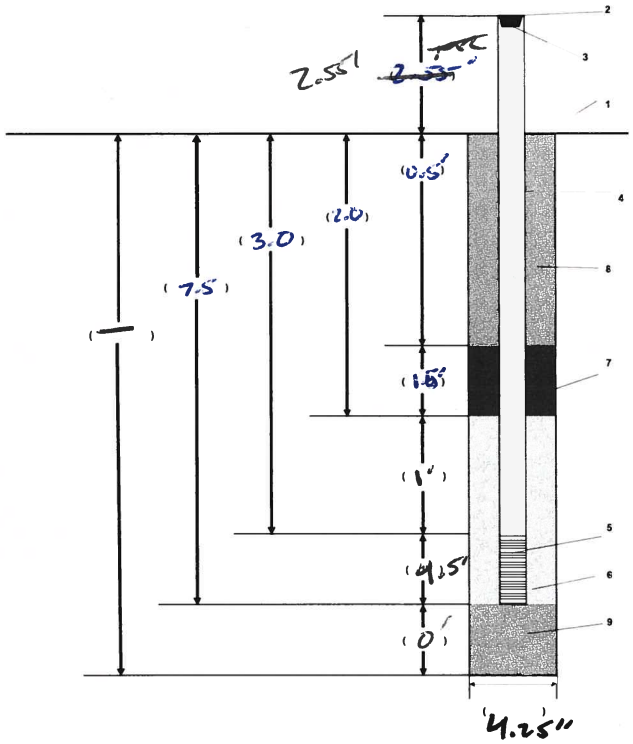
Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-014	General Guidance for Monitoring Well Installation, rev. 10/2018	CH2M	DPT Drill Rig	Y	Sampling rods and retractable stainless-steel without Teflon components. Polyethylene sampling tubing (not Teflon-lined) and stainless-steel foot valve. Biolube is acceptable substitute to drilling lube containing polytetrafluoroethylene (PFTE) or fluorine-containing substance. Direct push technology drill rig to be used. Well installation will be consistent with previous facility practices and ADEC guidance for short-term wells: The top of the ~~1 foot~~ screen will be set just above the water table. The annular space between the borehole wall and well screen shall be backfilled with a sand filter pack (native sands) placed around the annular space of the well screen from the bottom of the boring and extend to a minimum height of 2 feet above the top of the well screen, if feasible. If the depth to active zone groundwater is too shallow to accommodate a full 2 feet of sand above the top of the screen and still provide for an adequate seal extending to ground surface (i.e., if the well is less than 5 feet in total depth), the filter pack will extend to a minimum of 1 to 2 inches above the of the well screen after settling. A bentonite seal, at least 1 foot thick, if feasible, will be placed above the top of the sand pack.
SOP-015	Decontamination of Drilling Rigs and Equipment, rev 10/2018	CH2M	DPT Drill Rig	N	
SOP-016	MultiRae PID, rev. 10/2018	CH2M	PID	N	
SOP-017	Civil Surveying, rev. 10/2018	CH2M	Surveying equipment	N	
SOP-018	Monitoring Well and Borehole Abandonment rev. 10/2018	CH2M	DPT Drill Rig, bentonite	N	
I-C-04	Groundwater Sampling from Temporary Wells (Piezometers), rev. 3/2015	NAVFAC NW	Teflon-free tubing, Teflon-free bailer (if using bailer), PFAS-free pump, sample bottles (HDPE bottle with HDPE screw cap), laboratory pre-filled HDPE bottles containing field blank water, loose leaf paper without waterproof coating, clip board, pen (not Sharpie), nitrile or latex gloves	N	No Teflon components

Appendix C
Temporary Monitoring Well Completion Diagrams and Soil Boring Logs

CH2MHILL	PROJECT NUMBER	WELL NUMBER	SHEET 1 OF 1
	704758.CH.07	NARL-505-TW01	

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: NARL BARROW PFAS S1		LOCATION: NARL	
ELEVATION: —	DRILLING CONTRACTOR: GROTHER AK		
DRILLING METHOD AND EQUIPMENT USED: GEOPROBE 6620DT			
WATER LEVELS: ~3.5'	START: 1350	END: 1402 8/27/19	LOGGER: M. RADFORD



1 - Ground elevation at well: FLUSH MT

2 - Top of casing elevation:

3 - Wellhead cover type: N/A TEMP

4 - Dia/type of well casing: 2" Sch. 40 PVC

5 - Type/slot/size of screen: 2" Sch. 40 PVC/0.010" machine slotted

6 - Filter pack material: Native sands (3/4 BAG) PREMIER SILICA COLORADO SPRINGS PLANT 10/20

Quantity used:

7 - Seal material: Hydrated sodium bentonite pellets (1/4 BAG 3/8" BENTONITE PLUG)

Quantity used:

8 - Backfill material above seal: Native soil / GRAVEL

Quantity used:

9 - Backfill material below well bottom: Native soil N/A - AT PERMAFROST

Quantity used:

Development method:

Development time:

Estimated purge volume:

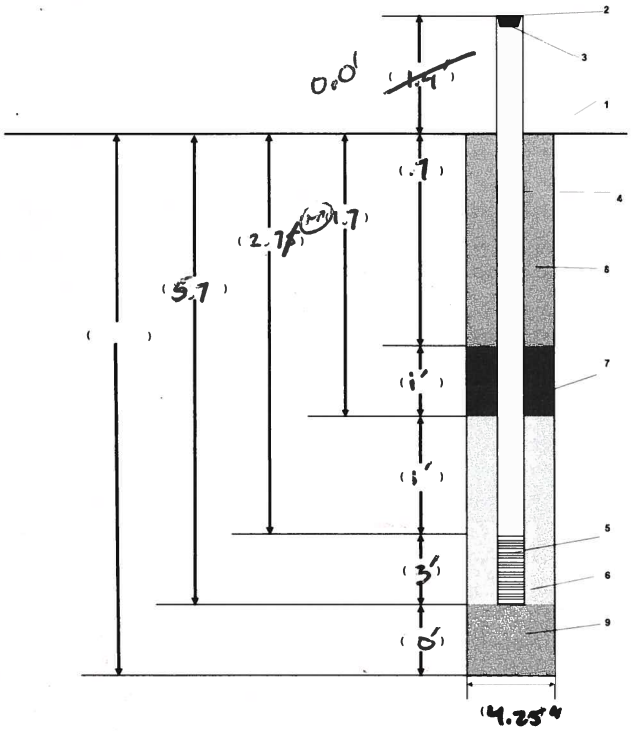
Comments:

Illustration not to scale.

CH2MHILL	PROJECT NUMBER	WELL NUMBER	SHEET 1 OF 1
	761758 CH.07	NARL-SOIL-TW07	

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: NARL BARROW PFAS SI		LOCATION: NARL, BARROW AK	
ELEVATION: —	DRILLING CONTRACTOR:	ARCTIC AK	
DRILLING METHOD AND EQUIPMENT USED: DPT- GEOPROBE 6620			
WATER LEVELS: 3.0' BGS	START: 1457	END: 1520 8/27/19	LOGGER: M. MANFORD



1 - Ground elevation at well	FLUSH MOUNT
2 - Top of casing elevation	
3 - Wellhead cover type	TRAMP CAP
4 - Dia/type of well casing	2" Sch. 40 PVC
5 - Type/slot/size of screen	2" Sch. 40 PVC/0.010" machine slotted
6 - Filter pack material	Native sands ~~#0/20~~
Quantity used	
7 - Seal material	Hydrated sodium bentonite pellets, 3/8" HOLE PLUG
Quantity used	1 1/2 BAG
8 - Backfill material above seal	Native soil 10/20 COLORADO SPECIALTY SILICA 1/2 BAG
Quantity used	
9 - Backfill material below well bottom	Native soil
Quantity used	
Development method	
Development time	
Estimated purge volume	

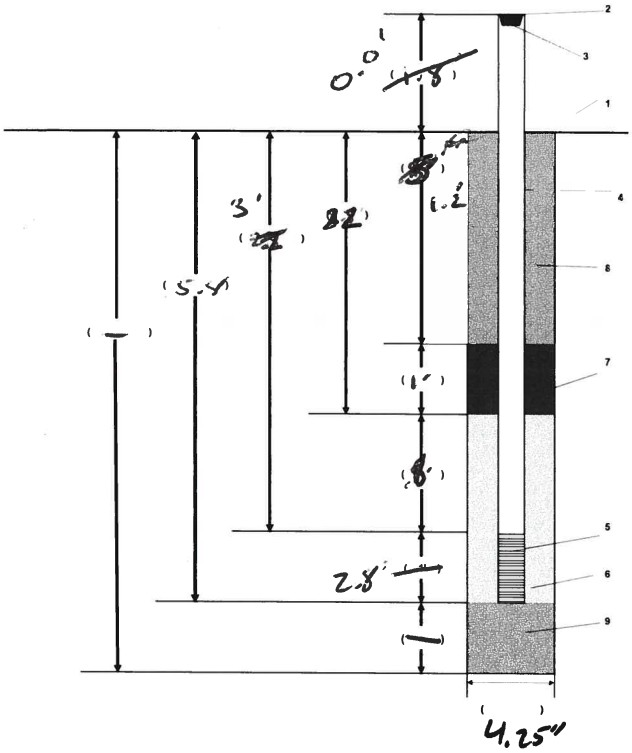
Comments

Illustration not to scale

CH2MHILL	PROJECT NUMBER	WELL NUMBER NARL-305-TW03	SHEET 1 OF 1

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: 704758.CH.07 NARL 2FA3 S1		LOCATION: BARROW, AK	
ELEVATION: —	DRILLING CONTRACTOR: GREATER AK		
DRILLING METHOD AND EQUIPMENT USED: DPT GEOPROBE 6610			
WATER LEVELS: 3-3.5'	START: 1605	END: 1620 8/27/19	LOGGER: M. RADFORD



1 - Ground elevation at well	FLUSH MOUNT
2 - Top of casing elevation	
3 - Wellhead cover type	
4 - Dia/type of well casing	2" Sch. 40 PVC
5 - Type/slot/size of screen	2" Sch. 40 PVC/0.010" machine slotted
6 - Filter pack material	Native sands
Quantity used	
7 - Seal material	Hydrated sodium bentonite pellets 3/8" HOLE PLUG
Quantity used	1/3 BAG
8 - Backfill material above seal	Native soil 20/20 COLORADO SPRINGS
Quantity used	SILICA 1/2 BAG
9 - Backfill material below well bottom	Native soil
Quantity used	
Development method	
Development time	
Estimated purge volume	

Comments

Illustration not to scale

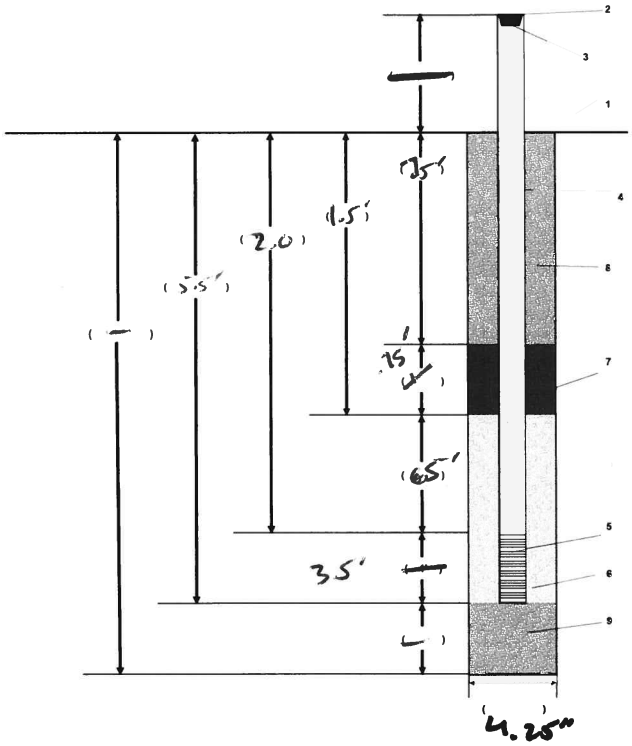
CH2MHILL

PROJECT NUMBER	WELL NUMBER	SHEET 1 OF 1
700758CH.07	NARL-SOS-TW04	

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: NARL PFAS SI		LOCATION: BARROW, AK	
ELEVATION: —	DRILLING CONTRACTOR:	GEOTEK AK	
DRILLING METHOD AND EQUIPMENT USED:	DPT, GEOPROBE 6620		
WATER LEVELS: 2.3'	START: 1720	END: 1835 8/27/19	LOGGER: M. RADFORD

- TERMINATED 1' NORTH OF ORIGINAL BORING DUE TO BRIDGING



1 - Ground elevation at well	FLUSH MOUNT
2 - Top of casing elevation	
3 - Wellhead cover type	
4 - Dia/type of well casing	2" Sch. 40 PVC
5 - Type/slot/size of screen	2" Sch. 40 PVC/0.010" machine slotted
6 - Filter pack material	Native sands 16/20 CLEAN SAND SPRINGS SILICA 3/4 BAG
Quantity used	
7 - Seal material	Hydrated sodium bentonite pelets 3/8" HOLEPLUG
Quantity used	3/4 BAG
8 - Backfill material above seal	Native soil
Quantity used	
9 - Backfill material below well bottom	Native soil
Quantity used	
Development method	
Development time	
Estimated purge volume	

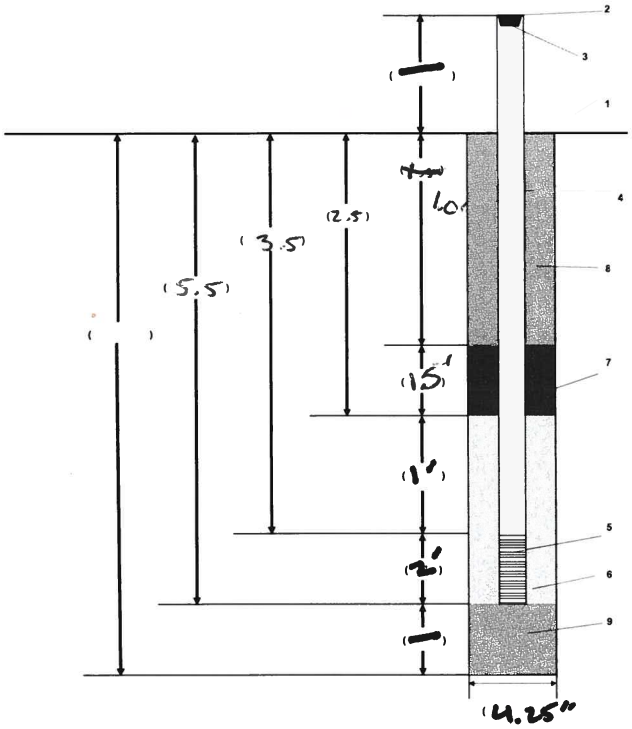
Comments

Illustration not to scale.

CH2MHILL	PROJECT NUMBER	WELL NUMBER	SHEET 1 OF 1
	704758CH.07	NARL-SOS"-TWO5"	

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: NARL PFAS S1		LOCATION: BARROW, AK	
ELEVATION: —	DRILLING CONTRACTOR: GEOTEK AK		
DRILLING METHOD AND EQUIPMENT USED: DPT - GEOPROBE 6620			
WATER LEVELS: ~4' BGS	START: 0906	END: 0920 8/28/19	LOGGER: M. RADFORD



1 - Ground elevation at well	FLUSH MOUNT
2 - Top of casing elevation	
3 - Wellhead cover type	
4 - Dia/type of well casing	2" Sch. 40 PVC
5 - Type/slot/size of screen	2" Sch. 40 PVC/0.010" machine slotted
6 - Filter pack material	Native sands
Quantity used	
7 - Seal material	Hydrated sodium bentonite pelets 3/8" HOLEPLUG
Quantity used	1/4 BAG
8 - Backfill material above seal	Native soil 10/20 COLORADO SPRINGS
Quantity used	SILICA 3/4 BAG
9 - Backfill material below well bottom	Native soil
Quantity used	
Development method	
Development time	
Estimated purge volume	

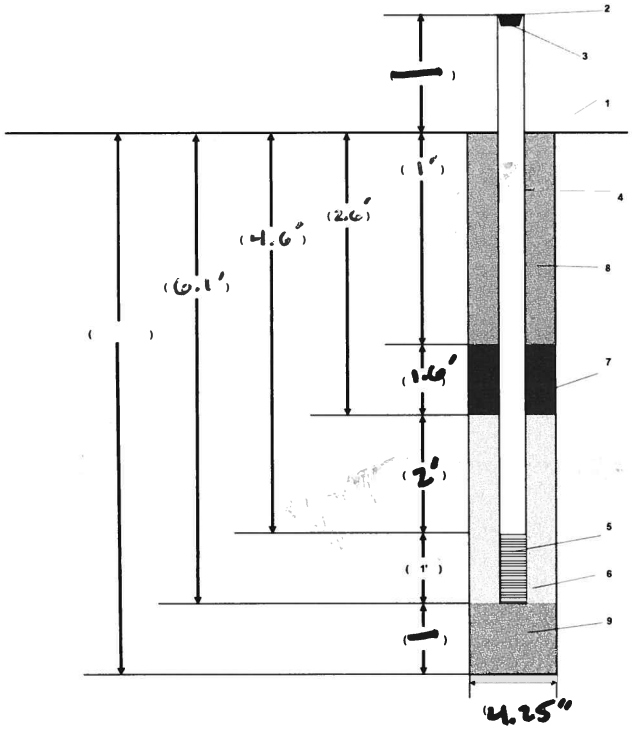
Comments

Illustration not to scale.

CH2MHILL	PROJECT NUMBER	WELL NUMBER	SHEET 1 OF 1
	704758CH.07	NAAL-505-TW06	

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: NAAL PFAS SI		LOCATION:	
ELEVATION: —	DRILLING CONTRACTOR: GEOTEK AK		
DRILLING METHOD AND EQUIPMENT USED: DPT GEOPROBE 6620			
WATER LEVELS: ~5.5'	START: 1000	END: 1015 8/28/19	LOGGER: M. RADFORD



1 - Ground elevation at well	FLUSH MOUNT
2 - Top of casing elevation	
3 - Wellhead cover type	Flush Mount
4 - Dia/type of well casing	2" Sch. 40 PVC
5 - Type/slot/size of screen	2" Sch. 40 PVC/0.010" machine slotted
6 - Filter pack material	Native sands
Quantity used	
7 - Seal material	Hydrated sodium bentonite pelets 3/8" HOLEPLUG
Quantity used	1/4 bag
8 - Backfill material above seal	Native soil 3/4 BAG COLORADO
Quantity used	SPRINGS SILICA
9 - Backfill material below well bottom	Native soil
Quantity used	
Development method	
Development time	
Estimated purge volume	

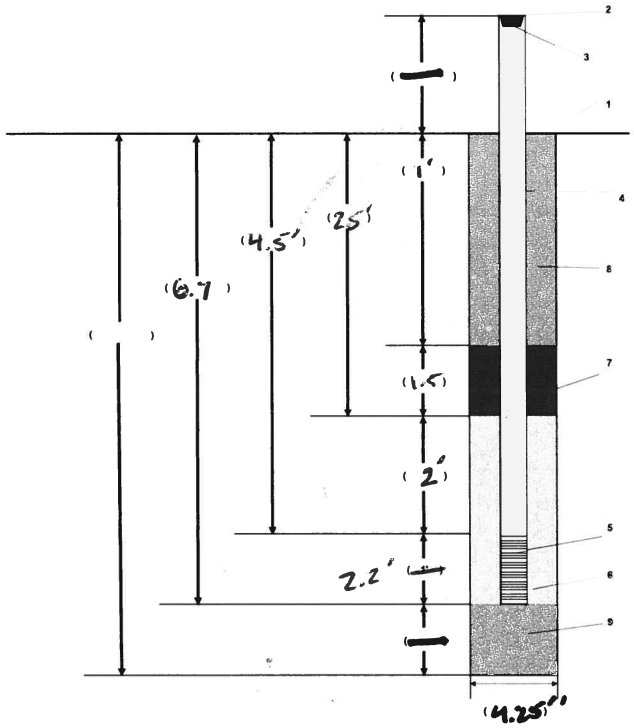
Comments

Illustration not to scale.

CH2MHILL	PROJECT NUMBER	WELL NUMBER	SHEET 1 OF 1
	704758CH.07	NARL505-TW07	

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: NARL PFAS SI		LOCATION: BARROW, AK	
ELEVATION: —		DRILLING CONTRACTOR: GEOTEK AK	
DRILLING METHOD AND EQUIPMENT USED: DPT; GEOPROBE 6620			
WATER LEVELS: 4.81	START: 1215	END: 1300 8/28/19	LOGGER: M. RADFORD



1 - Ground elevation at well	FLUSH MOUNT
2 - Top of casing elevation	
3 - Wellhead cover type	
4 - Dia/type of well casing	2" Sch. 40 PVC
5 - Type/slot/size of screen	2" Sch. 40 PVC/0.010" machine slotted
6 - Filter pack material	Native sands
Quantity used	
7 - Seal material	Hydrated sodium bentonite pelets 3/8" HOLEPLUG
Quantity used	1/4 BAG
8 - Backfill material above seal	Native soil 10/20 COLORADO SPRINGS
Quantity used	SILICA 3/4 BAG
9 - Backfill material below well bottom	Native soil
Quantity used	
Development method	
Development time	
Estimated purge volume	

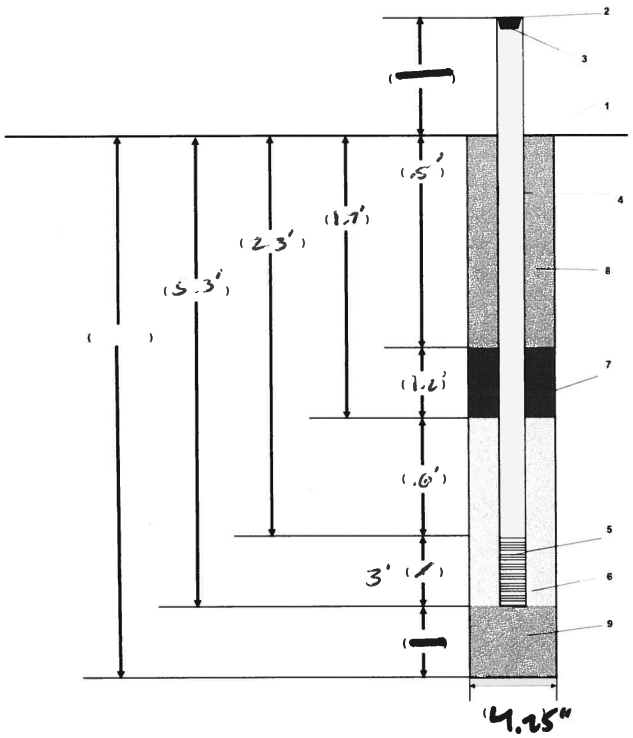
Comments

Illustration not to scale.

CH2MHILL	PROJECT NUMBER	WELL NUMBER	SHEET 1 OF 1
	704758CH.07	NAEL-SOS-TW08	

GROUND WATER MONITORING WELL COMPLETION DIAGRAM

PROJECT: NAEL PFAS S1		LOCATION: BARROW AK	
ELEVATION: [redacted]	DRILLING CONTRACTOR: GROTON AK		
DRILLING METHOD AND EQUIPMENT USED: DPT, GEOPROBE 6610			
WATER LEVELS:	START: 1320	END: 1336 8/28/19	LOGGER: M. IZAD & COD



1 - Ground elevation at well	FLUSH MOUNT
2 - Top of casing elevation	
3 - Wellhead cover type	
4 - Dia/type of well casing	2" Sch. 40 PVC
5 - Type/slot/size of screen	2" Sch. 40 PVC/0.010" machine slotted
6 - Filter pack material	Native sands
Quantity used	
7 - Seal material	Hydrated sodium bentonite pelets 3/8" HOLEPLUG
Quantity used	1/4 BAG
8 - Backfill material above seal	Native soil CLEAN COLLAPSE SPRINGS
Quantity used	SILICA 1/4 - 1/2 BAG
9 - Backfill material below well bottom	Native soil
Quantity used	
Development method	
Development time	
Estimated purge volume	

Comments

Illustration not to scale.

JACOBS

PROJECT NUMBER

BORING NUMBER NARL-SO5-SO11

SOIL BORING LOG

PROJECT: Former NARL Barrow PFAS SI LOCATION: SB11

ELEVATION: DRILLING CONTRACTOR: Geotek

DRILLING METHOD AND EQUIPMENT USED: Hand Auger

ATD WATER LEVEL: START: 8/25/14 END: 8/25/14 LOGGER: Tomos Davies

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone Above Hole
0					Sandy Gravel with little silt, moist, loose, Brown Silts + sands fine to medium Gravels Blue, Grey, Brown & Red clasts Sub rounded to Sub angular		-
2					becomes saturated and 4ft bgs sample taken just above this 3.5 - 4ft		-
3							
4							

JACOBS

PROJECT NUMBER	BORING NUMBER
	NARL-SD5-SD10

SOIL BORING LOG

PROJECT: Former NARL Barrow PFAs SI LOCATION: NARL Barrow

ELEVATION: DRILLING CONTRACTOR: GEOTEK

DRILLING METHOD AND EQUIPMENT USED: Hand Auger

ATD WATER LEVEL: START: 8/25/19 END: 8/25/19 LOGGER: Nicole Radon

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:
0			Hand auger		Sandy Gravel with little silt, moist, loose, Brown silts + sands Blue, Gray, Reddish brown fine to medium Gravels		
1							
2					starting at 2 ft bgs strong solvent sweet smell		PID 0.4 ppm
3					2.5-3 ft bgs water noted to submitted sample taken at this interval		
4							
5							

JACOBS

PROJECT NUMBER

BORING NUMBER NARL-SOS-SOØ9

SOIL BORING LOG

PROJECT: Former NARL Barrow PEAS ST LOCATION: NARL Barrow

ELEVATION: DRILLING CONTRACTOR: Geobek

DRILLING METHOD AND EQUIPMENT USED: Hand auger

ATD WATER LEVEL: START: END: LOGGER: Nicole Baden

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N')	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION, DRILLING ACTIONS/DRILLER COMMENTS; PID Readings: Breathing Zone: Above Hole:
0	0' to 6"	100%	Hand auger	N/A	Sandy Gravel with little silt loose density moist Brown sands + silts with Blue and Red Brown Gravels sub rounded to sub angular		0-6 inch sample NARL-SOS-SSO9-(0-0.5) time 14.50 PID = 0.0 ppm
2			Hand auger		Sandy Gravel, trace Silt (Silt content decreased), dark gray Brown w/ reddish Gravel, dark brown to black Sand, moist, loose. Fine to coarse Sand, fine to coarse Gravel		3.5ft to 3.8 Ft PID = 0.4 ppm fuel smell
3	30"						
	30" to 36"	100%			3.4' to 3.7' Same as above, increased Silt to little from trace		3.9-4.2 ft sample NARL-SOS-SBO9-(BD-) 16:15
4					See evidence of saturation around 4.3 however unable to recover core due to moisture content related to sloughing		

Appendix D
Temporary Monitoring and Existing Well Development Logs and Groundwater Sampling Sheets

WELL DEVELOPMENT DATASHEET

SHEET 1 OF

Well ID: NAVL-SOG-TW01

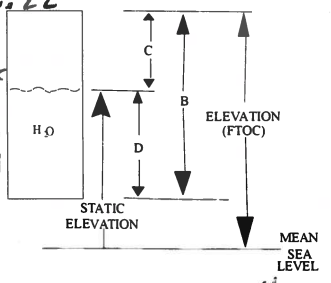
Project: NAVL PFAS SI
Location: NAVL-SOG-TW01
Project #: 704758 CH.07
Development Contractor/Geologist: GROTEK AK
Field Notebook #:

Date: 8/28/19
Start Time: 1600
End Time: 1728
Date Well Installed: 8/27/19 1400

Well Information and Purge Volume Calculation

Casing ID (inch):	Unit Casing Volume (A) (gal/ft):
0.75	0.02
1	0.04
1.5	0.09
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
7	2.00
8	2.61
10	4.08
12	5.88

Total Well Depth (B) (ft btoc): ~~9.5~~ 10.22'
Depth to Water (C) (ft btoc): - 6.95'
Length of Static Water Column in Well (feet): (B - C = D) = 3.27 ft



Unit Casing Volume (A) (gal/ft): x 0.16
Well Casing Volume (E) (gal): (D x A = E) = 0.52 gal
x 10
Total Purge Volume (F) (gal): (E x 10 well volumes = F) =

Well Screened Interval (ft btoc): 5.72-10.22 Approx. Sediment Depth in Well (ft): N/A

Development Methods

Method: ☐ Surging ☐ Pumping ☒ Bailing ☐ Other Describe: W/ STAINLESS BAILER + NYLON CORD
Surge time per interval (min): Number of development intervals:
Pump: ☐ Perist. ☐ Bladder ☐ Subm. ☐ Other Describe:
Purge time per interval (min): Purge Flow Rate (gpm): Total purge volume (gals):
Total purge time (min): Pump Intake Depth (ft btoc):
Bailer: ☐ Poly ☐ Teflon ☒ S.steel ☐ Other Describe:
Bailer Volume (gals): (0.25 / 0.33) Required Bailer Volumes: Total purge volume (gals):

Criteria for Stable Parameters

Parameter	Working Range (YSI 556MPS)	Stability Criteria	Depth to Water Stabilization	
			Time	DTW
Temperature	-5 to 45°C	± 1.0 °C		
pH	0 to 14 NTU	± 0.1		
Conductivity	0 to 200 mS/cm	± 3%		
ORP	-999 to +999 mV	± 10 mV		
Dissolved Oxygen	0 to 50 mg/L	± 10% or 0.2 mg/L		
Turbidity	0 to 1000 NTU	± 10% (≤10 NTU)		

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	~~1625~~ 1640	< PUMP	~~4.5~~ 5.0	~~7.11~~ 7.00	1.97	>1000	3.15	1.57*	-93
2	1642	< PUMP	7.0	7.17	2.27	"	2.90	1.42	-91
3	1649	8.2'	8.0	7.13	3.81	"	7.78	2.01	-95
4	1658	< PUMP	9.0			964			
5	1701	< PUMP	10.0			891			
6	1703	"	11.0			726			
7	1707	"	12.0			538			
8	1713	"	13.0			444			
9	1721		14.0			331			

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor: None, Low, Medium, High, Very Strong, H2S, (Fuel Like) Chemical ?, Unknown VOC = 23.7 PPM BZ = 0.2 PPM
Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments: STICK UP = 2.55 Ft
PUMPED DRY AFTER BAILING HTT 111

Revised February 2010.

ch2m

WELL DEVELOPMENT DATASHEET, cont'd.

Well ID: NPAL-505-TW01

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
10	1726		15			275			
11	1728		15.75			303			
12									
13									
14									
15									
16									
17									
18									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Additional Comments: (decon procedures, purge waster disposal, other)

WELL DEVELOPMENT DATASHEET

SHEET 1 OF

Well ID: NARL-SOS-TWP2

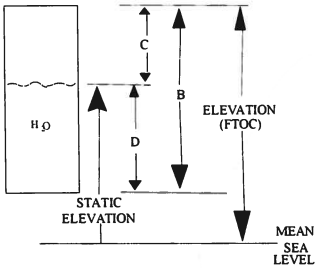
Project: Former NARL Barrow PFAS SI
Location: Barrow, AK
Project #: 704758 CH
Development Contractor/Geologist: CH2M/Jacobs
Field Notebook #: 1

Date: 8/29/19
Start Time: 1455
End Time: 1520
Date Well Installed: 8/28/19

Well Information and Purge Volume Calculation

Casing ID (inch):	Unit Casing Volume (A) (gal/ft):
0.75	0.02
1	0.04
1.5	0.09
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
7	2.00
8	2.61
10	4.08
12	5.88

Total Well Depth (B) (ft btoc): 5.54
Depth to Water (C) (ft btoc): - 5.47
Length of Static Water Column in Well (feet): (B - C = D) = 0.07
Unit Casing Volume (A) (gal/ft): x 0.16
Well Casing Volume (E) (gal): (D x A = E) = 0.01
x 10
Total Purge Volume (F) (gal): (E x 10 well volumes = F) =



Well Screened Interval (ft btoc): _____ Approx. Sediment Depth in Well (ft): NONE

Development Methods

Method: ☐ Surging ☒ Pumping ☐ Bailing ☐ Other Describe: _____
Surge time per interval (min): _____ Number of development intervals: 1

Pump: ☐ Perist. ☒ Bladder ☐ Subm. ☐ Other Describe: _____
Purge time per interval (min): _____ Purge Flow Rate (gpm): Not measured Total purge volume (gals): _____
Total purge time (min): 15 min Pump Intake Depth (ft btoc): _____

Bailer: ☐ Poly ☐ Teflon ☐ S.steel ☐ Other Describe: None, too little water
Bailer Volume (gals): _____ (0.25 / 0.33) Required Bailer Volumes: _____ Total purge volume (gals): 2.5 gal

8/29/19

Criteria for Stable Parameters

Parameter	Working Range (YSI 556MPS)	Stability Criteria	Depth to Water Stabilization	
			Time	DTW
Temperature	-5 to 45°C	± 1.0 °C		
pH	0 to 14 NTU	± 0.1		
Conductivity	0 to 200 mS/cm	± 3%		
ORP	-999 to +999 mV	± 10 mV		
Dissolved Oxygen	0 to 50 mg/L	± 10% or 0.2 mg/L		
Turbidity	0 to 1000 NTU	± 10% (≤10 NTU)		

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	1504	5.49	0.1			489			
2	1510	5.49	0.5			59.8			
3	1510	5.49	—			52.2			
4	1513	5.50	1.5			21.2			
5	1516	5.50	—			10.1			
6	1519	5.50	2.5			8.60			
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear), Amber, Tan, Brown, Grey, Milky White, Other:
Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, (Low), Medium, High, Very Turbid, Heavy Silts

Comments:

Revised February 2010.

ch2m

WELL DEVELOPMENT DATASHEET, cont'd.

Well ID: _____

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
10									
11									
12									
13									
14									
15									
16									
17									
18									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Additional Comments: (decon procedures, purge waster disposal, other)

FB07
1930

WELL DEVELOPMENT DATASHEET

SHEET 1 OF

Well ID: NARL-505-TW03

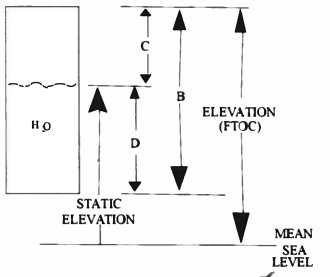
Project: Former NARL Barrow PFAS SI
Date: 8/28/19
Location: BARROW, AK
Start Time: 1735
Project #: 704758 CH.07
End Time: 1900
Development Contractor/Geologist: GRO TRK AK / N. BAROW #T. DAVIES
Field Notebook #:
Date Well Installed: 8/27/19 1617

Well Information and Purge Volume Calculation

Casing ID (inch):	Unit Casing Volume (A) (gal/ft):
0.75	0.02
1	0.04
1.5	0.09
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
7	2.00
8	2.61
10	4.08
12	5.88

Total Well Depth (B) (ft btoc): 5.55
Depth to Water (C) (ft btoc): - 5.3
Length of Static Water Column in Well (feet):
(B - C = D) = 0.25

Unit Casing Volume (A) (gal/ft): x 0.16
Well Casing Volume (E) (gal):
(D x A = E) = 0.04
x 10 Vols
Total Purge Volume (F) (gal):
(E x 10 well volumes = F) = 0.4



Well Screened Interval (ft btoc): 5.55-3' (MP) Approx. Sediment Depth in Well (ft): 0

Development Methods

Method: ☐ Surging ☐ Pumping ☑ Bailing ☐ Other Describe:
Surge time per interval (min): Number of development intervals:
Pump: ☐ Perist. ☐ Bladder ☐ Subm. ☐ Other Describe:
Purge time per interval (min): Purge Flow Rate (gpm): Total purge volume (gals):
Total purge time (min): Pump Intake Depth (ft btoc):
Bailer: ☐ Poly ☐ Teflon ☐ S.steel ☑ Other Describe:
Bailer Volume (gals): 0.5 (0.25 / 0.33) Required Bailer Volumes: Total purge volume (gals):

Criteria for Stable Parameters

Parameter	*Working Range (YSI 556MPS)*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	-5 to 45°C	± 1.0 °C		
pH	0 to 14 NTU	± 0.1		
Conductivity	0 to 200 mS/cm	± 3%		
ORP	-999 to +999 mV	± 10 mV		
Dissolved Oxygen	0 to 50 mg/L	± 10% or 0.2 mg/L		
Turbidity	0 to 1000 NTU	± 10% (≤10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	18:11	[illegible]							
2	18:24	5.3							
3	18:26	5.37				711			
4	18:28	5.38				461			
5	18:30	5.38	1.5			422			
6	18:32	5.38	2			323			
7	18:34	5.38	2.4			327			
8	18:36	5.38	2.8			218			
9	18:38	5.38	3.2			184			

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments: Conducted well Development Purge Data to be low rate test used Peristaltic Pump and Bailer

Revised February 2010.

ch2m

WELL DEVELOPMENT DATASHEET, cont'd.

Well ID: NAFL-SOS-TW03

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
10	18:40	5.38	3.6			182			
11	18:42	5.38	4			164			
12	18:44	5.38	4.4			154			
13	18:48	5.38	[illegible]			114			
14	18:52	5.38	5.8			103			
15	18:54	5.38	6.2			110			
16	18:58	5.38	7			100			
17									
18									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Additional Comments: (decon procedures, purge waster disposal, other)

WELL DEVELOPMENT DATASHEET

SHEET 1 OF 1

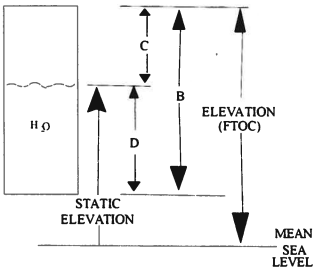
Well ID: NARL-SDS-TW05

Project: NARL Barrow PFAS SI
Location: Barrow, Alaska
Project #: 704758 CH
Development Contractor/Geologist: Geotek and CH2M/Jacobs
Field Notebook #: 1
Date: 8/29/19
Start Time: 0912
End Time: 0913
Date Well Installed: 8/28/19

Well Information and Purge Volume Calculation

Casing ID (inch):	Unit Casing Volume (A) (gal/ft):
0.75	0.02
1	0.04
1.5	0.09
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
7	2.00
8	2.61
10	4.08
12	5.88

Total Well Depth (B) (ft btoc): _____
Depth to Water (C) (ft btoc): - _____
Length of Static Water Column in Well (feet): (B - C = D) = _____
Unit Casing Volume (A) (gal/ft): x _____
Well Casing Volume (E) (gal): (D x A = E) = _____
x 10
Total Purge Volume (F) (gal): (E x 10 well volumes = F) = _____



Well Screened Interval (ft btoc): _____ Approx. Sediment Depth in Well (ft): _____

Development Methods

Method: ☐ Surging ☐ Pumping ☐ Bailing ☐ Other Describe: _____
Surge time per interval (min): _____ Number of development intervals: _____
Pump: ☐ Perist. ☐ Bladder ☐ Subm. ☐ Other Describe: _____
Purge time per interval (min): _____ Purge Flow Rate (gpm): _____ Total purge volume (gals): _____
Total purge time (min): _____ Pump Intake Depth (ft btoc): _____
Bailer: ☐ Poly ☐ Teflon ☐ S.steel ☐ Other Describe: _____
Bailer Volume (gals): _____ (0.25 / 0.33) Required Bailer Volumes: _____ Total purge volume (gals): _____

Criteria for Stable Parameters

Parameter	*Working Range (YSI 556MPS)*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	-5 to 45°C	± 1.0 °C		
pH	0 to 14 NTU	± 0.1		
Conductivity	0 to 200 mS/cm	± 3%		
ORP	-999 to +999 mV	± 10 mV		
Dissolved Oxygen	0 to 50 mg/L	± 10% or 0.2 mg/L		
Turbidity	0 to 1000 NTU	± 10% (≤10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	0912	DRY							
2	1357	DRY							
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

ch2m

WELL DEVELOPMENT DATASHEET, cont'd.

Well ID: _____

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
10									
11									
12									
13									
14									
15									
16									
17									
18									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Additional Comments: (decon procedures, purge waster disposal, other)

WELL DEVELOPMENT DATASHEET

SHEET 1 OF 1

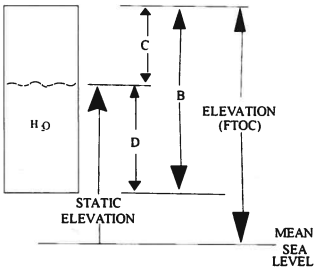
Well ID: NARL SOS TW06

Project: Former NARL Barrow PFAS SI
Location: Barrow, AK
Project #: 704758.CH
Development Contractor/Geologist: Geotek/CH2M Jacobs
Field Notebook #: 1
Date: 8/29/19
Start Time: 0915
End Time: 0915
Date Well Installed: 8/28/19

Well Information and Purge Volume Calculation

Casing ID (inch):	Unit Casing Volume (A) (gal/ft):
0.75	0.02
1	0.04
1.5	0.09
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
7	2.00
8	2.61
10	4.08
12	5.88

Total Well Depth (B) (ft btoc): _____
Depth to Water (C) (ft btoc): - _____
Length of Static Water Column in Well (feet):
(B - C = D) = _____
Unit Casing Volume (A) (gal/ft): x _____
Well Casing Volume (E) (gal):
(D x A = E) = _____
x 10
Total Purge Volume (F) (gal):
(E x 10 well volumes = F) = _____



Well Screened Interval (ft btoc): _____ Approx. Sediment Depth in Well (ft): _____

Development Methods

Method: ☐ Surging ☐ Pumping ☐ Bailing ☐ Other Describe: _____
Surge time per interval (min): _____ Number of development intervals: _____
Pump: ☐ Perist. ☐ Bladder ☐ Subm. ☐ Other Describe: _____
Purge time per interval (min): _____ Purge Flow Rate (gpm): _____ Total purge volume (gals): _____
Total purge time (min): _____ Pump Intake Depth (ft btoc): _____
Bailer: ☐ Poly ☐ Teflon ☐ S.steel ☐ Other Describe: _____
Bailer Volume (gals): _____ (0.25 / 0.33) Required Bailer Volumes: _____ Total purge volume (gals): _____

Criteria for Stable Parameters

Parameter	*Working Range (YSI 556MPS)*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	-5 to 45°C	± 1.0 °C		
pH	0 to 14 NTU	± 0.1		
Conductivity	0 to 200 mS/cm	± 3%		
ORP	-999 to +999 mV	± 10 mV		
Dissolved Oxygen	0 to 50 mg/L	± 10% or 0.2 mg/L		
Turbidity	0 to 1000 NTU	± 10% (≤10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	0915	DRY							
2	1355	DRY							
3									
4									
5									
6	/								
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

Revised February 2010.

1341 8/29/19
TW04 — DRY
1345 8/29/19
TW02 - 0.12" water

ch2m

WELL DEVELOPMENT DATASHEET, cont'd.

Well ID: _____

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
10									
11									
12									
13									
14									
15									
16									
17									
18									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Additional Comments: (decon procedures, purge waster disposal, other)

WELL DEVELOPMENT DATASHEET

SHEET 1 OF 1

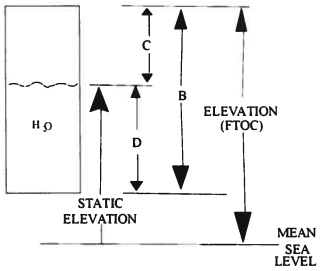
Well ID: NARL-SCS--TW07

Project: NARL Barrow PFAS SI
Location: Barrow, AK
Project #: 704758 CH
Development Contractor/Geologist: Brockk and CH2M/Jacobs
Field Notebook #: 2
Date: 8/29/18
Start Time: 0918
End Time: 0918
Date Well Installed: 8/28/19

Well Information and Purge Volume Calculation

Casing ID (inch):	Unit Casing Volume (A) (gal/ft):
0.75	0.02
1	0.04
1.5	0.09
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
7	2.00
8	2.61
10	4.08
12	5.88

Total Well Depth (B) (ft btoc): _____
Depth to Water (C) (ft btoc): - _____
Length of Static Water Column in Well (feet):
(B - C = D) = _____
Unit Casing Volume (A) (gal/ft): x _____
Well Casing Volume (E) (gal):
(D x A = E) = _____
x 10
Total Purge Volume (F) (gal):
(E x 10 well volumes = F) = _____



Well Screened Interval (ft btoc): _____ Approx. Sediment Depth in Well (ft): _____

Development Methods

Method: ☐ Surging ☐ Pumping ☐ Bailing ☐ Other Describe: _____
Surge time per interval (min): _____ Number of development intervals: _____
Pump: ☐ Perist. ☐ Bladder ☐ Subm. ☐ Other Describe: _____
Purge time per interval (min): _____ Purge Flow Rate (gpm): _____ Total purge volume (gals): _____
Total purge time (min): _____ Pump Intake Depth (ft btoc): _____
Bailer: ☐ Poly ☐ Teflon ☐ S.steel ☐ Other Describe: _____
Bailer Volume (gals): _____ (0.25 / 0.33) Required Bailer Volumes: _____ Total purge volume (gals): _____

Criteria for Stable Parameters

Parameter	*Working Range (YSI 556MPS)*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	-5 to 45°C	± 1.0 °C		
pH	0 to 14 NTU	± 0.1		
Conductivity	0 to 200 mS/cm	± 3%		
ORP	-999 to +999 mV	± 10 mV		
Dissolved Oxygen	0 to 50 mg/L	± 10% or 0.2 mg/L		
Turbidity	0 to 1000 NTU	± 10% (≤10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	0918	DRY							
2	1352	DRY							
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

ch2m

WELL DEVELOPMENT DATASHEET, cont'd.

Well ID: _____

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
10									
11									
12									
13									
14									
15									
16									
17									
18									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Additional Comments: (decon procedures, purge waster disposal, other)

WELL DEVELOPMENT DATASHEET

ch2m

SHEET 1 OF two

Well ID: NARL-505

Project: Fort Barron PFAS SI

Location: Barrow

Project #:

Development Contractor/Geologist: Tomas Davey / Geotech

Field Notebook #:

Date: 9/29/19

Start Time: 13:50

End Time: 14:38

Date Well Installed: 9/28/19

Well Information and Purge Volume Calculation

Casing ID (inch):	Unit Casing Volume (A) (gal/ft):
0.75	0.02
1	0.04
1.5	0.09
2	0.16
3	0.37
4	0.65
5	1.02
6	1.47
7	2.00
8	2.61
10	4.08
12	5.88

Total Well Depth (B) (ft btoc): 5.35

Depth to Water (C) (ft btoc): -3.77

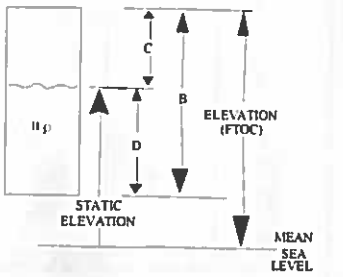
Length of Static Water Column in Well (feet): (B - C = D) = 1.58

Unit Casing Volume (A) (gal/ft): x 0.16

Well Casing Volume (E) (gal): (D x A = E) = 0.2528

x 10

Total Purge Volume (F) (gal): (E x 10 well volumes = F) = 2.528



Well Screened Interval (ft btoc): _____ Approx. Sediment Depth in Well (ft): _____

Development Methods

Method: ☐ Surging ☐ Pumping ☑ Bailing ☑ Other Describe: _____

Surge time per interval (min): _____ Number of development intervals: _____

Pump: ☐ Perist. ☐ Bladder ☑ Subm. ☐ Other Describe: _____

Purge time per interval (min): _____ Purge Flow Rate (gpm): _____ Total purge volume (gals): 14

Total purge time (min): _____ Pump Intake Depth (ft btoc): _____

Bailer: ☐ Poly ☐ Teflon ☑ S.steel ☐ Other Describe: _____

Bailer Volume (gals): _____ (0.25 / 0.33) Required Bailer Volumes: _____ Total purge volume (gals): 8

Criteria for Stable Parameters

Parameter	Working Range (YSI 556MPS)	Stability Criteria	Depth to Water Stabilization	
			Time	DTW
Temperature	-5 to 45°C	± 1.0 °C		
pH	0 to 14 NTU	± 0.1		
Conductivity	0 to 200 mS/cm	± 3%		
ORP	-999 to +999 mV	± 10 mV		
Dissolved Oxygen	0 to 50 mg/L	± 10% or 0.2 mg/L		
Turbidity	0 to 1000 NTU	± 10% (≤10 NTU)		

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1	12:15	pump on							
2	12:16	3P	13						
3	12:14	6P	19	pump off					
4	14:30	3P	pump on						
5	14:32		21	7.74	0.834	337	2.02	1.14	154
6	14:34		23	7.92	0.840	295	1.23	1.12	137
7	14:36		27	7.95	"	273	"	"	"
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, (Brown), Grey, Milky White, Other:

Odor: (None) Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, Low, Medium, High, (Very Turbid,) Heavy Silts

Comments: DP: below Pump
Surged with pump in between pumping events

Revised February 2010.

ch2m

WELL DEVELOPMENT DATASHEET, cont'd.

Well ID: _____

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
10									
11									
12									
13									
14									
15									
16									
17									
18									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Additional Comments: (decon procedures, purge waster disposal, other)

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: NAFL 505-TW01

Project: NAFL (AFFF) PFAS 51

Date: 8/29/19

Start Time: 1735

End Time: 1823

Field Team: M. RADFORD

Sample ID: NAFL-505-TW01-0819 Time: 1815 primary dup other:

Sample ID: NAFL-505-TW01P-0819 Time: 1820 primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):				Depth to Water (FTOC):	6.97
Depth to Oil/Water Interface (FTOC):				Total Depth (FTOC):	10.92
Casing diameter:	1 in.	2 in.	4 in.	Water Column (Ft):	3.25
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	0.53
Pump Intake Depth		8.5		Screen Interval	5.72-10.22
Stable DTW (FTOC):		7.41		Measured Stickup	2.55

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: PERI	Flow Rate (gpm): 200 mL/min
Pump Time: 31	Vol. Purged (gals): 7.41
	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1	1811	7.41
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1740	7.15	.25	7.09	.745	151	1.05	2.77	-29
2	1745	7.30	.5	6.91	.425	25.5	1.12	2.55	-35
3	1750	7.36	.75	6.87	.394	12.5	0.48	2.36	-51
4	1755	7.37	1.00	6.89	.397	8.66	0.0	2.20	-62
5	1800	7.39	1.25	6.91	.404	8.13	0.0	2.16	-69
6	1805	7.41	1.5	6.95	.436	9.85	0.0	2.06	-74
7	1808	7.41	1.75	6.97	.485	12.4	0.0	2.00	-78
8	1811	7.41	2.0	6.98	.596	15.5	0.0	1.99	-83
9									

≈200mL/min

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:

Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments: PID = 53.9 IN HEADSPACE, BZ=0.0 PPM

AT COND. SENSOR DRIFTING, ALL OTHER PARAMETERS STABLE

ch2m

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: _____

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: NAEL-SOS-TW02

Project: NAEL PFAS S1 Date: 8/30/19

Start Time: 1536

Field Team: M. RADFORD End Time: 1610

Sample ID: NAEL-SOS-TW02-0819 Time: primary dup other: 1608

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):			—	Depth to Water (FTOC):	5.48
Depth to Oil/Water Interface (FTOC):			—	Total Depth (FTOC):	5.54
Casing diameter:	1 in.	2 in.	4 in.	Water Column (Ft):	0.06
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	0.01
Pump Intake Depth			5.53	Screen Interval	2.54 - 5.54
Stable DTW (FTOC):			5.51	Measured Stickup	—

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:
Pump Type: PERI Flow Rate (gpm): 250 mL/min
Pump Time: 24 min Vol. Purged (gals): 2.5

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization* Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1543	5.51	.2	7.96	4.05	45.4	12.28	2.88	93
2	1546	5.51	.3	7.98	4.12	18.2	11.77	2.40	90
3	1549	5.51	.5	7.98	4.13	11.3	11.72	2.31	90
4	1552	5.51	.9	7.98	4.15	6.73	12.86	2.18	91
5	1555	5.51	1.3	7.97	4.16	5.58	12.~~85~~ MS	2.07	91
6	1558	5.51	1.7	7.97	4.17	4.67	12.20	2.00	92
7	1601	5.51	2.1	7.97	4.18	5.55	12.17	1.96	92
8	1604	5.51	2.5	7.99	4.21	6.19	12.14	1.75	91
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear), Amber, Tan, Brown, Grey, Milky White, Other:
Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: (None), Low, Medium, High, Very Turbid, Heavy Silts

Comments: PID = 0.9 PPM (HIGH SCALE) BL = 0.0

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: _____

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	**Size**	**Bottle Type**	**Laboratory Analysis**

Additional Comments: (decon procedures, purge waster disposal, other)

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: NAVL-SOS-TW03

Project: NAVL BARROW PFAS SI

Date: 8/30/19

Start Time: ~~1037~~ 1042

Field Team: M. RADFORD

End Time: 1110

Sample ID: NAVL-SOS-TW03 Time: 1104 (primary) dup other: 1

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Filtered? Y (N) 0.45um/1.0um

Depth to Top of Product (FTOC):			—	Depth to Water (FTOC):	5.38
Depth to Oil/Water Interface (FTOC):			—	Total Depth (FTOC):	5.55
Casing diameter:	1 in.	2 in.	4 in.	Water Column (Ft):	0.17
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	0.03
Pump Intake Depth			5.45	Screen Interval	3.55-3
Stable DTW (FTOC):			5.39	Measured Stickup	N/A

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:
Pump Type: PERI Flow Rate (gpm): ~200 ml/min
Pump Time: 25 mins Vol. Purged (gals): 1.4

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1	1104	5.39
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
(PZ) 1	~~1045~~	~~5.39~~	~~.2~~	~~4.16~~	~~0.002~~	~~8.38~~	~~12.94~~	~~8.63~~	~~301~~
2	~~1050~~	~~5.39~~	~~.5~~	~~4.10~~	~~0.002~~	~~4.91~~	~~12.94~~	~~8.63~~	~~301~~
3	~~1055~~	~~5.39~~	~~.75~~	~~4.16~~	~~0.002~~	~~4.44~~	~~12.94~~	~~8.63~~	
4	1055	5.39	.75	7.42	4.09	4.44	12.03	0.82	179
5	1058	5.39	1.0	7.45	4.09	4.19	11.25	0.79	179
6	1101	5.39	1.25	7.48	4.09	4.28	11.24	0.76	175
7	1104	5.39	1.4	7.49	4.09	4.16	11.26	0.71	172
8									
9									

350 ml/min
200 ml/min

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear,) Amber, Tan, Brown, Grey, Milky White, Other:
Odor: (None,) Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: (None,) Low, Medium, High, Very Turbid, Heavy Silts

Comments:
PID = 0.1 ppm, HORIBA SETTINGS INITIALLY INCORRECT

ch2m

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: _____

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis

Additional Comments: (decon procedures, purge waster disposal, other)

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: NARL-SOS-TW08

Project: NARL BARROW PFAS 21 Date: 8/30/19

Start Time: 1438

Field Team: M. RADFORD End Time:

Sample ID: NARL-SOS-TW08-0819 Time: 1505 primary dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):			—	Depth to Water (FTOC):	~~3.82~~ 3.85
Depth to Oil/Water Interface (FTOC):			—	Total Depth (FTOC):	5.35
Casing diameter:	1 in.	2 in.	4 in.	Water Column (Ft):	1.5
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	0.24
Pump Intake Depth			4.5	Screen Interval	2.35 - 5.35
Stable DTW (FTOC):			3.85	Measured Stickup	0.8

Method of Purging (circle one)

Pump: SUB BLDR PERIST OTHER:
Pump Type: PER1 Flow Rate (gpm): 200 ml/min
Pump Time: 25 min Vol. Purged (gals): 1.6

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 3% or min 0.2 °C	Time DTW
pH	0-14	± 0.1	
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10%	
ORP	-999 to +999 mV	± 10 mV	
Turbidity	0-800 NTU	± 10% (≥10 NTU)	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*	
1	1443	3.85	.1	8.01	0.709	254	1.85	6.98	131	300ml/min
2	1448	3.86	.3	8.09	.731	259	1.04	6.37	130	200ml/min
3	1451	3.87	.55	8.09	.727	259	1.24	6.11	130	
4	1455	3.88	.8	8.11	.729	254	1.42	5.94	128	
5	1459	3.87	1.1	8.11	.739	258	0.88	5.81	127	
6	1502	3.88	1.3	8.12	.741	259	0.83	5.73	125	
7	1505	3.88	1.6	8.12	.743	259	0.80	5.69	124	
8										
9										

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other:
Odor: None, Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, Low, Medium, High, Very Turbid, Heavy Silts

Comments:

ch2m

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: _____

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	**Size**	**Bottle Type**	**Laboratory Analysis**

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AS-wp-16D

Project: Former Narl Barrow, PFAS SI

Date: 8/21/19

Start Time: 14:45

Field Team: Tomos Davies

End Time: 15:30

Sample ID: NARL-SOS-wp-16D-0819 Time: 15:20 primary dup (other): MS/MSD

Sample ID: NARL-SOS-wp-16D-0819MS Time: 15:20 primary dup other:

Sample ID: NARL-SOS-wp-16D-0819SD Time: 15:20 primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):			–	Depth to Water (FTOC):	3.05
Depth to Oil/Water Interface (FTOC):			–	Total Depth (FTOC):	3.81
Casing diameter:	1 in.	(2 in)	4 in.	Water Column (Ft):	0.76
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	
Pump Intake Depth			3.4	Screen Interval	0.93
Stable DTW (FTOC):			3.06	Measured Stickup	1.53

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:

Pump Type: Flow Rate (~~gpm~~ mL): 215

Pump Time: Vol. Purged (gals):

Bailer: TEFLON SS OTHER:

Required Pulls: Bailer Vol. (gals): 0.25/ 0.33

Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 3% or min 0.2 °C	Time DTW
pH	0-14	± 0.1	
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10%	
ORP	-999 to +999 mV	± 10 mV	
Turbidity	0-800 NTU	± 10% (≥10 NTU)	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (~~gallons~~ L)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	14:45	3.05							
2	14:52	3.06	1	7.27	0.463	10.1	1.2	6.34	-64
3	14:58	3.06	2.5	7.09	0.479	6.71	0.47	5.55	-74
4	15:02	3.06	3.5	7.01	0.483	6.47	0	5.35	-77
5	15:06	3.06	4.5	6.98	0.486	5.91	0	5.27	-79
6	15:10	3.06	6	6.95	0.492	5.61	0	5.12	-82
7	15:14	3.06	7	6.95	0.496	5.45	0	5.02	-84
8	15:18	3.06	8	6.94	0.498	3.09	0	4.98	-85
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear), Amber, Tan, Brown, Grey, Milky White, Other:

Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: (None), Low, Medium, High, Very Turbid, Heavy Silts

Comments: PID: 0 ppm

ch2m

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: AS-WP-169

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
3 x 6	250mL	Poly	PFAS 18

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AFAS-WP-20

Project: NARL Barrow PFAS SI

Date: 08/21/19

Start Time: 10:15

End Time: 10:55

Field Team: Tomos Davies

Sample ID: NARL-AFAS-WP-20-0819 Time: 10:52 (primary) dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):			–	Depth to Water (FTOC):	2.3
Depth to Oil/Water Interface (FTOC):			–	Total Depth (FTOC):	3.22
Casing diameter:	1 in.	(2 in.)	4 in.	Water Column (Ft):	0.92
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	
Pump Intake Depth			2.4	Screen Interval	
Stable DTW (FTOC):			2.34	Measured Stickup	1.25

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:	Bailer: TEFLON SS OTHER:
Pump Type: Flow Rate (gpm): 140	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 3% or min 0.2 °C	Time 10:22 DTW 2.34
pH	0-14	± 0.1	
Conductivity	0-9.99 S/m	± 3%	
Dissolved Oxygen	0-19.99 mg/L	± 10%	
ORP	-999 to +999 mV	± 10 mV	
Turbidity	0-800 NTU	± 10% (≥10 NTU)	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	10:15	2.3							
2	10:22	2.34	1	6.14	0.785	[illegible] TU	0.64	4.4	29
3	10:26	2.34	1.6	6.12	0.841	[illegible] TU	0.14	3.98	13
4	10:30	2.34	2.8	6.10	0.900	[illegible] TU	0	3.76	-7
5	10:34	2.34	3.6	6.12	0.934	6.34	0	3.67	–
6	10:38	2.34	4.4	6.16	0.936	7.53	0	3.63	-25
7	10:42	2.34	5.2	6.2	0.962	5.46	0	3.57	-31
8	10:46	2.34	6	6.22	0.961	6.00	0	3.55	-35
9	10:50	2.34	6.8	6.25	0.980	5.82	0	3.52	-40

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color:	Clear, (Amber), Tan, Brown, Grey, Milky White, Other: Light amber
Odor:	None, Low, Medium, (High), Very Strong, H2S, (Fuel Like), Chemical ?, Unknown
Turbidity:	None, (Low), Medium, High, Very Turbid, Heavy Silts

Comments:

PID HEAD SPACE = 9.7 PPM LEL = 30%

BZ = 0.0 PPM

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: AFAS-MP-20

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	250mL	poly	PFAS 18

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AS-wp-18B

Project: Former NARL Barrow PFAS SI

Date: 08/21/19

Start Time: 11:48

End Time: 12:35

Field Team: Thomas Davies

Sample ID: NARL-SOS-wp-18B 0819 Time: 12:32 (primary) dup other:

Sample ID: _____ Time: _____ primary dup other: _____

Sample ID: _____ Time: _____ primary dup other: _____

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):			-	Depth to Water (FTOC):	2.54'
Depth to Oil/Water Interface (FTOC):			-	Total Depth (FTOC):	2.54 + 1.6
Casing diameter:	1 in.	(2 in.)	4 in.	Water Column (Ft):	1.66
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	1.66 · .163 = 2.27
Pump Intake Depth			3.3 ft	Screen Interval	2.5 - 4.2'
Stable DTW (FTOC):			2.57	Measured Stickup	1.60'

3 pt: 2.54 + 1.66

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:
Pump Type: Flow Rate (gpm): 240
Pump Time: Vol. Purged (gals):

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)* (L)	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	11:48	2.54							
2	11:55	2.6	4	6.64	0.811	40.9	0.02	4.39	-69
3	12:00	2.59	5	7.03	0.823	43.9	0	4.42	-92
4	12:05	2.58	6.2	7.07	0.809	46.7	0	4.47	-97
5	12:10	2.58	7.4	7.08	0.792	49.2	0	4.46	-104
6	12:15	2.59	8.2	7.07	0.762	53.2	0	4.44	-108
7	12:20	2.57	9.2	7.10	0.748	55.4	0	4.53	-111
8	12:25	2.58	10	7.11	0.728	55.8	0	4.61	-115
9	12:30	2.57	11	7.12	0.704	58.1	0	4.64	-117

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, (Amber), Tan, Brown, Grey, Milky White, Other: very pale amber yellow
Odor: (None) Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: None, (Low), Medium, High, Very Turbid, Heavy Silts

Comments:

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: AS-wp - 18B

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	250 mL	Poly	PFAS - 18

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AS-WP-10

Project: Former Naval Barrow PYASSL

Date: 08/20/19

Start Time: 15:04

End Time: 15:35

Field Team: Tomos Davies

Sample ID: NaRL-SOS-WP-10-0819 Time: 15:30 (primary) dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y/N 0.45um/1.0um

Depth to Top of Product (FTOC):			/	Depth to Water (FTOC):	2.81
Depth to Oil/Water Interface (FTOC):			/	Total Depth (FTOC):	4.4
Casing diameter:	1 in.	(2 in)	4 in.	Water Column (Ft):	
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	
Pump Intake Depth			3.4 ft bTOC	Screen Interval	
Stable DTW (FTOC):			2.45	Measured Stickup	2.19

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER: mLpm	Bailer: TEFLON SS OTHER:
Pump Type: Flow Rate (gpm): 230	Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Pump Time: Vol. Purged (gals):	Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*
Temperature	>0.00 °C	± 3% or min 0.2 °C	Time DTW
pH	0-14	± 0.1 ✓	
Conductivity	0-9.99 S/m	± 3% ✓	
Dissolved Oxygen	0-19.99 mg/L	± 10%	
ORP	-999 to +999 mV	± 10 mV	
Turbidity	0-800 NTU	± 10% (≥10 NTU) ✓	

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (~~gallons~~ L)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1501	2.81							
2	1504	Pump on							
3	1508	2.41	1	6.61	0.595		0	4.72	-66
4	1512	2.42	2	6.55	0.614		0	4.61	-83
5	1516	2.43	3	6.52	0.626	2.37	0	4.47	-101
6	1520	2.435	4	6.49	0.630	1.97	0	4.43	-109
7	1524	2.44	5	6.49	0.631	2.33	0	4.41	-112
8	1528	2.45	6	6.5	0.631	2.06	0	4.39	-116
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color:	Clear, Amber, Tan, Brown, Grey, Milky White, Other: yellow very pale
Odor:	None, (Low), Medium, High, Very Strong, H2S, (Fuel Like) Chemical ?, Unknown
Turbidity:	None, (Low) Medium, High, Very Turbid, Heavy Silts

Comments: sheen seen on tubing when purge stopped

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: AS-wp-10

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	150mL	Poly	PFAS - 18

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AS-WP-12

Project: NARL Barrow PFAS SI

Date: 8/20/19

Start Time: 14:22

End Time: 1700

Field Team: Nicole Baden, Maggie Radford

Sample ID: NARL-SOS-WP-12-0819 Time: 1700 (primary) dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y (N) 0.45um/1.0um

Depth to Top of Product (FTOC):		N/A	Depth to Water (FTOC):	13.5 TOC	
Depth to Oil/Water Interface (FTOC):		N/A	Total Depth (FTOC):	4.1 TOC	
Casing diameter:	1 in.	(2 in.) 4 in.	Water Column (Ft):	0.6	
gal/Ft of casing:	0.041	(0.163) 0.653	Casing Volume (gal)	0.098	
Pump Intake Depth		3.7' TOC	Screen Interval	2.53 - 4.23 TOC	
Stable DTW (FTOC):		See observations	Measured Stickup	2.1 ft	

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER: Bailer: TEFLON SS OTHER:

Pump Type: Flow Rate (gpm): 220 ml/min Required Pulls: Bailer Vol. (gals): 0.25/ 0.33

Pump Time: Vol. Purged (gals): ~~3.5~~ 3 gallons Vol Purged (gals): N/A

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1628	~~3.55~~ 3.55		6.85	0.366	15.5	3.84	4.68	-139
2	1631	~~3.54~~ 3.51		6.89	0.367	13.7	4.50	4.63	-143
3	1634	3.57		6.91	0.365	12.3	4.82	452	-147
4	1639	3.57		6.91	0.360	10.3	4.44	4.47	-153
5	1643	3.57		6.92	0.359	9.50	4.17	4.47	-156
6	1646	3.57		6.94	0.354	9.13	4.04	4.42	-159
7	1651	3.57	2.5	6.96	0.353	8.77	3.47	4.39	-162
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: Clear, Amber, Tan, Brown, Grey, Milky White, Other: Slightly yellow tint

Odor: None, Low, Medium, High, Very Strong, H2S, (Fuel Like) Chemical ?, Unknown

Turbidity: None, (Low) Medium, High, Very Turbid, Heavy Silts

Comments: lowered purge rate after first measurement, but pump increased to 280 ml/min

fuel odor in purge bucket, Slight sheen on purge water

ch2m

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: _____

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	250mL	poly	PFAS 18 compounds

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AS-WP-02C

Project: Former NARL Barrow PFAS SI

Date: 8/21/19

Start Time: 1456

Field Team: Nicole Bedon

End Time: 1537

Sample ID: NARL-SOS-WP-02C-0819 Time: 1530 (primary) dup other:

Sample ID: NARL-SOS-WP-02DP-0819 Time: 1535 primary (dup) other:

Sample ID: Time: primary dup other:

Filtered? Y (N) 0.45um/1.0um

Depth to Top of Product (FTOC):			N/A	Depth to Water (FTOC):	3.23	
Depth to Oil/Water Interface (FTOC):			N/A	Total Depth (FTOC):	4.16	
Casing diameter:	1 in.	(2 in.)	4 in.	Water Column (Ft):	0.93	
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	0.152	
Pump Intake Depth			3.5	Screen Interval	2.66 to 4.16' TOC	
Stable DTW (FTOC):			3.27	Measured Stickup	2.03	

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:
Pump Type: Flow Rate (gpm): 200 mL/min
Pump Time: Vol. Purged (gals): ~1.5 gal

Bailer: TEFLON SS OTHER:
Required Pulls: Bailer Vol. (gals): 0.25/ 0.33
Vol Purged (gals):

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1501	3.27		7.16	2.97	13.6	0.76	4.08	74
2	1504	3.28		7.32	3.03	7.49	0.00	3.31	39
3	1507	3.28	(1.5)	7.31	3.05	4.91	0.00	3.12	29
4	1515	3.29		7.27	3.09	3.38	0.00	2.89	20
5	1518	3.27		7.26	3.12	3.16	0.00	2.66	19
6	1521	3.27		7.24	3.13	2.96	0.00	2.59	18
7	1524	3.27	~1.5	7.23	3.15	2.71	0.00	2.53	18
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear), Amber, Tan, Brown, Grey, Milky White, Other:
Odor: (None), Low, Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown
Turbidity: (None), Low, Medium, High, Very Turbid, Heavy Silts

Comments: PID = 0.2 ppm TD = 4.16 TOC Screen = 1.5 ft Interval = 2.66 to 4.16

ch2m

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: AS-WP-02C

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	250 ML	poly	PFAS 18 Compounds

Additional Comments: (decon procedures, purge waster disposal, other)

ch2m

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AFAS-WP-21

Project: NAPL Barrow PFAS SI

Date: 8/21/19

Start Time: 1122

End Time: 1153

Field Team: Nicole Barlow, Maggie Radford

Sample ID: NAPL-AFAS-WP-21 Time: 1147 (primary) dup other:

Sample ID: Time: primary dup other:

Sample ID: Time: primary dup other:

Filtered? Y (N) 0.45um/1.0um

Depth to Top of Product (FTOC):			N/A	Depth to Water (FTOC):	3.22	
Depth to Oil/Water Interface (FTOC):			N/A	Total Depth (FTOC):	5.60	
Casing diameter:	1 in.	(2 in.)	4 in.	Water Column (Ft):	2.38	
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	0.39	
Pump Intake Depth			~4.5 ft	Screen Interval	3.95-5.60	
Stable DTW (FTOC):			3.24	Measured Stickup	2.30	

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:		Bailer: TEFLON SS OTHER:	
Pump Type:	Flow Rate (gpm): 240 mL/min	Required Pulls:	Bailer Vol. (gals): 0.25/ 0.33
Pump Time:	Vol. Purged (gals): ~2 gal	Vol Purged (gals):	

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1125	3.23		7.19	1.06	2.48	1.59	4.27	-154
2	1128	3.23		7.18	1.03	1.84	1.10	4.10	-146
3	1131	3.23		7.16	1.03	1.19	~~1.19~~ 1.98	4.09	-144
4	1134	3.23		7.14	1.03	0.79	0.90	4.05	-144
5	1137	3.24		7.13	1.03	0.81	0.82	4.04	-144
6	1140	3.24		7.11	1.03	0.71	0.72	4.05	-143
7	1143	3.24	~2 gall.	7.10	1.03	0.87	0.64	4.06	-143
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color: (Clear) Amber, Tan, Brown, Grey, Milky White, Other:

Odor: None, (Low) Medium, High, Very Strong, H2S, Fuel Like, Chemical ?, Unknown

Turbidity: (None) Low, Medium, High, Very Turbid, Heavy Silts Some black floaters

Comments: PID = 0.0 ppm TD = 3.30 ft bgs Screen = 1.65

Stick up = 2.30 ft

5.60 'TOC Screen = 3.95' to 5.60' TOC

ch2m·

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: AFAS-WP-21

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	250mL	Poly	PFAS 18 compounds

Additional Comments: (decon procedures, purge waster disposal, other)

See SAP and project instructions

ch2m

WELL PURGE AND SAMPLING FIELD SHEET

Well ID: AS-WP-11

Project: Former NARL Barrow PFAS S-C

Date: 8/21/19

Start Time: ~~0935~~ 0933

End Time: 1039

Field Team: Nicole Badon, Maggie Radford

Sample ID: NARL-SOS-WP-11-~~0824~~0819 Time: ~~09:38~~ (primary) dup other:

Sample ID: _____ Time: 10:33 primary dup other:

Sample ID: _____ Time: _____ primary dup other:

Filtered? Y (N) 0.45um/1.0um

Depth to Top of Product (FTOC):				Depth to Water (FTOC):	3.21' TOC
Depth to Oil/Water Interface (FTOC):				Total Depth (FTOC):	4.77
Casing diameter:	1 in.	(2 in.)	4 in.	Water Column (Ft):	1.67
gal/Ft of casing:	0.041	0.163	0.653	Casing Volume (gal)	0.27
Pump Intake Depth		~4 Ft		Screen Interval	2.87-4.77
Stable DTW (FTOC):		3.56		Measured Stickup	2.30

Method of Purging (circle one)

Pump: SUB BLDR (PERIST) OTHER:		Bailer: TEFLON SS OTHER:	
Pump Type:	Flow Rate (~~gpm~~): 240 mL/min	Required Pulls:	Bailer Vol. (gals): 0.25/ 0.33
Pump Time:	Vol. Purged (gals): 2.0	Vol Purged (gals):	

Criteria for Stable Parameters

Parameter	*Working Range*	*Stability Criteria*	*Depth to Water Stabilization*	
			Time	DTW
Temperature	>0.00 °C	± 3% or min 0.2 °C		
pH	0-14	± 0.1		
Conductivity	0-9.99 S/m	± 3%		
Dissolved Oxygen	0-19.99 mg/L	± 10%		
ORP	-999 to +999 mV	± 10 mV		
Turbidity	0-800 NTU	± 10% (≥10 NTU)		

Instrument Observations

Round	*Time*	*Water Level (ft BTOC)*	*Volume Purged (gallons)*	*pH*	*Cond (mS/cm)*	*Turbidity (NTU)*	*DO (mg/L)*	*Temp (C)*	*ORP (mV)*
1	1002	3.44		6.53	0.803	4.52	2.81	6.53	-115
2	1005	3.50		6.61	0.790	4.59	2.78	5.30	-125
3	1008	3.56		6.57	0.769	4.60	2.13	5.08	-127
4	1011	3.56		6.58	0.771	4.48	1.91	4.92	-129
5	1014	3.56		6.56	0.768	4.47	1.55	4.83	-131
6	1018	3.56		6.55	0.761	4.58	1.31	4.78	-131
7	1021	3.56		6.53	0.775	4.52	1.03	4.79	-132
8	1024	3.56		6.53	0.772	4.41	0.93	4.89	-133
9	1027	3.56	~2.0	6.51	0.757	4.51	0.68	4.77	-132

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sensory Observations

Color:	Clear, Amber, Tan, Brown, Grey, Milky White, Other: light yellow tint
Odor:	None, Low, Medium, High, Very Strong, H2S, (Fuel Like), Chemical ?, Unknown
Turbidity:	(None) Low, Medium, High, Very Turbid, Heavy Silts

Comments: PID Headspace = 0.0 ppm. TD= 2.47' bgs Screen 1.9' long
Stickup: 2.30
4.77' TOC Screen 2.87' to 4.77' TOC

ch2m

WELL PURGE AND SAMPLING FIELD SHEET, cntd.

Well ID: AS-WP-11

Instrument Observations

Round	Time	Water Level (ft BTOC)	Volume Purged (gallons)	pH	Cond (mS/cm)	Turbidity (NTU)	DO (mg/L)	Temp (C)	ORP (mV)
1									
2									
3									
4									
5									
6									
7									
8									
9									

Notes: Draw-down should ideally be less than 0.3 feet from the original depth to groundwater.
Minimal draw-down achieved and measured by: 1) pumping at a low rate (approximately 1 liter/ 3 minutes or .1 gal/min) and 2) continually measuring water levels in the well.

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	250 mL	poly	PFAS 18

Additional Comments: (decon procedures, purge waster disposal, other)

Appendix E
Field Activity Photo Log

PHOTOGRAPH LOG

Team: CH2M Personnel	**Date:** August and September 2019
Weather: Overcast and Rainy	
Name of Base/Site: Former NARL Barrow	

Photo #	*View, Direction*	*Location/Description*
		
Photo 1 (Above)	Northwest	Standing at Potential Crash Site B, facing northwest to Arctic Ocean adjacent to Site.
		
Photo 2 (Above)	North	Ground penetrating radar utility locating by contractor at Potential Crash Site B.

		
Photo 3 (Above)	East	Utility location near Building 136 in the vicinity of SO09.
		
Photo 4 (Above)	North	Utility location of SO09 near Building 136.



Photo 5 (Above)	Northeast	Cleared sample location SO10 near Building 136.



Photo 6 (Above)	Southeast	Cleared sample location TW01/SO01 near Building 136.



Photo 7 (Above)	Southwest	Cleared sample location TW01/SO01 near Building 136 and adjacent potential utilities.



Photo 8 (Above)	South	Flooded area behind Building 136.



Photo 9 (Above)	Northwest	Cleared sample location SO11 near Building 136 and adjacent potential utilities.



Photo 10 (Above)	North	Cleared sample location TW04/SO04 at Potential Crash Site A.



Photo 11 (Above)	North	Cleared sample location TW04/SO04 at Potential Crash Site A.



Photo 12 (Above)	North	Cleared sample location TW04/SO04 at Potential Crash Site A.



Photo 13 (Above)	Northwest	Cleared sample location TW03/SO03 at Potential Crash Site A.



Photo 14 (Above)	Northeast	Cleared sample location TW03/SO03 at Potential Crash Site A.



Photo 15 (Above)	North	Cleared sample location TW05/SO05 at Potential Crash Site A.



Photo 16 (Above)	West	Cleared sample location TW07/SO07 at Potential Crash Site B.



Photo 17 (Above)	North	Cleared sample location TW07/SO07 at Potential Crash Site B.



Photo 18 (Above)	Northeast	Cleared sample location TW07SO07 at Potential Crash Site B.



Photo 19 (Above)	South	Cleared sample location TW05/SO05 at Potential Crash Site B.



Photo 20 (Above)	Southwest	Cleared sample location TW06/SO06 at Potential Crash Site B.



Photo 21 (Above)	North	Cleared sample location TW08/SO08 at Potential Crash Site B.



Photo 22 (Above)	West	Cleared sample location TW08/SO08 at Potential Crash Site B.



Photo 23 (Above)	NA	Representative permafrost soil sample core.



Photo 24 (Above)	NA	Representative permafrost soil sample core.



Photo 25 (Above)	North	Direct push technology drill rig setting up at sample location TW05/SO05.

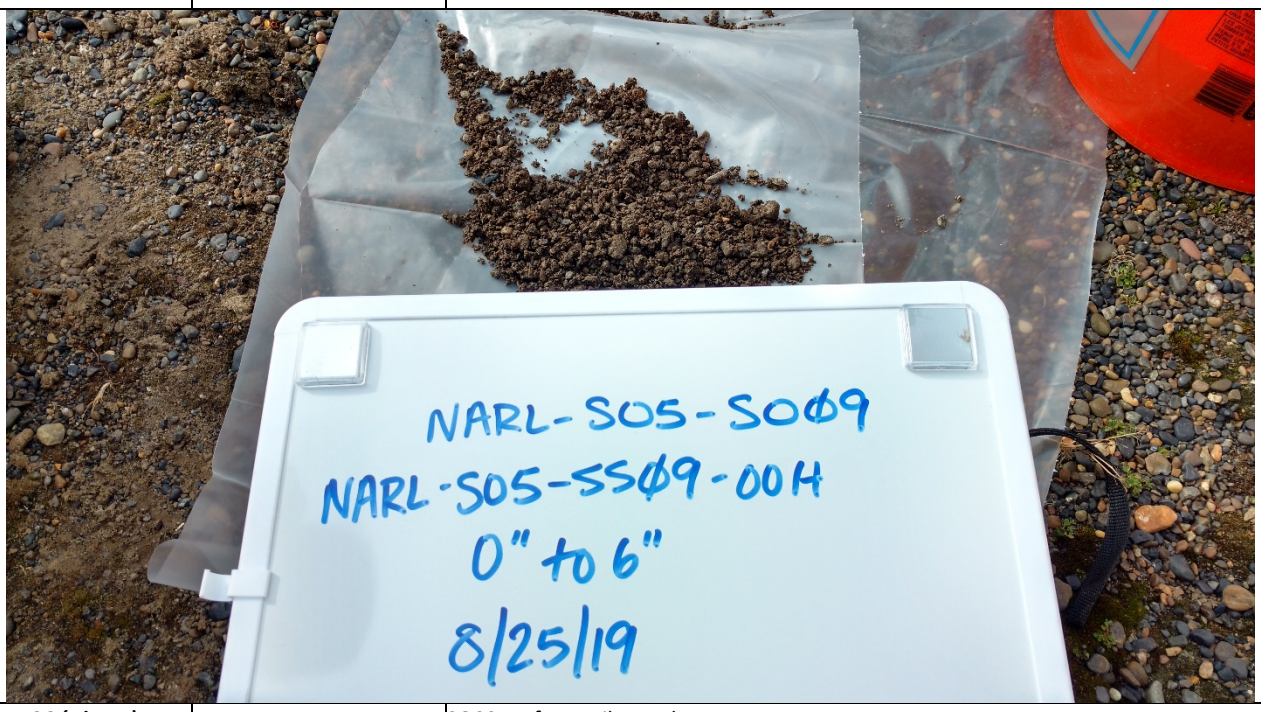


Photo 26 (Above)	NA	SO09 surface soil sample.



Photo 27 (Above)	NA	SO09 0- to 1-foot bgs soil sample.



Photo 28 (Above)	NA	SO09 3.5- to 4-foot bgs soil sample.



Photo 29 (Above)	NA	SO09 3.8- to 4.2-foot bgs soil sample.



Photo 30 (Above)	Southeast	Surface water sampling SW01 at Imikpuk Lake.



Photo 31 (Above)	South	Direct push technology drill rig soil sampling at TW01/SO01.



Photo 32 (Above)	Southeast	Direct push technology drill rig soil sampling at TW01/SO01.



Photo 33 (Above)	NA	Example of soil from direct push technology drill rig soil core at TW01/SO01.



Photo 34 (Above)	East	Direct push technology drill rig soil sampling at TW04/SO04.



Photo 35 (Above)	North	Gauging at TW07/SO07.



Photo 36 (Above)	North	Direct push technology drill rig soil sampling at TW05/SO05.

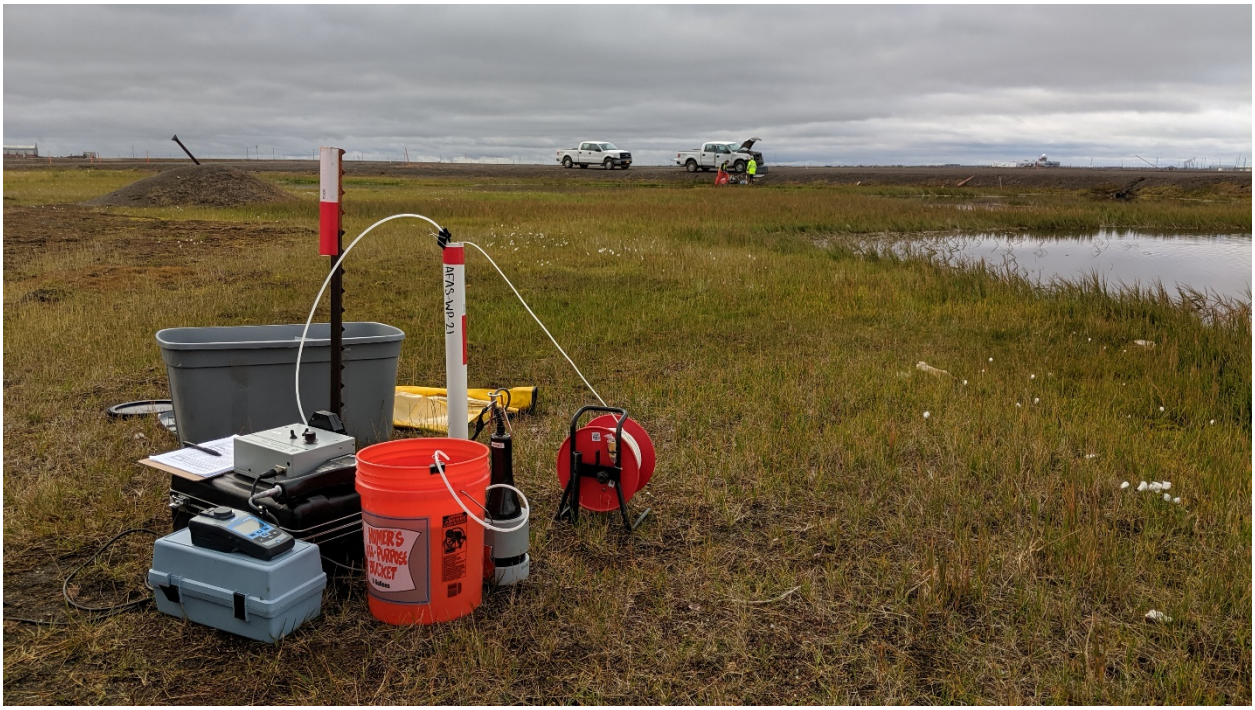


Photo 37 (Above)	East	Temporary monitoring well development of AFAS-WP-21.



Photo 38 (Above)	Northeast	Surface water sampling SW02 at Imikpuk Lake.



Photo 39 (Above)	Southeast	Surface water sampling SW01 at Imikpuk Lake.



Photo 40 (Above)	North	Surface water sampling SW04 at Imikpuk Lake.



Photo 41 (Above)	North	Surface water sampling SW04 at Imikpuk Lake.



Photo 42 (Above)	Southeast	Surface water sampling SW01 at Imikpuk Lake.



Photo 43 (Above)	Southeast	Surface water sampling SW01 at Imikpuk Lake.



Photo 44 (Above)	Southeast	Surface water sampling SW01 at Imikpuk Lake.



Photo 45 (Above)	Northeast	Hand augering utility clearance prior to direct push drilling TW01/SO01 at Building 136.



Photo 46 (Above)	NA	Hand augering utility clearance prior to direct push drilling TW01/SO01 at Building 136.



Photo 47 (Above)	NA	Hand augering utility clearance prior to direct push drilling TW01/SO01 at Building 136.



Photo 48 (Above)	NA	Soil core from sample location TW01/SO01.



Photo 49 (Above)	NA	Soil core from sample location TW01/SO01.

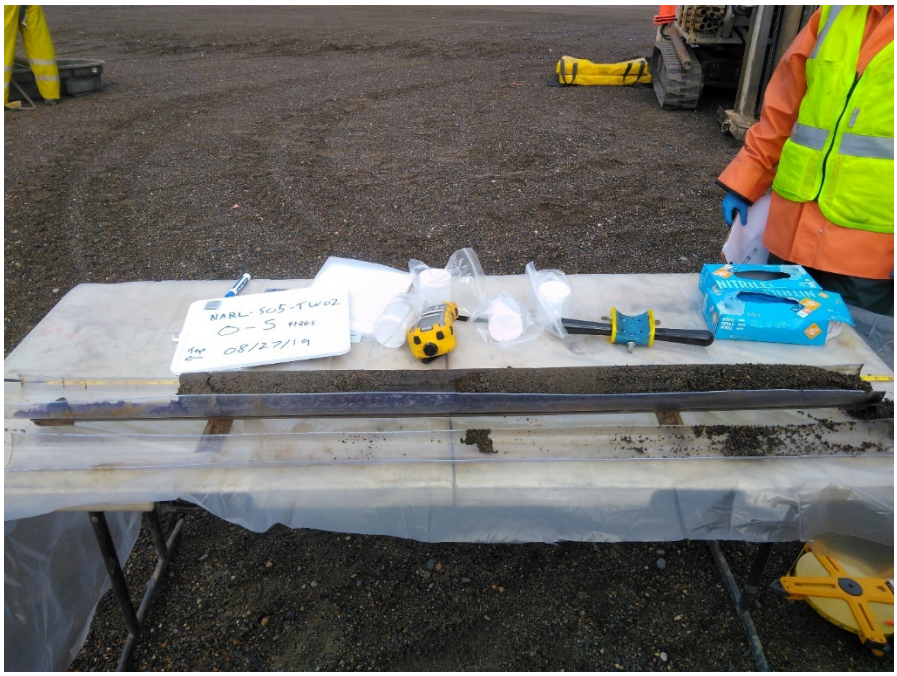


Photo 50 (Above)	NA	Soil core from sample location TW02/SO02.

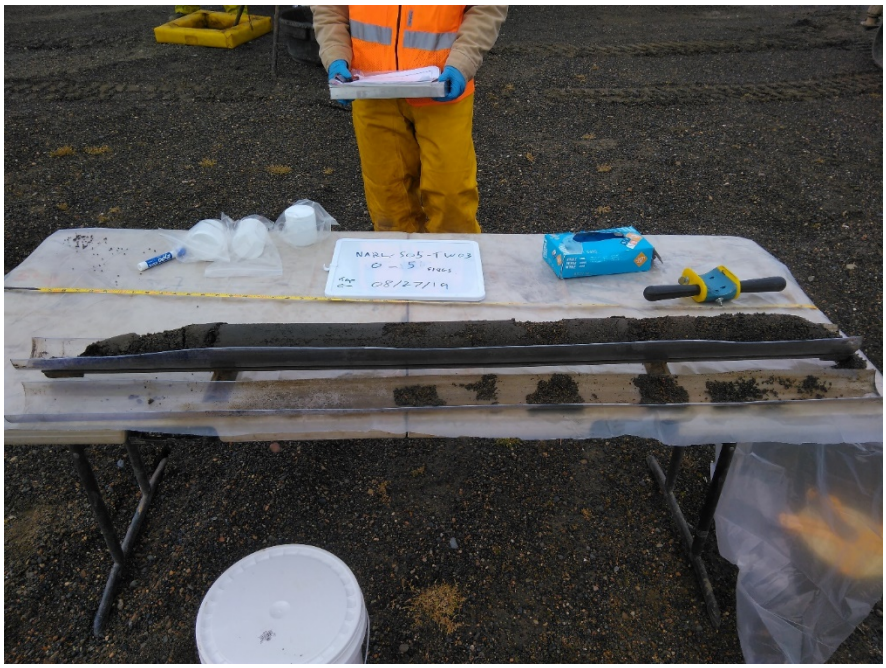
		
Photo 51 (Above)	NA	Soil core from sample location TW02/SO02.
		
Photo 52 (Above)	NA	Soil core from sample location TW03/SO03.



Photo 53 (Above)	NA	Soil core from sample location TW03/SO03.

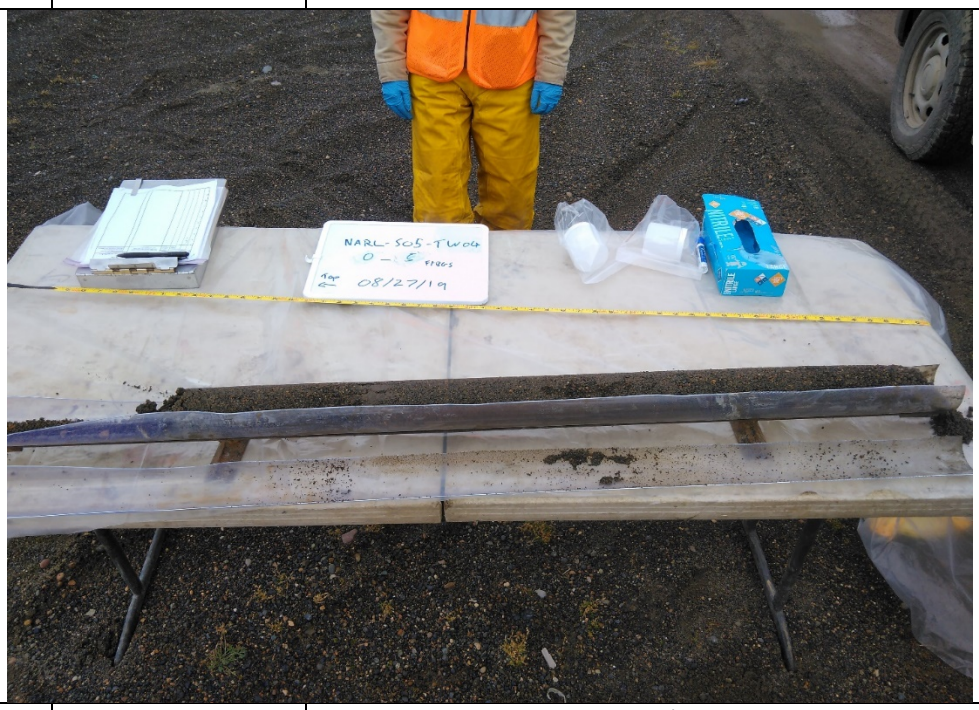


Photo 54 (Above)	NA	Soil core from sample location TW04/SO04.

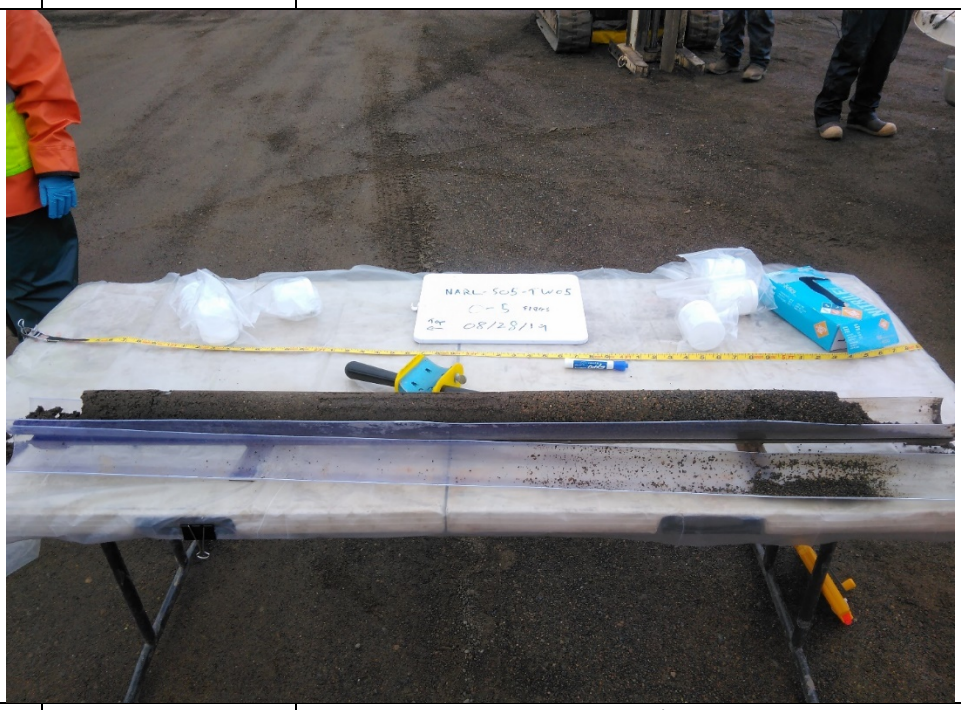
		
Photo 55 (Above)	NA	Soil core from sample location TW04/SO04.
		
Photo 56 (Above)	NA	Soil core from sample location TW05/SO05.



Photo 57 (Above)	NA	Soil core from sample location TW05/SO05.



Photo 58 (Above)	NA	Soil core from sample location TW06/SO06.



Photo 59 (Above)	NA	Soil core from sample location TW05/SO05.



Photo 60 (Above)	North	Direct push technology drill rig soil sampling at TO07/SO07.



Photo 61 (Above)	North	Direct push technology drill rig soil sampling at TW07/SO07.



Photo 62 (Above)	North	Direct push technology drill rig soil sampling at TW07/SO07.



Photo 63 (Above)	NA	Soil core from sample location TW07/SO07.



Photo 64 (Above)	NA	Soil core from sample location TW07/SO07.

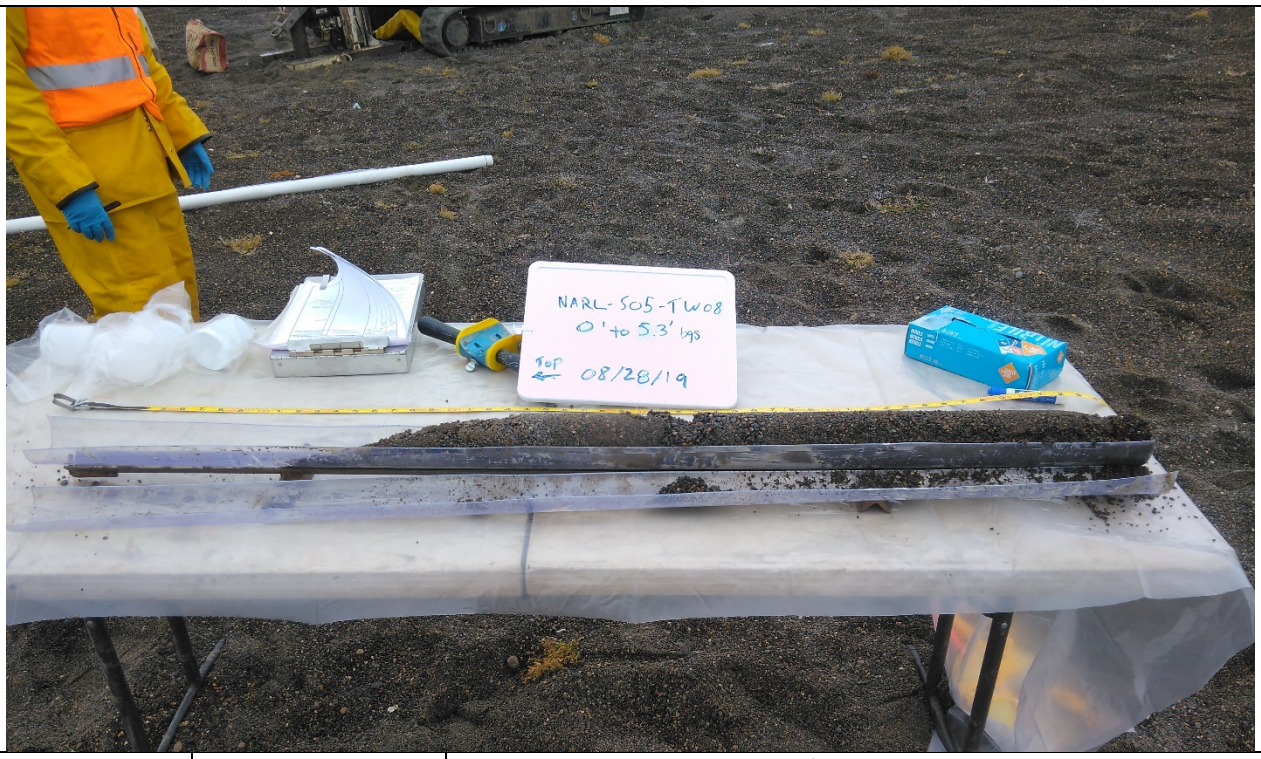


Photo 65 (Above)	NA	Soil core from sample location TW08/SO08.

Appendix F
Survey Report

CLEAN 9000 CTO-4117
Former Naval Arctic Research Laboratory Barrow,
Utqiaġvik, Alaska

Surveyor's Report
October 31, 2019

Umaiq Survey arrived on site at Former NARL Barrow on the afternoon of August 28, 2019. A safety meeting was held with Jacobs/CH2M Hill representatives and project specifics were discussed.

Equipment used: Trimble R-10 Base & Rover, 2M fixed Height Rod, Dutch Hill Tripod.

Lacking published horizontal/vertical control in the area, Umiaq established control at the site with three (3) new monuments and one (1) found rebar. Set monuments are 2" aluminum caps on 5/8" x 30" rebar set approximately 0.3' below ground level to ensure longevity. Set monuments are all intervisible. Umiaq also tied a local 5/8" rebar that has been used on multiple projects in the area over the years and has proven to be relatively stable.

Three hours and fifty-two minutes of static GNSS data was collected at base point (CP #50) commencing at 3:25 pm and ending at 7:17 pm on 8/28. Five hours and five minutes of static data was collected at base point (CP #50) commencing at 10:12 am and ending at 3:17 pm on 8/29. The two static sessions have significantly different satellite constellations. Instrument height measurements were made at the beginning and end of the survey each day. At the beginning the measurement is made in both feet and meters and checked to be within an acceptable tolerance (0.005' +/-). A third measurement is made at the end of the session in meters and checked against the initial measurement. This process was repeated on day two and all measurements were recorded in the field book. Static GNSS data was submitted to the National Geodetic Survey's (NGS) Online Positioning User Service (OPUS) for a tie to the required NAD-83(2011)(Ephoch2010.0000) Alaska State Plane zone 6 horizontal datum and NAVD88 utilizing Geoid12B vertical datum. The two OPUS solutions had a difference of 0.005' horizontally and 0.003' vertically. The two OPUS solutions were averaged and used as the basis of horizontal and vertical control for the project. All values are in U.S. Survey Feet.

Additional survey control (CP #51, 52, & 53) was established with RTK techniques using the process outlined below. Utilizing a 2M fixed height rod and bipod, the RTK rover was setup over the new control point. This point was occupied for three (3) minutes and 180 epochs. The rover initialization was then dumped and re-initialized on the fly. Once initialization was gained the control point was reoccupied for another three minutes. This process was repeated on day two (2) for a total of four (4) independent observations. All values were then averaged and populated as control. See BRW NARL CLEAN 9000 Survey Point Comparisons for error analysis and accuracies achieved. See attached Point List for Survey Control Values.

New monitoring wells TW01 thru TW08 elevations are on the north edge of the PVC. A black felt pen marker was used to make a permanent mark on the outside of the PVC. GNSS RTK was used to elevate the point. Utilizing a 2M fixed height rod with a topo foot and bipod, the RTK rover was setup over the north edge of the PVC. A black felt pen marker was used to make a permanent mark on the outside northerly edge of the PVC. This point was occupied for five (5)

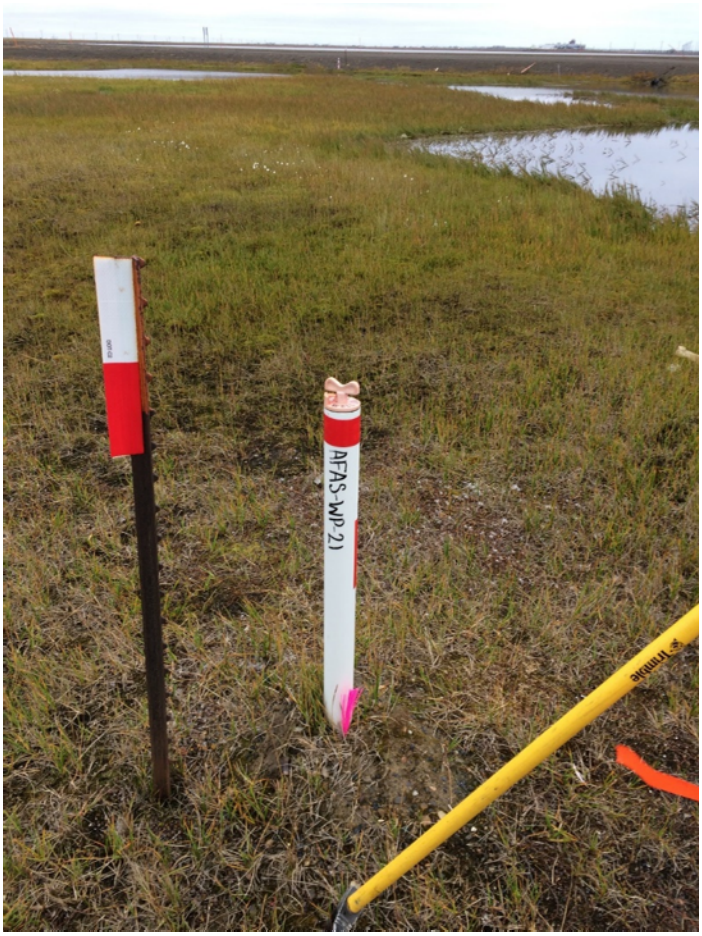
seconds and three (3) epochs. The rover initialization was then dumped and re-initialized on the fly. Once initialization was gained the elevation point was reoccupied for another five seconds. This process was repeated on day two (2) for a total of four (4) independent observations. All values were then averaged and the elevation of the monitoring well established. On day two the center of the well was located utilizing the fixed height rod with a pointed tip and bipod. The center was occupied twice in a similar fashion, dumping the rover and obtaining a new initialization between points. See BRW NARL CLEAN 9000 Survey Point Comparisons for error analysis and accuracies achieved. Excluding TW01 the new monitoring wells are below existing grade inside a well casing. TW01 was not in a well casing and extended approximately 2.5' above existing grade. There was a total of eight (8) new monitor wells surveyed. Existing ground surface elevations were taken nearby in a location representative of the average grade in that area.



(Typical new monitor well)

Existing monitor well elevations are on the north edge of the PVC as well. A 6" with spike with a pink whisker was set against the PVC at ground level as a point to obtain a solid elevation. GNSS RTK was used to elevate the point. Utilizing a 2M fixed height rod with a topo foot and bipod, the RTK rover was setup over spike. This point was occupied for five (5) seconds and

three (3) epochs. The rover initialization was then dumped and re-initialized on the fly. Once initialization was gained the elevation point was reoccupied for another five seconds. This process was repeated on day two (2) for a total of four (4) independent observations. All values were then averaged and the elevation of the spike established. A physical measurement was made from the spike to the top of the PVC and read by both surveyors in the field. Once both surveyors concurred, this measurement was recorded in the field book and used to calculate the top of PVC elevation for the existing wells. On day two an additional set GNSS RTK shots were taken butted up to the PVC and the three locations used to calculate the center of the well. See BRW NARL CLEAN 9000 Survey Point Comparisons for error analysis and accuracies achieved. Maps provided by Jacobs/CH2M Hill showed the most southerly existing well as AS-WP-21B. This well was marked as AS-WP-02C. Jacobs/CH2M Hill field personnel confirmed that this was the correct well to locate. There was a total of eight (8) existing monitor wells surveyed. Existing ground surface elevations were taken nearby in a location representative of the average grade in that area.



(Typical existing monitor well)

Soil boring elevations and locations were taken on top of a found spike with a pink whisker at three (3) locations. Utilizing a 2M fixed height rod with a topo foot and bipod, the RTK rover was setup over spike. This point was occupied for five (5) seconds and three (3) epochs. The rover initialization was then dumped and re-initialized on the fly. Once initialization was gained the point was reoccupied for another five seconds. This process was repeated on day two (2) for a total of four (4) independent observations. All values were then averaged and the elevation and

location of the spike established. See BRW NARL CLEAN 9000 Survey Point Comparisons for error analysis and accuracies achieved. There was a total of three (3) soil borings surveyed.



(Typical soil boring)

The methodology used to execute this survey has multiple levels of redundancy and all values reported are repeatable. Maintaining accurate horizontal and vertical values on objects (pvc, rebar, etc…) placed in gravel or tundra can be very challenging. Utilizing GNSS to establish the location of these points in the field is more reliable than traditional conventional survey techniques (level loops). With decades of experience in the arctic environment Umiaq survey certifies that this is the best way to perpetuate control and coordinate values.

BRW NARL Clean 9000	SURVEY CONTROL VALUES
Umiaq Survey	Phone: 907.762.0158
6700 Arctic Spur	Fax:
Anchorage, Alaska 99518	alan.griffin@UICUmiaq.com

Project file data		Coordinate System	
Name:	M:\Surveying\80217.19 BRW NARL Clean 9000\Gps\TBC\80217.19.vce	Name:	United States/State Plane 1983
Size:	114 KB	Datum:	NAD 1983 (Alaska)
Modified:	9/12/2019 9:11:58 AM (UTC:-8)	Zone:	Alaska Zone 6 5006
Time zone:	Alaskan Standard Time	Geoid:	GEOID12B (Alaska)
Reference number:	80217.19	Vertical datum:	NAVD88
Description:	SURVEY CONTROL VALUES	Calibrated site:	
Comment 1:			
Comment 2:			
Comment 3:			

Additional Coordinate System Details

Local Site Settings			
Project latitude:	?	Ground scale factor:	1
Project longitude:	?	False northing offset:	0.000
Project height:	50.000	False easting offset:	0.000

Point List

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
50	6339684.568	1799476.162	12.274	SET 2" AC
51	6340569.379	1799586.300	10.770	SET 2" AC
52	6342750.452	1802229.092	11.137	SET 2" AC
53	6342546.274	1803073.432	8.905	FND RBR

Calc'd By: AJG
Date: 09/16/2019

BRW NARL CLEAN 9000
Survey Point Comparisons

	DAY 1 SURVEY CONTROL					AVG	AVG	AVG
DESCRIPTION	NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
SET 2" AC	6340569.389	1799586.300	10.76	0.008	0.00	6340569.385	1799586.300	10.76
SET 2" AC	6340569.381	1799586.299	10.76					
SET 2" AC	6342750.446	1802229.079	11.15	0.008	0.01	6342750.449	1802229.082	11.15
SET 2" AC	6342750.452	1802229.085	11.14					
FND RBR	6342546.255	1803073.431	8.90	0.004	-0.01	6342546.254	1803073.433	8.90
FND RBR	6342546.253	1803073.434	8.91					

	DAY 2 SURVEY CONTROL					AVG	AVG	AVG
NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
6340569.367	1799586.303	10.77	0.013	-0.01	6340569.373	1799586.300	10.78
6340569.378	1799586.297	10.78					
6342750.451	1802229.106	11.15	0.013	0.04	6342750.456	1802229.102	11.13
6342750.461	1802229.098	11.11					
6342546.300	1803073.428	8.91	0.014	0.00	6342546.295	1803073.433	8.91
6342546.289	1803073.437	8.91					

DAY 1 VS DAY 2	
RADIAL	ELEV
0.013	-0.016
0.021	0.017
0.041	-0.008

	SURVEY CONTROL			
PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
51	6340569.379	1799586.300	10.77	SET 2" AC
52	6342750.453	1802229.092	11.14	SET 2" AC
53	6342546.274	1803073.433	8.91	FND RBR

	DAY 1 ELEV NEW WELL					AVG	AVG	AVG
DESCRIPTION	NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
TW01	6339180.368	1799050.900	14.02	0.056	0.02	6339180.340	1799050.901	14.00
TW01	6339180.312	1799050.902	13.99					
TW02	6339430.169	1798087.075	11.96	0.006	0.00	6339430.168	1798087.078	11.96
TW02	6339430.167	1798087.081	11.96					
TW03	6339460.594	1798217.824	11.92	0.006	0.01	6339460.591	1798217.825	11.92
TW03	6339460.588	1798217.825	11.92					
TW04	6339601.993	1798129.810	13.36	0.005	-0.01	6339601.992	1798129.813	13.36
TW04	6339601.991	1798129.815	13.37					
TW05	6342884.674	1802178.511	14.18	0.007	0.00	6342884.676	1802178.514	14.19
TW05	6342884.677	1802178.517	14.19					
TW06	6343017.686	1802287.617	14.28	0.004	0.00	6343017.686	1802287.615	14.28
TW06	6343017.686	1802287.613	14.28					
TW07	6343015.390	1802178.694	14.09	0.004	0.01	6343015.391	1802178.696	14.08
TW07	6343015.392	1802178.697	14.08					
TW08	6342436.183	1802191.745	8.83	0.013	0.02	6342436.179	1802191.750	8.82
TW08	6342436.175	1802191.755	8.81					

	DAY 2 ELEV NEW WELL					AVG	AVG	AVG
NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
6339180.327	1799050.934	14.08	0.026	-0.03	6339180.333	1799050.923	14.09
6339180.339	1799050.911	14.11					
6339430.165	1798087.061	11.95	0.008	0.01	6339430.162	1798087.060	11.95
6339430.158	1798087.058	11.94					
6339460.563	1798217.836	11.95	0.009	0.01	6339460.559	1798217.837	11.94
6339460.554	1798217.837	11.94					
6339601.983	1798129.814	13.38	0.010	0.00	6339601.980	1798129.810	13.38
6339601.977	1798129.806	13.38					
6342884.661	1802178.508	14.19	0.004	0.00	6342884.659	1802178.508	14.19
6342884.657	1802178.508	14.18					
6343017.676	1802287.610	14.28	0.010	0.01	6343017.677	1802287.605	14.28
6343017.677	1802287.600	14.27					
6343015.378	1802178.702	14.05	0.001	-0.03	6343015.378	1802178.702	14.07
6343015.378	1802178.701	14.08					
6342436.145	1802191.770	8.78	0.017	0.01	6342436.153	1802191.767	8.77
6342436.161	1802191.763	8.77					

DAY 1 VS DAY 2	
RADIAL	ELEV
0.023	-0.090
0.020	0.009
0.035	-0.022
0.012	-0.019
0.018	-0.001
0.014	0.002
0.014	0.015
0.031	0.049

	NEW MONITOR WELL TOP OF PVC ELEV NORTH SIDE			
PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
2001	6339180.337	1799050.912	14.05	TW01
2002	6339430.165	1798087.069	11.95	TW02
2003	6339460.575	1798217.831	11.93	TW03
2004	6339601.986	1798129.811	13.37	TW04
2005	6342884.667	1802178.511	14.19	TW05
2006	6343017.681	1802287.610	14.28	TW06
2007	6343015.385	1802178.699	14.08	TW07
2008	6342436.166	1802191.758	8.80	TW08

	DAY 1 SOIL BORING					AVG	AVG	AVG
DESCRIPTION	NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
S009	6339290.575	1798901.774	12.22	0.006	0.02	6339290.575	1798901.771	12.21
S009	6339290.575	1798901.768	12.20					
S010	6339224.905	1798951.014	11.86	0.014	-0.04	6339224.912	1798951.015	11.87
S010	6339224.919	1798951.015	11.89					
S011	6339247.412	1799136.901	11.53	0.004	0.01	6339247.413	1799136.900	11.53
S011	6339247.414	1799136.898	11.52					

	DAY 2 SOIL BORING					AVG	AVG	AVG
NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
6339290.479	1798901.767	12.29	0.040	0.01	6339290.492	1798901.783	12.28
6339290.505	1798901.798	12.28					
6339224.867	1798951.028	11.89	0.059	0.00	6339224.893	1798951.042	11.89
6339224.919	1798951.055	11.89					
6339247.429	1799136.881	11.48	0.019	-0.01	6339247.435	1799136.873	11.48
6339247.440	1799136.865	11.48					

DAY 1 VS DAY 2	
RADIAL	ELEV
0.084	-0.072
0.033	-0.015
0.034	0.049

	SOIL BORING TOP OF SPIKE WITH PINK FUZZY			
PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
2009	6339290.534	1798901.777	12.25	S009
2010	6339224.903	1798951.028	11.88	S010
2011	6339247.424	1799136.886	11.50	S011

	DAY 1 EXIST WELL @ SPIKE					AVG	AVG	AVG
DESCRIPTION	NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
AFAS-WP-20	6339439.928	1799282.245	7.86	0.001	-0.01	6339439.928	1799282.245	7.86
AFAS-WP-20	6339439.927	1799282.244	7.87					
AFAS-WP-21	6339320.790	1799414.402	7.85	0.012	0.03	6339320.784	1799414.401	7.84
AFAS-WP-21	6339320.778	1799414.400	7.82					
AS-WP-02C	6339133.418	1798101.023	6.10	0.003	0.01	6339133.418	1798101.025	6.10
AS-WP-02C	6339133.417	1798101.026	6.09					
AS-WP-10	6339102.050	1798607.983	6.06	0.002	0.00	6339102.049	1798607.984	6.06
AS-WP-10	6339102.048	1798607.984	6.06					
AS-WP-11	6339579.966	1799041.715	8.77	0.059	0.00	6339579.952	1799041.741	8.77
AS-WP-11	6339579.937	1799041.766	8.77					
AS-WP-12	6339129.596	1798963.555	6.20	0.011	0.02	6339129.591	1798963.553	6.19
AS-WP-12	6339129.586	1798963.551	6.18					
AS-WP-16D	6339027.524	1799182.550	6.21	0.002	0.00	6339027.525	1799182.551	6.21
AS-WP-16D	6339027.525	1799182.552	6.21					
AS-WP-18B	6339145.493	1799331.107	7.58	0.018	0.02	6339145.496	1799331.099	7.57
AS-WP-18B	6339145.498	1799331.090	7.56					

	DAY 2 EXIST WELL @ SPIKE					AVG	AVG	AVG
NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	ELEVATION
6339439.918	1799282.224	7.86	0.029	0.00	6339439.919	1799282.239	7.87
6339439.919	1799282.253	7.87					
6339320.791	1799414.392	7.85	0.026	0.01	6339320.783	1799414.382	7.84
6339320.775	1799414.372	7.83					
6339133.456	1798101.075	6.08	0.073	0.01	6339133.438	1798101.043	6.08
6339133.420	1798101.011	6.07					
6339102.086	1798607.998	6.05	0.012	-0.04	6339102.092	1798607.999	6.07
6339102.098	1798607.999	6.08					
6339579.924	1799041.753	8.78	0.009	0.01	6339579.925	1799041.758	8.77
6339579.925	1799041.762	8.77					
6339129.605	1798963.571	6.21	0.037	-0.01	6339129.615	1798963.555	6.22
6339129.624	1798963.539	6.23					
6339027.499	1799182.557	6.19	0.026	0.00	6339027.503	1799182.545	6.19
6339027.507	1799182.532	6.19					
6339145.494	1799331.095	7.57	0.008	0.00	6339145.493	1799331.099	7.57
6339145.492	1799331.103	7.57					

DAY 1 VS DAY 2	
RADIAL	ELEV
0.011	-0.002
0.019	-0.002
0.028	0.021
0.046	-0.006
0.032	-0.006
0.024	-0.028
0.022	0.021
0.003	-0.001

	EXISTING WELL TOP OF PVC ELEV NORTH SIDE			
PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
2012	6339439.923	1799282.242	9.30	AFAS-WP-20
2013	6339320.784	1799414.392	10.39	AFAS-WP-21
2014	6339133.428	1798101.034	8.24	AS-WP-02C
2015	6339102.071	1798607.991	8.25	AS-WP-10
2016	6339579.938	1799041.749	11.09	AS-WP-11
2017	6339129.603	1798963.554	8.28	AS-WP-12
2018	6339027.514	1799182.548	7.77	AS-WP-16D
2019	6339145.494	1799331.099	9.54	AS-WP-18B

	DAY 2 CENTER NEW WELL					AVG	AVG	
NORTHING	EASTING	ELEVATION	Radial	Delta Z	NORTHING	EASTING	DESC
6342884.549	1802178.504	14.31	0.001	0.01	6342884.549	1802178.504	CTR_TW05
6342884.549	1802178.503	14.30					
6343015.299	1802178.658	14.17	0.003	-0.02	6343015.300	1802178.657	CTR_TW07
6343015.301	1802178.656	14.19					
6343017.581	1802287.577	14.43	0.009	0.01	6343017.585	1802287.575	CTR_TW06
6343017.588	1802287.572	14.42					
6339430.082	1798087.067	12.05	0.006	-0.02	6339430.080	1798087.065	CTR_TW02
6339430.078	1798087.063	12.07					
6339601.915	1798129.785	13.46	0.003	-0.01	6339601.917	1798129.785	CTR_TW04
6339601.918	1798129.785	13.46					
6339460.500	1798217.820	12.05	0.009	0.00	6339460.497	1798217.818	CTR_TW03
6339460.493	1798217.815	12.06					
6342436.087	1802191.778	8.95	0.015	-0.01	6342436.091	1802191.772	CTR_TW08
6342436.095	1802191.765	8.95					
6339180.255	1799050.896	14.15	0.033	0.06	6339180.250	1799050.912	CTR_TW01
6339180.245	1799050.927	14.09					

	CENTER NEW WELL			
PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
3005	6342884.549	1802178.504	-9999	CTR_TW05
3007	6343015.3	1802178.657	-9999	CTR_TW07
3006	6343017.585	1802287.575	-9999	CTR_TW06
3002	6339430.08	1798087.065	-9999	CTR_TW02
3004	6339601.917	1798129.785	-9999	CTR_TW04
3003	6339460.497	1798217.818	-9999	CTR_TW03
3008	6342436.091	1802191.772	-9999	CTR_TW08
3001	6339180.25	1799050.912	-9999	CTR_TW01

Appendix G
Investigation-derived Waste Profiles and Disposal Manifests

Sample ID	NARL-S05-WW01-083019
Sample Date	8/30/19
Chemical Name	
Semivolatile Organic Compounds (NG/L)	
11Cl-PF3OUdS	0.36 U
9Cl-PF3ONS	0.36 U
Adona	0.36 U
HFPO-DA	0.36 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	0.89 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (MeFOSAA	1.79 U
Perfluorobutanesulfonic acid (PFBS)	9.49
Perfluorodecanoic Acid (PFDA)	0.45 U
Perfluorododecanoic Acid (PFDoA)	0.45 U
Perfluoroheptanoic acid (PFHpA)	0.45 U
Perfluorohexanesulfonic acid (PFHxS)	211 D
Perfluorohexanoic Acid (PFHxA)	61.2 D
Perfluorononanoic acid (PFNA)	0.89 U
Perfluorooctane Sulfonate (PFOS)	259 D
Perfluorooctanoic acid (PFOA)	135 D
Perfluorotetradecanoic Acid (PFTeDA)	0.89 U
Perfluorotridecanoic Acid (PFTrDA)	0.45 U
Perfluoroundecanoic Acid (PFUnA)	0.89 U

Notes:

D - Compound identified in an analysis at a secondary dilution factor.

NG/L - Nanograms per liter

NS - Not sampled

U - The material was analyzed for, but not detected

Sample ID	NARL-S05-WS01-082919
Sample Date	8/29/19
Chemical Name	
Semivolatile Organic Compounds (NG/G)	
11Cl-PF3OUdS	1.01 U
9Cl-PF3ONS	1.01 U
Adona	1.01 U
HFPO-DA	2.02 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	2.02 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (MeFOSAA	2.53 U
Perfluorobutanesulfonic acid (PFBS)	1.01 U
Perfluorodecanoic Acid (PFDA)	1.01 U
Perfluorododecanoic Acid (PFDoA)	0.51 U
Perfluoroheptanoic acid (PFHpA)	1.01 U
Perfluorohexanesulfonic acid (PFHxS)	0.51 U
Perfluorohexanoic Acid (PFHxA)	1.01 U
Perfluorononanoic acid (PFNA)	1.01 U
Perfluorooctane Sulfonate (PFOS)	1.01 U
Perfluorooctanoic acid (PFOA)	1.01 U
Perfluorotetradecanoic Acid (PFTeDA)	2.02 U
Perfluorotridecanoic Acid (PFTrDA)	1.01 U
Perfluoroundecanoic Acid (PFUnA)	1.01 U

Notes:
NG/G - Nanograms per gram
NS - Not sampled
U - The material was analyzed for, but not detected

474060

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
AK2170027245	4	907-751-4493	2019-00592

GENERATOR

5. Generator's Name and Mailing Address
NAVFAC NW
1101 TAUTOG CIRCLE
SILVERDALE, WA 98315
Generator's Phone: 503-201-5000

Generator's Site Address (if different than mailing address)
US NAVY ARCTIC RESEARCH LABORATORY, BARROW, AK 99723

6. Transporter 1 Company Name
ECC, INC
(907) 644-0428
U.S. EPA ID Number
AK3000202408

7. Transporter 2 Company Name
NORTHERN AIR CARGO
U.S. EPA ID Number
AKD003845526

8. Designated Facility Name and Site Address
CHEMICAL WASTE MANAGEMENT OF NW
17629 CEDAR SPRINGS LANE
ARLINGTON, OR 97812
Facility's Phone: 541-454-2643
U.S. EPA ID Number
ORD089452353

HM	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
	1. MATERIAL NOT REGULATED BY D.O.T.(IDW WATER)	3	DM	1200	P	
	2. MATERIAL NOT REGULATED BY D.O.T.(IDW SOIL)	1	DM	650	P	
	3.					
	4.					

13. Special Handling Instructions and Additional Information
1) OR343350 IDW WATER 3 X 55-GAL DRUMS X004
2) OR343352 IDW SOIL 1 X 55-GAL DRUMS X004

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.
Generator's/Offeror's Printed/Typed Name: Charles Escola U.S. Navy
Signature: Charles Escola
Month 10 Day 24 Year 19

INT'L
15. International Shipments ☐ Import to U.S. ☐ Export from U.S.
Transporter Signature (for exports only):
Port of entry/exit:
Date leaving U.S.:

TRANSPORTER
16. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: Amanda Steed
Signature:
Month 10 Day 31 Year 19
Transporter 2 Printed/Typed Name: JATONGACOA
Signature:
Month 10 Day 31 Year 19

DESIGNATED FACILITY
17. Discrepancy
17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
17b. Alternate Facility (or Generator)
Manifest Reference Number:
U.S. EPA ID Number
Facility's Phone:
17c. Signature of Alternate Facility (or Generator)
Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a
Printed/Typed Name:
Signature:
Month 11 Day 7 Year 19

169-BLC-O 5 11977 (Rev. 9/09)

DESIGNATED FACILITY TO GENERATOR

gm

474060

NON-HAZARDOUS WASTE MANIFEST (Continuation Sheet)	19. Generator ID Number AK2170027245	20. Page 2 OF 4	21. Waste Tracking Number 2019-00392

22. Generator's Name: NAVFAC NW

23. Transporter 3 Company Name: ECC. INC. — U.S. EPA ID Number: AKR000202408

24. Transporter 4 Company Name: WEAVER BROTHERS — U.S. EPA ID Number: AKD002848372

HM	25. Waste Shipping Name and Description	26. Containers No.	26. Containers Type	27. Total Quantity	28. Unit Wt./Vol.	

29. Special Handling Instructions and Additional Information

GENERATOR

TRANSPORTER

30. Transporter 3 Acknowledgment of Receipt of Materials
Printed/Typed Name: Don Maloney — Signature — Month 11 Day 1 Year 19

31. Transporter 4 Acknowledgment of Receipt of Materials
Printed/Typed Name: FRED BALASI — Signature — Month 11 Day 01 Year 19

DESIGNATED FACILITY

32. Discrepancy

170-BLC-O 6 10502 (Rev. 8/06)

DESIGNATED FACILITY TO GENERATOR

474060

NON-HAZARDOUS WASTE MANIFEST (Continuation Sheet)	19. Generator ID Number	20. Page	21. Waste Tracking Number
	AK2170027245	3 OF 4	2019-00392

22. Generator's Name: NAVFAC NW

23. Transporter 5 Company Name: TOTE MARITIME ALASKA, LLC — U.S. EPA ID Number: WAD070397955

24. Transporter 6 Company Name: ~~GRAHAM TRUCKING~~ H A C ENVIRONMENTAL — U.S. EPA ID Number: CAR 000030114 (~~WAD000000000~~)

HM	25. Waste Shipping Name and Description	26. Containers No.	26. Containers Type	27. Total Quantity	28. Unit Wt./Vol.	

29. Special Handling Instructions and Additional Information

GENERATOR

TRANSPORTER

30. Transporter 5 Acknowledgment of Receipt of Materials
Printed/Typed Name: T. DIAZ — Signature: [signature] — Month: 11 Day: 4 Year: 19

31. Transporter 6 Acknowledgment of Receipt of Materials
Printed/Typed Name: G. Keddy — Signature: [signature] — Month: 11 Day: 12 Year: 19

DESIGNATED FACILITY

32. Discrepancy
Carrier change from Graham to H-A-C

170-BLC-O 6 10502 (Rev. 8/06) DESIGNATED FACILITY TO GENERATOR

474060

NON-HAZARDOUS WASTE MANIFEST (Continuation Sheet)

19. Generator ID Number: AK2170027245

20. Page: 4 OF 4

21. Waste Tracking Number: 2019-00392

22. Generator's Name: NAVFAC NW

23. Transporter 7 Company Name: ENVIRONMENTAL COMPLIANCE — U.S. EPA ID Number: ORQ000032743

24. Transporter 8 Company Name: Chemical Waste Management of the NW — U.S. EPA ID Number: ORD089452353

GENERATOR

HM	25. Waste Shipping Name and Description	26. Containers No.	26. Containers Type	27. Total Quantity	28. Unit Wt./Vol.	

29. Special Handling Instructions and Additional Information

TRANSPORTER

30. Transporter 7 Acknowledgment of Receipt of Materials

Printed/Typed Name: Jason Comer — Signature: [signature] — Month: 11 Day: 12 Year: 19

31. Transporter 8 Acknowledgment of Receipt of Materials

Printed/Typed Name: Robert Blagg — Signature: R Blagg — Month: 11 Day: 12 Year: 19

DESIGNATED FACILITY

32. Discrepancy

170-BLC-O 6 10502 (Rev. 8/06)

DESIGNATED FACILITY TO GENERATOR

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites and Prevention and Emergency Response Programs

Transport, Treatment, & Disposal Approval Form for Contaminated Media

DEC HAZARD/SPILL ID #	NAME OF SPILL OR CONTAMINATED SITE
557	NARL - Sitewide PFAS

SITE OR SPILL LOCATION
Former NARL Barrow, Airstrip Site (Site 5), Utqiagvik

CURRENT LOCATION AND TYPE OF CONTAMINATED MEDIA	SOURCE OF THE CONTAMINATION
Navy treatment building at Airstrip Site. Soil and water.	Investigation derived waste (decontamination, development, and purge water, drill cuttings)

COMPOUNDS OF CONCERN	ESTIMATED VOLUME	DATE(S) GENERATED
PFAS, gasoline- and diesel-range petroleum hydrocarbons	200 gallons	August 12 - 30, 2019

POST TREATMENT ANALYSIS REQUIRED *(such as GRO, DRO, RRO, BTEX, and/or Chlorinated Solvents)*
8260 VOCs, 8270 SVOCs, 8015 TPH all, 6010 total metals (RCRA), pH, ignitability, PFAS

COMMENTS
Investigation derived waste generated during PFAS Site Inspection

Facility Accepting the Contaminated Media

NAME OF THE FACILITY	PHYSICAL ADDRESS/PHONE NUMBER
Chemical Waste Management of NW	17629 CEDAR SPRINGS LANE ARLINGTON, OR 97812; 541-454-2643

Responsible Party and Contractor Information

BUSINESS/NAME	ADDRESS/PHONE NUMBER
NAVFAC NW/ Kendra Leibman	NAVFAC NW 1101 Tautog Circle, Suite 203 Silverdale, WA 98315-1101; (360) 396-0022

Kendra Leibman
Name of the Person Requesting Approval (printed)

Remedial Project Manager/NAVFAC NW
Title/Association

Signature

10/17/2019
Date

360-396-0022
Phone Number

----------DEC USE ONLY----------

Based on the information provided, ADEC approves transport of the above-described media for treatment in accordance with the approved facility operations plan. The Responsible Party or their consultant must submit to the DEC Project Manager a copy of weight/volume receipts of the loads transported to the facility and a post treatment analytical report. If the media is contaminated soil, it shall be transported as a covered load in compliance with 18 AAC 60.015.

Eric Breitenberger
DEC Project Manager Name (printed)

Environmental Program Manager
Project Manager Title

Eric Breitenberger
Signature

10/23/2019
Date

907-451-2158
Phone Number

Appendix H
Analytical Data

Table H1. Groundwater Analytical Data

Site Inspection Report for Per- and Polyfluoroalkyl Substances at
Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Sample ID	NARL-S05-WP-20-0819	NARL-S05-AFAS-WP-21-0819	NARL-S05-TW01-0819	NARL-S05-TW01P-0819	NARL-S05-TW02-0819	NARL-S05-TW03-0819	NARL-S05-TW08-0819	NARL-S05-WP-02C-0819
Sample Date	08/21/19	08/21/19	08/29/19	08/29/19	08/30/19	08/30/19	08/30/19	08/21/19
Chemical Name								
Semivolatile Organic Compounds (UG/L)								
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	0.00038 U	0.00034 U	0.00038 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00035 U
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	0.00038 U	0.00034 U	0.00038 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00035 U
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	0.00038 U	0.00034 U	0.00038 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00035 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	0.00096 U	0.00086 U	0.00094 U	0.00091 U	0.00091 U	0.00091 U	0.00091 U	0.00088 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	0.00192 U	0.00172 U	0.01564	0.01595	0.00182 U	0.00182 U	0.00182 U	0.00175 U
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00038 UJ	0.00034 U	0.00038 UJ	0.00036 UJ	0.00036 U	0.00036 U	0.00036 U	0.00035 U
Perfluorooctane Sulfonate (PFOS)	0.13148	0.63524	0.25989	0.25557	0.02552	0.00355 U	0.00206 U	0.29516
Perfluoroundecanoic Acid (PFUnA)	0.00096 U	0.00086 U	0.00094 U	0.00091 U	0.00091 U	0.00091 U	0.00091 U	0.00088 U
Perfluorohexanoic Acid (PFHxA)	0.06458 J	0.05844	0.01377	0.01648 J	0.02189	0.00342 J	0.00045 U	0.01063
Perfluorododecanoic Acid (PFDoA)	0.00048 U	0.00043 U	0.00047 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00044 U
Perfluorooctanoic acid (PFOA)	0.26562	0.09967	0.02637	0.02489	0.24087	0.00215 J	0.00136 J	0.02981
Perfluorodecanoic Acid (PFDA)	0.00048 U	0.0008 J	0.00047 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00044 U
Perfluorohexanesulfonic acid (PFHxS)	1.32534	0.21593	0.09269	0.08208	0.07554	0.01254	0.00161 J	0.12546
Perfluorobutanesulfonic acid (PFBS)	0.0153 J	0.02314	0.00965	0.00868	0.00473 J	0.00194 J	0.00045 UJ	0.00464
Perfluoroheptanoic acid (PFHpA)	0.01923	0.01192	0.00582	0.00494	0.00821	0.00101 J	0.00045 U	0.00554
Perfluorononanoic acid (PFNA)	0.00183 J	0.00254 J	0.00083 J	0.00086 J	0.00093 J	0.00032 J	0.00045 J	0.00116 J
Perfluorotetradecanoic Acid (PFTeDA)	0.00096 U	0.00086 U	0.00228 J	0.00202 J	0.00091 U	0.00091 U	0.00091 U	0.00088 U
Perfluorotridecanoic Acid (PFTrDA)	0.00048 U	0.00043 U	0.00047 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00044 U

Notes:

Shading indicates detections
NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UG/L - Micrograms per liter

Table H1. Groundwater Analytical Data

Site Inspection Report for Per- and Polyfluoroalkyl Substances at
Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Sample ID	NARL-S05-WP-02CP-0819	NARL-S05-WP-10-0819	NARL-S05-WP-11-0819	NARL-S05-WP-12-0819	NARL-S05-WP-16D-0819	NARL-S05-WP-18B-0819
Sample Date	08/21/19	08/20/19	08/21/19	08/20/19	08/21/19	08/21/19
Chemical Name						
Semivolatile Organic Compounds (UG/L)						
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	0.00035 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	0.00035 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	0.00035 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	0.00088 U	0.00091 U	0.00089 U	0.00049 J	0.00089 U	0.00089 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	0.00175 U	0.01253	0.00179 U	0.01383	0.00179 U	0.00179 U
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00035 U	0.00036 U	0.00036 U	0.00036 UJ	0.00036 U	0.00036 U
Perfluorooctane Sulfonate (PFOS)	0.34145	4.20351	0.37913	1.44532	2.88116	0.85615
Perfluoroundecanoic Acid (PFUnA)	0.00088 U	0.00038 J	0.00089 U	0.00032 J	0.00089 U	0.00089 U
Perfluorohexanoic Acid (PFHxA)	0.01418	0.75599	0.03877 J	0.02599 J	0.10795	0.14516
Perfluorododecanoic Acid (PFDoA)	0.00044 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U
Perfluorooctanoic acid (PFOA)	0.03588	5.67898	0.23629	0.02214	0.27321	0.24348
Perfluorodecanoic Acid (PFDA)	0.00044 U	0.00342 J	0.00045 U	0.00155 J	0.00107 J	0.00169 J
Perfluorohexanesulfonic acid (PFHxS)	0.13249	5.78384	0.56414	0.45943	1.06493	0.24635
Perfluorobutanesulfonic acid (PFBS)	0.00516	0.04858	0.0134	0.00743	0.02481	0.01143
Perfluoroheptanoic acid (PFHpA)	0.00615	0.20368	0.03163	0.01616 J	0.0259	0.02395
Perfluorononanoic acid (PFNA)	0.00123 J	0.02363	0.00273 J	0.00197 J	0.00326 J	0.00428 J
Perfluorotetradecanoic Acid (PFTeDA)	0.00088 U	0.00091 U	0.00089 U	0.00089 U	0.00089 U	0.00089 U
Perfluorotridecanoic Acid (PFTrDA)	0.00044 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U

Notes:

Shading indicates detections

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UG/L - Micrograms per liter

Table H2. Surface Soil Analytical Data

Site Inspection Report for Per- and Polyfluoroalkyl Substances at
Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Sample ID	NARL-S05-SS01-0_0-0_5-0819	NARL-S05-SS02-0_0-0_5-0819	NARL-S05-SS03-0_0-0_5-0819	NARL-S05-SS03P-0_0-0_5-0819	NARL-S05-SS04-0_0-0_5-0819	NARL-S05-SS05-0_0-0_5-0819	NARL-S05-SS06-0_0-0_5-0819
Sample Date	08/27/19	08/27/19	08/27/19	08/27/19	08/27/19	08/28/19	08/28/19
Chemical Name							
Semivolatile Organic Compounds (UG/KG)							
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2.08 U	2.17 U	2.07 U	1.99 U	2 U	2.05 U	2.09 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2.6 U	2.72 U	2.59 U	2.49 U	2.5 U	2.56 U	2.62 U
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	2.08 U	2.17 U	2.07 U	1.99 U	2 U	2.05 U	2.09 U
Perfluorooctane Sulfonate (PFOS)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluoroundecanoic Acid (PFUnA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluorohexanoic Acid (PFHxA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluorododecanoic Acid (PFDoA)	0.52 U	0.54 U	0.52 U	0.5 U	0.5 U	0.51 U	0.52 U
Perfluorooctanoic acid (PFOA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluorodecanoic Acid (PFDA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluorohexanesulfonic acid (PFHxS)	0.52 U	0.54 U	0.52 U	0.5 U	0.5 U	0.51 U	0.52 U
Perfluorobutanesulfonic acid (PFBS)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluoroheptanoic acid (PFHpA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluorononanoic acid (PFNA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U
Perfluorotetradecanoic Acid (PFTeDA)	2.08 U	2.17 U	2.07 U	1.99 U	2 U	2.05 U	2.09 U
Perfluorotridecanoic Acid (PFTrDA)	1.04 U	1.09 U	1.04 U	1 U	1 U	1.03 U	1.05 U

Notes:

Shading indicates detections
NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
UG/KG - Micrograms per kilogram

Table H2. Surface Soil Analytical Data

Site Inspection Report for Per- and Polyfluoroalkyl Substances at
Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Sample ID	NARL-S05-SS07-0_0-0_5-0819	NARL-S05-SS08-0_0-0_5-0819	NARL-S05-SS09-0_0-0_5-0819	NARL-S05-SS10-0_0-0_5-0819	NARL-S05-SS10P-0_0-0_5-0819	NARL-S05-SS11-0_0-0_5-0819
Sample Date	08/28/19	08/28/19	08/25/19	08/25/19	08/25/19	08/25/19
Chemical Name						
Semivolatile Organic Compounds (UG/KG)						
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2.25 U	2 U	2.16 U	2.12 U	2.11 U	2.09 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2.81 U	2.5 U	2.7 U	2.65 U	2.63 U	2.62 U
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	2.25 U	2 U	2.16 U	2.12 U	2.11 U	2.09 U
Perfluorooctane Sulfonate (PFOS)	1.12 U	1 U	1.11 J	1.06 U	1.05 U	1.03 J
Perfluoroundecanoic Acid (PFUnA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
Perfluorohexanoic Acid (PFHxA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
Perfluorododecanoic Acid (PFDoA)	0.56 U	0.5 U	0.54 U	0.53 U	0.53 U	0.52 U
Perfluorooctanoic acid (PFOA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
Perfluorodecanoic Acid (PFDA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
Perfluorohexanesulfonic acid (PFHxS)	0.56 U	0.5 U	0.54 U	0.53 U	0.53 U	0.52 U
Perfluorobutanesulfonic acid (PFBS)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
Perfluoroheptanoic acid (PFHpA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
Perfluorononanoic acid (PFNA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U
Perfluorotetradecanoic Acid (PFTeDA)	2.25 U	2 U	2.16 U	2.12 U	2.11 U	2.09 U
Perfluorotridecanoic Acid (PFTrDA)	1.12 U	1 U	1.08 U	1.06 U	1.05 U	1.05 U

Notes:

Shading indicates detections
NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
UG/KG - Micrograms per kilogram

Table H3. Subsurface Soil Analytical Data

Site Inspection Report for Per- and Polyfluoroalkyl Substances at
Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Sample ID	NARL-S05-SB01-3_0-3_5-0819	NARL-S05-SB02-2_0-2_5-0819	NARL-S05-SB03-3_0-3_5-0819	NARL-S05-SB04-1_8-2_3-0819	NARL-S05-SB05-3_5-4_0-0819	NARL-S05-SB05P-3_5-4_0-0819	NARL-S05-SB06-5_0-5_5-0819
Sample Date	08/27/19	08/27/19	08/27/19	08/27/19	08/28/19	08/28/19	08/28/19
Chemical Name							
Semivolatile Organic Compounds (UG/KG)							
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2.03 U	2.11 U	2.13 U	1.98 U	2.01 U	1.97 U	2.03 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2.54 U	2.63 U	2.66 U	2.48 U	2.51 U	2.46 U	2.54 U
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	2.03 U	2.11 U	2.13 U	1.98 U	2.01 U	1.97 U	2.03 U
Perfluorooctane Sulfonate (PFOS)	0.47 J	1.05 U	1.06 U	3.35 J	1.01 U	0.99 U	1.02 U
Perfluoroundecanoic Acid (PFUnA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
Perfluorohexanoic Acid (PFHxA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
Perfluorododecanoic Acid (PFDoA)	0.51 U	0.53 U	0.53 U	0.5 U	0.5 U	0.49 U	0.51 U
Perfluorooctanoic acid (PFOA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
Perfluorodecanoic Acid (PFDA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
Perfluorohexanesulfonic acid (PFHxS)	0.51 U	0.53 U	0.53 U	0.5 U	0.5 U	0.49 U	0.51 U
Perfluorobutanesulfonic acid (PFBS)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
Perfluoroheptanoic acid (PFHpA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
Perfluorononanoic acid (PFNA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U
Perfluorotetradecanoic Acid (PFTeDA)	2.03 U	2.11 U	2.13 U	1.98 U	2.01 U	1.97 U	2.03 U
Perfluorotridecanoic Acid (PFTrDA)	1.02 U	1.05 U	1.06 U	0.99 U	1.01 U	0.99 U	1.02 U

Notes:

Shading indicates detections

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UG/KG - Micrograms per kilogram

Table H3. Subsurface Soil Analytical Data

Site Inspection Report for Per- and Polyfluoroalkyl Substances at
Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Sample ID	NARL-S05-SB07-4_2-4_7-0819	NARL-S05-SB08-2_2-2_7-0819	NARL-S05-SB09-3_8-4_2-0819	NARL-S05-SB10-2_5-3_0-0819	NARL-S05-SB11-3_5-4_0-0819
Sample Date	08/28/19	08/28/19	08/25/19	08/25/19	08/25/19
Chemical Name					
Semivolatile Organic Compounds (UG/KG)					
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	1.96 U	2.13 U	2.01 U	2.07 U	2.05 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2.45 U	2.66 U	2.51 U	2.59 U	2.56 U
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	1.96 U	2.13 U	2.01 U	2.07 U	2.05 U
Perfluorooctane Sulfonate (PFOS)	0.98 U	1.06 U	1.01 U	1.04 U	1.32 J
Perfluoroundecanoic Acid (PFUnA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
Perfluorohexanoic Acid (PFHxA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
Perfluorododecanoic Acid (PFDoA)	0.49 U	0.53 U	0.5 U	0.52 U	0.51 U
Perfluorooctanoic acid (PFOA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
Perfluorodecanoic Acid (PFDA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
Perfluorohexanesulfonic acid (PFHxS)	0.49 U	0.53 U	0.5 U	0.52 U	0.51 U
Perfluorobutanesulfonic acid (PFBS)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
Perfluoroheptanoic acid (PFHpA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
Perfluorononanoic acid (PFNA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U
Perfluorotetradecanoic Acid (PFTeDA)	1.96 U	2.13 U	2.01 U	2.07 U	2.05 U
Perfluorotridecanoic Acid (PFTrDA)	0.98 U	1.06 U	1.01 U	1.04 U	1.03 U

Notes:

Shading indicates detections

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UG/KG - Micrograms per kilogram

Table H4. Surface Water Analytical Data

Site Inspection Report for Per- and Polyfluoroalkyl Substances at
Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

Sample ID	NARL-S05-SW01-0819	NARL-S05-SW02-0819	NARL-S05-SW02P-0819	NARL-S05-SW03-0819	NARL-S05-SW04-0819	NARL-S05-SW05-0819
Sample Date	08/20/19	08/20/19	08/20/19	08/20/19	08/20/19	08/20/19
Chemical Name						
Semivolatile Organic Compounds (UG/L)						
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U	0.00036 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	0.00089 U	0.00089 U	0.00089 U	0.00089 U	0.00089 U	0.00089 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	0.00179 U	0.00179 U	0.00179 U	0.00179 U	0.00179 U	0.00179 U
Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036 UJ	0.00036 UJ	0.00036 UJ	0.00036 UJ	0.00036 UJ	0.00036 UJ
Perfluorooctane Sulfonate (PFOS)	0.12915	0.095	0.08168	0.12309	0.141	0.21112
Perfluoroundecanoic Acid (PFUnA)	0.00089 U	0.00089 U	0.00089 U	0.00089 U	0.00089 U	0.00089 U
Perfluorohexanoic Acid (PFHxA)	0.03809 J	0.03699 J	0.04358 J	0.04092 J	0.0377 J	0.03687 J
Perfluorododecanoic Acid (PFDoA)	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U
Perfluorooctanoic acid (PFOA)	0.0721	0.07857	0.08905	0.07341	0.06646	0.07767
Perfluorodecanoic Acid (PFDA)	0.00015 J	0.00022 J	0.00045 U	0.00024 J	0.00045 U	0.00023 J
Perfluorohexanesulfonic acid (PFHxS)	0.13632	0.13994	0.16955	0.11931	0.11793	0.11548
Perfluorobutanesulfonic acid (PFBS)	0.00526	0.00577	0.006 J	0.00728	0.00614	0.006
Perfluoroheptanoic acid (PFHpA)	0.0094 J	0.01068 J	0.01005 J	0.00977	0.00928 J	0.01066 J
Perfluorononanoic acid (PFNA)	0.00085 J	0.00062 J	0.00065 J	0.00098 J	0.00096 J	0.00105 J
Perfluorotetradecanoic Acid (PFTeDA)	0.00089 U	0.00089 U	0.00089 U	0.00089 U	0.00089 U	0.00089 U
Perfluorotridecanoic Acid (PFTrDA)	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U	0.00045 U

Notes:

Shading indicates detections

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

UG/L - Micrograms per liter

Appendix I
Data Quality Assessment Report

Data Quality Assessment, Former Naval Arctic Research Laboratory Barrow (NARL), Barrow, Alaska

DATE: January 23, 2020

1. Introduction

The purpose of this memorandum is to present the results of the data validation process for the water and soil samples collected at the NARL Site. The results of the data validation process are presented in this memorandum and Attachments 1 through 3. Completed Alaska Department of Environmental Conservation (ADEC) laboratory data review checklists are provided as Attachment 4. Chain of custody corrections are documented in Attachment 5.

The samples were collected in August 2019.

Samples were submitted to Battelle Norwell Operations in Norwell, Massachusetts for the analyses listed in the table below.

Method	Analytical Method Description	Matrix
Battelle SOP 5-369-07	PFAS	Water, Soil

The sample results were validated by Environmental Data Services, Inc. for compliance with the analytical method requirements. Data validation reports for the following sample delivery groups (SDGs; **Attachment 1**) were reviewed by CH2M HILL, Inc. (CH2M) for this data quality assessment.

SDG	Description
19-0794	10 water samples for PFAS analysis
19-0795	9 water samples for PFAS analysis
19-0829	11 water samples for PFAS analysis
19-0830	12 soil samples for PFAS analysis
19-0831	13 soil samples for PFAS analysis

The process for conducting the data quality assessment included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in guidance documents including *Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFAS) Analyzed Using EPA Method 537* (USEPA, 2018), and *Sampling and Analysis Plan Site Inspection for Per- and Polyfluoroalkyl Substances* (CH2M, 2019), and professional judgment. The quality assurance/quality control (QA/QC) summary forms and data reports were reviewed and the resulting findings are documented within each subsection that follows.

During the data validation, if QA/QC parameters were not within the acceptance limits, associated sample results were appended with a primary qualifying flag that indicated a possible anomaly with these data. The qualifying flags originated during the data review and validation processes. This qualification also included the use of secondary sub-qualifier flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier to these data. The definitions of the primary qualifiers are presented below. The secondary sub-qualifier flags are defined and presented in **Attachment 2**.

2. Validation Flag Definitions

The following primary qualifiers were used to qualify the data:

[BLANK]: Detected. The analyte was analyzed for and detected at the concentration shown.

[J]: Estimated. The analyte was present, but the reported value may not be accurate or precise.

[U]: Undetected. The analyte was analyzed for but not detected above the method detection limit.

[UJ]: Detection limit estimated. The analyte was analyzed for but qualified as not detected; the detection limit is estimated.

[R]: Rejected. The data are not usable.

[Exclude]: Excluded. Data were not used due to another value being more appropriate.

3. Quality Control Measures

The following list represents the QA/QC measures that were reviewed during the data quality evaluation procedure for organic data:

- Holding Times – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- Blank samples – Method blank, equipment blank, and trip blank samples were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- Surrogate Recoveries – Surrogate compounds are added to each sample and the recoveries are used to monitor lab performance and possible matrix interference.
- Laboratory Control Sample (LCS)/Laboratory Control Sample Duplicate (LCSD) – These samples are a "controlled matrix," laboratory reagent water, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples – Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. Precision information is also determined by calculating the reproducibility between the recoveries of each spiked parameter.
- Field Duplicate Samples – These samples are collected to determine precision between a native and its duplicate. This information can only be determined when target compounds are detected.
- Internal Standards – These are compounds added to the sample extracts prior to analysis. Their retention times and response are evaluated for method compliance. The internal standards are used in quantification of the target parameters and to monitor the instrument sensitivity and response for stability during analysis.
- Initial Calibration – The initial calibration ensures the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest. Multiple standard solutions are analyzed to determine the response and linearity of the instrument over a varying concentration range.
- Continuing Calibration – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds by analysis of a standard solution(s) at known concentrations.

4. Quality Control Review

The QA/QC parameters for all samples were within acceptable control limits with the exceptions listed below. A brief overview of the data evaluation follows:

4.1 Holding Time

All holding time requirements were met.

4.2 Recoveries - Surrogate, MS/MSD, and LCS/LCSD

Surrogates, MS/MSD, and LCS/LCSD recoveries all met acceptance criteria with the exception of those listed below:

The samples listed in the table below exhibited low surrogate recoveries. Affected data are summarized in **Attachment 3**.

Sample Name
NARL-S05-SW01-0819
NARL-S05-SW02-0819
NARL-S05-SW02P-0819
NARL-S05-SW03-0819
NARL-S05-SW04-0819
NARL-S05-SW05-0819
NARL-S05-WP-12-0819
NARL-S05-WP-11-0819
NARL-S05-WP-20-0819
NARL-S05-EB01-082119
NARL-S05-TW01-0819
NARL-S05-TW01P-0819
NARL-S05-TW03-0819
NARL-S05-TW08-0819
NARL-S05-TW02-0819

4.3 Analytical Blanks

The analytes listed below were detected in low levels in the field blank, equipment blanks, and method blanks.

- The results for PFOA in samples NARL-S05-FB01-082119, NARL-S05-EB01-082119, NARL-S05-EB02-082119, and NARL-S05-EB03-082119 were qualified as not detected due to the detection of PFOA in the method blank. These detected results were qualified as not detected (U) and were not used to assess and qualify associated sample data.

Sample ID	Analyte	Conc. µg/L	Lab Flag
NARL-S05-FB01-082119	Perfluorooctanoic acid (PFOA)	0.00042	J
NARL-S05-EB01-082119	Perfluorooctanoic acid (PFOA)	0.00041	J
NARL-S05-EB02-082119	Perfluorooctanoic acid (PFOA)	0.00042	J
NARL-S05-EB03-082119	Perfluorooctanoic acid (PFOA)	0.00047	J
NARL-S05-EB07-082819	Perfluorooctane Sulfonate (PFOS)	0.00172	J
NARL-S05-EB09-082919	Perfluorooctane Sulfonate (PFOS)	0.00037	J
CV262PB-FS	Perfluorooctanoic acid (PFOA)	0.00028	J
CV264PB-FS	Perfluorooctanoic acid (PFOA)	0.0003	J

Affected data are summarized in **Attachment 3**.

Calibration

All calibration criteria were met.

Reproducibility

All reproducibility criteria were met.

5. PARCC

Precision is defined as the agreement between duplicate results, and was estimated by comparing duplicate MS recoveries, and field duplicate sample results. The precision between the native and field duplicate sample results was within acceptable criteria for all analyses indicating that the sample matrix did not significantly interfere with the overall analytical process.

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. For organic analyses, each sample was spiked with surrogate compounds. Additionally, a matrix spike (MS)/matrix spike duplicate (MSD) and laboratory control sample (LCS) were spiked

with a known parameter concentration before preparation. Internal standards also provide a measure of accuracy. Internal standards, surrogates, and MS/MSD provide a measure of the matrix effects on the analytical accuracy. The LCS demonstrates accuracy of the method and the laboratory's ability to meet the method criteria. Accuracy is also assessed by calibration responses. Potential biases and trends were evaluated by first determining whether a QA/QC exceedance may indicate a potential bias or trend. If so, then the exceedance was examined to determine whether the bias or trend was significant enough to warrant rejection of data. None of the data were rejected; however, approximately 35 data points were J or UJ-qualified due to low bias in surrogate recovery.

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition (for example, nature and extent of contamination). Representativeness is a subjective parameter and is used to evaluate the efficacy of the sample planning design. In terms of data quality, representativeness was assured, because the sampling team followed approved standard operating procedures for sample collection and handling, and the laboratory followed approved standard operating procedures for sample handling, preparation, and analysis. All field samples were collected and analyzed as proposed in the SAP.

Completeness is defined as the percentage of measurements that are judged to be valid; validity being defined by the data quality objectives (DQOs). Therefore, completeness is calculated as the number of analytically sound results that are available for use compared to the total number of measurements made. The National Functional Guidelines data validation guidance designates all results except those R-qualified as "rejected" to be available for use as analytically sound results. The R-qualifier is the only qualifier that negatively affects a data point's availability. The data set is 100% complete and the completeness goal of 95% was exceeded.

Comparability is another qualitative measure designed to express the confidence with which one data set may be compared to another. Factors that affect comparability are sample collection and handling techniques, sample matrix, and analytical methods. In this case, because approved SOPs were used for sample collection and handling, common sample matrices were evaluated (water), and USEPA SW-846 methods were utilized, the data user may express confidence in that fact that this data set is comparable to others of acceptable data quality. Comparability is controlled by the other PARCC parameters, because data sets can be compared with confidence only when precision and accuracy are known. Precision and accuracy were demonstrated to be acceptable, and the data user may be confident that this data set is comparable to others of high data quality.

The recalculation of the laboratory quantitation was performed at a 10% frequency as per the statement of work with no anomalies found. The assumptions made about the PARCC were proper and correct. No error in judgment was found during this review of the data validation reports.

6. Conclusion

A review of the analytical data submitted regarding the NARL sampling event in August 2019 by CH2M has been completed. The validation review demonstrated that the analytical systems were generally in control and the data results can be used in the project decision making process.

7. References

CH2M HILL, Inc. (CH2M). 2019. *Uniform Federal Policy – Sampling and Analysis Plan (UFP-SAP), Sampling and Analysis Plan Site Inspection for Per- and Polyfluoroalkyl Substances*.

United States Environmental Protection Agency (USEPA). 2018. Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537. November.

Attachment 1
Data Validation Reports

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NARL BARROW, ALASKA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 19-0794
Laboratory: Battelle Norwell Operations, Norwell, Massachusetts
Site: NARL Barrow, Alaska
Date: December 3, 2019

PFAS			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	NARL-S05-SW01-0819	I6835-FS	Water
1MS	NARL-S05-SW01-0819MS	I6836-FSMS	Water
1MSD	NARL-S05-SW01-0819MSD	I6837-FSMSD	Water
2	NARL-S05-SW02-0819	I6838-FS	Water
3	NARL-S05-SW02P-0819	I6839-FS	Water
4	NARL-S05-SW03-0819	I6840-FS	Water
5	NARL-S05-SW04-0819	I6841-FS	Water
6	NARL-S05-SW05-0819	I6842-FS	Water
7	NARL-S05-WP-10-0819	I6843-FS	Water
8	NARL-S05-WP-12-0819	I6844-FS	Water
9	NARL-S05-WP-11-0819	I6845-FS	Water
10	NARL-S05-WP-20-0819	I6846-FS	Water

A full data validation was performed on the analytical data for ten water samples collected on August 20-21, 2019 by CH2M HILL at the NARL site in Barrow, Alaska. The samples were analyzed under the Analysis of Perfluorinated Substances in Environmental Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS) and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.1.

Specific method references are as follows:

Analysis	*Method References*
PFAS	Battelle SOP 5-369-07

The data have been validated according to the protocols and quality control (QC) requirements of the analytical methods and the USEPA Data Review and Validation Guidelines as follows:

- The USEPA "Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537," November 2018;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data are acceptable for the intended purposes as qualified for the deficiencies detailed in this report.

Please note that any results qualified (U) due to blank contamination may be then qualified (J) due to another action. Therefore, the results may be qualified (UJ) due to the culmination of the blank contaminations and actions from other exceedances of QC criteria.

Per- and Polyfluoroalkyl Substances (PFAS)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for water samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent recovery (%R) criteria were met.

Method Blank

- The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
CV262PB-FS	PFOA	0.28	None	All Samples >10X

Field QC Blank

- Field QC samples are summarized below.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
NARL-S05-EB01-082119	None - ND	-	-	-
NARL-S05-FB01-082119	None - ND	-	-	-

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate %R values except for the following.

EDS Sample ID	Surrogate	%R	Qualifier
1	13C5-PFHxA	31%	J - Associated Compound
	13C4-PFHpA	48%	J - Associated Compound
	13C3-HFPO-DA	40%	UJ - Associated Compound
2	13C5-PFHxA	35%	J - Associated Compound
	13C4-PFHpA	44%	J - Associated Compound
	13C3-HFPO-DA	42%	UJ - Associated Compound
3	13C5-PFHxA	27%	J - Associated Compound
	13C4-PFHpA	45%	J - Associated Compound
	13C3-HFPO-DA	36%	UJ - Associated Compound
	13C3-PFBS	41%	J - Associated Compound
4	13C5-PFHxA	31%	J - Associated Compound
	13C3-HFPO-DA	46%	UJ - Associated Compound
5	13C5-PFHxA	29%	J - Associated Compound

EDS Sample ID	Surrogate	%R	Qualifier
5	13C4-PFHpA	46%	J - Associated Compound
	13C3-HFPO-DA	37%	UJ - Associated Compound
6	13C5-PFHxA	29%	J - Associated Compound
	13C4-PFHpA	45%	J - Associated Compound
	13C3-HFPO-DA	36%	UJ - Associated Compound
8	13C5-PFHxA	28%	J - Associated Compound
	13C4-PFHpA	43%	J - Associated Compound
	13C3-HFPO-DA	34%	UJ - Associated Compound
9	13C5-PFHxA	45%	J - Associated Compound
10	13C5-PFHxA	40%	J - Associated Compound
	13C3-HFPO-DA	45%	UJ - Associated Compound
	13C3-PFBS	33%	J - Associated Compound

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable percent recoveries (%R) and RPD values except for the following.

MS/MSD Sample ID	Compound	MS %R/MSD %R/ RPD	Qualifier
1	2 Compounds	Low/High/High	None - 4X Rule Applies

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria.

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- Several compounds in various samples were analyzed at a dilution due to high concentrations. The reporting limits were adjusted accordingly. No action was required.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	NARL-S05-SW02-0819 ng/L	NARL-S05-SW02P-0819 ng/L	RPD	Qualifier
PFHxA	36.99	43.58	16%	None
PFHpA	10.68	10.05	6%	None
PFOA	78.57	89.05	13%	None
PFNA	0.62	0.65	5%	None
PFDA	0.22	0.45U	NC	None
PFBS	5.77	6.00	4%	None
PFHxS	139.94	169.55	19%	None
PFOS	95.00	81.68	15%	None

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: _____ Dated: 12/3/19

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-SW01-0819
Battelle ID	I6835-FS
Sample Type	SA
Collection Date	08/20/2019
Extraction Date	08/30/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.280
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	38.09 J	I6835-FS(0)	1.000	9/20/2019	0.17	0.45	4.46	SSL
PFHpA	375-85-9	9.40 J	I6835-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	SSL
PFOA	335-67-1	72.10	I6835-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFNA	375-95-1	0.85 J	I6835-FS(0)	1.000	9/20/2019	0.23	0.89	4.46	
PFDA	335-76-2	0.15 J	I6835-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFUnA	2058-94-8	0.89 U	I6835-FS(0)	1.000	9/20/2019	0.26	0.89	4.46	
PFDoA	307-55-1	0.45 U	I6835-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFTrDA	72629-94-8	0.45 U	I6835-FS(0)	1.000	9/20/2019	0.13	0.45	4.46	
PFTeDA	376-06-7	0.89 U	I6835-FS(0)	1.000	9/20/2019	0.22	0.89	4.46	
NMeFOSAA	2355-31-9	1.79 U	I6835-FS(0)	1.000	9/20/2019	0.50	1.79	4.46	
NEtFOSAA	2991-50-6	0.89 U	I6835-FS(0)	1.000	9/20/2019	0.44	0.89	4.46	
PFBS	375-73-5	5.26	I6835-FS(0)	1.000	9/20/2019	0.12	0.45	4.46	
PFHxS	355-46-4	136.32	I6835-FS-D(3)	10.000	9/20/2019	0.98	3.57	44.64	
PFOS	1763-23-1	129.15	I6835-FS-D(3)	10.000	9/20/2019	1.70	4.46	44.64	
HFPO-DA	13252-13-6	0.36 U J	I6835-FS(0)	1.000	9/20/2019	0.18	0.36	4.46	SSL
Adona	919005-14-4	0.36 U	I6835-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
11Cl-PF3OUdS	763051-92-9	0.36 U	I6835-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
9Cl-PF3ONS	756426-58-1	0.36 U	I6835-FS(0)	1.000	9/20/2019	0.09	0.36	4.46	

NW 11/29/19

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

2

Client ID		NARL-S05-SW02-0819							
Battelle ID		I6838-FS							
Sample Type		SA							
Collection Date		08/20/2019							
Extraction Date		08/30/2019							
Analytical Instrument		Sciex 6500+ LC/MS/MS							
% Moisture		NA							
Matrix		AQ							
Sample Size		0.280							
Size Unit-Basis		L							
Analyte	CAS No.	Result (ng/L)		Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	36.99 J		I6838-FS(0)	1.000	9/20/2019	0.17	0.45	4.46	SSC
PFHpA	375-85-9	10.68 J		I6838-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	1
PFOA	335-67-1	78.57		I6838-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFNA	375-95-1	0.62 J		I6838-FS(0)	1.000	9/20/2019	0.23	0.89	4.46	
PFDA	335-76-2	0.22 J		I6838-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFUnA	2058-94-8	0.89 U		I6838-FS(0)	1.000	9/20/2019	0.26	0.89	4.46	
PFDoA	307-55-1	0.45 U		I6838-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFTrDA	72629-94-8	0.45 U		I6838-FS(0)	1.000	9/20/2019	0.13	0.45	4.46	
PFTeDA	376-06-7	0.89 U		I6838-FS(0)	1.000	9/20/2019	0.22	0.89	4.46	
NMeFOSAA	2355-31-9	1.79 U		I6838-FS(0)	1.000	9/20/2019	0.50	1.79	4.46	
NEtFOSAA	2991-50-6	0.89 U		I6838-FS(0)	1.000	9/20/2019	0.44	0.89	4.46	
PFBS	375-73-5	5.77		I6838-FS(0)	1.000	9/20/2019	0.12	0.45	4.46	
PFHxS	355-46-4	139.94 D		I6838-FS-D(3)	3.333	9/20/2019	0.33	1.19	14.88	
PFOS	1763-23-1	95.00 D		I6838-FS-D(3)	3.333	9/20/2019	0.57	1.49	14.88	
HFPO-DA	13252-13-6	0.36 U J		I6838-FS(0)	1.000	9/20/2019	0.18	0.36	4.46	SSC
Adona	919005-14-4	0.36 U		I6838-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
11Cl-PF3OUdS	763051-92-9	0.36 U		I6838-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
9Cl-PF3ONS	756426-58-1	0.36 U		I6838-FS(0)	1.000	9/20/2019	0.09	0.36	4.46	

NW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

3

Client ID	NARL-S05-SW02P-0819
Battelle ID	I6839-FS
Sample Type	SA
Collection Date	08/20/2019
Extraction Date	08/30/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.280
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	43.58 J	I6839-FS(0)	1.000	9/20/2019	0.17	0.45	4.46	SSL
PFHpA	375-85-9	10.05 J	I6839-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	↓
PFOA	335-67-1	89.05	I6839-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFNA	375-95-1	0.65 J	I6839-FS(0)	1.000	9/20/2019	0.23	0.89	4.46	
PFDA	335-76-2	0.45 U	I6839-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFUnA	2058-94-8	0.89 U	I6839-FS(0)	1.000	9/20/2019	0.26	0.89	4.46	
PFDoA	307-55-1	0.45 U	I6839-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFTrDA	72629-94-8	0.45 U	I6839-FS(0)	1.000	9/20/2019	0.13	0.45	4.46	
PFTeDA	376-06-7	0.89 U	I6839-FS(0)	1.000	9/20/2019	0.22	0.89	4.46	
NMeFOSAA	2355-31-9	1.79 U	I6839-FS(0)	1.000	9/20/2019	0.50	1.79	4.46	
NEtFOSAA	2991-50-6	0.89 U	I6839-FS(0)	1.000	9/20/2019	0.44	0.89	4.46	
PFBS	375-73-5	6.00 J	I6839-FS(0)	1.000	9/20/2019	0.12	0.45	4.46	SSL
PFHxS	355-46-4	169.55 D	I6839-FS-D(3)	5.000	9/23/2019	0.49	1.79	22.32	
PFOS	1763-23-1	81.68 D	I6839-FS-D(3)	5.000	9/23/2019	0.85	2.23	22.32	
HFPO-DA	13252-13-6	0.36 UJ	I6839-FS(0)	1.000	9/20/2019	0.18	0.36	4.46	SSL
Adona	919005-14-4	0.36 U	I6839-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
11Cl-PF3OUdS	763051-92-9	0.36 U	I6839-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
9Cl-PF3ONS	756426-58-1	0.36 U	I6839-FS(0)	1.000	9/20/2019	0.09	0.36	4.46	

NW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

4

Client ID		NARL-S05-SW03-0819							
Battelle ID		I6840-FS							
Sample Type		SA							
Collection Date		08/20/2019							
Extraction Date		08/30/2019							
Analytical Instrument		Sciex 6500+ LC/MS/MS							
% Moisture		NA							
Matrix		AQ							
Sample Size		0.280							
Size Unit-Basis		L							
Analyte	CAS No.	Result (ng/L)		Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	40.92	J	I6840-FS(0)	1.000	9/20/2019	0.17	0.45	4.46	SSL
PFHpA	375-85-9	9.77		I6840-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFOA	335-67-1	73.41		I6840-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFNA	375-95-1	0.98	J	I6840-FS(0)	1.000	9/20/2019	0.23	0.89	4.46	
PFDA	335-76-2	0.24	J	I6840-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFUnA	2058-94-8	0.89	U	I6840-FS(0)	1.000	9/20/2019	0.26	0.89	4.46	
PFDoA	307-55-1	0.45	U	I6840-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFTrDA	72629-94-8	0.45	U	I6840-FS(0)	1.000	9/20/2019	0.13	0.45	4.46	
PFTeDA	376-06-7	0.89	U	I6840-FS(0)	1.000	9/20/2019	0.22	0.89	4.46	
NMeFOSAA	2355-31-9	1.79	U	I6840-FS(0)	1.000	9/20/2019	0.50	1.79	4.46	
NEtFOSAA	2991-50-6	0.89	U	I6840-FS(0)	1.000	9/20/2019	0.44	0.89	4.46	
PFBS	375-73-5	7.28		I6840-FS(0)	1.000	9/20/2019	0.12	0.45	4.46	
PFHxS	355-46-4	119.31	ϕ	I6840-FS-D(3)	3.333	9/20/2019	0.33	1.19	14.88	
PFOS	1763-23-1	123.09	ϕ	I6840-FS-D(3)	3.333	9/20/2019	0.57	1.49	14.88	
HFPO-DA	13252-13-6	0.36	U UJ	I6840-FS(0)	1.000	9/20/2019	0.18	0.36	4.46	SSL
Adona	919005-14-4	0.36	U	I6840-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
11Cl-PF3OUdS	763051-92-9	0.36	U	I6840-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
9Cl-PF3ONS	756426-58-1	0.36	U	I6840-FS(0)	1.000	9/20/2019	0.09	0.36	4.46	

NH 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

5

Client ID		NARL-S05-SW04-0819							
Battelle ID		I6841-FS							
Sample Type		SA							
Collection Date		08/20/2019							
Extraction Date		08/30/2019							
Analytical Instrument		Sciex 6500+ LC/MS/MS							
% Moisture		NA							
Matrix		AQ							
Sample Size		0.280							
Size Unit-Basis		L							
Analyte	CAS No.	Result (ng/L)		Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	37.70	J	I6841-FS(0)	1.000	9/20/2019	0.17	0.45	4.46	SSL
PFHpA	375-85-9	9.28	J	I6841-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	SSL
PFOA	335-67-1	66.46		I6841-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFNA	375-95-1	0.96	J	I6841-FS(0)	1.000	9/20/2019	0.23	0.89	4.46	
PFDA	335-76-2	0.45	U	I6841-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFUnA	2058-94-8	0.89	U	I6841-FS(0)	1.000	9/20/2019	0.26	0.89	4.46	
PFDoA	307-55-1	0.45	U	I6841-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFTrDA	72629-94-8	0.45	U	I6841-FS(0)	1.000	9/20/2019	0.13	0.45	4.46	
PFTeDA	376-06-7	0.89	U	I6841-FS(0)	1.000	9/20/2019	0.22	0.89	4.46	
NMeFOSAA	2355-31-9	1.79	U	I6841-FS(0)	1.000	9/20/2019	0.50	1.79	4.46	
NEtFOSAA	2991-50-6	0.89	U	I6841-FS(0)	1.000	9/20/2019	0.44	0.89	4.46	
PFBS	375-73-5	6.14		I6841-FS(0)	1.000	9/20/2019	0.12	0.45	4.46	
PFHxS	355-46-4	117.93	D	I6841-FS-D(3)	3.333	9/20/2019	0.33	1.19	14.88	
PFOS	1763-23-1	141.00	D	I6841-FS-D(3)	3.333	9/20/2019	0.57	1.49	14.88	
HFPO-DA	13252-13-6	0.36	U UJ	I6841-FS(0)	1.000	9/20/2019	0.18	0.36	4.46	SSL
Adona	919005-14-4	0.36	U	I6841-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
11Cl-PF3OUdS	763051-92-9	0.36	U	I6841-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
9Cl-PF3ONS	756426-58-1	0.36	U	I6841-FS(0)	1.000	9/20/2019	0.09	0.36	4.46	

NW 11/28/19
Analyzed by: Schultz, Stephanie
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

6

Client ID	NARL-S05-SW05-0819
Battelle ID	I6842-FS
Sample Type	SA
Collection Date	08/20/2019
Extraction Date	08/30/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.280
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	36.87 J	I6842-FS(0)	1.000	9/20/2019	0.17	0.45	4.46	SSL
PFHpA	375-85-9	10.66 J	I6842-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	SSL
PFOA	335-67-1	77.67	I6842-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFNA	375-95-1	1.05 J	I6842-FS(0)	1.000	9/20/2019	0.23	0.89	4.46	
PFDA	335-76-2	0.23 J	I6842-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFUnA	2058-94-8	0.89 U	I6842-FS(0)	1.000	9/20/2019	0.26	0.89	4.46	
PFDoA	307-55-1	0.45 U	I6842-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFTrDA	72629-94-8	0.45 U	I6842-FS(0)	1.000	9/20/2019	0.13	0.45	4.46	
PFTeDA	376-06-7	0.89 U	I6842-FS(0)	1.000	9/20/2019	0.22	0.89	4.46	
NMeFOSAA	2355-31-9	1.79 U	I6842-FS(0)	1.000	9/20/2019	0.50	1.79	4.46	
NEtFOSAA	2991-50-6	0.89 U	I6842-FS(0)	1.000	9/20/2019	0.44	0.89	4.46	
PFBS	375-73-5	6.00	I6842-FS(0)	1.000	9/20/2019	0.12	0.45	4.46	
PFHxS	355-46-4	115.48 J	I6842-FS-D(3)	5.000	9/20/2019	0.49	1.79	22.32	
PFOS	1763-23-1	211.12 J	I6842-FS-D(3)	5.000	9/20/2019	0.85	2.23	22.32	
HFPO-DA	13252-13-6	0.36 U UJ	I6842-FS(0)	1.000	9/20/2019	0.18	0.36	4.46	SSL
Adona	919005-14-4	0.36 U	I6842-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
11Cl-PF3OUdS	763051-92-9	0.36 U	I6842-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
9Cl-PF3ONS	756426-58-1	0.36 U	I6842-FS(0)	1.000	9/20/2019	0.09	0.36	4.46	

NW 11/28/19

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

7

Client ID		NARL-S05-WP-10-0819						
Battelle ID		I6843-FS						
Sample Type		SA						
Collection Date		08/20/2019						
Extraction Date		08/30/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		AQ						
Sample Size		0.275						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	755.99 Ø	I6843-FS-D(5)	12.500	9/20/2019	2.16	5.68	56.82
PFHpA	375-85-9	203.68	I6843-FS(0)	1.000	9/20/2019	0.15	0.45	4.55
PFOA	335-67-1	5678.98 Ø	I6843-FS-D(7)	125.000	9/23/2019	20.45	56.82	568.18
PFNA	375-95-1	23.63	I6843-FS(0)	1.000	9/20/2019	0.24	0.91	4.55
PFDA	335-76-2	3.42 J	I6843-FS(0)	1.000	9/20/2019	0.15	0.45	4.55
PFUnA	2058-94-8	0.38 J	I6843-FS(0)	1.000	9/20/2019	0.26	0.91	4.55
PFDoA	307-55-1	0.45 U	I6843-FS(0)	1.000	9/20/2019	0.16	0.45	4.55
PFTrDA	72629-94-8	0.45 U	I6843-FS(0)	1.000	9/20/2019	0.14	0.45	4.55
PFTeDA	376-06-7	0.91 U	I6843-FS(0)	1.000	9/20/2019	0.23	0.91	4.55
NMeFOSAA	2355-31-9	12.53	I6843-FS(0)	1.000	9/20/2019	0.51	1.82	4.55
NEtFOSAA	2991-50-6	0.91 U	I6843-FS(0)	1.000	9/20/2019	0.45	0.91	4.55
PFBS	375-73-5	48.58	I6843-FS(0)	1.000	9/20/2019	0.12	0.45	4.55
PFHxS	355-46-4	5783.84 Ø	I6843-FS-D(7)	125.000	9/23/2019	12.50	45.45	568.18
PFOS	1763-23-1	4203.51 Ø	I6843-FS-D(7)	125.000	9/23/2019	21.59	56.82	568.18
HFPO-DA	13252-13-6	0.36 U	I6843-FS(0)	1.000	9/20/2019	0.18	0.36	4.55
Adona	919005-14-4	0.36 U	I6843-FS(0)	1.000	9/20/2019	0.16	0.36	4.55
11Cl-PF3OUdS	763051-92-9	0.36 U	I6843-FS(0)	1.000	9/20/2019	0.16	0.36	4.55
9Cl-PF3ONS	756426-58-1	0.36 U	I6843-FS(0)	1.000	9/20/2019	0.09	0.36	4.55

11/28/19
Analyzed by: Schultz, Stephanie
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

8

Client ID	NARL-S05-WP-12-0819
Battelle ID	I6844-FS
Sample Type	SA
Collection Date	08/20/2019
Extraction Date	08/30/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.280
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	25.99 J	I6844-FS(0)	1.000	9/20/2019	0.17	0.45	4.46	SSL
PFHpA	375-85-9	16.16 J	I6844-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	J
PFOA	335-67-1	22.14	I6844-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFNA	375-95-1	1.97 J	I6844-FS(0)	1.000	9/20/2019	0.23	0.89	4.46	
PFDA	335-76-2	1.55 J	I6844-FS(0)	1.000	9/20/2019	0.14	0.45	4.46	
PFUnA	2058-94-8	0.32 J	I6844-FS(0)	1.000	9/20/2019	0.26	0.89	4.46	
PFDoA	307-55-1	0.45 U	I6844-FS(0)	1.000	9/20/2019	0.16	0.45	4.46	
PFTrDA	72629-94-8	0.45 U	I6844-FS(0)	1.000	9/20/2019	0.13	0.45	4.46	
PFTeDA	376-06-7	0.89 U	I6844-FS(0)	1.000	9/20/2019	0.22	0.89	4.46	
NMeFOSAA	2355-31-9	13.83	I6844-FS(0)	1.000	9/20/2019	0.50	1.79	4.46	
NEtFOSAA	2991-50-6	0.49 J	I6844-FS(0)	1.000	9/20/2019	0.44	0.89	4.46	
PFBS	375-73-5	7.43	I6844-FS(0)	1.000	9/20/2019	0.12	0.45	4.46	
PFHxS	355-46-4	459.43 D	I6844-FS-D(3)	10.000	9/20/2019	0.98	3.57	44.64	
PFOS	1763-23-1	1445.32 D	I6844-FS-D(5)	33.333	9/20/2019	5.65	14.88	148.81	
HFPO-DA	13252-13-6	0.360 UJ	I6844-FS(0)	1.000	9/20/2019	0.18	0.36	4.46	SSL
Adona	919005-14-4	0.36 U	I6844-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
11Cl-PF3OUdS	763051-92-9	0.36 U	I6844-FS(0)	1.000	9/20/2019	0.16	0.36	4.46	
9Cl-PF3ONS	756426-58-1	0.36 U	I6844-FS(0)	1.000	9/20/2019	0.09	0.36	4.46	

Nov 11 2019

Analyzed by: Schultz, Stephanie
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

9

Client ID	NARL-S05-WP-11-0819
Battelle ID	I6845-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/30/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.280
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	38.77 J	I6845-FS(0)	1.000	9/20/2019	0.17	0.45	4.46
PFHpA	375-85-9	31.63	I6845-FS(0)	1.000	9/20/2019	0.14	0.45	4.46
PFOA	335-67-1	236.29 Ø	I6845-FS-D(3)	5.000	9/20/2019	0.80	2.23	22.32
PFNA	375-95-1	2.73 J	I6845-FS(0)	1.000	9/20/2019	0.23	0.89	4.46
PFDA	335-76-2	0.45 U	I6845-FS(0)	1.000	9/20/2019	0.14	0.45	4.46
PFUnA	2058-94-8	0.89 U	I6845-FS(0)	1.000	9/20/2019	0.26	0.89	4.46
PFDoA	307-55-1	0.45 U	I6845-FS(0)	1.000	9/20/2019	0.16	0.45	4.46
PFTrDA	72629-94-8	0.45 U	I6845-FS(0)	1.000	9/20/2019	0.13	0.45	4.46
PFTeDA	376-06-7	0.89 U	I6845-FS(0)	1.000	9/20/2019	0.22	0.89	4.46
NMeFOSAA	2355-31-9	1.79 U	I6845-FS(0)	1.000	9/20/2019	0.50	1.79	4.46
NEtFOSAA	2991-50-6	0.89 U	I6845-FS(0)	1.000	9/20/2019	0.44	0.89	4.46
PFBS	375-73-5	13.40	I6845-FS(0)	1.000	9/20/2019	0.12	0.45	4.46
PFHxS	355-46-4	564.14 Ø	I6845-FS-D(5)	10.000	9/20/2019	0.98	3.57	44.64
PFOS	1763-23-1	379.13 Ø	I6845-FS-D(5)	10.000	9/20/2019	1.70	4.46	44.64
HFPO-DA	13252-13-6	0.36 U	I6845-FS(0)	1.000	9/20/2019	0.18	0.36	4.46
Adona	919005-14-4	0.36 U	I6845-FS(0)	1.000	9/20/2019	0.16	0.36	4.46
11Cl-PF3OUdS	763051-92-9	0.36 U	I6845-FS(0)	1.000	9/20/2019	0.16	0.36	4.46
9Cl-PF3ONS	756426-58-1	0.36 U	I6845-FS(0)	1.000	9/20/2019	0.09	0.36	4.46

SSL

NW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 9/24/2019

BATTELLE
It can be done

10

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-WP-20-0819
Battelle ID	I6846-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/30/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.260
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	64.58 J	I6846-FS(0)	1.000	9/20/2019	0.18	0.48	4.81	SSC
PFHpA	375-85-9	19.23	I6846-FS(0)	1.000	9/20/2019	0.15	0.48	4.81	
PFOA	335-67-1	265.62 D	I6846-FS-D(3)	5.000	9/20/2019	0.87	2.40	24.04	
PFNA	375-95-1	1.83 J	I6846-FS(0)	1.000	9/20/2019	0.25	0.96	4.81	
PFDA	335-76-2	0.48 U	I6846-FS(0)	1.000	9/20/2019	0.15	0.48	4.81	
PFUnA	2058-94-8	0.96 U	I6846-FS(0)	1.000	9/20/2019	0.28	0.96	4.81	
PFDoA	307-55-1	0.48 U	I6846-FS(0)	1.000	9/20/2019	0.17	0.48	4.81	
PFTrDA	72629-94-8	0.48 U	I6846-FS(0)	1.000	9/20/2019	0.14	0.48	4.81	
PFTeDA	376-06-7	0.96 U	I6846-FS(0)	1.000	9/20/2019	0.24	0.96	4.81	
NMeFOSAA	2355-31-9	1.92 U	I6846-FS(0)	1.000	9/20/2019	0.54	1.92	4.81	
NEtFOSAA	2991-50-6	0.96 U	I6846-FS(0)	1.000	9/20/2019	0.47	0.96	4.81	
PFBS	375-73-5	15.30 J	I6846-FS(0)	1.000	9/20/2019	0.13	0.48	4.81	SSC
PFHxS	355-46-4	1325.34 D	I6846-FS-D(7)	125.000	9/20/2019	13.22	48.08	600.96	
PFOS	1763-23-1	131.48 D	I6846-FS-D(3)	5.000	9/20/2019	0.91	2.40	24.04	
HFPO-DA	13252-13-6	0.38 U UJ	I6846-FS(0)	1.000	9/20/2019	0.19	0.38	4.81	SSC
Adona	919005-14-4	0.38 U	I6846-FS(0)	1.000	9/20/2019	0.17	0.38	4.81	
11Cl-PF3OUdS	763051-92-9	0.38 U	I6846-FS(0)	1.000	9/20/2019	0.17	0.38	4.81	
9Cl-PF3ONS	756426-58-1	0.38 U	I6846-FS(0)	1.000	9/20/2019	0.10	0.38	4.81	

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NARL BARROW, ALASKA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 19-0795
Laboratory: Battelle Norwell Operations, Norwell, Massachusetts
Site: NARL Barrow, Alaska
Date: December 3, 2019

PFAS			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	NARL-S05-AFAS-WP-21-0819	I6847-FS	Water
2	NARL-S05-WP-18B-0819	I6848-FS	Water
3	NARL-S05-WP-02C-0819	I6849-FS	Water
4	NARL-S05-WP-02CP-0819	I6850-FS	Water
5	NARL-S05-WP-16D-0819	I6851-FS	Water
5MS	NARL-S05-WP-16D-0819MS	I6851-FSMS	Water
5MSD	NARL-S05-WP-16D-0819MSD	I6851-FSMSD	Water
6	NARL-S05-FB01-082119	I6854-FS	Water
7	NARL-S05-EB01-082119	I6855-FS	Water
8	NARL-S05-EB02-082119	I6856-FS	Water
9	NARL-S05-EB03-082119	I6857-FS	Water

A full data validation was performed on the analytical data for five water samples, three aqueous equipment blank samples, and one aqueous field blank sample collected on August 21, 2019 by CH2M HILL at the NARL site in Barrow, Alaska. The samples were analyzed under the Analysis of Perfluorinated Substances in Environmental Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS) and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.1.

Specific method references are as follows:

Analysis	*Method References*
PFAS	Battelle SOP 5-369-07

The data have been validated according to the protocols and quality control (QC) requirements of the analytical methods and the USEPA Data Review and Validation Guidelines as follows:

- The USEPA "Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537," November 2018;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data are acceptable for the intended purposes as qualified for the deficiencies detailed in this report.

Please note that any results qualified (U) due to blank contamination may be then qualified (J) due to another action. Therefore, the results may be qualified (UJ) due to the culmination of the blank contaminations and actions from other exceedances of QC criteria.

Per- and Polyfluoroalkyl Substances (PFAS)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for soil samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent recovery (%R) criteria were met.

Method Blank

- The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
CV264PB-FS	PFOA	0.30	U	6-9

Field QC Blank

- Field QC samples are summarized below.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
NARL-S05-FB01-082119	None – ND	-	-	-
NARL-S05-EB01-082119	None – ND	-	-	-
NARL-S05-EB02-082119	None – ND	-	-	-
NARL-S05-EB03-082119	None – ND	-	-	-

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate %R criteria except for the following.

EDS Sample ID	Surrogate	%R	Qualifier
7	13C5-PFHxA	29%	UJ - Associated Compound
	13C4-PFHpA	40%	UJ - Associated Compound
	13C8-PFOA	49%	UJ - Associated Compound
	13C3-HFPO-DA	27%	UJ - Associated Compound

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable percent recoveries (%R) and RPD values except for the following.

MS/MSD Sample ID	Compound	MS %R/MSD %R/ RPD	Qualifier
5	3 Compounds	High/Low/High	None - 4X Rule Applies

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria.

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- Several compounds in various samples were analyzed at a dilution due to high concentrations. The reporting limits were adjusted accordingly. No action was required.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	NARL-S05-WP-02C-0819 ng/L	NARL-S05-WP-02CP-0819 ng/L	RPD	Qualifier
PFHxA	10.63	14.18	29%	
PFHpA	5.54	6.15	10%	None
PFOA	29.81	35.88	19%	None
PFNA	1.16	1.23	6%	None
PFBS	4.64	5.16	11%	None
PFHxS	125.46	132.49	6%	None
PFOS	295.16	341.45	15%	None

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: _____ Dated: 12/3/19

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-AFAS-WP-21-0819
Battelle ID	I6847-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.290
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	58.44	I6847-FS(0)	1.000	9/21/2019	0.16	0.43	4.31
PFHpA	375-85-9	11.92	I6847-FS(0)	1.000	9/21/2019	0.14	0.43	4.31
PFOA	335-67-1	99.67 D	I6847-FS-D(3)	5.000	9/21/2019	0.78	2.16	21.55
PFNA	375-95-1	2.54 J	I6847-FS(0)	1.000	9/21/2019	0.22	0.86	4.31
PFDA	335-76-2	0.80 J	I6847-FS(0)	1.000	9/21/2019	0.14	0.43	4.31
PFUnA	2058-94-8	0.86 U	I6847-FS(0)	1.000	9/21/2019	0.25	0.86	4.31
PFDoA	307-55-1	0.43 U	I6847-FS(0)	1.000	9/21/2019	0.16	0.43	4.31
PFTrDA	72629-94-8	0.43 U	I6847-FS(0)	1.000	9/21/2019	0.13	0.43	4.31
PFTeDA	376-06-7	0.86 U	I6847-FS(0)	1.000	9/21/2019	0.22	0.86	4.31
NMeFOSAA	2355-31-9	1.72 U	I6847-FS(0)	1.000	9/21/2019	0.48	1.72	4.31
NEtFOSAA	2991-50-6	0.86 U	I6847-FS(0)	1.000	9/21/2019	0.42	0.86	4.31
PFBS	375-73-5	23.14	I6847-FS(0)	1.000	9/21/2019	0.11	0.43	4.31
PFHxS	355-46-4	215.93 D	I6847-FS-D(3)	5.000	9/21/2019	0.47	1.72	21.55
PFOS	1763-23-1	635.24 D	I6847-FS-D(7)	50.000	9/23/2019	8.19	21.55	215.52
HFPO-DA	13252-13-6	0.34 U	I6847-FS(0)	1.000	9/21/2019	0.17	0.34	4.31
Adona	919005-14-4	0.34 U	I6847-FS(0)	1.000	9/21/2019	0.16	0.34	4.31
11Cl-PF3OUdS	763051-92-9	0.34 U	I6847-FS(0)	1.000	9/21/2019	0.16	0.34	4.31
9Cl-PF3ONS	756426-58-1	0.34 U	I6847-FS(0)	1.000	9/21/2019	0.09	0.34	4.31

NW 11/28/19

Analyzed by: Griffith, Lauren
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

2

Client ID	NARL-S05-WP-18B-0819
Battelle ID	I6848-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.280
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	145.16	I6848-FS(0)	1.000	9/21/2019	0.17	0.45	4.46
PFHpA	375-85-9	23.95	I6848-FS(0)	1.000	9/21/2019	0.14	0.45	4.46
PFOA	335-67-1	243.48 D	I6848-FS-D(3)	10.000	9/21/2019	1.61	4.46	44.64
PFNA	375-95-1	4.28 J	I6848-FS(0)	1.000	9/21/2019	0.23	0.89	4.46
PFDA	335-76-2	1.69 J	I6848-FS(0)	1.000	9/21/2019	0.14	0.45	4.46
PFUnA	2058-94-8	0.89 U	I6848-FS(0)	1.000	9/21/2019	0.26	0.89	4.46
PFDoA	307-55-1	0.45 U	I6848-FS(0)	1.000	9/21/2019	0.16	0.45	4.46
PFTrDA	72629-94-8	0.45 U	I6848-FS(0)	1.000	9/21/2019	0.13	0.45	4.46
PFTeDA	376-06-7	0.89 U	I6848-FS(0)	1.000	9/21/2019	0.22	0.89	4.46
NMeFOSAA	2355-31-9	1.79 U	I6848-FS(0)	1.000	9/21/2019	0.50	1.79	4.46
NEtFOSAA	2991-50-6	0.89 U	I6848-FS(0)	1.000	9/21/2019	0.44	0.89	4.46
PFBS	375-73-5	11.43	I6848-FS(0)	1.000	9/21/2019	0.12	0.45	4.46
PFHxS	355-46-4	246.35 D	I6848-FS-D(5)	33.333	9/21/2019	3.27	11.90	148.81
PFOS	1763-23-1	856.15 D	I6848-FS-D(5)	33.333	9/21/2019	5.65	14.88	148.81
HFPO-DA	13252-13-6	0.36 U	I6848-FS(0)	1.000	9/21/2019	0.18	0.36	4.46
Adona	919005-14-4	0.36 U	I6848-FS(0)	1.000	9/21/2019	0.16	0.36	4.46
11Cl-PF3OUdS	763051-92-9	0.36 U	I6848-FS(0)	1.000	9/21/2019	0.16	0.36	4.46
9Cl-PF3ONS	756426-58-1	0.36 U	I6848-FS(0)	1.000	9/21/2019	0.09	0.36	4.46

MW 11/28/19
Analyzed by: Griffith, Lauren

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

3

Client ID	NARL-S05-WP-02C-0819
Battelle ID	I6849-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.285
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	10.63	I6849-FS(0)	1.000	9/21/2019	0.17	0.44	4.39
PFHpA	375-85-9	5.54	I6849-FS(0)	1.000	9/21/2019	0.14	0.44	4.39
PFOA	335-67-1	29.81 D	I6849-FS-D(3)	3.333	9/21/2019	0.53	1.46	14.62
PFNA	375-95-1	1.16 J	I6849-FS(0)	1.000	9/21/2019	0.23	0.88	4.39
PFDA	335-76-2	0.44 U	I6849-FS(0)	1.000	9/21/2019	0.14	0.44	4.39
PFUnA	2058-94-8	0.88 U	I6849-FS(0)	1.000	9/21/2019	0.25	0.88	4.39
PFDoA	307-55-1	0.44 U	I6849-FS(0)	1.000	9/21/2019	0.16	0.44	4.39
PFTrDA	72629-94-8	0.44 U	I6849-FS(0)	1.000	9/21/2019	0.13	0.44	4.39
PFTeDA	376-06-7	0.88 U	I6849-FS(0)	1.000	9/21/2019	0.22	0.88	4.39
NMeFOSAA	2355-31-9	1.75 U	I6849-FS(0)	1.000	9/21/2019	0.49	1.75	4.39
NEtFOSAA	2991-50-6	0.88 U	I6849-FS(0)	1.000	9/21/2019	0.43	0.88	4.39
PFBS	375-73-5	4.64	I6849-FS(0)	1.000	9/21/2019	0.11	0.44	4.39
PFHxS	355-46-4	125.46 D	I6849-FS-D(3)	3.333	9/21/2019	0.32	1.17	14.62
PFOS	1763-23-1	295.16 D	I6849-FS-D(5)	16.667	9/23/2019	2.78	7.31	73.10
HFPO-DA	13252-13-6	0.35 U	I6849-FS(0)	1.000	9/21/2019	0.18	0.35	4.39
Adona	919005-14-4	0.35 U	I6849-FS(0)	1.000	9/21/2019	0.16	0.35	4.39
11Cl-PF3OUdS	763051-92-9	0.35 U	I6849-FS(0)	1.000	9/21/2019	0.16	0.35	4.39
9Cl-PF3ONS	756426-58-1	0.35 U	I6849-FS(0)	1.000	9/21/2019	0.09	0.35	4.39

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

4

Client ID	NARL-S05-WP-02CP-0819
Battelle ID	I6850-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.285
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	14.18	I6850-FS(0)	1.000	9/21/2019	0.17	0.44	4.39
PFHpA	375-85-9	6.15	I6850-FS(0)	1.000	9/21/2019	0.14	0.44	4.39
PFOA	335-67-1	35.88 D	I6850-FS-D(3)	5.000	9/21/2019	0.79	2.19	21.93
PFNA	375-95-1	1.23 J	I6850-FS(0)	1.000	9/21/2019	0.23	0.88	4.39
PFDA	335-76-2	0.44 U	I6850-FS(0)	1.000	9/21/2019	0.14	0.44	4.39
PFUnA	2058-94-8	0.88 U	I6850-FS(0)	1.000	9/21/2019	0.25	0.88	4.39
PFDoA	307-55-1	0.44 U	I6850-FS(0)	1.000	9/21/2019	0.16	0.44	4.39
PFTrDA	72629-94-8	0.44 U	I6850-FS(0)	1.000	9/21/2019	0.13	0.44	4.39
PFTeDA	376-06-7	0.88 U	I6850-FS(0)	1.000	9/21/2019	0.22	0.88	4.39
NMeFOSAA	2355-31-9	1.75 U	I6850-FS(0)	1.000	9/21/2019	0.49	1.75	4.39
NEtFOSAA	2991-50-6	0.88 U	I6850-FS(0)	1.000	9/21/2019	0.43	0.88	4.39
PFBS	375-73-5	5.16	I6850-FS(0)	1.000	9/21/2019	0.11	0.44	4.39
PFHxS	355-46-4	132.49 D	I6850-FS-D(3)	5.000	9/21/2019	0.48	1.75	21.93
PFOS	1763-23-1	341.45 D	I6850-FS-D(5)	25.000	9/23/2019	4.17	10.96	109.65
HFPO-DA	13252-13-6	0.35 U	I6850-FS(0)	1.000	9/21/2019	0.18	0.35	4.39
Adona	919005-14-4	0.35 U	I6850-FS(0)	1.000	9/21/2019	0.16	0.35	4.39
11Cl-PF3OUdS	763051-92-9	0.35 U	I6850-FS(0)	1.000	9/21/2019	0.16	0.35	4.39
9Cl-PF3ONS	756426-58-1	0.35 U	I6850-FS(0)	1.000	9/21/2019	0.09	0.35	4.39

NW 11/28/19
Analyzed by: Griffith, Lauren
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

5

Client ID	NARL-S05-WP-16D-0819
Battelle ID	I6851-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.280
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	107.95 D	I6851-FS-D(3)	5.000	9/21/2019	0.85	2.23	22.32
PFHpA	375-85-9	25.90	I6851-FS(0)	1.000	9/21/2019	0.14	0.45	4.46
PFOA	335-67-1	273.21 D	I6851-FS-D(3)	5.000	9/21/2019	0.80	2.23	22.32
PFNA	375-95-1	3.26 J	I6851-FS(0)	1.000	9/21/2019	0.23	0.89	4.46
PFDA	335-76-2	1.07 J	I6851-FS(0)	1.000	9/21/2019	0.14	0.45	4.46
PFUnA	2058-94-8	0.89 U	I6851-FS(0)	1.000	9/21/2019	0.26	0.89	4.46
PFDoA	307-55-1	0.45 U	I6851-FS(0)	1.000	9/21/2019	0.16	0.45	4.46
PFTrDA	72629-94-8	0.45 U	I6851-FS(0)	1.000	9/21/2019	0.13	0.45	4.46
PFTeDA	376-06-7	0.89 U	I6851-FS(0)	1.000	9/21/2019	0.22	0.89	4.46
NMeFOSAA	2355-31-9	1.79 U	I6851-FS(0)	1.000	9/21/2019	0.50	1.79	4.46
NEtFOSAA	2991-50-6	0.89 U	I6851-FS(0)	1.000	9/21/2019	0.44	0.89	4.46
PFBS	375-73-5	24.81	I6851-FS(0)	1.000	9/21/2019	0.12	0.45	4.46
PFHxS	355-46-4	1064.93 D	I6851-FS-D(7)	41.667	9/21/2019	4.09	14.88	186.01
PFOS	1763-23-1	2881.16 D	I6851-FS-D(9)	208.333	9/23/2019	35.34	93.01	930.06
HFPC-DA	13252-13-6	0.36 U	I6851-FS(0)	1.000	9/21/2019	0.18	0.36	4.46
Adona	919005-14-4	0.36 U	I6851-FS(0)	1.000	9/21/2019	0.16	0.36	4.46
11Cl-PF3OUdS	763051-92-9	0.36 U	I6851-FS(0)	1.000	9/21/2019	0.16	0.36	4.46
9Cl-PF3ONS	756426-58-1	0.36 U	I6851-FS(0)	1.000	9/21/2019	0.09	0.36	4.46

MW 11/28/19
Analyzed by: Griffith, Lauren
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

6

Client ID	NARL-S05-FB01-082119
Battelle ID	I6854-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.295
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.42 U	I6854-FS(0)	1.000	9/21/2019	0.16	0.42	4.24
PFHpA	375-85-9	0.42 U	I6854-FS(0)	1.000	9/21/2019	0.14	0.42	4.24
PFOA	335-67-1	0.42 ~~0.21 J~~ U	I6854-FS(0)	1.000	9/21/2019	0.15	0.42	4.24
PFNA	375-95-1	0.85 U	I6854-FS(0)	1.000	9/21/2019	0.22	0.85	4.24
PFDA	335-76-2	0.42 U	I6854-FS(0)	1.000	9/21/2019	0.14	0.42	4.24
PFUnA	2058-94-8	0.85 U	I6854-FS(0)	1.000	9/21/2019	0.25	0.85	4.24
PFDoA	307-55-1	0.42 U	I6854-FS(0)	1.000	9/21/2019	0.15	0.42	4.24
PFTrDA	72629-94-8	0.42 U	I6854-FS(0)	1.000	9/21/2019	0.13	0.42	4.24
PFTeDA	376-06-7	0.85 U	I6854-FS(0)	1.000	9/21/2019	0.21	0.85	4.24
NMeFOSAA	2355-31-9	1.69 U	I6854-FS(0)	1.000	9/21/2019	0.47	1.69	4.24
NEtFOSAA	2991-50-6	0.85 U	I6854-FS(0)	1.000	9/21/2019	0.42	0.85	4.24
PFBS	375-73-5	0.42 U	I6854-FS(0)	1.000	9/21/2019	0.11	0.42	4.24
PFHxS	355-46-4	0.34 U	I6854-FS(0)	1.000	9/21/2019	0.09	0.34	4.24
PFOS	1763-23-1	0.42 U	I6854-FS(0)	1.000	9/21/2019	0.16	0.42	4.24
HFPC-DA	13252-13-6	0.34 U	I6854-FS(0)	1.000	9/21/2019	0.17	0.34	4.24
Adona	919005-14-4	0.34 U	I6854-FS(0)	1.000	9/21/2019	0.15	0.34	4.24
11Cl-PF3OUdS	763051-92-9	0.34 U	I6854-FS(0)	1.000	9/21/2019	0.15	0.34	4.24
9Cl-PF3ONS	756426-58-1	0.34 U	I6854-FS(0)	1.000	9/21/2019	0.08	0.34	4.24

MBL

NW 11/28/19

Analyzed by: Griffith, Lauren
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

7

Client ID	NARL-S05-EB01-082119
Battelle ID	I6855-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.305
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	0.41 J UJ	I6855-FS(0)	1.000	9/21/2019	0.16	0.41	4.10	SSL
PFHpA	375-85-9	0.41 J UJ	I6855-FS(0)	1.000	9/21/2019	0.13	0.41	4.10	
PFOA	335-67-1	0.41 ~~0.21~~ UJ	I6855-FS(0)	1.000	9/21/2019	0.15	0.41	4.10	MBL
PFNA	375-95-1	0.82 U	I6855-FS(0)	1.000	9/21/2019	0.21	0.82	4.10	
PFDA	335-76-2	0.41 U	I6855-FS(0)	1.000	9/21/2019	0.13	0.41	4.10	
PFUnA	2058-94-8	0.82 U	I6855-FS(0)	1.000	9/21/2019	0.24	0.82	4.10	
PFDoA	307-55-1	0.41 U	I6855-FS(0)	1.000	9/21/2019	0.15	0.41	4.10	
PFTrDA	72629-94-8	0.41 U	I6855-FS(0)	1.000	9/21/2019	0.12	0.41	4.10	
PFTeDA	376-06-7	0.82 U	I6855-FS(0)	1.000	9/21/2019	0.20	0.82	4.10	
NMeFOSAA	2355-31-9	1.64 U	I6855-FS(0)	1.000	9/21/2019	0.46	1.64	4.10	
NEtFOSAA	2991-50-6	0.82 U	I6855-FS(0)	1.000	9/21/2019	0.40	0.82	4.10	
PFBS	375-73-5	0.41 U	I6855-FS(0)	1.000	9/21/2019	0.11	0.41	4.10	
PFHxS	355-46-4	0.33 U	I6855-FS(0)	1.000	9/21/2019	0.09	0.33	4.10	
PFOS	1763-23-1	0.41 U	I6855-FS(0)	1.000	9/21/2019	0.16	0.41	4.10	
HFPO-DA	13252-13-6	0.33 J UJ	I6855-FS(0)	1.000	9/21/2019	0.16	0.33	4.10	SSL
Adona	919005-14-4	0.33 U	I6855-FS(0)	1.000	9/21/2019	0.15	0.33	4.10	
11Cl-PF3OUdS	763051-92-9	0.33 U	I6855-FS(0)	1.000	9/21/2019	0.15	0.33	4.10	
9Cl-PF3ONS	756426-58-1	0.33 U	I6855-FS(0)	1.000	9/21/2019	0.08	0.33	4.10	

MW 11281.9

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS nvestigation
Project No.: 100130604-CTO4117

8

Client ID		NARL-S05-EB02-082119						
Battelle ID		I6856-FS						
Samp e Type		SA						
Collection Date		08/21/2019						
Extraction Date		08/29/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		AQ						
Samp e Size		0.295						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.42 U	I6856-FS(0)	1.000	9/23/2019	0.16	0.42	4.24
PFHpA	375-85-9	0.42 U	I6856-FS(0)	1.000	9/23/2019	0.14	0.42	4.24
PFOA	335-67-1	0.42 ~~0.19~~ U	I6856-FS(0)	1.000	9/23/2019	0.15	0.42	4.24
PFNA	375-95-1	0.85 U	I6856-FS(0)	1.000	9/23/2019	0.22	0.85	4.24
PFDA	335-76-2	0.42 U	I6856-FS(0)	1.000	9/23/2019	0.14	0.42	4.24
PFUnA	2058-94-8	0.85 U	I6856-FS(0)	1.000	9/23/2019	0.25	0.85	4.24
PFDoA	307-55-1	0.42 U	I6856-FS(0)	1.000	9/23/2019	0.15	0.42	4.24
PFTrDA	72629-94-8	0.42 U	I6856-FS(0)	1.000	9/23/2019	0.13	0.42	4.24
PFTeDA	376-06-7	0.85 U	I6856-FS(0)	1.000	9/23/2019	0.21	0.85	4.24
NMeFOSAA	2355-31-9	1.69 U	I6856-FS(0)	1.000	9/23/2019	0.47	1.69	4.24
NEtFOSAA	2991-50-6	0.85 U	I6856-FS(0)	1.000	9/23/2019	0.42	0.85	4.24
PFBS	375-73-5	0.42 U	I6856-FS(0)	1.000	9/23/2019	0.11	0.42	4.24
PFHxS	355-46-4	0.34 U	I6856-FS(0)	1.000	9/23/2019	0.09	0.34	4.24
PFOS	1763-23-1	0.42 U	I6856-FS(0)	1.000	9/23/2019	0.16	0.42	4.24
HFPO-DA	13252-13-6	0.34 U	I6856-FS(0)	1.000	9/23/2019	0.17	0.34	4.24
Adona	919005-14-4	0.34 U	I6856-FS(0)	1.000	9/23/2019	0.15	0.34	4.24
11Cl-PF3OUdS	763051-92-9	0.34 U	I6856-FS(0)	1.000	9/23/2019	0.15	0.34	4.24
9Cl-PF3ONS	756426-58-1	0.34 U	I6856-FS(0)	1.000	9/23/2019	0.08	0.34	4.24

0.42 MBL

NW 11/28/19

Analyzed by: Griffith, Lauren
Printed: 9/24/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

9

Client ID	NARL-S05-EB03-082119
Battelle ID	I6857-FS
Sample Type	SA
Collection Date	08/21/2019
Extraction Date	08/29/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	AQ
Sample Size	0.265
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.47 U	I6857-FS(0)	1.000	9/21/2019	0.18	0.47	4.72
PFHpA	375-85-9	0.47 U	I6857-FS(0)	1.000	9/21/2019	0.15	0.47	4.72
PFOA	335-67-1	0.47 ~~0.21~~ U	I6857-FS(0)	1.000	9/21/2019	0.17	0.47	4.72
PFNA	375-95-1	0.94 U	I6857-FS(0)	1.000	9/21/2019	0.25	0.94	4.72
PFDA	335-76-2	0.47 U	I6857-FS(0)	1.000	9/21/2019	0.15	0.47	4.72
PFUnA	2058-94-8	0.94 U	I6857-FS(0)	1.000	9/21/2019	0.27	0.94	4.72
PFDoA	307-55-1	0.47 U	I6857-FS(0)	1.000	9/21/2019	0.17	0.47	4.72
PFTrDA	72629-94-8	0.47 U	I6857-FS(0)	1.000	9/21/2019	0.14	0.47	4.72
PFTeDA	376-06-7	0.94 U	I6857-FS(0)	1.000	9/21/2019	0.24	0.94	4.72
NMeFOSAA	2355-31-9	1.89 U	I6857-FS(0)	1.000	9/21/2019	0.53	1.89	4.72
NEtFOSAA	2991-50-6	0.94 U	I6857-FS(0)	1.000	9/21/2019	0.46	0.94	4.72
PFBS	375-73-5	0.47 U	I6857-FS(0)	1.000	9/21/2019	0.12	0.47	4.72
PFHxS	355-46-4	0.38 U	I6857-FS(0)	1.000	9/21/2019	0.10	0.38	4.72
PFOS	1763-23-1	0.47 U	I6857-FS(0)	1.000	9/21/2019	0.18	0.47	4.72
HFPO-DA	13252-13-6	0.38 U	I6857-FS(0)	1.000	9/21/2019	0.19	0.38	4.72
Adona	919005-14-4	0.38 U	I6857-FS(0)	1.000	9/21/2019	0.17	0.38	4.72
11Cl-PF3OUdS	763051-92-9	0.38 U	I6857-FS(0)	1.000	9/21/2019	0.17	0.38	4.72
9Cl-PF3ONS	756426-58-1	0.38 U	I6857-FS(0)	1.000	9/21/2019	0.09	0.38	4.72

MBL

9/28/19

Analyzed by: Griffith, Lauren
Printed: 9/24/2019

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NARL BARROW, ALASKA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 19-0829
Laboratory: Battelle Norwell Operations, Norwell, Massachusetts
Site: NARL Barrow, Alaska
Date: December 3, 2019

PFAS			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	NARL-S05-TW01-0819	I7686-FS	Water
2	NARL-S05-TW01P-0819	I7687-FS	Water
3	NARL-S05-TW03-0819	I7688-FS	Water
4	NARL-S05-TW08-0819	I7691-FS	Water
5	NARL-S05-TW02-0819	I7692-FS	Water
6	NARL-S05-EB06-082819	I7704-FS	Water
7	NARL-S05-EB07-082819	I7705-FS	Water
8	NARL-S05-EB08-082919	I7706-FS	Water
9	NARL-S05-EB09-082919	I7707-FS	Water
10	NARL-S05-EB04-082519	I7715-FS	Water
11	NARL-S05-EB05-082719	I7727-FS	Water

A full data validation was performed on the analytical data for five water samples and six aqueous equipment blank samples collected on August 25-30, 2019 by CH2M HILL at the NARL site in Barrow, Alaska. The samples were analyzed under the Analysis of Perfluorinated Substances in Environmental Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS) and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.1.

Specific method references are as follows:

Analysis	*Method References*
PFAS	Battelle SOP 5-369-07

The data have been validated according to the protocols and quality control (QC) requirements of the analytical methods and the USEPA Data Review and Validation Guidelines as follows:

- The USEPA "Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537," November 2018;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data are acceptable for the intended purposes as qualified for the deficiencies detailed in this report.

Please note that any results qualified (U) due to blank contamination may be then qualified (J) due to another action. Therefore, the results may be qualified (UJ) due to the culmination of the blank contaminations and actions from other exceedances of QC criteria.

Per- and Polyfluoroalkyl Substances (PFAS)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for water samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent recovery (%R) criteria were met.

Method Blank

- The method blanks were free of contamination.

Field QC Blank

- Field QC samples are summarized below.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
NARL-S05-EB04-082519	None - ND	-	-	-
NARL-S05-EB05-082719	None - ND	-	-	-
NARL-S05-EB06-082819	None - ND	-	-	-
NARL-S05-EB07-082819	PFOS	1.72	None	To be applied to other packages
NARL-S05-EB08-082919	None - ND	-	-	-
NARL-S05-EB09-082919	PFOS	0.37	U	3, 4

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate %R values except for the following.

EDS Sample ID	Surrogate	%R	Qualifier
1	13C3-HFPO-DA	48%	UJ - Associated Compound
2	13C3-HFPO-DA	34%	UJ - Associated Compound
	13C5-PFHxA	40%	J - Associated Compound
3	13C3-PFBS	39%	J - Associated Compound
4	13C3-PFBS	35%	UJ - Associated Compound
5	13C3-PFBS	31%	J - Associated Compound

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- MS/MSD samples were not analyzed.

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria.

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- Several compounds in various samples were analyzed at a dilution due to high concentrations. The reporting limits were adjusted accordingly. No action was required.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	NARL-S05-TW01-0819 ng/L	NARL-S05-TW01P-0819 ng/L	RPD	Qualifier
PFHxA	13.77	16.48	18%	None
PFHpA	5.82	4.94	16%	None
PFOA	26.37	24.89	6%	None
PFNA	0.83	0.86	4%	None
PFTeDA	2.28	2.02	12%	None
NMeFOSAA	15.64	15.95	1%	None
PFBS	9.65	8.68	11%	None
PFHxS	92.69	82.08	12%	None
PFOS	259.89	255.57	1%	None

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: D. Weaver Dated: 12/3/19

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-TW01-0819
Battelle ID	I7686-FS
Sample Type	SA
Collection Date	08/29/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	GW
Sample Size	0.265
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	13.77	I7686-FS(0)	1.000	9/25/2019	0.18	0.47	4.72	
PFHpA	375-85-9	5.82	I7686-FS(0)	1.000	9/25/2019	0.15	0.47	4.72	
PFOA	335-67-1	26.37	I7686-FS(0)	1.000	9/25/2019	0.17	0.47	4.72	
PFNA	375-95-1	0.83 J	I7686-FS(0)	1.000	9/25/2019	0.25	0.94	4.72	
PFDA	335-76-2	0.47 U	I7686-FS(0)	1.000	9/25/2019	0.15	0.47	4.72	
PFUnA	2058-94-8	0.94 U	I7686-FS(0)	1.000	9/25/2019	0.27	0.94	4.72	
PFDoA	307-55-1	0.47 U	I7686-FS(0)	1.000	9/25/2019	0.17	0.47	4.72	
PFTrDA	72629-94-8	0.47 U	I7686-FS(0)	1.000	9/25/2019	0.14	0.47	4.72	
PFTeDA	376-06-7	2.28 J	I7686-FS(0)	1.000	9/25/2019	0.24	0.94	4.72	
NMeFOSAA	2355-31-9	15.64	I7686-FS(0)	1.000	9/25/2019	0.53	1.89	4.72	
NEtFOSAA	2991-50-6	0.94 U	I7686-FS(0)	1.000	9/25/2019	0.46	0.94	4.72	
PFBS	375-73-5	9.65	I7686-FS(0)	1.000	9/25/2019	0.12	0.47	4.72	
PFHxS	355-46-4	92.69	I7686-FS(0)	1.000	9/25/2019	0.10	0.38	4.72	
PFOS	1763-23-1	259.89 D	I7686-FS-D(3)	5.000	9/27/2019	0.90	2.36	23.58	
HFPO-DA	13252-13-6	0.38 UJ	I7686-FS(0)	1.000	9/25/2019	0.19	0.38	4.72	SSL
Adona	919005-14-4	0.38 U	I7686-FS(0)	1.000	9/25/2019	0.17	0.38	4.72	
11Cl-PF3OUdS	763051-92-9	0.38 U	I7686-FS(0)	1.000	9/25/2019	0.17	0.38	4.72	
9Cl-PF3ONS	756426-58-1	0.38 U	I7686-FS(0)	1.000	9/25/2019	0.09	0.38	4.72	

11/28/19
Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

2

Client ID		NARL-S05-TW01P-0819							
Battelle ID		I7687-FS							
Sample Type		SA							
Collection Date		08/29/2019							
Extraction Date		09/06/2019							
Analytical Instrument		Sciex 6500+ LC/MS/MS							
% Moisture		NA							
Matrix		GW							
Sample Size		0.275							
Size Unit-Basis		L							
Analyte	CAS No.	Result (ng/L)		Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	16.48	J	I7687-FS(0)	1.000	9/25/2019	0.17	0.45	4.55	SSC
PFHpA	375-85-9	4.94		I7687-FS(0)	1.000	9/25/2019	0.15	0.45	4.55	
PFOA	335-67-1	24.89		I7687-FS(0)	1.000	9/25/2019	0.16	0.45	4.55	
PFNA	375-95-1	0.86	J	I7687-FS(0)	1.000	9/25/2019	0.24	0.91	4.55	
PFDA	335-76-2	0.45	U	I7687-FS(0)	1.000	9/25/2019	0.15	0.45	4.55	
PFUnA	2058-94-8	0.91	U	I7687-FS(0)	1.000	9/25/2019	0.26	0.91	4.55	
PFDoA	307-55-1	0.45	U	I7687-FS(0)	1.000	9/25/2019	0.16	0.45	4.55	
PFTrDA	72629-94-8	0.45	U	I7687-FS(0)	1.000	9/25/2019	0.14	0.45	4.55	
PFTeDA	376-06-7	2.02	J	I7687-FS(0)	1.000	9/25/2019	0.23	0.91	4.55	
NMeFOSAA	2355-31-9	15.95		I7687-FS(0)	1.000	9/25/2019	0.51	1.82	4.55	
NEtFOSAA	2991-50-6	0.91	U	I7687-FS(0)	1.000	9/25/2019	0.45	0.91	4.55	
PFBS	375-73-5	8.68		I7687-FS(0)	1.000	9/25/2019	0.12	0.45	4.55	
PFHxS	355-46-4	82.08		I7687-FS(0)	1.000	9/25/2019	0.10	0.36	4.55	
PFOS	1763-23-1	255.57	D	I7687-FS-D(3)	5.000	9/27/2019	0.86	2.27	22.73	
HFPO-DA	13252-13-6	0.36	U J	I7687-FS(0)	1.000	9/25/2019	0.18	0.36	4.55	SSC
Adona	919005-14-4	0.36	U	I7687-FS(0)	1.000	9/25/2019	0.16	0.36	4.55	
11Cl-PF3OUdS	763051-92-9	0.36	U	I7687-FS(0)	1.000	9/25/2019	0.16	0.36	4.55	
9Cl-PF3ONS	756426-58-1	0.36	U	I7687-FS(0)	1.000	9/25/2019	0.09	0.36	4.55	

MW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

3

Client ID	NARL-S05-TW03-0819
Battelle ID	I7688-FS
Sample Type	SA
Collection Date	08/30/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	NA
Matrix	GW
Sample Size	0.275
Size Unit-Basis	L

Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ	
PFHxA	307-24-4	3.42 J	I7688-FS(0)	1.000	9/25/2019	0.17	0.45	4.55	
PFHpA	375-85-9	1.01 J	I7688-FS(0)	1.000	9/25/2019	0.15	0.45	4.55	
PFOA	335-67-1	2.15 J	I7688-FS(0)	1.000	9/25/2019	0.16	0.45	4.55	
PFNA	375-95-1	0.32 J	I7688-FS(0)	1.000	9/25/2019	0.24	0.91	4.55	
PFDA	335-76-2	0.45 U	I7688-FS(0)	1.000	9/25/2019	0.15	0.45	4.55	
PFUnA	2058-94-8	0.91 U	I7688-FS(0)	1.000	9/25/2019	0.26	0.91	4.55	
PFDoA	307-55-1	0.45 U	I7688-FS(0)	1.000	9/25/2019	0.16	0.45	4.55	
PFTrDA	72629-94-8	0.45 U	I7688-FS(0)	1.000	9/25/2019	0.14	0.45	4.55	
PFTeDA	376-06-7	0.91 U	I7688-FS(0)	1.000	9/25/2019	0.23	0.91	4.55	
NMeFOSAA	2355-31-9	1.82 U	I7688-FS(0)	1.000	9/25/2019	0.51	1.82	4.55	
NEtFOSAA	2991-50-6	0.91 U	I7688-FS(0)	1.000	9/25/2019	0.45	0.91	4.55	
PFBS	375-73-5	1.94 J	I7688-FS(0)	1.000	9/25/2019	0.12	0.45	4.55	SSL
PFHxS	355-46-4	12.54	I7688-FS(0)	1.000	9/25/2019	0.10	0.36	4.55	
PFOS	1763-23-1	3.55 U	I7688-FS(0)	1.000	9/25/2019	0.17	0.45	4.55	EBL
HFPO-DA	13252-13-6	0.36 U	I7688-FS(0)	1.000	9/25/2019	0.18	0.36	4.55	
Adona	919005-14-4	0.36 U	I7688-FS(0)	1.000	9/25/2019	0.16	0.36	4.55	
11Cl-PF3OUdS	763051-92-9	0.36 U	I7688-FS(0)	1.000	9/25/2019	0.16	0.36	4.55	
9Cl-PF3ONS	756426-58-1	0.36 U	I7688-FS(0)	1.000	9/25/2019	0.09	0.36	4.55	

NW 11/28/19

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

4

Client ID		NARL-S05-TW08-0819						
Battelle ID		I7691-FS						
Sample Type		SA						
Collection Date		08/30/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		GW						
Sample Size		0.275						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.45 U	I7691-FS(0)	1.000	9/25/2019	0.17	0.45	4.55
PFHpA	375-85-9	0.45 U	I7691-FS(0)	1.000	9/25/2019	0.15	0.45	4.55
PFOA	335-67-1	1.36 J	I7691-FS(0)	1.000	9/25/2019	0.16	0.45	4.55
PFNA	375-95-1	0.45 J	I7691-FS(0)	1.000	9/25/2019	0.24	0.91	4.55
PFDA	335-76-2	0.45 U	I7691-FS(0)	1.000	9/25/2019	0.15	0.45	4.55
PFUnA	2058-94-8	0.91 U	I7691-FS(0)	1.000	9/25/2019	0.26	0.91	4.55
PFDoA	307-55-1	0.45 U	I7691-FS(0)	1.000	9/25/2019	0.16	0.45	4.55
PFTrDA	72629-94-8	0.45 U	I7691-FS(0)	1.000	9/25/2019	0.14	0.45	4.55
PFTeDA	376-06-7	0.91 U	I7691-FS(0)	1.000	9/25/2019	0.23	0.91	4.55
NMeFOSAA	2355-31-9	1.82 U	I7691-FS(0)	1.000	9/25/2019	0.51	1.82	4.55
NEtFOSAA	2991-50-6	0.91 U	I7691-FS(0)	1.000	9/25/2019	0.45	0.91	4.55
PFBS	375-73-5	0.45 UJ	I7691-FS(0)	1.000	9/25/2019	0.12	0.45	4.55
PFHxS	355-46-4	1.61 J	I7691-FS(0)	1.000	9/25/2019	0.10	0.36	4.55
PFOS	1763-23-1	2.06 U	I7691-FS(0)	1.000	9/25/2019	0.17	0.45	4.55
HFPO-DA	13252-13-6	0.36 U	I7691-FS(0)	1.000	9/25/2019	0.18	0.36	4.55
Adona	919005-14-4	0.36 U	I7691-FS(0)	1.000	9/25/2019	0.16	0.36	4.55
11Cl-PF3OUdS	763051-92-9	0.36 U	I7691-FS(0)	1.000	9/25/2019	0.16	0.36	4.55
9Cl-PF3ONS	756426-58-1	0.36 U	I7691-FS(0)	1.000	9/25/2019	0.09	0.36	4.55

SSL

EBL

11/28/19
Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

5

Client ID		NARL-S05-TW02-0819						
Battelle ID		I7692-FS						
Sample Type		SA						
Collection Date		08/30/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		GW						
Sample Size		0.275						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	21.89	I7692-FS(0)	1.000	9/25/2019	0.17	0.45	4.55
PFHpA	375-85-9	8.21	I7692-FS(0)	1.000	9/25/2019	0.15	0.45	4.55
PFOA	335-67-1	240.87 Ø	I7692-FS-D(5)	25.000	9/27/2019	4.09	11.36	113.64
PFNA	375-95-1	0.93 J	I7692-FS(0)	1.000	9/25/2019	0.24	0.91	4.55
PFDA	335-76-2	0.45 U	I7692-FS(0)	1.000	9/25/2019	0.15	0.45	4.55
PFUnA	2058-94-8	0.91 U	I7692-FS(0)	1.000	9/25/2019	0.26	0.91	4.55
PFDoA	307-55-1	0.45 U	I7692-FS(0)	1.000	9/25/2019	0.16	0.45	4.55
PFTrDA	72629-94-8	0.45 U	I7692-FS(0)	1.000	9/25/2019	0.14	0.45	4.55
PFTeDA	376-06-7	0.91 U	I7692-FS(0)	1.000	9/25/2019	0.23	0.91	4.55
NMeFOSAA	2355-31-9	1.82 U	I7692-FS(0)	1.000	9/25/2019	0.51	1.82	4.55
NEtFOSAA	2991-50-6	0.91 U	I7692-FS(0)	1.000	9/25/2019	0.45	0.91	4.55
PFBS	375-73-5	4.73 J	I7692-FS(0)	1.000	9/25/2019	0.12	0.45	4.55 SSL
PFHxS	355-46-4	75.54 Ø	I7692-FS-D(3)	5.000	9/25/2019	0.50	1.82	22.73
PFOS	1763-23-1	25.52	I7692-FS(0)	1.000	9/25/2019	0.17	0.45	4.55
HFPO-DA	13252-13-6	0.36 U	I7692-FS(0)	1.000	9/25/2019	0.18	0.36	4.55
Adona	919005-14-4	0.36 U	I7692-FS(0)	1.000	9/25/2019	0.16	0.36	4.55
11Cl-PF3OUdS	763051-92-9	0.36 U	I7692-FS(0)	1.000	9/25/2019	0.16	0.36	4.55
9Cl-PF3ONS	756426-58-1	0.36 U	I7692-FS(0)	1.000	9/25/2019	0.09	0.36	4.55

NW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

6

Client ID		NARL-S05-EB06-082819						
Battelle ID		I7704-FS						
Sample Type		SA						
Collection Date		08/28/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		WATER						
Sample Size		0.300						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.16	0.42	4.17
PFHpA	375-85-9	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFOA	335-67-1	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.15	0.42	4.17
PFNA	375-95-1	0.83 U	I7704-FS(0)	1.000	9/25/2019	0.22	0.83	4.17
PFDA	335-76-2	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFUnA	2058-94-8	0.83 U	I7704-FS(0)	1.000	9/25/2019	0.24	0.83	4.17
PFDoA	307-55-1	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.15	0.42	4.17
PFTrDA	72629-94-8	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFTeDA	376-06-7	0.83 U	I7704-FS(0)	1.000	9/25/2019	0.21	0.83	4.17
NMeFOSAA	2355-31-9	1.67 U	I7704-FS(0)	1.000	9/25/2019	0.47	1.67	4.17
NEtFOSAA	2991-50-6	0.83 U	I7704-FS(0)	1.000	9/25/2019	0.41	0.83	4.17
PFBS	375-73-5	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.11	0.42	4.17
PFHxS	355-46-4	0.33 U	I7704-FS(0)	1.000	9/25/2019	0.09	0.33	4.17
PFOS	1763-23-1	0.42 U	I7704-FS(0)	1.000	9/25/2019	0.16	0.42	4.17
HFPO-DA	13252-13-6	0.33 U	I7704-FS(0)	1.000	9/25/2019	0.17	0.33	4.17
Adona	919005-14-4	0.33 U	I7704-FS(0)	1.000	9/25/2019	0.15	0.33	4.17
11Cl-PF3OUdS	763051-92-9	0.33 U	I7704-FS(0)	1.000	9/25/2019	0.15	0.33	4.17
9Cl-PF3ONS	756426-58-1	0.33 U	I7704-FS(0)	1.000	9/25/2019	0.08	0.33	4.17

NW 11/28/19

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

7

Client ID		NARL-S05-EB07-082819						
Battelle ID		I7705-FS						
Sample Type		SA						
Collection Date		08/28/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		WATER						
Sample Size		0.300						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.42 U	I7705-FS(0)	1.000	9/25/2019	0.16	0.42	4.17
PFHpA	375-85-9	0.42 U	I7705-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFOA	335-67-1	0.42 U	I7705-FS(0)	1.000	9/25/2019	0.15	0.42	4.17
PFNA	375-95-1	0.83 U	I7705-FS(0)	1.000	9/25/2019	0.22	0.83	4.17
PFDA	335-76-2	0.42 U	I7705-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFUnA	2058-94-8	0.83 U	I7705-FS(0)	1.000	9/25/2019	0.24	0.83	4.17
PFDoA	307-55-1	0.42 U	I7705-FS(0)	1.000	9/25/2019	0.15	0.42	4.17
PFTrDA	72629-94-8	0.42 U	I7705-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFTeDA	376-06-7	0.83 U	I7705-FS(0)	1.000	9/25/2019	0.21	0.83	4.17
NMeFOSAA	2355-31-9	1.67 U	I7705-FS(0)	1.000	9/25/2019	0.47	1.67	4.17
NEtFOSAA	2991-50-6	0.83 U	I7705-FS(0)	1.000	9/25/2019	0.41	0.83	4.17
PFBS	375-73-5	0.42 U	I7705-FS(0)	1.000	9/25/2019	0.11	0.42	4.17
PFHxS	355-46-4	0.33 U	I7705-FS(0)	1.000	9/25/2019	0.09	0.33	4.17
PFOS	1763-23-1	1.72 J	I7705-FS(0)	1.000	9/25/2019	0.16	0.42	4.17
HFPO-DA	13252-13-6	0.33 U	I7705-FS(0)	1.000	9/25/2019	0.17	0.33	4.17
Adona	919005-14-4	0.33 U	I7705-FS(0)	1.000	9/25/2019	0.15	0.33	4.17
11Cl-PF3OUdS	763051-92-9	0.33 U	I7705-FS(0)	1.000	9/25/2019	0.15	0.33	4.17
9Cl-PF3ONS	756426-58-1	0.33 U	I7705-FS(0)	1.000	9/25/2019	0.08	0.33	4.17

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

8

Client ID		NARL-S05-EB08-082919						
Battelle ID		I7706-FS						
Sample Type		SA						
Collection Date		08/29/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		WATER						
Sample Size		0.290						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
PFHpA	375-85-9	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.14	0.43	4.31
PFOA	335-67-1	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
PFNA	375-95-1	0.86 U	I7706-FS(0)	1.000	9/25/2019	0.22	0.86	4.31
PFDA	335-76-2	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.14	0.43	4.31
PFUnA	2058-94-8	0.86 U	I7706-FS(0)	1.000	9/25/2019	0.25	0.86	4.31
PFDoA	307-55-1	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
PFTrDA	72629-94-8	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.13	0.43	4.31
PFTeDA	376-06-7	0.86 U	I7706-FS(0)	1.000	9/25/2019	0.22	0.86	4.31
NMeFOSAA	2355-31-9	1.72 U	I7706-FS(0)	1.000	9/25/2019	0.48	1.72	4.31
NEtFOSAA	2991-50-6	0.86 U	I7706-FS(0)	1.000	9/25/2019	0.42	0.86	4.31
PFBS	375-73-5	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.11	0.43	4.31
PFHxS	355-46-4	0.34 U	I7706-FS(0)	1.000	9/25/2019	0.09	0.34	4.31
PFOS	1763-23-1	0.43 U	I7706-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
HFPO-DA	13252-13-6	0.34 U	I7706-FS(0)	1.000	9/25/2019	0.17	0.34	4.31
Adona	919005-14-4	0.34 U	I7706-FS(0)	1.000	9/25/2019	0.16	0.34	4.31
11Cl-PF3OUdS	763051-92-9	0.34 U	I7706-FS(0)	1.000	9/25/2019	0.16	0.34	4.31
9Cl-PF3ONS	756426-58-1	0.34 U	I7706-FS(0)	1.000	9/25/2019	0.09	0.34	4.31

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

9

Client ID		NARL-S05-EB09-082919						
Battelle ID		I7707-FS						
Sample Type		SA						
Collection Date		08/29/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		WATER						
Sample Size		0.300						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.42 U	I7707-FS(0)	1.000	9/25/2019	0.16	0.42	4.17
PFHpA	375-85-9	0.42 U	I7707-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFOA	335-67-1	0.42 U	I7707-FS(0)	1.000	9/25/2019	0.15	0.42	4.17
PFNA	375-95-1	0.83 U	I7707-FS(0)	1.000	9/25/2019	0.22	0.83	4.17
PFDA	335-76-2	0.42 U	I7707-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFUnA	2058-94-8	0.83 U	I7707-FS(0)	1.000	9/25/2019	0.24	0.83	4.17
PFDoA	307-55-1	0.42 U	I7707-FS(0)	1.000	9/25/2019	0.15	0.42	4.17
PFTrDA	72629-94-8	0.42 U	I7707-FS(0)	1.000	9/25/2019	0.13	0.42	4.17
PFTeDA	376-06-7	0.83 U	I7707-FS(0)	1.000	9/25/2019	0.21	0.83	4.17
NMeFOSAA	2355-31-9	1.67 U	I7707-FS(0)	1.000	9/25/2019	0.47	1.67	4.17
NEtFOSAA	2991-50-6	0.83 U	I7707-FS(0)	1.000	9/25/2019	0.41	0.83	4.17
PFBS	375-73-5	0.42 U	I7707-FS(0)	1.000	9/25/2019	0.11	0.42	4.17
PFHxS	355-46-4	0.33 U	I7707-FS(0)	1.000	9/25/2019	0.09	0.33	4.17
PFOS	1763-23-1	0.37 J	I7707-FS(0)	1.000	9/25/2019	0.16	0.42	4.17
HFPO-DA	13252-13-6	0.33 U	I7707-FS(0)	1.000	9/25/2019	0.17	0.33	4.17
Adona	919005-14-4	0.33 U	I7707-FS(0)	1.000	9/25/2019	0.15	0.33	4.17
11Cl-PF3OUdS	763051-92-9	0.33 U	I7707-FS(0)	1.000	9/25/2019	0.15	0.33	4.17
9Cl-PF3ONS	756426-58-1	0.33 U	I7707-FS(0)	1.000	9/25/2019	0.08	0.33	4.17

11/28/19

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

10

Client ID		NARL-S05-EB04-082519						
Battelle ID		I7715-FS						
Sample Type		SA						
Collection Date		08/25/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		WATER						
Sample Size		0.290						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
PFHpA	375-85-9	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.14	0.43	4.31
PFOA	335-67-1	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
PFNA	375-95-1	0.86 U	I7715-FS(0)	1.000	9/25/2019	0.22	0.86	4.31
PFDA	335-76-2	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.14	0.43	4.31
PFUnA	2058-94-8	0.86 U	I7715-FS(0)	1.000	9/25/2019	0.25	0.86	4.31
PFDoA	307-55-1	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
PFTrDA	72629-94-8	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.13	0.43	4.31
PFTeDA	376-06-7	0.86 U	I7715-FS(0)	1.000	9/25/2019	0.22	0.86	4.31
NMeFOSAA	2355-31-9	1.72 U	I7715-FS(0)	1.000	9/25/2019	0.48	1.72	4.31
NEtFOSAA	2991-50-6	0.86 U	I7715-FS(0)	1.000	9/25/2019	0.42	0.86	4.31
PFBS	375-73-5	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.11	0.43	4.31
PFHxS	355-46-4	0.34 U	I7715-FS(0)	1.000	9/25/2019	0.09	0.34	4.31
PFOS	1763-23-1	0.43 U	I7715-FS(0)	1.000	9/25/2019	0.16	0.43	4.31
HFPO-DA	13252-13-6	0.34 U	I7715-FS(0)	1.000	9/25/2019	0.17	0.34	4.31
Adona	919005-14-4	0.34 U	I7715-FS(0)	1.000	9/25/2019	0.16	0.34	4.31
11Cl-PF3OUdS	763051-92-9	0.34 U	I7715-FS(0)	1.000	9/25/2019	0.16	0.34	4.31
9Cl-PF3ONS	756426-58-1	0.34 U	I7715-FS(0)	1.000	9/25/2019	0.09	0.34	4.31

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

11

Client ID		NARL-S05-EB05-082719						
Battelle ID		I7727-FS						
Sample Type		SA						
Collection Date		08/27/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		NA						
Matrix		WATER						
Sample Size		0.295						
Size Unit-Basis		L						
Analyte	CAS No.	Result (ng/L)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.16	0.42	4.24
PFHpA	375-85-9	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.14	0.42	4.24
PFOA	335-67-1	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.15	0.42	4.24
PFNA	375-95-1	0.85 U	I7727-FS(0)	1.000	9/25/2019	0.22	0.85	4.24
PFDA	335-76-2	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.14	0.42	4.24
PFUnA	2058-94-8	0.85 U	I7727-FS(0)	1.000	9/25/2019	0.25	0.85	4.24
PFDoA	307-55-1	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.15	0.42	4.24
PFTrDA	72629-94-8	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.13	0.42	4.24
PFTeDA	376-06-7	0.85 U	I7727-FS(0)	1.000	9/25/2019	0.21	0.85	4.24
NMeFOSAA	2355-31-9	1.69 U	I7727-FS(0)	1.000	9/25/2019	0.47	1.69	4.24
NEtFOSAA	2991-50-6	0.85 U	I7727-FS(0)	1.000	9/25/2019	0.42	0.85	4.24
PFBS	375-73-5	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.11	0.42	4.24
PFHxS	355-46-4	0.34 U	I7727-FS(0)	1.000	9/25/2019	0.09	0.34	4.24
PFOS	1763-23-1	0.42 U	I7727-FS(0)	1.000	9/25/2019	0.16	0.42	4.24
HFPO-DA	13252-13-6	0.34 U	I7727-FS(0)	1.000	9/25/2019	0.17	0.34	4.24
Adona	919005-14-4	0.34 U	I7727-FS(0)	1.000	9/25/2019	0.15	0.34	4.24
11Cl-PF3OUdS	763051-92-9	0.34 U	I7727-FS(0)	1.000	9/25/2019	0.15	0.34	4.24
9Cl-PF3ONS	756426-58-1	0.34 U	I7727-FS(0)	1.000	9/25/2019	0.08	0.34	4.24

MW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NARL BARROW, ALASKA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 19-0830
Laboratory: Battelle Norwell Operations, Norwell, Massachusetts
Site: NARL Barrow, Alaska
Date: December 3, 2019

PFAS			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	NARL-S05-SB08-2.2-2.7-0819	I7695-FS	Soil
1MS	NARL-S05-SB08-2.2-2.7-0819MS	I7693-FSMS	Soil
1MSD	NARL-S05-SB08-2.2-2.7-0819MSD	I7694-FSMSD	Soil
2	NARL-S05-SS08-0.0-0.5-0819	I7696-FS	Soil
3	NARL-S05-SS05-0.0-0.5-0819	I7697-FS	Soil
4	NARL-S05-SB05P-3.5-4.0-0819	I7698-FS	Soil
5	NARL-S05-SB05-3.5-4.0-0819	I7699-FS	Soil
6	NARL-S05-SB06-5.0-5.5-0819	I7700-FS	Soil
7	NARL-S05-SS06-0.0-0.5-0819	I7701-FS	Soil
8	NARL-S05-SB07-4.2-4.7-0819	I7702-FS	Soil
9	NARL-S05-SS07-0.0-0.5-0819	I7703-FS	Soil
10	NARL-S05-SS09-0.0-0.5-0819	I7708-FS	Soil
11	NARL-S05-SB09-3.8-4.2-0819	I7709-FS	Soil
12	NARL-S05-SS10-0.0-0.5-0819	I7710-FS	Soil

A full data validation was performed on the analytical data for twelve soil samples collected on August 25-28, 2019 by CH2M HILL at the NARL site in Barrow, Alaska. The samples were analyzed under the Analysis of Perfluorinated Substances in Environmental Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS) and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.1.

Specific method references are as follows:

Analysis	*Method References*
PFAS	Battelle SOP 5-369-07

The data have been validated according to the protocols and quality control (QC) requirements of the analytical methods and the USEPA Data Review and Validation Guidelines as follows:

- The USEPA "Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537," November 2018;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data are acceptable for the intended purposes. There were no qualifications.

Per- and Polyfluoroalkyl Substances (PFAS)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for soil samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent recovery (%R) criteria were met.

Method Blank

- The method blanks were free of contamination.

Field QC Blank

- Field QC samples are summarized below.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
NARL-S05-EB04-082519	None - ND	-	-	-
NARL-S05-EB06-082819	None - ND	-	-	-
NARL-S05-EB07-082819	PFOS	1.72	None	All Associated ND

Surrogate Spike Recoveries

- All %R criteria were met.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable percent recoveries (%R) and RPD values.

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria.

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- All criteria were met.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	NARL-S05-SS10P-0.0-0.5-0819 ng/g	NARL-S05-SS10-0.0-0.5-0819 ng/g	RPD	Qualifier
None	ND	ND	-	-

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: _____ Dated: 12/3/19

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-SB08-2.2-2.7-0819
Battelle ID	I7695-FS
Sample Type	SA
Collection Date	08/28/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.91
Matrix	SOIL
Sample Size	1.88
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.35	1.06	5.32
PFHpA	375-85-9	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.47	1.06	5.32
PFOA	335-67-1	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.53	1.06	5.32
PFNA	375-95-1	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.46	1.06	5.32
PFDA	335-76-2	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.29	1.06	5.32
PFUnA	2058-94-8	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.44	1.06	5.32
PFDoA	307-55-1	0.53 U	I7695-FS(3)	10.000	9/26/2019	0.26	0.53	5.32
PFTrDA	72629-94-8	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.30	1.06	5.32
PFTeDA	376-06-7	2.13 U	I7695-FS(3)	10.000	9/26/2019	0.67	2.13	5.32
NMeFOSAA	2355-31-9	2.66 U	I7695-FS(3)	10.000	9/26/2019	1.19	2.66	5.32
NEtFOSAA	2991-50-6	2.13 U	I7695-FS(3)	10.000	9/26/2019	0.61	2.13	5.32
PFBS	375-73-5	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.38	1.06	5.32
PFHxS	355-46-4	0.53 U	I7695-FS(3)	10.000	9/26/2019	0.23	0.53	5.32
PFOS	1763-23-1	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.29	1.06	5.32
HFPO-DA	13252-13-6	2.13 U	I7695-FS(3)	10.000	9/26/2019	0.61	2.13	5.32
Adona	919005-14-4	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.34	1.06	5.32
11Cl-PF3OUdS	763051-92-9	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.43	1.06	5.32
9Cl-PF3ONS	756426-58-1	1.06 U	I7695-FS(3)	10.000	9/26/2019	0.48	1.06	5.32

NW 11/28/19

Analyzed by: Griffith, Lauren
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

7

Client ID	NARL-S05-SS08-0.0-0.5-0819
Battelle ID	I7696-FS
Sample Type	SA
Collection Date	08/28/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	1.59
Matrix	SOIL
Sample Size	2.00
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.33	1.00	5.00
PFHpA	375-85-9	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.44	1.00	5.00
PFOA	335-67-1	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.50	1.00	5.00
PFNA	375-95-1	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.43	1.00	5.00
PFDA	335-76-2	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.27	1.00	5.00
PFUnA	2058-94-8	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.41	1.00	5.00
PFDoA	307-55-1	0.50 U	I7696-FS(3)	10.000	9/26/2019	0.24	0.50	5.00
PFTrDA	72629-94-8	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.28	1.00	5.00
PFTeDA	376-06-7	2.00 U	I7696-FS(3)	10.000	9/26/2019	0.63	2.00	5.00
NMeFOSAA	2355-31-9	2.50 U	I7696-FS(3)	10.000	9/26/2019	1.12	2.50	5.00
NEtFOSAA	2991-50-6	2.00 U	I7696-FS(3)	10.000	9/26/2019	0.57	2.00	5.00
PFBS	375-73-5	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.36	1.00	5.00
PFHxS	355-46-4	0.50 U	I7696-FS(3)	10.000	9/26/2019	0.22	0.50	5.00
PFOS	1763-23-1	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.27	1.00	5.00
HFPO-DA	13252-13-6	2.00 U	I7696-FS(3)	10.000	9/26/2019	0.57	2.00	5.00
Adona	919005-14-4	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.32	1.00	5.00
11Cl-PF3OUdS	763051-92-9	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.40	1.00	5.00
9Cl-PF3ONS	756426-58-1	1.00 U	I7696-FS(3)	10.000	9/26/2019	0.45	1.00	5.00

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

3

Client ID	NARL-S05-SS05-0.0-0.5-0819
Battelle ID	I7697-FS
Sample Type	SA
Collection Date	08/28/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	3.50
Matrix	SOIL
Sample Size	1.95
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.34	1.03	5.13
PFHpA	375-85-9	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.45	1.03	5.13
PFOA	335-67-1	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.51	1.03	5.13
PFNA	375-95-1	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.44	1.03	5.13
PFDA	335-76-2	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.28	1.03	5.13
PFUnA	2058-94-8	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.42	1.03	5.13
PFDoA	307-55-1	0.51 U	I7697-FS(3)	10.000	9/26/2019	0.25	0.51	5.13
PFTrDA	72629-94-8	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.29	1.03	5.13
PFTeDA	376-06-7	2.05 U	I7697-FS(3)	10.000	9/26/2019	0.65	2.05	5.13
NMeFOSAA	2355-31-9	2.56 U	I7697-FS(3)	10.000	9/26/2019	1.15	2.56	5.13
NEtFOSAA	2991-50-6	2.05 U	I7697-FS(3)	10.000	9/26/2019	0.58	2.05	5.13
PFBS	375-73-5	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.37	1.03	5.13
PFHxS	355-46-4	0.51 U	I7697-FS(3)	10.000	9/26/2019	0.23	0.51	5.13
PFOS	1763-23-1	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.28	1.03	5.13
HFPO-DA	13252-13-6	2.05 U	I7697-FS(3)	10.000	9/26/2019	0.58	2.05	5.13
Adona	919005-14-4	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.33	1.03	5.13
11Cl-PF3OUdS	763051-92-9	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.41	1.03	5.13
9Cl-PF3ONS	756426-58-1	1.03 U	I7697-FS(3)	10.000	9/26/2019	0.46	1.03	5.13

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

4

Client ID		NARL-S05-SB05P-3.5-4.0-0819						
Battelle ID		I7698-FS						
Sample Type		SA						
Collection Date		08/28/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		1.85						
Matrix		SOIL						
Sample Size		2.03						
Size Unit-Basis		g						
Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.33	0.99	4.93
PFHpA	375-85-9	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.43	0.99	4.93
PFOA	335-67-1	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.49	0.99	4.93
PFNA	375-95-1	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.42	0.99	4.93
PFDA	335-76-2	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.27	0.99	4.93
PFUnA	2058-94-8	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.40	0.99	4.93
PFDoA	307-55-1	0.49 U	I7698-FS(3)	10.000	9/26/2019	0.24	0.49	4.93
PFTrDA	72629-94-8	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.28	0.99	4.93
PFTeDA	376-06-7	1.97 U	I7698-FS(3)	10.000	9/26/2019	0.62	1.97	4.93
NMeFOSAA	2355-31-9	2.46 U	I7698-FS(3)	10.000	9/26/2019	1.10	2.46	4.93
NEtFOSAA	2991-50-6	1.97 U	I7698-FS(3)	10.000	9/26/2019	0.56	1.97	4.93
PFBS	375-73-5	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.35	0.99	4.93
PFHxS	355-46-4	0.49 U	I7698-FS(3)	10.000	9/26/2019	0.22	0.49	4.93
PFOS	1763-23-1	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.27	0.99	4.93
HFPO-DA	13252-13-6	1.97 U	I7698-FS(3)	10.000	9/26/2019	0.56	1.97	4.93
Adona	919005-14-4	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.32	0.99	4.93
11Cl-PF3OUdS	763051-92-9	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.39	0.99	4.93
9Cl-PF3ONS	756426-58-1	0.99 U	I7698-FS(3)	10.000	9/26/2019	0.44	0.99	4.93

MW 11/28/19

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

5

Client ID	NARL-S05-SB05-3.5-4.0-0819
Battelle ID	I7699-FS
Sample Type	SA
Collection Date	08/28/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.23
Matrix	SOIL
Sample Size	1.99
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.33	1.01	5.03
PFHpA	375-85-9	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.44	1.01	5.03
PFOA	335-67-1	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.50	1.01	5.03
PFNA	375-95-1	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.43	1.01	5.03
PFDA	335-76-2	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.27	1.01	5.03
PFUnA	2058-94-8	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.41	1.01	5.03
PFDoA	307-55-1	0.50 U	I7699-FS(3)	10.000	9/26/2019	0.24	0.50	5.03
PFTrDA	72629-94-8	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.28	1.01	5.03
PFTeDA	376-06-7	2.01 U	I7699-FS(3)	10.000	9/26/2019	0.63	2.01	5.03
NMeFOSAA	2355-31-9	2.51 U	I7699-FS(3)	10.000	9/26/2019	1.13	2.51	5.03
NEtFOSAA	2991-50-6	2.01 U	I7699-FS(3)	10.000	9/26/2019	0.57	2.01	5.03
PFBS	375-73-5	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.36	1.01	5.03
PFHxS	355-46-4	0.50 U	I7699-FS(3)	10.000	9/26/2019	0.22	0.50	5.03
PFOS	1763-23-1	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.27	1.01	5.03
HFPO-DA	13252-13-6	2.01 U	I7699-FS(3)	10.000	9/26/2019	0.57	2.01	5.03
Adona	919005-14-4	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.32	1.01	5.03
11Cl-PF3OUdS	763051-92-9	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.40	1.01	5.03
9Cl-PF3ONS	756426-58-1	1.01 U	I7699-FS(3)	10.000	9/26/2019	0.45	1.01	5.03

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-SB06-5.0-5.5-0819
Battelle ID	I7700-FS
Sample Type	SA
Collection Date	08/28/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.40
Matrix	SOIL
Sample Size	1.97
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.34	1.02	5.08
PFHpA	375-85-9	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.45	1.02	5.08
PFOA	335-67-1	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.51	1.02	5.08
PFNA	375-95-1	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.44	1.02	5.08
PFDA	335-76-2	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.27	1.02	5.08
PFUnA	2058-94-8	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.42	1.02	5.08
PFDoA	307-55-1	0.51 U	I7700-FS(3)	10.000	9/26/2019	0.24	0.51	5.08
PFTrDA	72629-94-8	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.28	1.02	5.08
PFTeDA	376-06-7	2.03 U	I7700-FS(3)	10.000	9/26/2019	0.64	2.03	5.08
NMeFOSAA	2355-31-9	2.54 U	I7700-FS(3)	10.000	9/26/2019	1.14	2.54	5.08
NEtFOSAA	2991-50-6	2.03 U	I7700-FS(3)	10.000	9/26/2019	0.58	2.03	5.08
PFBS	375-73-5	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.37	1.02	5.08
PFHxS	355-46-4	0.51 U	I7700-FS(3)	10.000	9/26/2019	0.22	0.51	5.08
PFOS	1763-23-1	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.27	1.02	5.08
HFPO-DA	13252-13-6	2.03 U	I7700-FS(3)	10.000	9/26/2019	0.58	2.03	5.08
Adona	919005-14-4	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.32	1.02	5.08
11Cl-PF3OUdS	763051-92-9	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.41	1.02	5.08
9Cl-PF3ONS	756426-58-1	1.02 U	I7700-FS(3)	10.000	9/26/2019	0.46	1.02	5.08

NW 11/28/19
Analyzed by: Griffith, Lauren
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

7

Client ID	NARL-S05-SS06-0.0-0.5-0819
Battelle ID	I7701-FS
Sample Type	SA
Collection Date	08/28/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	7.42
Matrix	SOIL
Sample Size	1.91
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.35	1.05	5.24
PFHpA	375-85-9	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.46	1.05	5.24
PFOA	335-67-1	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.52	1.05	5.24
PFNA	375-95-1	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.45	1.05	5.24
PFDA	335-76-2	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.28	1.05	5.24
PFUnA	2058-94-8	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.43	1.05	5.24
PFDoA	307-55-1	0.52 U	I7701-FS(3)	10.000	9/26/2019	0.25	0.52	5.24
PFTrDA	72629-94-8	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.29	1.05	5.24
PFTeDA	376-06-7	2.09 U	I7701-FS(3)	10.000	9/26/2019	0.66	2.09	5.24
NMeFOSAA	2355-31-9	2.62 U	I7701-FS(3)	10.000	9/26/2019	1.17	2.62	5.24
NEtFOSAA	2991-50-6	2.09 U	I7701-FS(3)	10.000	9/26/2019	0.60	2.09	5.24
PFBS	375-73-5	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.38	1.05	5.24
PFHxS	355-46-4	0.52 U	I7701-FS(3)	10.000	9/26/2019	0.23	0.52	5.24
PFOS	1763-23-1	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.28	1.05	5.24
HFPO-DA	13252-13-6	2.09 U	I7701-FS(3)	10.000	9/26/2019	0.60	2.09	5.24
Adona	919005-14-4	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.34	1.05	5.24
11Cl-PF3OUdS	763051-92-9	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.42	1.05	5.24
9Cl-PF3ONS	756426-58-1	1.05 U	I7701-FS(3)	10.000	9/26/2019	0.47	1.05	5.24

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

8

Client ID		NARL-S05-SB07-4.2-4.7-0819						
Battelle ID		I7702-FS						
Sample Type		SA						
Collection Date		08/28/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		1.85						
Matrix		SOIL						
Sample Size		2.04						
Size Unit-Basis		g						
Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.32	0.98	4.90
PFHpA	375-85-9	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.43	0.98	4.90
PFOA	335-67-1	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.49	0.98	4.90
PFNA	375-95-1	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.42	0.98	4.90
PFDA	335-76-2	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.26	0.98	4.90
PFUnA	2058-94-8	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.40	0.98	4.90
PFDoA	307-55-1	0.49 U	I7702-FS(3)	10.000	9/26/2019	0.24	0.49	4.90
PFTrDA	72629-94-8	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.27	0.98	4.90
PFTeDA	376-06-7	1.96 U	I7702-FS(3)	10.000	9/26/2019	0.62	1.96	4.90
NMeFOSAA	2355-31-9	2.45 U	I7702-FS(3)	10.000	9/26/2019	1.10	2.45	4.90
NEtFOSAA	2991-50-6	1.96 U	I7702-FS(3)	10.000	9/26/2019	0.56	1.96	4.90
PFBS	375-73-5	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.35	0.98	4.90
PFHxS	355-46-4	0.49 U	I7702-FS(3)	10.000	9/26/2019	0.22	0.49	4.90
PFOS	1763-23-1	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.26	0.98	4.90
HFPO-DA	13252-13-6	1.96 U	I7702-FS(3)	10.000	9/26/2019	0.56	1.96	4.90
Adona	919005-14-4	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.31	0.98	4.90
11Cl-PF3OUdS	763051-92-9	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.39	0.98	4.90
9Cl-PF3ONS	756426-58-1	0.98 U	I7702-FS(3)	10.000	9/26/2019	0.44	0.98	4.90

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

9

Client ID	NARL-S05-SS07-0.0-0.5-0819
Battelle ID	I7703-FS
Sample Type	SA
Collection Date	08/28/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	8.15
Matrix	SOIL
Sample Size	1.78
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.37	1.12	5.62
PFHpA	375-85-9	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.49	1.12	5.62
PFOA	335-67-1	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.56	1.12	5.62
PFNA	375-95-1	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.48	1.12	5.62
PFDA	335-76-2	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.30	1.12	5.62
PFUnA	2058-94-8	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.46	1.12	5.62
PFDoA	307-55-1	0.56 U	I7703-FS(3)	10.000	9/26/2019	0.27	0.56	5.62
PFTrDA	72629-94-8	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.31	1.12	5.62
PFTeDA	376-06-7	2.25 U	I7703-FS(3)	10.000	9/26/2019	0.71	2.25	5.62
NMeFOSAA	2355-31-9	2.81 U	I7703-FS(3)	10.000	9/26/2019	1.26	2.81	5.62
NEtFOSAA	2991-50-6	2.25 U	I7703-FS(3)	10.000	9/26/2019	0.64	2.25	5.62
PFBS	375-73-5	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.40	1.12	5.62
PFHxS	355-46-4	0.56 U	I7703-FS(3)	10.000	9/26/2019	0.25	0.56	5.62
PFOS	1763-23-1	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.30	1.12	5.62
HFPO-DA	13252-13-6	2.25 U	I7703-FS(3)	10.000	9/26/2019	0.64	2.25	5.62
Adona	919005-14-4	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.36	1.12	5.62
11Cl-PF3OUdS	763051-92-9	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.45	1.12	5.62
9Cl-PF3ONS	756426-58-1	1.12 U	I7703-FS(3)	10.000	9/26/2019	0.51	1.12	5.62

NEW 11/28/19

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

10

Client ID	NARL-S05-SS09-0.0-0.5-0819
Battelle ID	I7708-FS
Sample Type	SA
Collection Date	08/25/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	6.30
Matrix	SOIL
Sample Size	1.85
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.36	1.08	5.41
PFHpA	375-85-9	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.48	1.08	5.41
PFOA	335-67-1	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.54	1.08	5.41
PFNA	375-95-1	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.46	1.08	5.41
PFDA	335-76-2	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.29	1.08	5.41
PFUnA	2058-94-8	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.44	1.08	5.41
PFDoA	307-55-1	0.54 U	I7708-FS(3)	10.000	9/26/2019	0.26	0.54	5.41
PFTrDA	72629-94-8	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.30	1.08	5.41
PFTeDA	376-06-7	2.16 U	I7708-FS(3)	10.000	9/26/2019	0.68	2.16	5.41
NMeFOSAA	2355-31-9	2.70 U	I7708-FS(3)	10.000	9/26/2019	1.21	2.70	5.41
NEtFOSAA	2991-50-6	2.16 U	I7708-FS(3)	10.000	9/26/2019	0.62	2.16	5.41
PFBS	375-73-5	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.39	1.08	5.41
PFHxS	355-46-4	0.54 U	I7708-FS(3)	10.000	9/26/2019	0.24	0.54	5.41
PFOS	1763-23-1	1.11 J	I7708-FS(3)	10.000	9/26/2019	0.29	1.08	5.41
HFPO-DA	13252-13-6	2.16 U	I7708-FS(3)	10.000	9/26/2019	0.62	2.16	5.41
Adona	919005-14-4	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.35	1.08	5.41
11Cl-PF3OUdS	763051-92-9	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.43	1.08	5.41
9Cl-PF3ONS	756426-58-1	1.08 U	I7708-FS(3)	10.000	9/26/2019	0.49	1.08	5.41

11/28/19
Analyzed by: Griffith, Lauren
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-SB09-3.8-4.2-0819
Battelle ID	I7709-FS
Sample Type	SA
Collection Date	08/25/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.55
Matrix	SOIL
Sample Size	1.99
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.33	1.01	5.03
PFHpA	375-85-9	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.44	1.01	5.03
PFOA	335-67-1	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.50	1.01	5.03
PFNA	375-95-1	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.43	1.01	5.03
PFDA	335-76-2	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.27	1.01	5.03
PFUnA	2058-94-8	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.41	1.01	5.03
PFDoA	307-55-1	0.50 U	I7709-FS(3)	10.000	9/26/2019	0.24	0.50	5.03
PFTrDA	72629-94-8	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.28	1.01	5.03
PFTeDA	376-06-7	2.01 U	I7709-FS(3)	10.000	9/26/2019	0.63	2.01	5.03
NMeFOSAA	2355-31-9	2.51 U	I7709-FS(3)	10.000	9/26/2019	1.13	2.51	5.03
NEtFOSAA	2991-50-6	2.01 U	I7709-FS(3)	10.000	9/26/2019	0.57	2.01	5.03
PFBS	375-73-5	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.36	1.01	5.03
PFHxS	355-46-4	0.50 U	I7709-FS(3)	10.000	9/26/2019	0.22	0.50	5.03
PFOS	1763-23-1	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.27	1.01	5.03
HFPO-DA	13252-13-6	2.01 U	I7709-FS(3)	10.000	9/26/2019	0.57	2.01	5.03
Adona	919005-14-4	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.32	1.01	5.03
11Cl-PF3OUdS	763051-92-9	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.40	1.01	5.03
9Cl-PF3ONS	756426-58-1	1.01 U	I7709-FS(3)	10.000	9/26/2019	0.45	1.01	5.03

NW 11/28/19
Analyzed by: Griffith, Lauren
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

12

Client ID	NARL-S05-SS10-0.0-0.5-0819
Battelle ID	I7710-FS
Sample Type	SA
Collection Date	08/25/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	4.38
Matrix	SOIL
Sample Size	1.89
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.35	1.06	5.29
PFHpA	375-85-9	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.47	1.06	5.29
PFOA	335-67-1	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.53	1.06	5.29
PFNA	375-95-1	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.46	1.06	5.29
PFDA	335-76-2	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.29	1.06	5.29
PFUnA	2058-94-8	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.43	1.06	5.29
PFDoA	307-55-1	0.53 U	I7710-FS(3)	10.000	9/26/2019	0.25	0.53	5.29
PFTrDA	72629-94-8	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.30	1.06	5.29
PFTeDA	376-06-7	2.12 U	I7710-FS(3)	10.000	9/26/2019	0.67	2.12	5.29
NMeFOSAA	2355-31-9	2.65 U	I7710-FS(3)	10.000	9/26/2019	1.19	2.65	5.29
NEtFOSAA	2991-50-6	2.12 U	I7710-FS(3)	10.000	9/26/2019	0.60	2.12	5.29
PFBS	375-73-5	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.38	1.06	5.29
PFHxS	355-46-4	0.53 U	I7710-FS(3)	10.000	9/26/2019	0.23	0.53	5.29
PFOS	1763-23-1	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.29	1.06	5.29
HFPO-DA	13252-13-6	2.12 U	I7710-FS(3)	10.000	9/26/2019	0.60	2.12	5.29
Adona	919005-14-4	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.34	1.06	5.29
11Cl-PF3OUdS	763051-92-9	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.42	1.06	5.29
9Cl-PF3ONS	756426-58-1	1.06 U	I7710-FS(3)	10.000	9/26/2019	0.48	1.06	5.29

ENVIRONMENTAL
Data Services, Inc.

DATA VALIDATION SUMMARY REPORT
NARL BARROW, ALASKA

Client: CH2M HILL, Inc., Corvallis, Oregon
SDG: 19-0831
Laboratory: Battelle Norwell Operations, Norwell, Massachusetts
Site: NARL Barrow, Alaska
Date: December 3, 2019

PFAS			
EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	NARL-S05-SS10P-0.0-0.5-0819	I7711-FS	Soil
2	NARL-S05-SB10-2.5-3.0-0819	I7712-FS	Soil
3	NARL-S05-SS11-0.0-0.5-0819	I7713-FS	Soil
4	NARL-S05-SB11-3.5-4.0-0819	I7714-FS	Soil
5	NARL-S05-SB02-2.0-2.5-0819	I7716-FS	Soil
6	NARL-S05-SS04-0.0-0.5-0819	I7717-FS	Soil
7	NARL-S05-SB03-3.0-3.5-0819	I7718-FS	Soil
8	NARL-S05-SS03P-0.0-0.5-0819	I7719-FS	Soil
9	NARL-S05-SB04-1.8-2.3-0819	I7721-FS	Soil
10	NARL-S05-SS02-0.0-0.5-0819	I7722-FS	Soil
10MS	NARL-S05-SS02-0.0-0.5-0819MS	I7720-FSMS	Soil
10MSD	NARL-S05-SS02-0.0-0.5-0819MSD	I7724-FSMSD	Soil
11	NARL-S05-SB01-3.0-3.5-0819	I7723-FS	Soil
12	NARL-S05-SS01-0.0-0.5-0819	I7725-FS	Soil
13	NARL-S05-SS03-0.0-0.5-0819	I7726-FS	Soil

A full data validation was performed on the analytical data for thirteen soil samples collected on August 25-27, 2019 by CH2M HILL at the NARL site in Barrow, Alaska. The samples were analyzed under the Analysis of Perfluorinated Substances in Environmental Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS) and the U.S. Department of Defense (DoD) Quality Systems Manual (QSM), Version 5.1.

Specific method references are as follows:

Analysis	*Method References*
PFAS	Battelle SOP 5-369-07

The data have been validated according to the protocols and quality control (QC) requirements of the analytical methods and the USEPA Data Review and Validation Guidelines as follows:

- The USEPA "Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537," November 2018;
- and the reviewer's professional judgment.

The following data quality indicators were reviewed for this report:

Organics

- Date Completeness, Case Narrative & Custody Documentation
- Holding times
- Liquid Chromatography/Mass Spectrometry (LC/MS) Tuning
- Initial and continuing calibration summaries
- Method blank and field QC blank contamination
- Surrogate Spike recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries
- Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) recoveries
- Internal standard area and retention time summary forms
- Target Compound Identification
- Compound Quantitation
- Field Duplicate sample precision

A full (Level IV) data validation was performed with this review including a recalculation of 10% of the detected results in the samples.

Data Usability Assessment

There were no rejections of data.

Overall the data are acceptable for the intended purposes. There were no qualifications.

Per- and Polyfluoroalkyl Substances (PFAS)

Data Completeness, Case Narrative & Custody Documentation

- The case narrative and chain-of-custody documentation were included in the data package as required. All criteria were met.

Holding Times

- All samples were extracted within 14 days for soil samples and analyzed within 28 days.

LC/MS Tuning

- All criteria were met.

Initial Calibration

- All relative standard deviation (%RSD) and/or correlation coefficients criteria were met.

Continuing Calibration

- All percent recovery (%R) criteria were met.

Method Blank

- The method blanks were free of contamination.

Field QC Blank

- Field QC samples are summarized below.

Blank ID	Compound	Conc. ng/L	Qualifier	Affected Samples
NARL-S05-EB04-082519	None - ND	-	-	-
NARL-S05-EB05-082719	None - ND	-	-	-

Surrogate Spike Recoveries

- All samples exhibited acceptable surrogate percent recoveries (%R).

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries

- The MS/MSD samples exhibited acceptable percent recoveries (%R) and RPD values.

Laboratory Control Samples

- The LCS samples exhibited acceptable percent recoveries (%R).

Internal Standard (IS) Area Performance

- All internal standards met response and retention time (RT) criteria.

Target Compound Identification

- All mass spectra and quantitation criteria were met.

Compound Quantitation

- All criteria were met.

Field Duplicate Sample Precision

- Field duplicate results are summarized below. The precision was acceptable.

Compound	NARL-S05-SS10P-0.0-0.5-0819 ng/g	NARL-S05-SS10-0.0-0.5-0819 ng/g	RPD	Qualifier
None	ND	ND	-	-

Compound	NARL-S05-SS03P-0.0-0.5-0819 ng/g	NARL-S05-SS03-0.0-0.5-0819 ng/g	RPD	Qualifier
None	ND	ND	-	-

Please contact the undersigned at (757) 564-0090 if you have any questions or need further information.

Signed: _____ Dated: 12/3/19

Nancy Weaver
Senior Chemist

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The analyte is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis has been "tentatively identified" or "presumptively" as present and the associated numerical value is the estimated concentration in the samples.
UJ	The analyte was analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the samples.

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID		NARL-S05-SS10P-0.0-0.5-0819						
Battelle ID		I7711-FS						
Sample Type		SA						
Collection Date		08/25/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		5.63						
Matrix		SOIL						
Sample Size		1.90						
Size Unit-Basis		g						
Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.35	1.05	5.26
PFHpA	375-85-9	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.46	1.05	5.26
PFOA	335-67-1	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.53	1.05	5.26
PFNA	375-95-1	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.45	1.05	5.26
PFDA	335-76-2	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.28	1.05	5.26
PFUnA	2058-94-8	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.43	1.05	5.26
PFDoA	307-55-1	0.53 U	I7711-FS(3)	10.000	9/26/2019	0.25	0.53	5.26
PFTrDA	72629-94-8	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.29	1.05	5.26
PFTeDA	376-06-7	2.11 U	I7711-FS(3)	10.000	9/26/2019	0.66	2.11	5.26
NMeFOSAA	2355-31-9	2.63 U	I7711-FS(3)	10.000	9/26/2019	1.18	2.63	5.26
NEtFOSAA	2991-50-6	2.11 U	I7711-FS(3)	10.000	9/26/2019	0.60	2.11	5.26
PFBS	375-73-5	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.38	1.05	5.26
PFHxS	355-46-4	0.53 U	I7711-FS(3)	10.000	9/26/2019	0.23	0.53	5.26
PFOS	1763-23-1	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.28	1.05	5.26
HFPO-DA	13252-13-6	2.11 U	I7711-FS(3)	10.000	9/26/2019	0.60	2.11	5.26
Adona	919005-14-4	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.34	1.05	5.26
11Cl-PF3OUdS	763051-92-9	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.42	1.05	5.26
9Cl-PF3ONS	756426-58-1	1.05 U	I7711-FS(3)	10.000	9/26/2019	0.47	1.05	5.26

MW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

2

Client ID	NARL-S05-SB10-2.5-3.0-0819
Battelle ID	I7712-FS
Sample Type	SA
Collection Date	08/25/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.98
Matrix	SOIL
Sample Size	1.93
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.34	1.04	5.18
PFHpA	375-85-9	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.46	1.04	5.18
PFOA	335-67-1	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.52	1.04	5.18
PFNA	375-95-1	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.45	1.04	5.18
PFDA	335-76-2	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.28	1.04	5.18
PFUnA	2058-94-8	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.42	1.04	5.18
PFDoA	307-55-1	0.52 U	I7712-FS(3)	10.000	9/26/2019	0.25	0.52	5.18
PFTrDA	72629-94-8	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.29	1.04	5.18
PFTeDA	376-06-7	2.07 U	I7712-FS(3)	10.000	9/26/2019	0.65	2.07	5.18
NMeFOSAA	2355-31-9	2.59 U	I7712-FS(3)	10.000	9/26/2019	1.16	2.59	5.18
NEtFOSAA	2991-50-6	2.07 U	I7712-FS(3)	10.000	9/26/2019	0.59	2.07	5.18
PFBS	375-73-5	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.37	1.04	5.18
PFHxS	355-46-4	0.52 U	I7712-FS(3)	10.000	9/26/2019	0.23	0.52	5.18
PFOS	1763-23-1	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.28	1.04	5.18
HFPO-DA	13252-13-6	2.07 U	I7712-FS(3)	10.000	9/26/2019	0.59	2.07	5.18
Adona	919005-14-4	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.33	1.04	5.18
11Cl-PF3OUdS	763051-92-9	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.41	1.04	5.18
9Cl-PF3ONS	756426-58-1	1.04 U	I7712-FS(3)	10.000	9/26/2019	0.47	1.04	5.18

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

3

Client ID	NARL-S05-SS11-0.0-0.5-0819
Battelle ID	I7713-FS
Sample Type	SA
Collection Date	08/25/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	4.86
Matrix	SOIL
Sample Size	1.91
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.35	1.05	5.24
PFHpA	375-85-9	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.46	1.05	5.24
PFOA	335-67-1	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.52	1.05	5.24
PFNA	375-95-1	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.45	1.05	5.24
PFDA	335-76-2	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.28	1.05	5.24
PFUnA	2058-94-8	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.43	1.05	5.24
PFDoA	307-55-1	0.52 U	I7713-FS(3)	10.000	9/26/2019	0.25	0.52	5.24
PFTrDA	72629-94-8	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.29	1.05	5.24
PFTeDA	376-06-7	2.09 U	I7713-FS(3)	10.000	9/26/2019	0.66	2.09	5.24
NMeFOSAA	2355-31-9	2.62 U	I7713-FS(3)	10.000	9/26/2019	1.17	2.62	5.24
NEtFOSAA	2991-50-6	2.09 U	I7713-FS(3)	10.000	9/26/2019	0.60	2.09	5.24
PFBS	375-73-5	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.38	1.05	5.24
PFHxS	355-46-4	0.52 U	I7713-FS(3)	10.000	9/26/2019	0.23	0.52	5.24
PFOS	1763-23-1	1.03 J	I7713-FS(3)	10.000	9/26/2019	0.28	1.05	5.24
HFPO-DA	13252-13-6	2.09 U	I7713-FS(3)	10.000	9/26/2019	0.60	2.09	5.24
Adona	919005-14-4	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.34	1.05	5.24
11Cl-PF3OUdS	763051-92-9	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.42	1.05	5.24
9Cl-PF3ONS	756426-58-1	1.05 U	I7713-FS(3)	10.000	9/26/2019	0.47	1.05	5.24

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

4

Client ID	NARL-S05-SB11-3.5-4.0-0819
Battelle ID	I7714-FS
Sample Type	SA
Collection Date	08/25/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	3.53
Matrix	SOIL
Sample Size	1.95
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.34	1.03	5.13
PFHpA	375-85-9	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.45	1.03	5.13
PFOA	335-67-1	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.51	1.03	5.13
PFNA	375-95-1	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.44	1.03	5.13
PFDA	335-76-2	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.28	1.03	5.13
PFUnA	2058-94-8	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.42	1.03	5.13
PFDoA	307-55-1	0.51 U	I7714-FS(3)	10.000	9/26/2019	0.25	0.51	5.13
PFTrDA	72629-94-8	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.29	1.03	5.13
PFTeDA	376-06-7	2.05 U	I7714-FS(3)	10.000	9/26/2019	0.65	2.05	5.13
NMeFOSAA	2355-31-9	2.56 U	I7714-FS(3)	10.000	9/26/2019	1.15	2.56	5.13
NEtFOSAA	2991-50-6	2.05 U	I7714-FS(3)	10.000	9/26/2019	0.58	2.05	5.13
PFBS	375-73-5	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.37	1.03	5.13
PFHxS	355-46-4	0.51 U	I7714-FS(3)	10.000	9/26/2019	0.23	0.51	5.13
PFOS	1763-23-1	1.32 J	I7714-FS(3)	10.000	9/26/2019	0.28	1.03	5.13
HFPO-DA	13252-13-6	2.05 U	I7714-FS(3)	10.000	9/26/2019	0.58	2.05	5.13
Adona	919005-14-4	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.33	1.03	5.13
11Cl-PF3OUdS	763051-92-9	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.41	1.03	5.13
9Cl-PF3ONS	756426-58-1	1.03 U	I7714-FS(3)	10.000	9/26/2019	0.46	1.03	5.13

MW 11/28/19
Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

5

Client ID	NARL-S05-SB02-2.0-2.5-0819
Battelle ID	I7716-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	4.25
Matrix	SOIL
Sample Size	1.90
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.35	1.05	5.26
PFHpA	375-85-9	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.46	1.05	5.26
PFOA	335-67-1	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.53	1.05	5.26
PFNA	375-95-1	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.45	1.05	5.26
PFDA	335-76-2	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.28	1.05	5.26
PFUnA	2058-94-8	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.43	1.05	5.26
PFDoA	307-55-1	0.53 U	I7716-FS(3)	10.000	9/26/2019	0.25	0.53	5.26
PFTrDA	72629-94-8	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.29	1.05	5.26
PFTeDA	376-06-7	2.11 U	I7716-FS(3)	10.000	9/26/2019	0.66	2.11	5.26
NMeFOSAA	2355-31-9	2.63 U	I7716-FS(3)	10.000	9/26/2019	1.18	2.63	5.26
NEtFOSAA	2991-50-6	2.11 U	I7716-FS(3)	10.000	9/26/2019	0.60	2.11	5.26
PFBS	375-73-5	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.38	1.05	5.26
PFHxS	355-46-4	0.53 U	I7716-FS(3)	10.000	9/26/2019	0.23	0.53	5.26
PFOS	1763-23-1	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.28	1.05	5.26
HFPO-DA	13252-13-6	2.11 U	I7716-FS(3)	10.000	9/26/2019	0.60	2.11	5.26
Adona	919005-14-4	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.34	1.05	5.26
11Cl-PF3OUdS	763051-92-9	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.42	1.05	5.26
9Cl-PF3ONS	756426-58-1	1.05 U	I7716-FS(3)	10.000	9/26/2019	0.47	1.05	5.26

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

Client ID	NARL-S05-SS04-0.0-0.5-0819
Battelle ID	I7717-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.97
Matrix	SOIL
Sample Size	2.00
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.33	1.00	5.00
PFHpA	375-85-9	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.44	1.00	5.00
PFOA	335-67-1	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.50	1.00	5.00
PFNA	375-95-1	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.43	1.00	5.00
PFDA	335-76-2	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.27	1.00	5.00
PFUnA	2058-94-8	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.41	1.00	5.00
PFDoA	307-55-1	0.50 U	I7717-FS(3)	10.000	9/26/2019	0.24	0.50	5.00
PFTrDA	72629-94-8	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.28	1.00	5.00
PFTeDA	376-06-7	2.00 U	I7717-FS(3)	10.000	9/26/2019	0.63	2.00	5.00
NMeFOSAA	2355-31-9	2.50 U	I7717-FS(3)	10.000	9/26/2019	1.12	2.50	5.00
NEtFOSAA	2991-50-6	2.00 U	I7717-FS(3)	10.000	9/26/2019	0.57	2.00	5.00
PFBS	375-73-5	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.36	1.00	5.00
PFHxS	355-46-4	0.50 U	I7717-FS(3)	10.000	9/26/2019	0.22	0.50	5.00
PFOS	1763-23-1	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.27	1.00	5.00
HFPO-DA	13252-13-6	2.00 U	I7717-FS(3)	10.000	9/26/2019	0.57	2.00	5.00
Adona	919005-14-4	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.32	1.00	5.00
11Cl-PF3OUdS	763051-92-9	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.40	1.00	5.00
9Cl-PF3ONS	756426-58-1	1.00 U	I7717-FS(3)	10.000	9/26/2019	0.45	1.00	5.00

MW 11/27/19
Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

7

Client ID	NARL-S05-SB03-3.0-3.5-0819
Battelle ID	I7718-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	8.06
Matrix	SOIL
Sample Size	1.88
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.35	1.06	5.32
PFHpA	375-85-9	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.47	1.06	5.32
PFOA	335-67-1	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.53	1.06	5.32
PFNA	375-95-1	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.46	1.06	5.32
PFDA	335-76-2	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.29	1.06	5.32
PFUnA	2058-94-8	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.44	1.06	5.32
PFDoA	307-55-1	0.53 U	I7718-FS(3)	10.000	9/26/2019	0.26	0.53	5.32
PFTrDA	72629-94-8	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.30	1.06	5.32
PFTeDA	376-06-7	2.13 U	I7718-FS(3)	10.000	9/26/2019	0.67	2.13	5.32
NMeFOSAA	2355-31-9	2.66 U	I7718-FS(3)	10.000	9/26/2019	1.19	2.66	5.32
NEtFOSAA	2991-50-6	2.13 U	I7718-FS(3)	10.000	9/26/2019	0.61	2.13	5.32
PFBS	375-73-5	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.38	1.06	5.32
PFHxS	355-46-4	0.53 U	I7718-FS(3)	10.000	9/26/2019	0.23	0.53	5.32
PFOS	1763-23-1	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.29	1.06	5.32
HFPO-DA	13252-13-6	2.13 U	I7718-FS(3)	10.000	9/26/2019	0.61	2.13	5.32
Adona	919005-14-4	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.34	1.06	5.32
11Cl-PF3OUdS	763051-92-9	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.43	1.06	5.32
9Cl-PF3ONS	756426-58-1	1.06 U	I7718-FS(3)	10.000	9/26/2019	0.48	1.06	5.32

NW 11/28/19
Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

8

Client ID		NARL-S05-SS03P-0.0-0.5-0819						
Battelle ID		I7719-FS						
Sample Type		SA						
Collection Date		08/27/2019						
Extraction Date		09/06/2019						
Analytical Instrument		Sciex 6500+ LC/MS/MS						
% Moisture		4.60						
Matrix		SOIL						
Sample Size		2.01						
Size Unit-Basis		g						
Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.33	1.00	4.98
PFHpA	375-85-9	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.44	1.00	4.98
PFOA	335-67-1	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.50	1.00	4.98
PFNA	375-95-1	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.43	1.00	4.98
PFDA	335-76-2	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.27	1.00	4.98
PFUnA	2058-94-8	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.41	1.00	4.98
PFDoA	307-55-1	0.50 U	I7719-FS(3)	10.000	9/26/2019	0.24	0.50	4.98
PFTrDA	72629-94-8	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.28	1.00	4.98
PFTeDA	376-06-7	1.99 U	I7719-FS(3)	10.000	9/26/2019	0.63	1.99	4.98
NMeFOSAA	2355-31-9	2.49 U	I7719-FS(3)	10.000	9/26/2019	1.11	2.49	4.98
NEtFOSAA	2991-50-6	1.99 U	I7719-FS(3)	10.000	9/26/2019	0.57	1.99	4.98
PFBS	375-73-5	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.36	1.00	4.98
PFHxS	355-46-4	0.50 U	I7719-FS(3)	10.000	9/26/2019	0.22	0.50	4.98
PFOS	1763-23-1	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.27	1.00	4.98
HFPO-DA	13252-13-6	1.99 U	I7719-FS(3)	10.000	9/26/2019	0.57	1.99	4.98
Adona	919005-14-4	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.32	1.00	4.98
11Cl-PF3OUdS	763051-92-9	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.40	1.00	4.98
9Cl-PF3ONS	756426-58-1	1.00 U	I7719-FS(3)	10.000	9/26/2019	0.45	1.00	4.98

MW 11/28/19
Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

9

Client ID	NARL-S05-SB04-1.8-2.3-0819
Battelle ID	I7721-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.90
Matrix	SOIL
Sample Size	2.02
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.33	0.99	4.95
PFHpA	375-85-9	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.44	0.99	4.95
PFOA	335-67-1	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.50	0.99	4.95
PFNA	375-95-1	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.43	0.99	4.95
PFDA	335-76-2	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.27	0.99	4.95
PFUnA	2058-94-8	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.41	0.99	4.95
PFDoA	307-55-1	0.50 U	I7721-FS(3)	10.000	9/26/2019	0.24	0.50	4.95
PFTrDA	72629-94-8	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.28	0.99	4.95
PFTeDA	376-06-7	1.98 U	I7721-FS(3)	10.000	9/26/2019	0.62	1.98	4.95
NMeFOSAA	2355-31-9	2.48 U	I7721-FS(3)	10.000	9/26/2019	1.11	2.48	4.95
NEtFOSAA	2991-50-6	1.98 U	I7721-FS(3)	10.000	9/26/2019	0.56	1.98	4.95
PFBS	375-73-5	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.36	0.99	4.95
PFHxS	355-46-4	0.50 U	I7721-FS(3)	10.000	9/26/2019	0.22	0.50	4.95
PFOS	1763-23-1	3.35 J	I7721-FS(3)	10.000	9/26/2019	0.27	0.99	4.95
HFPO-DA	13252-13-6	1.98 U	I7721-FS(3)	10.000	9/26/2019	0.56	1.98	4.95
Adona	919005-14-4	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.32	0.99	4.95
11Cl-PF3OUdS	763051-92-9	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.40	0.99	4.95
9Cl-PF3ONS	756426-58-1	0.99 U	I7721-FS(3)	10.000	9/26/2019	0.45	0.99	4.95

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

10

Client ID	NARL-S05-SS02-0.0-0.5-0819
Battelle ID	I7722-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	4.53
Matrix	SOIL
Sample Size	1.84
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.36	1.09	5.43
PFHpA	375-85-9	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.48	1.09	5.43
PFOA	335-67-1	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.54	1.09	5.43
PFNA	375-95-1	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.47	1.09	5.43
PFDA	335-76-2	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.29	1.09	5.43
PFUnA	2058-94-8	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.45	1.09	5.43
PFDoA	307-55-1	0.54 U	I7722-FS(3)	10.000	9/26/2019	0.26	0.54	5.43
PFTrDA	72629-94-8	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.30	1.09	5.43
PFTeDA	376-06-7	2.17 U	I7722-FS(3)	10.000	9/26/2019	0.68	2.17	5.43
NMeFOSAA	2355-31-9	2.72 U	I7722-FS(3)	10.000	9/26/2019	1.22	2.72	5.43
NEtFOSAA	2991-50-6	2.17 U	I7722-FS(3)	10.000	9/26/2019	0.62	2.17	5.43
PFBS	375-73-5	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.39	1.09	5.43
PFHxS	355-46-4	0.54 U	I7722-FS(3)	10.000	9/26/2019	0.24	0.54	5.43
PFOS	1763-23-1	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.29	1.09	5.43
HFPO-DA	13252-13-6	2.17 U	I7722-FS(3)	10.000	9/26/2019	0.62	2.17	5.43
Adona	919005-14-4	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.35	1.09	5.43
11Cl-PF3OUdS	763051-92-9	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.43	1.09	5.43
9Cl-PF3ONS	756426-58-1	1.09 U	I7722-FS(3)	10.000	9/26/2019	0.49	1.09	5.43

NW 11/28/19

Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

11

Client ID	NARL-S05-SB01-3.0-3.5-0819
Battelle ID	I7723-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	3.57
Matrix	SOIL
Sample Size	1.97
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.34	1.02	5.08
PFHpA	375-85-9	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.45	1.02	5.08
PFOA	335-67-1	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.51	1.02	5.08
PFNA	375-95-1	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.44	1.02	5.08
PFDA	335-76-2	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.27	1.02	5.08
PFUnA	2058-94-8	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.42	1.02	5.08
PFDoA	307-55-1	0.51 U	I7723-FS(3)	10.000	9/26/2019	0.24	0.51	5.08
PFTrDA	72629-94-8	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.28	1.02	5.08
PFTeDA	376-06-7	2.03 U	I7723-FS(3)	10.000	9/26/2019	0.64	2.03	5.08
NMeFOSAA	2355-31-9	2.54 U	I7723-FS(3)	10.000	9/26/2019	1.14	2.54	5.08
NEtFOSAA	2991-50-6	2.03 U	I7723-FS(3)	10.000	9/26/2019	0.58	2.03	5.08
PFBS	375-73-5	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.37	1.02	5.08
PFHxS	355-46-4	0.51 U	I7723-FS(3)	10.000	9/26/2019	0.22	0.51	5.08
PFOS	1763-23-1	0.47 J	I7723-FS(3)	10.000	9/26/2019	0.27	1.02	5.08
HFPO-DA	13252-13-6	2.03 U	I7723-FS(3)	10.000	9/26/2019	0.58	2.03	5.08
Adona	919005-14-4	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.32	1.02	5.08
11Cl-PF3OUdS	763051-92-9	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.41	1.02	5.08
9Cl-PF3ONS	756426-58-1	1.02 U	I7723-FS(3)	10.000	9/26/2019	0.46	1.02	5.08

MW 11/28/19
Analyzed by: Schultz, Stephanie
Printed: 10/1/2019

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

12

Client ID	NARL-S05-SS01-0.0-0.5-0819
Battelle ID	I7725-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	2.99
Matrix	SOIL
Sample Size	1.92
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.34	1.04	5.21
PFHpA	375-85-9	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.46	1.04	5.21
PFOA	335-67-1	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.52	1.04	5.21
PFNA	375-95-1	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.45	1.04	5.21
PFDA	335-76-2	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.28	1.04	5.21
PFUnA	2058-94-8	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.43	1.04	5.21
PFDoA	307-55-1	0.52 U	I7725-FS(3)	10.000	9/26/2019	0.25	0.52	5.21
PFTrDA	72629-94-8	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.29	1.04	5.21
PFTeDA	376-06-7	2.08 U	I7725-FS(3)	10.000	9/26/2019	0.66	2.08	5.21
NMeFOSAA	2355-31-9	2.60 U	I7725-FS(3)	10.000	9/26/2019	1.17	2.60	5.21
NEtFOSAA	2991-50-6	2.08 U	I7725-FS(3)	10.000	9/26/2019	0.59	2.08	5.21
PFBS	375-73-5	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.38	1.04	5.21
PFHxS	355-46-4	0.52 U	I7725-FS(3)	10.000	9/26/2019	0.23	0.52	5.21
PFOS	1763-23-1	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.28	1.04	5.21
HFPO-DA	13252-13-6	2.08 U	I7725-FS(3)	10.000	9/26/2019	0.59	2.08	5.21
Adona	919005-14-4	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.33	1.04	5.21
11Cl-PF3OUdS	763051-92-9	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.42	1.04	5.21
9Cl-PF3ONS	756426-58-1	1.04 U	I7725-FS(3)	10.000	9/26/2019	0.47	1.04	5.21

BATTELLE
It can be done

Project Client: CH2M
Project Name: CTO-4117: Northwest PFAS Investigation
Project No.: 100130604-CTO4117

13

Client ID	NARL-S05-SS03-0.0-0.5-0819
Battelle ID	I7726-FS
Sample Type	SA
Collection Date	08/27/2019
Extraction Date	09/06/2019
Analytical Instrument	Sciex 6500+ LC/MS/MS
% Moisture	5.69
Matrix	SOIL
Sample Size	1.93
Size Unit-Basis	g

Analyte	CAS No.	Result (ng/g_Dry)	Extract ID	DF	Analysis Date	DL	LOD	LOQ
PFHxA	307-24-4	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.34	1.04	5.18
PFHpA	375-85-9	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.46	1.04	5.18
PFOA	335-67-1	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.52	1.04	5.18
PFNA	375-95-1	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.45	1.04	5.18
PFDA	335-76-2	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.28	1.04	5.18
PFUnA	2058-94-8	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.42	1.04	5.18
PFDoA	307-55-1	0.52 U	I7726-FS(3)	10.000	9/26/2019	0.25	0.52	5.18
PFTrDA	72629-94-8	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.29	1.04	5.18
PFTeDA	376-06-7	2.07 U	I7726-FS(3)	10.000	9/26/2019	0.65	2.07	5.18
NMeFOSAA	2355-31-9	2.59 U	I7726-FS(3)	10.000	9/26/2019	1.16	2.59	5.18
NEtFOSAA	2991-50-6	2.07 U	I7726-FS(3)	10.000	9/26/2019	0.59	2.07	5.18
PFBS	375-73-5	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.37	1.04	5.18
PFHxS	355-46-4	0.52 U	I7726-FS(3)	10.000	9/26/2019	0.23	0.52	5.18
PFOS	1763-23-1	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.28	1.04	5.18
HFPO-DA	13252-13-6	2.07 U	I7726-FS(3)	10.000	9/26/2019	0.59	2.07	5.18
Adona	919005-14-4	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.33	1.04	5.18
11Cl-PF3OUdS	763051-92-9	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.41	1.04	5.18
9Cl-PF3ONS	756426-58-1	1.04 U	I7726-FS(3)	10.000	9/26/2019	0.47	1.04	5.18

Attachment 2
Secondary Data Qualifier Codes

Attachment 2. Secondary Data Qualifier, or Validation Reason, Codes

Secondary Data Qualifier	Description
%SOL	High Moisture content
2C	Second Column – Poor Dual Column Reproducibility
2S	Second Source – Bad reproducibility between tandem detectors
BD	Blank Spike/Blank Spike Duplicate(LCS/LCSD) Precision
BRL	Below Reporting Limit
BSH	Blank Spike/LCS – High Recovery
BSL	Blank Spike/LCS – Low Recovery
CC	Continuing Calibration
CCBL	Continuing Calibration Blank Contamination
CCH	Continuing Calibration Verification – High Recovery
CCL	Continuing Calibration Verification – Low Recovery
DL	Redundant Result – due to Dilution
EBL	Equipment Blank Contamination
EMPC	Estimated Possible Maximum Concentration
ESH	Extraction Standard - High Recovery
ESL	Extraction Standard - Low Recovery
FBL	Field Blank Contamination
FD	Field Duplicate
GBL	Grinding Blank Contamination
GBSH	Ground Blank Spike/LCS – High Recovery
GBSL	Ground Blank Spike/LCS – Low Recovery
HT	Holding Time
ICB	Initial Calibration – Bad Linearity or Curve Function
ICH	Initial Calibration – High Relative Response Factors
ICL	Initial Calibration – Low Relative Response Factors
IR15	Ion ratio exceeds +/- 15% difference
ISH	Internal Standard – High Recovery
ISL	Internal Standard – Low Recovery
LD	Lab Duplicate Reproducibility
LR	Concentration Exceeds Linear Range
MBL	Method Blank Contamination
MDP	Matrix Spike/Matrix Spike Duplicate Precision
MI	Matrix interference obscuring the raw data
MSH	Matrix Spike and/or Matrix Spike Duplicate – High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate – Low Recovery
OT	Other

Attachment 2. Secondary Data Qualifier, or Validation Reason, Codes

Secondary Data Qualifier	Description
PD	Pesticide Degradation
RE	Redundant Result - due to Reanalysis or Re-extraction
SD	Serial Dilution Reproducibility
SSH	Spiked Surrogate – High Recovery
SSL	Spiked Surrogate – Low Recovery
TBL	Trip Blank Contamination
TN	Tune

Attachment 3
Assigned Qualifiers

Attachment 3. Assigned Qualifiers.

Sample ID	Sample Type	Analytical Method	Parameter	Lab Result	Lab Qual	Final Result	Primary Qualifier	Units	Secondary Qualifier
NARL-S05-EB01-082119	EB	PFAS_QSM5.1	Perfluorooctanoic acid (PFOA)	0.00021	J	0.00041	UJ	UG_L	SSL
NARL-S05-EB01-082119	EB	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.00041	U	0.00041	UJ	UG_L	SSL
NARL-S05-EB01-082119	EB	PFAS_QSM5.1	Perfluoroheptanoic acid (PFHpA)	0.00041	U	0.00041	UJ	UG_L	SSL
NARL-S05-EB01-082119	EB	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00033	U	0.00033	UJ	UG_L	SSL
NARL-S05-EB02-082119	EB	PFAS_QSM5.1	Perfluorooctanoic acid (PFOA)	0.00019	J	0.00042	U	UG_L	MBL
NARL-S05-EB03-082119	EB	PFAS_QSM5.1	Perfluorooctanoic acid (PFOA)	0.00021	J	0.00047	U	UG_L	MBL
NARL-S05-FB01-082119	FB	PFAS_QSM5.1	Perfluorooctanoic acid (PFOA)	0.00021	J	0.00042	U	UG_L	MBL
NARL-S05-SW01-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.03809		0.03809	J	UG_L	SSL
NARL-S05-SW01-0819	N	PFAS_QSM5.1	Perfluoroheptanoic acid (PFHpA)	0.0094		0.0094	J	UG_L	SSL
NARL-S05-SW01-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-SW02-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.03699		0.03699	J	UG_L	SSL
NARL-S05-SW02-0819	N	PFAS_QSM5.1	Perfluoroheptanoic acid (PFHpA)	0.01068		0.01068	J	UG_L	SSL
NARL-S05-SW02-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-SW02P-0819	FD	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.04358		0.04358	J	UG_L	SSL
NARL-S05-SW02P-0819	FD	PFAS_QSM5.1	Perfluoroheptanoic acid (PFHpA)	0.01005		0.01005	J	UG_L	SSL
NARL-S05-SW02P-0819	FD	PFAS_QSM5.1	Perfluorobutanesulfonic acid (PFBS)	0.006		0.006	J	UG_L	SSL
NARL-S05-SW02P-0819	FD	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-SW03-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.04092		0.04092	J	UG_L	SSL
NARL-S05-SW03-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-SW04-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.0377		0.0377	J	UG_L	SSL
NARL-S05-SW04-0819	N	PFAS_QSM5.1	Perfluoroheptanoic acid (PFHpA)	0.00928		0.00928	J	UG_L	SSL
NARL-S05-SW04-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-SW05-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.03687		0.03687	J	UG_L	SSL
NARL-S05-SW05-0819	N	PFAS_QSM5.1	Perfluoroheptanoic acid (PFHpA)	0.01066		0.01066	J	UG_L	SSL
NARL-S05-SW05-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-TW01-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00038	U	0.00038	UJ	UG_L	SSL
NARL-S05-TW01P-0819	FD	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.01648		0.01648	J	UG_L	SSL
NARL-S05-TW01P-0819	FD	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-TW02-0819	N	PFAS_QSM5.1	Perfluorobutanesulfonic acid (PFBS)	0.00473		0.00473	J	UG_L	SSL
NARL-S05-TW03-0819	N	PFAS_QSM5.1	Perfluorobutanesulfonic acid (PFBS)	0.00194	J	0.00194	J	UG_L	SSL
NARL-S05-TW03-0819	N	PFAS_QSM5.1	Perfluorooctane Sulfonate (PFOS)	0.00355	J	0.00355	U	UG_L	EBL
NARL-S05-TW08-0819	N	PFAS_QSM5.1	Perfluorobutanesulfonic acid (PFBS)	0.00045	U	0.00045	UJ	UG_L	SSL
NARL-S05-TW08-0819	N	PFAS_QSM5.1	Perfluorooctane Sulfonate (PFOS)	0.00206	J	0.00206	U	UG_L	EBL
NARL-S05-WP-11-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.03877		0.03877	J	UG_L	SSL
NARL-S05-WP-12-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.02599		0.02599	J	UG_L	SSL
NARL-S05-WP-12-0819	N	PFAS_QSM5.1	Perfluoroheptanoic acid (PFHpA)	0.01616		0.01616	J	UG_L	SSL
NARL-S05-WP-12-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00036	U	0.00036	UJ	UG_L	SSL
NARL-S05-WP-20-0819	N	PFAS_QSM5.1	Perfluorohexanoic Acid (PFHxA)	0.06458		0.06458	J	UG_L	SSL
NARL-S05-WP-20-0819	N	PFAS_QSM5.1	Perfluorobutanesulfonic acid (PFBS)	0.0153		0.0153	J	UG_L	SSL
NARL-S05-WP-20-0819	N	PFAS_QSM5.1	Perfluoro-2-methyl-3-oxahexanoic acid (HFPO-DA)	0.00038	U	0.00038	UJ	UG_L	SSL

Attachment 4
ADEC Laboratory Data Review Checklists

Laboratory Data Review Checklist

Completed By:

Tiffany Davis

Title:

Data Validator

Date:

6/15/2020

Consultant Firm:

CH2M

Laboratory Name:

Battelle Norwell Operations, Norwell, Massachusetts

Laboratory Report Number:

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

ADEC File Number:

310.38.037

Hazard Identification Number:

26855

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

   Yes☒ No☐ N/A☐ Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

   Yes☐ No☐ N/A☒ Comments:

2. Chain of Custody (CoC)

   a. CoC information completed, signed, and dated (including released/received by)?

   Yes☒ No☐ N/A☐ Comments:

   b. Correct analyses requested?

   Yes☒ No☐ N/A☐ Comments:

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

   Yes☒ No☐ N/A☐ Comments:

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

   Yes☒ No☐ N/A☐ Comments:

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes☒ No☐ N/A☐ Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes☒ No☐ N/A☐ Comments:

Sample IDs were revised and documented.

e. Data quality or usability affected?

Comments:

N/A

4. Case Narrative

a. Present and understandable?

Yes☒ No☐ N/A☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes☒ No☐ N/A☐ Comments:

QC failures – see Data Quality Assessment report narrative for additional information

c. Were all corrective actions documented?

Yes☒ No☐ N/A☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Results were qualified and all data is usable.

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes☒ No☐ N/A☐ Comments:

b. All applicable holding times met?

Yes☒ No☐ N/A☐ Comments:

c. All soils reported on a dry weight basis?

Yes☐ No☐ N/A☒ Comments:

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

Yes☒ No☐ N/A☐ Comments:

e. Data quality or usability affected?

no

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. All method blank results less than limit of quantitation (LOQ) or project specified objectives?

Yes☐ No☒ N/A☐ Comments:

PFOA was detected (0.28ng/L) in method blank DV262PB-FS.

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

iii. If above LOQ or project specified objectives, what samples are affected?

Comments:

No samples affected, all samples >10x.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☒ N/A☐ Comments:

v. Data quality or usability affected?

Comments:

Not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

N/A

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Note: Leave blank if not required for project

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes☐ No☒ N/A☐ Comments:

2 compounds exceeded acceptance criteria but the sample concentration was 4x the spike amount. No data were affected.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes☐ No☒ N/A☐ Comments:

2 compounds exceeded acceptance criteria but the sample concentration was 4x the spike amount. No data were affected.

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None. Sample concentration was 4x spike amount.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☒ N/A☐ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

None. Sample concentration was 4x spike amount.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes☒ No☐ N/A☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes☐ No☒ N/A☐ Comments:

Surrogates had low recoveries for lab sample IDs #1-6, 8-10.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes☒ No☐ N/A☐ Comments:

Yes, flags are clearly defined.

iv. Data quality or usability affected?

Comments:

Flags were applied for low surrogate recoveries.

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes☐ No☐ N/A☒ Comments:

No VOC analysis requested.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

Yes☐ No☐ N/A☒ Comments:

iii. All results less than LOQ and project specified objectives?

Yes☐ No☐ N/A☒ Comments:

iv. If above LOQ or project specified objectives, what samples are affected?

Comments:

v. Data quality or usability affected?

Comments:

N/A

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes☒ No☐ N/A☐ Comments:

ii. Submitted blind to lab?

Yes☐ No☒ N/A☐ Comments:

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

RPD (%) = Absolute value of: $\frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

Yes☒ No☐ N/A☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

N/A

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes☒ No☐ N/A☐ Comments:

i. All results less than LOQ and project specified objectives?

Yes☒ No☐ N/A☐ Comments:

ii. If above LOQ or project specified objectives, what samples are affected?

Comments:

iii. Data quality or usability affected?

Comments:

N/A

DP-19-0674, Batch 19-0794

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

   a. Defined and appropriate?

      Yes☐ No☐ N/A☒ Comments:

No other flags were applied.

Laboratory Data Review Checklist

Completed By:

Tiffany Davis

Title:

Data Validator

Date:

6/15/2020

Consultant Firm:

CH2M

Laboratory Name:

Battelle Norwell Operations, Norwell, Massachusetts

Laboratory Report Number:

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

ADEC File Number:

310.38.037

Hazard Identification Number:

26855

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

   Yes☒ No☐ N/A☐ Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

   Yes☐ No☐ N/A☒ Comments:

2. Chain of Custody (CoC)

   a. CoC information completed, signed, and dated (including released/received by)?

   Yes☒ No☐ N/A☐ Comments:

   b. Correct analyses requested?

   Yes☒ No☐ N/A☐ Comments:

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

   Yes☒ No☐ N/A☐ Comments:

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

   Yes☒ No☐ N/A☐ Comments:

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes☒ No☐ N/A☐ Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes☒ No☐ N/A☐ Comments:

Sample IDs were revised and documented.

e. Data quality or usability affected?

Comments:

N/A

4. Case Narrative

a. Present and understandable?

Yes☒ No☐ N/A☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes☒ No☐ N/A☐ Comments:

c. Were all corrective actions documented?

Yes☒ No☐ N/A☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Results were qualified and all data is usable.

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes☒ No☐ N/A☐ Comments:

b. All applicable holding times met?

Yes☒ No☐ N/A☐ Comments:

c. All soils reported on a dry weight basis?

Yes☐ No☐ N/A☒ Comments:

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

Yes☒ No☐ N/A☐ Comments:

e. Data quality or usability affected?

N/A

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. All method blank results less than limit of quantitation (LOQ) or project specified objectives?

Yes☐ No☒ N/A☐ Comments:

PFOA was detected (0.30ng/L) in method blank CV264PB-FS.

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

iii. If above LOQ or project specified objectives, what samples are affected?

Comments:

Samples #6-9 were affected.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☒ No☐ N/A☐ Comments:

Data flags are clearly defined.

v. Data quality or usability affected?

Comments:

Samples #6-9 were qualified as non-detect (U) due to blank contamination.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

N/A

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Note: Leave blank if not required for project

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes☐ No☒ N/A☐ Comments:

3 compounds exceeded acceptance criteria but the sample concentration was 4x the spike amount. No data were affected.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes☐ No☒ N/A☐ Comments:

3 compounds exceeded acceptance criteria but the sample concentration was 4x the spike amount. No data were affected.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None. Sample concentration was 4x spike amount.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☒ N/A☐ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

None. Sample concentration was 4x spike amount.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes☒ No☐ N/A☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes☐ No☒ N/A☐ Comments:

Surrogates had low recoveries for lab sample #7

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes☒ No☐ N/A☐ Comments:

Yes, flags are clearly defined.

iv. Data quality or usability affected?

Comments:

Flags were applied for low surrogate recoveries.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes☐ No☐ N/A☒ Comments:

No VOC analysis requested.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

Yes☐ No☐ N/A☒ Comments:

iii. All results less than LOQ and project specified objectives?

Yes☐ No☐ N/A☒ Comments:

iv. If above LOQ or project specified objectives, what samples are affected?

Comments:

v. Data quality or usability affected?

Comments:

N/A

Batch 19-0795
Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes☒ No☐ N/A☐ Comments:

ii. Submitted blind to lab?

Yes☐ No☒ N/A☐ Comments:

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

Yes☒ No☐ N/A☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

N/A

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes☒ No☐ N/A☐ Comments:

i. All results less than LOQ and project specified objectives?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0795 Package DP-19-0675

Laboratory Report Date:

9/24/2019

CS Site Name:

NARL- Sitewide PFAS

ii. If above LOQ or project specified objectives, what samples are affected?

Comments:

iii. Data quality or usability affected?

Comments:

N/A

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes☐ No☐ N/A☒ Comments:

No other flags were applied.

Laboratory Data Review Checklist

Completed By:

Tiffany Davis

Title:

Data Validator

Date:

6/15/2020

Consultant Firm:

CH2M

Laboratory Name:

Battelle Norwell Operations, Norwell, Massachusetts

Laboratory Report Number:

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

ADEC File Number:

310.38.037

Hazard Identification Number:

26855

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

   Yes☒ No☐ N/A☐ Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

   Yes☐ No☐ N/A☒ Comments:

2. Chain of Custody (CoC)

   a. CoC information completed, signed, and dated (including released/received by)?

   Yes☒ No☐ N/A☐ Comments:

   b. Correct analyses requested?

   Yes☒ No☐ N/A☐ Comments:

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

   Yes☒ No☐ N/A☐ Comments:

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

   Yes☒ No☐ N/A☐ Comments:

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes☒ No☐ N/A☐ Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes☒ No☐ N/A☐ Comments:

Sample IDs were revised and documented.

e. Data quality or usability affected?

Comments:

N/A

4. Case Narrative

a. Present and understandable?

Yes☒ No☐ N/A☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes☒ No☐ N/A☐ Comments:

c. Were all corrective actions documented?

Yes☒ No☐ N/A☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Results were qualified and all data is usable.

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes☒ No☐ N/A☐ Comments:

b. All applicable holding times met?

Yes☒ No☐ N/A☐ Comments:

c. All soils reported on a dry weight basis?

Yes☐ No☐ N/A☒ Comments:

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

Yes☒ No☐ N/A☐ Comments:

e. Data quality or usability affected?

N/A

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. All method blank results less than limit of quantitation (LOQ) or project specified objectives?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iii. If above LOQ or project specified objectives, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

v. Data quality or usability affected?

Comments:

N/A

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

N/A

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Note: Leave blank if not required for project

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

No MS/MSD included in this SDG.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes☐ No☐ N/A☒ Comments:

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes☐ No☐ N/A☒ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes☒ No☐ N/A☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes☐ No☒ N/A☐ Comments:

Surrogates had low recoveries for lab samples #1-5

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes☒ No☐ N/A☐ Comments:

Yes, flags are clearly defined.

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Data quality or usability affected?

Comments:

Flags were applied for low surrogate recoveries.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes☐ No☐ N/A☒ Comments:

No VOC analysis requested.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

Yes☐ No☐ N/A☒ Comments:

iii. All results less than LOQ and project specified objectives?

Yes☐ No☐ N/A☒ Comments:

iv. If above LOQ or project specified objectives, what samples are affected?

Comments:

v. Data quality or usability affected?

Comments:

N/A

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0829
Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

ii. Submitted blind to lab?

Yes☐ No☒ N/A☐ Comments:

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

Yes☒ No☐ N/A☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

N/A

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes☒ No☐ N/A☐ Comments:

i. All results less than LOQ and project specified objectives?

Yes☐ No☒ N/A☐ Comments:

PFOS was detected in EB NARL-S05-EB07-082819 (1.72ng/L) and EB NARL-S05-EB09-082919 (0.37ng/L). Results were qualified.

ii. If above LOQ or project specified objectives, what samples are affected?

Comments:

Samples #3 & 4 and qualified in associated samples in other SDGs.

iii. Data quality or usability affected?

Comments:

N/A

Batch 19-0829 Package DP-19-0716

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

   a. Defined and appropriate?

      Yes☐ No☐ N/A☒ Comments:

No other flags were applied.

Laboratory Data Review Checklist

Completed By:

Tiffany Davis

Title:

Data Validator

Date:

6/15/2020

Consultant Firm:

CH2M

Laboratory Name:

Battelle Norwell Operations, Norwell, Massachusetts

Laboratory Report Number:

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

ADEC File Number:

310.38.037

Hazard Identification Number:

26855

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

   Yes☒ No☐ N/A☐ Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

   Yes☐ No☐ N/A☒ Comments:

2. Chain of Custody (CoC)

   a. CoC information completed, signed, and dated (including released/received by)?

   Yes☒ No☐ N/A☐ Comments:

   b. Correct analyses requested?

   Yes☒ No☐ N/A☐ Comments:

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

   Yes☒ No☐ N/A☐ Comments:

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

   Yes☒ No☐ N/A☐ Comments:

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes☒ No☐ N/A☐ Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes☒ No☐ N/A☐ Comments:

Sample IDs were revised and documented.

e. Data quality or usability affected?

Comments:

N/A

4. Case Narrative

a. Present and understandable?

Yes☒ No☐ N/A☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes☒ No☐ N/A☐ Comments:

c. Were all corrective actions documented?

Yes☒ No☐ N/A☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

N/A

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes☒ No☐ N/A☐ Comments:

b. All applicable holding times met?

Yes☒ No☐ N/A☐ Comments:

c. All soils reported on a dry weight basis?

Yes☒ No☐ N/A☐ Comments:

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

Yes☒ No☐ N/A☐ Comments:

e. Data quality or usability affected?

N/A

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. All method blank results less than limit of quantitation (LOQ) or project specified objectives?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iii. If above LOQ or project specified objectives, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

v. Data quality or usability affected?

Comments:

N/A

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

N/A

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Note: Leave blank if not required for project

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes☒ No☐ N/A☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes☒ No☐ N/A☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes☒ No☐ N/A☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Data quality or usability affected?

Comments:

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes☐ No☐ N/A☒ Comments:

No VOC analysis requested.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

Yes☐ No☐ N/A☒ Comments:

iii. All results less than LOQ and project specified objectives?

Yes☐ No☐ N/A☒ Comments:

iv. If above LOQ or project specified objectives, what samples are affected?

Comments:

v. Data quality or usability affected?

Comments:

N/A

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0830
Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

ii. Submitted blind to lab?

Yes☐ No☒ N/A☐ Comments:

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

Yes☒ No☐ N/A☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

N/A

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes☒ No☐ N/A☐ Comments:

i. All results less than LOQ and project specified objectives?

Yes☐ No☒ N/A☐ Comments:

PFOS was detected in EB NARL-S05-EB07-082819 (1.72ng/L).

ii. If above LOQ or project specified objectives, what samples are affected?

Comments:

All associated samples were non-detect, no data were qualified.

iii. Data quality or usability affected?

Comments:

No

Batch 19-0830 Package DP-19-0717

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

   a. Defined and appropriate?

      Yes☐ No☐ N/A☒ Comments:

Laboratory Data Review Checklist

Completed By:

Tiffany Davis

Title:

Data Validator

Date:

6/15/2020

Consultant Firm:

CH2M

Laboratory Name:

Battelle Norwell Operations, Norwell, Massachusetts

Laboratory Report Number:

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

ADEC File Number:

310.38.037

Hazard Identification Number:

26855

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

   a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?

   Yes☒ No☐ N/A☐ Comments:

   b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?

   Yes☐ No☐ N/A☒ Comments:

2. Chain of Custody (CoC)

   a. CoC information completed, signed, and dated (including released/received by)?

   Yes☒ No☐ N/A☐ Comments:

   b. Correct analyses requested?

   Yes☒ No☐ N/A☐ Comments:

3. Laboratory Sample Receipt Documentation

   a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

   Yes☒ No☐ N/A☐ Comments:

   b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

   Yes☒ No☐ N/A☐ Comments:

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes☒ No☐ N/A☐ Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes☒ No☐ N/A☐ Comments:

Sample IDs were revised and documented.

e. Data quality or usability affected?

Comments:

N/A

4. Case Narrative

a. Present and understandable?

Yes☒ No☐ N/A☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes☒ No☐ N/A☐ Comments:

c. Were all corrective actions documented?

Yes☒ No☐ N/A☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

N/A

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes☒ No☐ N/A☐ Comments:

b. All applicable holding times met?

Yes☒ No☐ N/A☐ Comments:

c. All soils reported on a dry weight basis?

Yes☒ No☐ N/A☐ Comments:

d. Are the reported LOQs less than the Cleanup Level or the minimum required detection level for the project?

Yes☒ No☐ N/A☐ Comments:

e. Data quality or usability affected?

N/A

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. All method blank results less than limit of quantitation (LOQ) or project specified objectives?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iii. If above LOQ or project specified objectives, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

v. Data quality or usability affected?

Comments:

N/A

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

Yes☒ No☐ N/A☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

N/A

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Note: Leave blank if not required for project

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes☒ No☐ N/A☐ Comments:

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes☐ No☐ N/A☒ Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes☒ No☐ N/A☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes☐ No☐ N/A☒ Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes☒ No☐ N/A☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes☒ No☐ N/A☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

iv. Data quality or usability affected?

Comments:

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes☐ No☐ N/A☒ Comments:

No VOC analysis requested.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

Yes☐ No☐ N/A☒ Comments:

iii. All results less than LOQ and project specified objectives?

Yes☐ No☐ N/A☒ Comments:

iv. If above LOQ or project specified objectives, what samples are affected?

Comments:

v. Data quality or usability affected?

Comments:

N/A

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes☒ No☐ N/A☐ Comments:

Batch 19-0831 Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

ii. Submitted blind to lab?

Yes☐ No☒ N/A☐ Comments:

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1-R_2)}{((R_1+R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

Yes☒ No☐ N/A☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

N/A

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes☒ No☐ N/A☐ Comments:

i. All results less than LOQ and project specified objectives?

Yes☒ No☐ N/A☐ Comments:

ii. If above LOQ or project specified objectives, what samples are affected?

Comments:

iii. Data quality or usability affected?

Comments:

Batch 19-0831
Package DP-19-0718

Laboratory Report Date:

10/1/2019

CS Site Name:

NARL- Sitewide PFAS

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

   a. Defined and appropriate?

      Yes☐ No☐ N/A☒ Comments:

Attachment 5
Corrections to Chains of Custody

Corrections to COCs

TO: Battelle/Jonathan Thorn

COPIES: File
SDG: 19-0794, 19-0795, 19-830 and 19-831
Juan Acaron/Jacobs

FROM: Seng Camus/Jacobs

DATE: 10/22/2019

This memo is to document corrections made to entries on the Chains of Custody (CoCs) for NARL Alaska 19-0794, 19-0795, 19-830 and 19-831

The corrections include changes to the Sample IDs (soil and water samples will be separate):

Water Table

Sample ID	Incorrect Sample ID	Date	Time	SDG
NARL-S05-WP-02C-0819	NARL-SO5-WP-02C-0819	8/21/2019	15:30	19-0795
NARL-S05-WP-02CP-0819	NARL-SO5-WP-02CP-0819	8/21/2019	15:35	19-0795
NARL-S05-WP-10-0819	NARL-SO5-WP-10-0819	8/20/2019	15:30	19-0794
NARL-S05-WP-11-0819	NARL-SO5-WP-11-0819	8/21/2019	10:33	19-0794
NARL-S05-WP-12-0819	NARL-SO5-WP-12-0819	8/20/2019	17:00	19-0794
NARL-S05-WP-16D-0819	NARL-SO5-WP16D-0819	8/21/2019	15:20	19-0795
NARL-S05-WP-16D-0819-MS	NARL-SO5-WP16D-0819-MS	8/21/2019	15:20	19-0795
NARL-S05-WP-16D-0819-SD	NARL-SO5-WP16D-0819-SD	8/21/2019	15:20	19-0795
NARL-S05-WP-18B-0819	NARL-SO5-WP-18B-0819	8/21/2019	12:32	19-0795
NARL-S05-WP-20-0819	NARL-SO5-WP-20-0819	8/21/2019	10:52	19-0794
NARL-S05-AFAS-WP-21-0819	NARL-SO5-AFAS-WP21-0819	8/21/2019	11:47	19-0795
NARL-S05-SW01-0819	NARL-SO5-SW01-0819	8/20/2019	9:35	19-0794
NARL-S05-SW01-0819-MS	NARL-SO5-SW01-0819-MS	8/20/2019	9:35	19-0794
NARL-S05-SW01-0819-SD	NARL-SO5-SW01-0819-SD	8/20/2019	9:35	19-0794
NARL-S05-SW02-0819	NARL-SO5-SW02-0819	8/20/2019	10:15	19-0794
NARL-S05-SW02P-0819	NARL-SO5-SW02P-0819	8/20/2019	10:25	19-0794
NARL-S05-SW03-0819	NARL-SO5-SW03-0819	8/20/2019	10:50	19-0794
NARL-S05-SW04-0819	NARL-SO5-SW04-0819	8/20/2019	11:50	19-0794
NARL-S05-SW05-0819	NARL-SO5-SW05-0819	8/20/2019	12:10	19-0794
NARL-S05-FB01-082119	NARL-SO5-FB01-0819	8/21/2019	15:20	19-0795
NARL-S05-EB01-082119	NARL-SO5-EB01-0819	8/21/2019	15:30	19-0795
NARL-S05-EB02-082119	NARL-SO5-EB02-0819	8/21/2019	15:55	19-0795
NARL-S05-EB03-082119	NARL-SO5-EB03-0819	8/21/2019	16:10	19-0795

Soil Table

Sample ID	Incorrect Sample ID	Date	Time	SDG
NARL-S05-SB10-2.5-3.0-0819	NARL-S05-SB10-2.5-3-0819	8/25/2019	16:45	19-0831

Appendix J
PFAS Characteristics

TECHNICAL MEMORANDUM

PFAS Characteristics, Former Naval Arctic Research Laboratory (NARL) Barrow, Alaska

DATE: November 30, 2020

The purpose of this memorandum is to present per- and polyfluoroalkyl substances (PFAS) characteristics for data collected during the Site Inspection (SI) at Former Naval Arctic Research Laboratory (NARL) Barrow. This memorandum includes discussion of PFAS for which no screening levels are established; this information is supplementary and may be used to support remedial investigation planning and conceptual site model development.

Of the 18 PFAS detected during the SI, PFOS, PFOA, and PFHxS were detected at the highest concentrations in groundwater and surface water. **Figures J-1** and **J-2** show the proportions of each of these three PFAS (and all other detected PFAS) for groundwater and surface water. In most groundwater samples, PFOS or PFHxS are the predominant PFAS detected. PFOS and PFHxS are both perfluoroalkane sulfonic acids, a class of PFAS with identical sulfonic acid functional groups and varying carbon chain lengths. PFOS and PFHxS are associated with AFFF manufactured from the late 1960s until 2002 using the electrochemical fluorination process ("legacy AFFF"). Legacy AFFF contained PFOS as well as certain longer-chain precursors that can break down in the environment to PFOS and PFHxS (ITRC, 2018a, 2018b). PFOA was also detected in groundwater samples. Some older formulations of legacy AFFF may have contained PFOA or precursors that may break down in the environment to form PFOA (ITRC, 2018a).

While results for most wells show relatively similar proportions of PFAS (with the highest concentrations being PFOS, followed by PFHxS, followed by PFOA), differences are noted at the following wells:

- Results for NARL-S05-WP-11 and NARL-AFAS-WP-20 show a higher proportion of PFHxS than other wells. PFHxS is anticipated to be more mobile than PFOS (its longer-chained analogue) (ITRC, 2018c).
- Results for NARL-S05-TW02 and NARL-S05-WP-10 (which is the location of the highest detected concentrations of total PFAS [16.71 µg/kg total detected PFAS]) show a higher proportion of PFOA than other wells. PFOA is generally anticipated to be more mobile in groundwater than PFOS (ITRC, 2018c).

Samples collected within Imikpuk Lake, show relatively similar PFAS proportions to each other, likely reflecting natural mixing actions within the lake. For comparison, groundwater concentrations of PFAS detected in groundwater samples in the southwestern portion of the Airstrip Site were averaged and the relative proportions are shown on **Figure J-2**. The proportions of PFAS in the lake are similar to the southwestern Airstrip Site groundwater averages. This similarity suggests transport of PFAS in groundwater may be a past or current source of PFAS to Imikpuk Lake.

References

Interstate Technology and Regulatory Council (ITRC). 2018a. Aqueous Film-Forming Foam (AFFF). October. https://pfas-1.itrcweb.org/wp-content/uploads/2019/03/pfas-fact-sheet-afff-10-3-18.pdf.

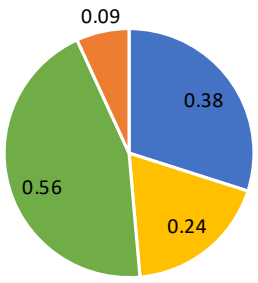
ITRC. 2018b. History and Use of Per- and Polyfluoroalkyl Substances (PFAS). November. https://pfas-1.itrcweb.org/wp-content/uploads/2017/11/pfas_fact_sheet_history_and_use__11_13_17.pdf.

ITRC. 2018c. Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances. March. https://pfas-1.itrcweb.org/wp-content/uploads/2018/03/pfas_fact_sheet_fate_and_transport__3_16_18.pdf.

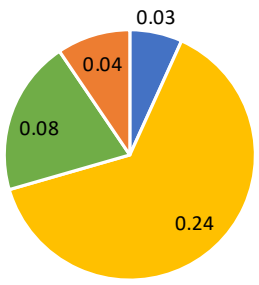
Figures

\\dc1vs01\GISNavyClean\MULTI_REGION\NW_PFAS\MapFiles\NARL_Barrow\SI\FigureJ-1_PFAS_Proportions_in_Groundwater.mxd12/1/2020DRUCKC

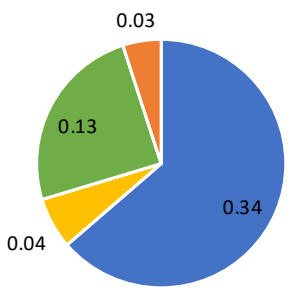
NARL-S05-WP-11 / 1.27 µg/L total



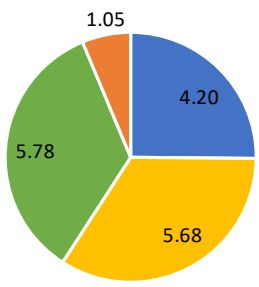
NARL-S05-TW02 / 0.38 µg/L total



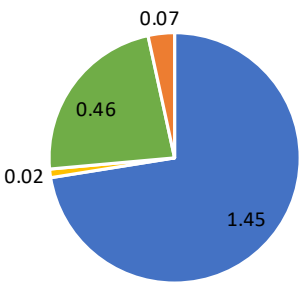
NARL-S05-WP-02C / 0.54 µg/L total



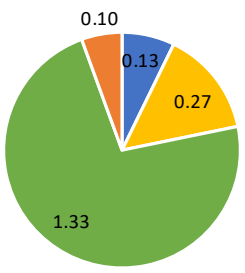
NARL-S05-WP-10 / 16.71 µg/L total



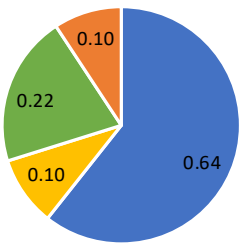
NARL-S05-WP-12 / 1.99 µg/L total



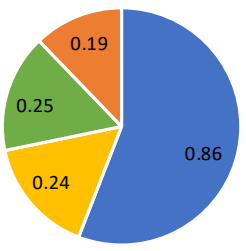
NARL-AFAS-WP-20 / 1.82 µg/L total



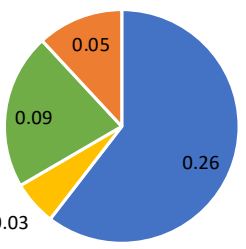
NARL-AFAS-WP-21 / 1.05 µg/L total



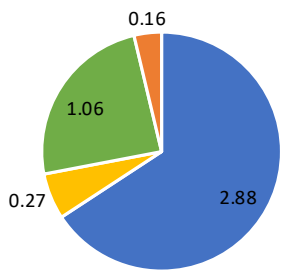
NARL-S05-WP-18 / 1.53 µg/L total



NARL-S05-TW01 / 0.43 µg/L total



NARL-S05-WP-16 / 4.38 µg/L total



NARL-S05-TW03*

NARL-S05-TW08*

POTENTIAL CRASH SITE B (LOCATION APPROXIMATE)

POTENTIAL CRASH SITE A (LOCATION APPROXIMATE)

AIRSTRIP SITE

ARCTIC OCEAN

Surface Water Drainage Divide

North Depression

South Depression

Stevenson Road

136

NORTH SALT LAGOON

IMIKPUK LAKE

Notes:

HQ = hazard quotient

PFAS = per- and polyfluoroalkyl substances

PFHxS = Perfluorohexanesulfonic acid

PFOA = Perfluorooctanoic acid

PFOS = Perfluorooctane Sulfonate

SL = Screening Level

USEPA = United States Environmental Protection Agency

*PFAS proportions not shown due to insufficient detections

1. Concentrations reported in micrograms per liter (µg/L)
2. Where applicable, the higher concentration between the primary and field duplicate samples is shown

- PFOS
- PFOA
- PFHxS
- All other detected compounds

LEGEND

- Anticipated Groundwater Flow Direction
- Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary
- Monitoring Well with SL Exceedance
- Monitoring Well with no Exceedance

NOTE:
Some features are labeled with only their building number; additional information is provided in the text of this report.

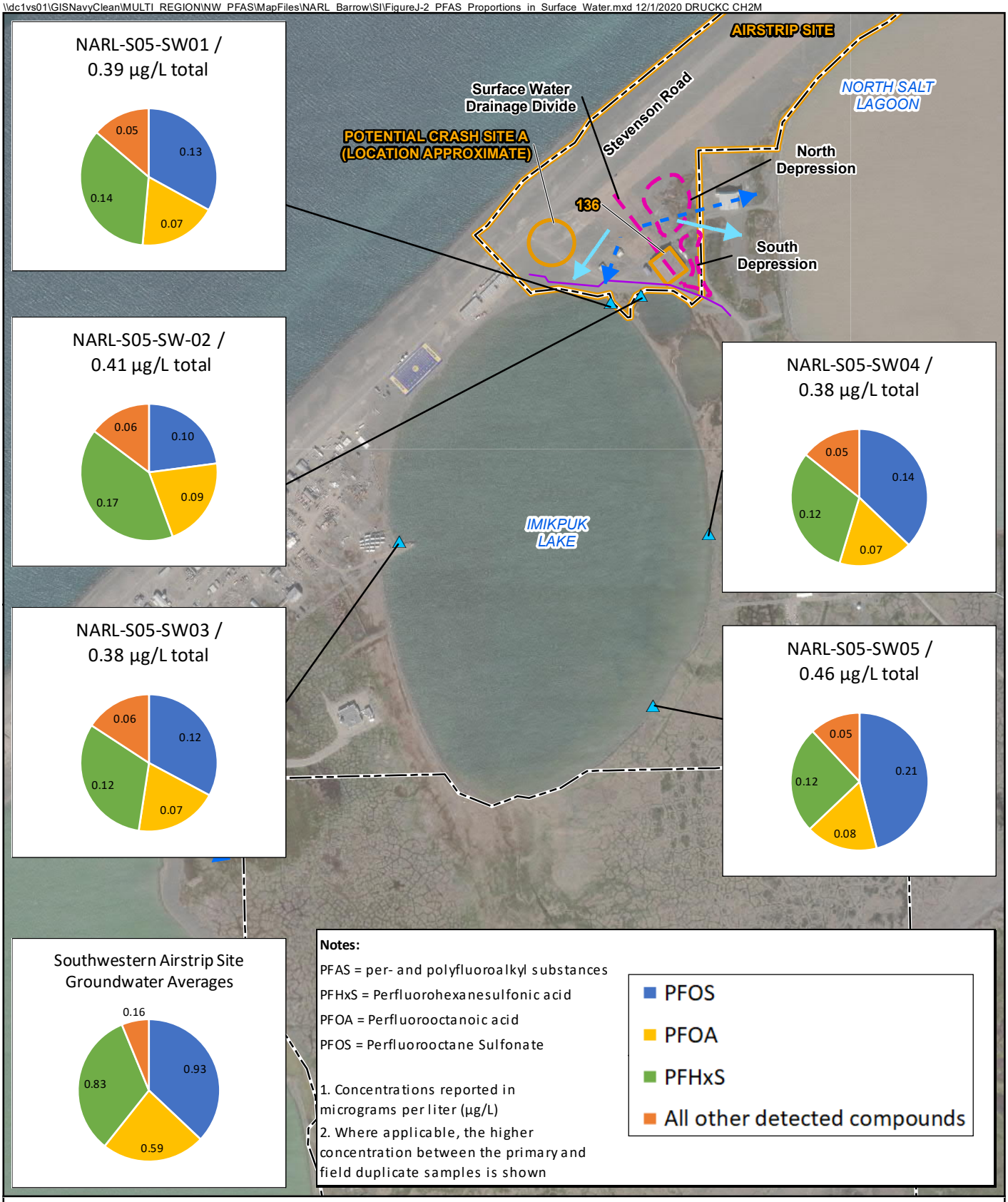
Figure J-1
PFAS Proportions in Groundwater at Airstrip Site
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake
Former NARL Barrow, Utqiaġvik, Alaska

0 500 1,000 Feet

1 inch = 1,000 feet

N

ch2m



LEGEND

- Groundwater Flow Direction
- Anticipated Surface Water Drainage Direction
- Containment Berm
- Surface Drainage Feature
- Potential PFAS Source Areas
- Current Navy Property Boundary
- 2019 Surface Water Samples

NOTE:
Some features are labeled with only their building number; additional information is provided in the text of this report.

0 500 1,000 Feet
1 inch = 1,000 feet
N

Figure J-2
PFAS Proportions in Surface Water in Imikpuk Lake
Site Inspection Report for PFAS at Airstrip Site and Imikpuk Lake Former NARL Barrow, Utqiaġvik, Alaska

ch2m

Appendix K
ProUCL Output

ProUCL Output

Building 136 Groundwater

Site Inspection Report for PFAS

Former NARL Barrow, Utqiaġvik, Alaska and Associated Special Area

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/14/2020 9:51:08 AM
From File	NARL_RDE_GW_r1.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Perfluorooctane Sulfonate (PFOS)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.131	Mean	1.349
Maximum	4.204	Median	0.746
SD	1.457	Std. Error of Mean	0.515
Coefficient of Variation	1.08	Skewness	1.376

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.82	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.325	95% Adjusted-CLT UCL (Chen-1995)	2.464
		95% Modified-t UCL (Johnson-1978)	2.367

Gamma GOF Test

A-D Test Statistic	0.241	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.159	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.301	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.026	k star (bias corrected MLE)	0.725
Theta hat (MLE)	1.315	Theta star (bias corrected MLE)	1.862
nu hat (MLE)	16.41	nu star (bias corrected)	11.59

MLE Mean (bias corrected)	1.349	MLE Sd (bias corrected)	1.585
		Approximate Chi Square Value (0.05)	4.96
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	3.92

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.153	95% Adjusted Gamma UCL (use when n<50)	3.989

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.029	Mean of logged Data	-0.262
Maximum of Logged Data	1.436	SD of logged Data	1.188

Assuming Lognormal Distribution

95% H-UCL	8.984	90% Chebyshev (MVUE) UCL	3.141
95% Chebyshev (MVUE) UCL	3.941	97.5% Chebyshev (MVUE) UCL	5.051
99% Chebyshev (MVUE) UCL	7.231		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.196	95% Jackknife UCL	2.325
95% Standard Bootstrap UCL	2.138	95% Bootstrap-t UCL	3.946
95% Hall's Bootstrap UCL	6.644	95% Percentile Bootstrap UCL	2.213
95% BCA Bootstrap UCL	2.451		
90% Chebyshev(Mean, Sd) UCL	2.895	95% Chebyshev(Mean, Sd) UCL	3.595
97.5% Chebyshev(Mean, Sd) UCL	4.567	99% Chebyshev(Mean, Sd) UCL	6.476

Suggested UCL to Use

95% Student's-t UCL	2.325

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Perfluorooctanoic acid (PFOA)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0

Minimum	0.0221	Mean	0.856
Maximum	5.679	Median	0.24
SD	1.952	Std. Error of Mean	0.69
Coefficient of Variation	2.281	Skewness	2.812

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.468	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.492	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.163	95% Adjusted-CLT UCL (Chen-1995)	2.724
		95% Modified-t UCL (Johnson-1978)	2.277

Gamma GOF Test

A-D Test Statistic	1.071	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.775	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.411	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.312	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.426	k star (bias corrected MLE)	0.349
Theta hat (MLE)	2.011	Theta star (bias corrected MLE)	2.45
nu hat (MLE)	6.809	nu star (bias corrected)	5.589
MLE Mean (bias corrected)	0.856	MLE Sd (bias corrected)	1.448
		Approximate Chi Square Value (0.05)	1.434
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	0.97

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.336	95% Adjusted Gamma UCL (use when n<50)	4.932

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.286	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.81	Mean of logged Data	-1.687
Maximum of Logged Data	1.737	SD of logged Data	1.725

Assuming Lognormal Distribution

95% H-UCL	27.03	90% Chebyshev (MVUE) UCL	1.654
95% Chebyshev (MVUE) UCL	2.136	97.5% Chebyshev (MVUE) UCL	2.806
99% Chebyshev (MVUE) UCL	4.121		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.991	95% Jackknife UCL	2.163
95% Standard Bootstrap UCL	1.913	95% Bootstrap-t UCL	15.71
95% Hall's Bootstrap UCL	14.75	95% Percentile Bootstrap UCL	2.226
95% BCA Bootstrap UCL	2.906		
90% Chebyshev(Mean, Sd) UCL	2.926	95% Chebyshev(Mean, Sd) UCL	3.864
97.5% Chebyshev(Mean, Sd) UCL	5.165	99% Chebyshev(Mean, Sd) UCL	7.721

Suggested UCL to Use

99% Chebyshev (Mean, Sd) UCL 7.721

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.