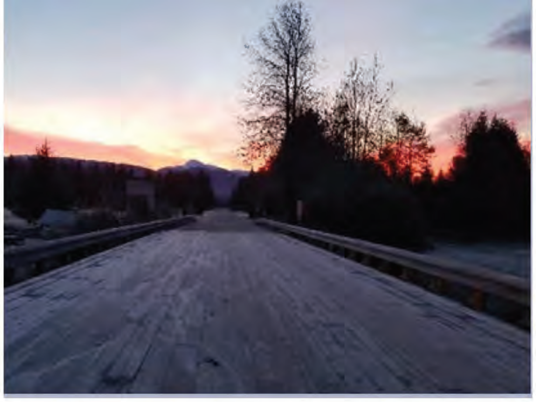

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REVISION 1

SUMMARY

Gustavus PFAS 2019 Site Characterization

GUSTAVUS, ALASKA

April 2020

Shannon & Wilson No: 102599-008

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Submitted To: Alaska Department of Transportation & Public Facilities
2301 Peger Road
Fairbanks, Alaska 99709

Attn: Samantha Cummings

Subject: REVISION 1 SUMMARY, GUSTAVUS PFAS 2019 SITE CHARACTERIZATION, GUSTAVUS, ALASKA

Shannon & Wilson prepared this report as a summary of our site characterization services to date in Gustavus, Alaska. The services were conducted on behalf of the Alaska Department of Transportation & Public Facilities (DOT&PF). Our scope of services was specified in our Work Plan dated July 2019 and authorized on September 17, 2019 by DOT&PF under our Professional Services Agreement Number 25-19-1-013 Per- and Polyfluoroalkyl Substance (PFAS) Related Environmental & Engineering Services.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.

Craig Beebe
Geologist
Role: Primary Author

Kristen Freiburger, Associate
Senior Chemist
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ACRONYMS

AAC	Alaska Administrative Code
ADONA	4,8-dioxa-3H-perfluorononanoic acid
AFFF	aqueous film-forming foam
bgs	below ground surface
°C	degrees Celsius
COC	chain of custody
CSM	conceptual site model
CUL	cleanup levels
DEC	Alaska Department of Environmental Conservation
DO	dissolved oxygen
DOT&PF	Alaska Department of Transportation & Public Facilities
DQO	data quality objective
DRM	Alaska Department of Administration Division of Risk Management
EPA	U.S. Environmental Protection Agency
GAC	granular activated carbon
GST	Gustavus Airport Terminal
HDPE	high-density polyethylene
HFPO-DA	hexafluoropropylene oxide dimer acid
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LHA	Lifetime Health Advisory
LOQ	limit of quantification
mg/L	milligrams per liter
mV	millivolts
MS/MSD	matrix spike/matrix spike duplicate
N-EtFOSAA	N-ethyl perfluorooctane sulfonamidoacetic acid
N-MeFOSAA	N-methyl perfluorooctane sulfonamidoacetic acid
NPS	National Park Service
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perflurohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFTeA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnA	perfluororoundecanoic acid
ppt	parts per trillion
QA/QC	quality assurance/quality control

ACRONYMS

RPD	relative percent difference
SSHP	site safety and health plan
TWP	temporary well point
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µS	microSiemens
YSI	multiprobe water quality meter
11Cl-PF3OUdS	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
9Cl-PF3ONS	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid

1 INTRODUCTION

Shannon & Wilson, Inc. has prepared this report to document our site characterization activities near the Gustavus Airport (GST) in Gustavus, Alaska in October 2019. The GST is an active, Alaska Department of Environmental Conservation (DEC) listed contaminated site due to the presence of per- and polyfluoroalkyl substances (PFAS) in groundwater and surface water (File Number 1507.38.017, Hazard ID 26904).

This report was prepared for the Alaska Department of Transportation & Public Facilities (DOT&PF) in accordance with the terms and conditions of our contract, relevant DEC guidance documents, and 18 Alaska Administrative Code (AAC) 75.335.

1.1 Purpose and Objectives

Our project objectives were to sample surface soil, subsurface soil, sediment, surface water, and groundwater in and around the GST to better understand the extent of PFAS contamination resulting from the historic use of fire-fighting foam by the DOT&PF. Our project goals were to identify PFAS source areas and evaluate the horizontal and vertical extent of contamination on the GST property and in the offsite aquifers and surface-water drainage channels.

1.2 Background

The GST terminal is located at 1 Airport Way in Gustavus, Alaska. The property is owned by the DOT&PF, who also owns multiple adjacent parcels. The geographic coordinates of the GST terminal are latitude 58.4252, longitude -135.7074.

The DOT&PF Crash and Fire Rescue program used aqueous film forming foam (AFFF) for training, systems testing, and emergency response at the GST for many years. Areas of potential use include the DOT&PF Crash and Fire Rescue building, near the intersection of runways 02/20 and 11/29 as well as near the southeast end of runway 11/29 (Figure 1, Site Map). The precise timeline and locations of AFFF use at the GST are unknown.

AFFF contains PFAS, a category of persistent organic compounds considered emerging contaminants. Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are two PFAS commonly found at sites where AFFFs were used. Due to their persistence, toxicity, and bioaccumulative potential, these compounds are of increasing concern to environmental and health agencies. The U.S. Environmental Protection Agency (EPA) published a Lifetime Health Advisory (LHA) level for PFOS and PFOA in drinking water in

May 2016 of 70 parts per trillion (ppt) for the sum of PFOS and PFOA. The DEC Contaminated Sites Program published groundwater-cleanup levels for PFOS and PFOA in November 2016 of 400 ppt for each compound. Prior to the publication of these levels, there were no state-level cleanup levels established for PFAS.

On May 4, 2018 DEC informed DOT&PF the airport terminal well and National Park Service (NPS) Water System well were at risk for PFAS contamination. On June 27, 2018, DOT&PF sampled both drinking-water supply wells for the presence of PFAS. The analytical results were received on July 30, 2018. The airport terminal well contained levels of PFAS exceeding the EPA's LHA level. The NPS well had detections of several PFAS less than the EPA's LHA level. DOT&PF and the Alaska Department of Administration Division of Risk Management (DRM) contacted Shannon & Wilson regarding the Gustavus results. We began private-well search and sampling efforts in August 2018.

On August 20, 2018, the DEC published a Technical Memorandum outlining a new action level for the sum of 5 PFAS (PFOS, PFOS, perfluorohexane sulfonate [PFHxS], perfluoroheptanoate [PFHpA], and perfluorononanoate [PFNA]) in drinking water. The action levels proposed in the August 2018 Technical Memorandum were submitted as proposed regulation. PFAS projects for the State of Alaska adopted the proposed regulatory action level from August 2018 to March 2019, although the proposed regulation was not formally adopted.

The initial response and private-well sampling in Gustavus referenced the sum of 5 PFAS action level for the purposes of assessing drinking-water well contamination. Private-water wells used for drinking and/or cooking with concentrations for the sum of 5 PFAS exceeding 65 ppt were provided with an alternative drinking-water source.

On April 9, 2019 DEC issued an update to the August 20, 2018 Technical Memorandum rescinding the previous action level and realigning with EPA's LHA. The memo notes "In order to align state actions to the recently announced EPA plans, DEC will use the EPA LHA (PFOS+PFOA above 0.07 μg/L) as the Action Level. Any new testing for PFAS will be for PFOS and PFOA only."

On October 2, 2019 DEC issued a second update to the August 20, 2018 Technical Memorandum stating, "Any new testing for PFAS will report the full suite of PFAS compounds analyzed by the appropriate EPA Method." EPA Method 537.1 includes the suite of 18 PFAS outlined in section 1.4 below.

1.3 Geology and Hydrology

The GST sampling area lies in a glacial outwash plain. The plain is bounded by the Chilkat Mountain Range to the northeast, Glacier Bay to the northwest and the Icy Strait to the south. Fluvial deposits are found with increasing frequency near the shoreline. Due to a high rate of glacial isostatic rebound, high silt concentrations are also observed closer to the shoreline.

Exhibit 1-1: South end of runway 02/20 facing the Chilkat Mountains.

Our knowledge of subsurface geology and hydrology in the investigation area is based on observations we made during drilling and information related to us by a local well driller. Our investigation noted the sampling area is mostly comprised of fluvial and marine sediments. The soil profile generally consists of water-bearing, interbedded sand and silt underlain by a silty clay or clay confining layer. The confining layer was observed at varying depths ranging from approximately 13 to 45 feet below ground surface (bgs).

The depth to the water table ranged from 0.33 feet bgs to 8.75 feet bgs on the east side of the Salmon River. At the well cluster by City Hall, the water table ranged from 13.75 to 13.80 feet bgs. Table 2 presents the well-survey information, depth-to-water measurements, and calculated water-table elevations.

1.4 Contaminants of Concern and Action Levels

The primary contaminants of concern are PFOS and PFOA.

On April 9, 2019, DEC issued an amendment to its August 20, 2018 Technical Memorandum to align the states action level with the EPA LHA of 70 ppt for the sum of PFOS and PFOA.

On October 2, 2019, DEC published a Technical Memorandum amending the April 9, 2019 Technical Memorandum and adding additional PFAS analytes to the testing requirements. The action level remains 70 ppt for the sum of PFOS and PFOA. However, the following list of 18 PFAS are to be analyzed for at PFAS sites.

- PFOS
- PFOA
- PFHpA
- PFNA
- PFHxS
- perfluorobutanesulfonic acid (PFBS)
- perluorodecanoic acid (PFDA)
- perluorododecanoic acid (PFDoA)
- perfluorohexanoic acid (PFHxA)
- perfluorotetradecanoic acid (PFTeA)
- perfluorotridecanoic acid (PFTrDA)
- perfluoroundecanoic acid (PFUnA)
- hexafluoropropylene oxide dimer acid (HFPO-DA)
- N-ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)
- N-methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)
- 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11CL-PF3OUdS)
- 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9CL-PF3ONS)
- 4,8-dioxa-3H-perfluorononanoic acid (ADONA)

The current drinking-water action level based on the current DEC Technical Memorandum and the current DEC groundwater cleanup levels for PFOS and PFOA based on Tables B1 and C from 18 AAC 75 are summarized below in Exhibit 1-2.

Exhibit 1-2: Applicable Regulatory Action Levels

Media	Compound	Level
Drinking water	PFOS + PFOA	70 ppt[1]
Groundwater	PFOS	400 ppt[2]
Groundwater	PFOA	400 ppt[2]
Soil	PFOS	3.0 µg/kg[3]
Soil	PFOA	1.7 µg/kg[3]

Notes:

ppt is equivalent to nanograms per liter (ng/L)

µg/kg = micrograms per kilogram

1 Drinking-water action level reported in DEC October 2019 Technical Memorandum.

2 DEC groundwater-cleanup level is reported in micrograms per liter (ug/L) in 18 AAC 75.345, Table C.

3 DEC migration-to-groundwater soil-cleanup levels are reported in 18 AAC 75.341, Table B1.

1.5 Scope of Services

Our scope of services summarized in this report includes implementation of our July 2019 Work Plan. Prior to beginning field activities, the Work Plan was approved by the DEC.

Our activities included:

- collection of 14 surface soil samples, with additional surface soil samples collected from two potential AFFF release locations;
- collection of 10 samples from surface water near the GST;
- installation and sampling of 8 temporary well points;
- installation and sampling of 15 monitoring wells at 12 locations (some locations include two wells screened at different depths);
- groundwater elevation survey to estimate groundwater flow direction and gradient;
- laboratory analysis for the above-listed samples; and
- evaluation and reporting of the analytical data.

This report was prepared for the exclusive use of the DOT&PF and its representatives. This work presents our professional judgment as to the conditions of the site. Information presented here is based on the sampling and analyses we performed. This report should not be used for other purposes without our approval or if any of the following occurs:

- Project details change, or new information becomes available, such as revised regulatory levels or the discovery of additional source areas.

- Conditions change due to natural forces or human activity at, under, or adjacent to the project site.
- Assumptions stated in this report have changed.
- If the site ownership or land use has changed.
- Regulations, laws, or cleanup levels change.
- If the site's regulatory status has changed.

If any of these occur, we should be retained to review the applicability of our recommendations. This report should not be used for other purposes without Shannon & Wilson's review. If a service is not specifically indicated in this report, do not assume it was performed.

1.6 Summary of Previous Work

To date, we have sampled a total of 113 private wells for PFAS analytes over several visits to Gustavus since August 2018. We also collected seven surface-water samples during the August 2018, September 2018 and March 2019 sampling events. In addition, we held several public-outreach meetings in conjunction with State of Alaska employees to inform residents about the project.

Private-well sample concentrations for the sum of PFOS and PFOA ranged from not-detected to 6,110 ppt for wells associated with the GST PFAS project. Private-well sampling areas were expanded until the concentration for the PFAS concentrations were below the applicable DEC regulatory level along the edges of the sample area. Private-water well depths are generally between 15-25 feet bgs based on information provided by the residents and the former local driller who installed most of the wells. No well-drilling or construction logs were available to confirm these depths. Our private-well sampling was able to approximate the impacted area of contamination in this depth range of the aquifer. However, we were not able to obtain samples from deeper levels of the aquifer due to the absence of available wells.

2 FIELD ACTIVITIES

This section summarizes the site characterization field activities preformed during October of 2019. The following Shannon & Wilson personnel collected analytical samples for this project. These individuals are State of Alaska Qualified Samplers per 18 AAC 75.333[b] and 18 AAC 78.088[b].

- Cherissa Dukelow, Environmental Scientist

- Kristen Freiburger, Environmental Chemist
- Craig Beebe, Geologist

Our team is aware of the potential for cross-contamination of PFAS from numerous everyday items. We took appropriate precautions to prevent cross-contamination, including discontinuing the use of personal protective equipment and field supplies known to contain PFAS, using liner bags to contain samples before and after sample collection, hand washing, and donning a fresh pair of disposable nitrile gloves before sample collection. Additionally, samples were collected in laboratory-supplied, high-density polyethylene (HDPE) containers to prevent PFAS from adhering to the container.

2.1 Surface Water Sampling

Exhibit 2-1: Example of surface water sample location.

We collected ten surface-water analytical samples during the October 2019 sampling event. Samples were collected from drainage ditches and ponds around and near the airport. These samples were collected with the use of a dust-free, PFAS-free, new disposable clear plastic cups. Cups were submerged approximately 6 inches below the surface of the water body using a freshly gloved hand. Sample water was then transferred directly to the sample bottle. Where possible, samples were collected from the mid-point of the water body. Refer to Figure 2 for surface-water sample locations. The samples were submitted for the analysis of 18 PFAS by EPA Method 537.1.

2.2 Soil Borings

We subcontracted Discovery Drilling, Inc. (Discovery) to advance soil borings at twelve locations between October 5, 2019 and October 12, 2019 (Figure 3). Prior to drilling activities, we requested utility locates from local utility providers using the Alaska Digline. Discovery used their 6217 DT drill rig to advance the borings. We collected nine subsurface soil analytical samples and one field duplicate from the two borings on the GST property near the "old" and "new" fire training areas. Samples were collected with a new stainless-steel spoon every five feet or at significant changes in lithology, in accordance with our Work Plan. Analytical samples were submitted for the suite of 18 PFAS and analyzed by EPA method 537.1. We observed groundwater ranging from 0.33 feet to 13.80 feet bgs and a confining layer from approximately 13 to 45 feet bgs. Our boring logs are included in Appendix A, Boring Logs.

West of Wilson Road, the inferred surface of the confining layer generally slopes southwest, increasing in depth as the layer approaches the ocean. The groundwater table appears to follow the same general pattern in this area with a more west-southwest gradient north of Faraway Road (Figure 4). The confining layer is deeper in between Glen's Ditch Road and Moose Lane than on the edges of this area. From the available data, the groundwater table between Glen's Ditch Road and Moose Lane appears to flow in a more southerly direction. At the two soil borings on the airport property, the confining layer was encountered at 17.5 feet bgs near the new fire-training area and 13 feet bgs at the old fire-training area. In this area the groundwater table appears to flow east-southeast and southeast off the runway.

2.3 Monitoring Wells

Discovery installed fifteen monitoring wells between October 5 and October 12, 2019. Monitoring wells are co-located with soil boring locations, as shown on our soil boring logs (Figure 2). The monitoring well depths were dependent on the depth of the confining layer. Generally, where at least 36 feet between the water table and confining layer existed, two monitoring wells were installed at a given location, one spanning the water table, and one set immediately above the confining layer, except for location MW-2 next to the river. Two monitoring wells were installed at locations MW-1, MW-2, and MW-3; one monitoring well was installed at locations MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11, and MW-12. This change to the scope was approved by DEC during drilling activities.

We installed two monitoring wells on site, and thirteen monitoring wells off site. Monitoring well depths range from fifteen to forty-six feet bgs. The approximate (rounded) depth of the monitoring well is denoted in the well name (i.e. MW-10-20 was installed at approximately 20 feet bgs).

Exhibit 2-2: Monitoring well development; visually checking turbidity.

No sooner than twenty-four hours after installation, the monitoring wells were developed using an inertial pump with a foot valve and surge block until purge water was clear. Immediately following development, we purged the monitoring well using a peri-pump until water parameters stabilized or a total of three well volumes had been purged. We measured these parameters using a multiprobe water quality meter (YSI) and recorded pH, temperature in degrees Celsius (°C), conductivity in microSiemens (µS), dissolved oxygen (DO) in milligrams per liter (mg/L), and redox potential in millivolts (mV) approximately once every three minutes until sample collection. The following values were used to indicate stability for a minimum of three consecutive readings: ±0.1 pH, ±3 percent °C, ±10 percent DO, ±3 percent conductivity, and ±10mV redox. Water clarity (visual) was also recorded. Following parameter stabilization, we collected PFAS water samples using laboratory-supplied containers. Samples were submitted for analysis of 18 PFAS via EPA Method 537.1.

We discharged purge water to a 55-gallon drum, allowed the sediment to settle, and then used granular activated carbon (GAC) to filter the water before discharging to the ground surface.

Copies of the Monitoring Well Sampling Logs are included in Appendix B, Field Forms.

2.4 Temporary Well Points

Discovery installed eight temporary well points (TWPs) using 1-inch diameter PVC casing. TWP locations were selected to fill in areas with potential data gaps from the private-well sampling efforts (Figure 2). The TWPs were purged using a peri-pump and new, disposable PFAS-free tubing. Parameters (temperature, pH, conductivity, DO, and redox potential) were measured using a YSI and samples were collected following parameter stabilization, as defined in Section 2.3, or until 3 well volumes had been reached. The TWP groundwater samples were submitted for 18 PFAS analytes by EPA Method 537.1.

Sample logs for the TWP groundwater samples are included in Appendix B, Field Forms.

2.5 Sediment and Surface Soil Sampling

We collected 41 primary surface soil samples and 9 sediment samples between October 10 and October 14, 2019. Surface soil samples were collected along the active runway perimeters and at potential AFFF release locations. Samples were collected in a grid formation from the former fire-training pit. A grid was not possible in the new fire-training location, as most of the area is asphalted, as shown in Exhibit 2-3. We collected surface soil

Exhibit 2-3: New fire-training location.

samples from the edge of asphalt and near the outfall of three culverts directly in the drainage pathway leading from the asphalted area. We collected surface samples using a decontaminated hand trowel to dig to the target depth, then a new, disposable stainless-steel spoon to fill the laboratory-provided sample jars.

Sediment samples were collected at the same location as surface-water samples, except for location SW-19-05 (Figure 2). These locations were along runway drainage ditches, confluence of drainage ditches and along Glen's ditch. Collection of the sediment samples was completed using a decontaminated hand auger or decontaminated hand-trowel. Laboratory-provided sample jars were filled with the use of a disposable stainless-steel spoon. Care was taken to prevent large pieces of vegetation from entering the sample.

Sediment and surface soil samples were submitted for analysis of 18 PFAS by EPA Method 537.1. Samplings logs are available in Appendix B.

2.6 Hydraulic Gradient and Well Survey

Lounsbury and Associates, Inc. conducted a survey of the monitoring wells and TWPs beginning on October 15, 2019, measuring the well casing elevations and longitude/latitude of each location. We measured the depth to water from the well casing for each monitoring well and TWP on October 15, 2019. We calculated hydraulic gradient using the *U.S. Environmental Protection Agency Online Hydraulic Gradient Calculator* with well location coordinates, elevation, and depth-to-water values measured on October 15, 2019 as inputs. Results from the 2019 calculations indicate groundwater flow direction varies by location. Near the southern end of runway 11/29, calculations indicated groundwater flow direction is generally east-southeast with a heading of 108 degrees from north and a slope of 0.0015 vertical foot per horizontal foot (Figure 2). In the private-well sampling area north of Parker Drive, the flow direction is generally west-southwest with a heading of 256 degrees from north and a slope of 0.0042 vertical foot per horizontal foot. Within the private-well sampling area south of Parker Drive, the flow direction is generally south-southwest with a heading of 194 degrees from north and a slope of 0.0036 vertical foot per horizontal foot. Results of the survey are presented in Table 1.

2.7 Investigation-derived Waste

Soil generated from borings were contained in nineteen labeled 55-gallon drums and temporarily stored at the DOT&PF property. Pending DEC approval of the drum analytical results, soil will be disposed of by DOT&PF personnel on-site or shipped to a disposal facility. This report does not address the final disposal of the drums.

Purge water generated during groundwater sampling activities was filtered through our portable GAC system and disposed of to the ground surface. The GAC system consisted of three, sealed 5-gallon buckets containing GAC. The buckets were placed in series and fitted with a valve capable of adjusting the water flow through the GAC bucket, providing additional resonance time, where needed. Water used to decontaminate the drill augers was also disposed of through the GAC system. Following the completion of groundwater sampling, the GAC was containerized in a labeled 55-gallon drum awaiting disposal.

2.8 Deviations from the Work Plan

In general, we conducted our services in accordance with the approved Work Plan. The following are deviations from the approved Work Plan.

- Immediately prior to our Gustavus visit, DEC released an update to their August 20, 2018 Technical Memorandum on October 2, 2019. Samples were analyzed for the suite of 18 analytes listed in the EPA Method 537.1, instead of for PFOS and PFOA only.

- Due to encountering considerable sand heave at shallow depths, augers were used to complete the deeper wells. With the use of augers and a wood plug we were able to mitigate the sand heave at depth.
- Due to the volume of soil cuttings, soil generated during monitoring well installation was stored in a combination of a five-gallon buckets and 55-gallon drums.
- To reduce the likelihood of damage from snowplows and other machinery, monitoring wells were completed with flush-mount monuments instead of stickup monuments.
- To reduce the potential for cross contamination, temporary well points were installed with one-inch schedule 40 PVC pipe instead of reusable SP15 steel rods.
- Our Work Plan called for collection of surface-water samples using a peristaltic pump and disposable tubing. Due to access issues at some of the locations, surface-water samples were collected with a new disposable, PFAS-free plastic cup. This method was used at each surface-water location for consistency.
- Our Work Plan stated an Eckmann Dredge would be used to collect sediment samples. Due to heavy vegetation and soil conditions, sediment samples were collected with the use of a hand-operated auger.
- Our Work Plan called for taking a daily field blank by pouring PFAS-free water into a sample bottle in the same location project samples were collected. Due to the limited availability of laboratory grade PFAS-free water, we dedicated the PFAS-free water to decontamination efforts and equipment blanks.
- Our Work Plan called for a grid-pattern sampling at the new AFFF training area (Figure 1) near the intersections of runway 11/29 and 02/20. The training area is located on pavement that is sloped towards several drains. After discussion with DEC, we sampled at culvert outfalls and the associated runoff ditches.
- Due to the relatively shallow depth of the confining layer at 9 of the 12 planned well-cluster locations, we installed only one of the two wells at each of those locations. In most of these cases the well screens would have overlapped by several feet if two wells had been installed. In the location where one monitoring well was installed, wells were completed with a screened interval of ten feet. With the exception of MW-12-10, where a 5-foot screen was installed due to the shallow confining layer.
- Due to falling temperatures and after discussion with DEC, a dry decontamination of drill rod and auger was used starting October 8, 2019. A lined pit was constructed to catch soil from rods and augers, which were heated until the metal was red hot and then brushed clean. The soil was containerized into a 55-gallon drum. Additionally, soil borings were drilled in the order of least contaminated to most contaminated (based on previous private well results) in order to minimize cross-contamination potential.

3 ANALYTICAL RESULTS

We submitted the analytical samples collected throughout this project to TestAmerica Laboratories, Inc. (TestAmerica) in West Sacramento, California, also referred to as Eurofins, for determination of PFAS using EPA Method 537.1. This method analyzes a suite of 18 PFAS; we requested analysis of all 18 PFAS, as required by DEC's October 2, 2019 Technical Memorandum.

The analytical results are presented in Tables 2 through 6. The analytical laboratory reports and corresponding DEC Laboratory Data-Review Checklists (LDRCs) are included in Appendices C and D, respectively. Figures 2 and 3 also present analytical results with respect to DEC regulatory levels.

3.1 Groundwater Samples

The groundwater is a known drinking-water source in Gustavus. Groundwater results were compared to the drinking-water action level presented in DEC's October 2019 Technical Memorandum of 70 ppt for the sum of PFOA and PFOS.

We collected 23 analytical groundwater samples from 15 monitoring wells and 8 TWPs (Figure 2). PFOS and PFOA were detected in monitoring wells MW-9-30 and MW-12-10 above 70 ppt for the sum. Monitoring well MW-12-10 is located in the former fire training pit near the southern end of runway 11/29. Monitoring well MW-9-30 is located along Wilson Road, between Far Away Road and Gustavus Road.

Monitoring wells MW-10-20, MW-11-15, and TWP-08 contained PFOS+PFOA concentrations below (but within 25 percent of) the 70 ppt action level. The following monitoring wells were not reported to contain detectable concentrations of PFOS or PFOA: MW-1-15, MW-1-40, MW-2-30, MW-4-20, MW-5-20, MW-6-20, TWP-01, TWP-03, and TWP-04.

Analytical results for the monitoring well and TWP groundwater samples are summarized in Table 2.

3.2 Surface Water Samples

Private wells in Gustavus are largely comprised of shallow (15-25 feet bgs) likely affected by surface-water infiltration. In the absence of a DEC surface-water cleanup level, we compared the surface water results to the 70 ppt drinking-water action level presented in DEC's October 2019 Technical Memorandum.

We collected 10 analytical surface water samples within or near the airport property (Figure 2). PFOS and PFOA were detected above the action level in surface water samples *SW-19-03, SW-19-06, SW-19-07*, and *SW-19-10* four samples. Of these four surface-water locations, two samples (*SW-19-06* and *SW-19-10*) were collected from drainage ditches on either side of the southern end of runway 11/29, *SW-19-03* was collected from the drainage ditch just north of Moose Ln and *SW-19-07* was collected from the slough near the southern end of runway 02/20, locally referred to as the "duck pond."

Analytical results for the surface water samples are summarized in Table 3.

3.3 Soil Samples

Soil results were compared to 18 AAC 75 Table B1 Method Two – Soil Cleanup Levels (Migration to Groundwater [MTGW] values) of 3.0 µg/kg for PFOS and 1.7 µg/kg PFOA.

3.3.1 Subsurface Soil Samples

We collected 9 analytical samples from the two on-site soil borings (SB-11 and SB-12; Figure 3). PFOS was detected above the DEC MTGW soil cleanup level in the samples collected from the top two feet of both borings. SB-12 is located in the former ("old") fire training burn pit near the southern end of runway 11/29. SB-11 is across a drainage ditch from the "new" fire training area near the north end of runway 02/20.

Analytical sample results for the subsurface soil samples are summarized in Table 4.

3.3.2 Surface Soil Samples

We collected 26 surface soil samples and 3 field duplicates along the two runways and from within the former fire training pit (locations *SS-19-01* through *SS-19-29*; Figure 3). PFOS was detected above the MTGW soil cleanup level in eight project samples and two field duplicates (*SS-19-02, SS-19-05, SS-19-06, SS-19-08, SS-19-12, SS-19-13, SS-19-14, SS-19-17, SS-19-18, and SS-19-19*).

We also collected surface-soil samples from culverts and drainage outfalls in the direct drainage pathway from the "new" fire training area (locations *SS-19-30* through *SS-19-32* and *Culvert-1 through Culvert-3*). Each of these locations exceeded the PFOS MTGW cleanup level by twenty times or greater. The outfall samples also exceed PFOA MTGW for samples *SS-19-30, SS-19-31, Culvert 1 and Culvert 3*.

Exhibit 3-1: Collecting surface soil sample near *Culvert 2*.

Analytical sample results for the surface soil samples are summarized in Table 5.

3.3.3 Sediment Soil Samples

We collected nine primary sediment samples (one at each surface water location, except for *SW-19-05*) from drainage ditches on and near the airport property (Figure 2). Due to the absence of a sediment cleanup level, we compared sediment concentrations to the DEC MTGW soil cleanup levels for PFOS and PFOA. PFOS was detected above the MTGW soil cleanup level in three sediment samples (*SW-19-03*, *SW-19-06*, and *SW-19-08*); PFOA was not detected above the MTGW soil cleanup level in the sediment samples. The sediment samples with PFOS exceedances are in drainage ditches diverting water from the "new" and "old" fire training areas.

Analytical sample results for the sediment samples are summarized in Table 5.

3.4 Soil IDW Samples

Exhibit 3-2: Soil IDW storage drums.

We collected analytical samples from each 55-gallon drum containing soil derived from investigation activities. None of the analytical results were above DEC cleanup levels; however, the drums do contain soil from locations where the analytical results exceed DEC cleanup levels. Additionally, Drum 15 contains the spent GAC used for filtrating purged groundwater. A separate letter report will be submitted to DOT&PF and DEC presenting the analytical results and discussing disposal options. The drums will be disposed of accordingly, following DEC approval. DEC approval will be obtained prior to moving or disposing of the soil drums using the DEC Transport, Treatment, and Disposal form.

3.5 GAC Confirmation Samples

GAC confirmation water samples were collected following the development of MW-8-20 (*GAC #1*) and MW-12-10 (*GAC #2*). Trace levels of PFOS was detected in sample *GAC #2*. GAC treatment of purge water and decontamination water is considered successful.

Analytical sample results for the GAC confirmation samples are summarized in Table 6.

4 UPDATED CONCEPTUAL SITE MODEL

We revisited the preliminary conceptual site model (CSM) presented in our Work Plan. The DEC CSM scoping form and graphic form are presented in Appendix E. Per DEC's request, we also completed an ecoscoping form which is presented in Appendix F.

4.1 Description of Potential Receptors

We consider commercial/industrial workers, site visitors, construction workers, subsistence hunters and consumers, farmers/gardeners, and residents to be current or future potential receptors.

4.2 Potential Exposure Pathways

Potential human exposure pathways include inhalation of fugitive dust; direct contact with contaminated sediment; and incidental soil and groundwater ingestion. Additionally, ingestion of wild and farmed foods may be a human exposure pathway as PFOS and PFOA are bioaccumulative (DEC; 2017).

4.2.1 Soil

Incidental ingestion may be a potential direct-contact exposure pathway for soil. Direct contact with the contaminated surface and subsurface soil at the site is unlikely at present. However, future excavation at the site may result in ingestion of soil by commercial workers, site visitors, residents, or construction workers. Contaminated surface soil can become entrained in fugitive dust, which could be a current exposure pathway for site workers, visitors, and nearby residents.

4.2.2 Groundwater

Ingestion of groundwater is an exposure pathway, as several private wells near the GST have been found to have PFAS contamination that exceeds state regulatory levels. Private-wells near the GST are generally shallow, at about 15 – 25 feet bgs. We understand setting wells in a deeper, uncontaminated aquifer is not an option in Gustavus.

4.2.3 Surface Water and Biota

Surface water, while unlikely to be an exposure pathway because PFAS is not readily absorbed through the skin, is contributing to groundwater contamination by moving contaminants off-site. Animals are known to use the area where a previous surface-water sample showed contamination. Due to the bioaccumulative risk of PFAS, biota is considered a potential pathway for exposure. Our site assessment activities are not designed to assess the biota exposure pathway. However, we understand the State of Alaska is conducting sampling at various PFAS sites to investigate this pathway.

5 DISCUSSION AND RECOMMENDATIONS

We present here our discussion relevant to PFAS in groundwater, surface water and soil at and near the GST property.

5.1 Comparison to Regulatory Limits and Discussion

PFOS was frequently the highest detected PFAS in the analytical samples. Analytical results for the project samples are presented in Tables 2 through 5.

Of the 15 monitoring-well and TWP groundwater samples, monitoring wells MW-9-30 (offsite) and MW-12-10 (onsite) had PFAS concentrations exceeding the action level of 70 ppt for the sum of PFOS and PFOA. MW-9-30 is along Wilson Road in a known area of groundwater contamination, based on private-well results. MW-12-10 is in the former ("old") fire training pit near the southern end of runway 11/29. Additionally, monitoring wells MW-10-20, MW-11-15, and TWP-08 contained PFOS and/or PFOA concentrations below, but within 25 percent of, the 70 ppt action level.

Surface-water concentrations exceeded the action level of 70 ppt for the sum of PFOS and PFOA at locations *SW-19-03, SW-19-06, SW-19-07*, and *SW-19-10* (Figure 2). Location *SW-19-06, SW-19-07*, and *SW-19-08* are repeat sample locations for the August 2018 samples *SW-2002, SW-2001*, and *SW-2000*, respectively. Information for these samples is presented in our summary report *August 2018 to November 2018 Private Well Sampling - Revision 1*, dated April 2019. The highest concentration observed during both sampling events is observed in the samples collected from the drainage outfall near the former fire training pit at the southern end of runway 11/29. The second highest concentrations observed during both sampling events is observed in samples *SW-19-07* and *SW-2001* collected from the slough north of the 02/20 runway, also referred to by the local community as the "duck pond."

During our October 2019 sampling event, we observed water moving from the "duck pond" into the drainage channel known as Glen's Ditch. The ditch meets a drainage channel from the airport at location *SW-19-08* (Figure 2) and flows south to the Icy Strait. Slightly lower concentrations of PFOS and PFOA are observed in *SW-19-04* compared to *SW-19-08*, located downstream of *SW-19-08*. Concentrations in *SW-19-03* are similar to concentrations reported for the airport terminal well located near the drainage ditch. However, private wells located on Moose Lane and monitoring well MW-7-20 are also in the area of the *SW-19-03* ditch but do not have measurable PFOS and PFOA concentrations or have trace-level concentrations.

In the absence of federal or state regulatory values for PFAS contaminants in sediment, we reference the most stringent soil cleanup level (MTGW) for comparing to sediments. We are unable to address if the MTGW is sufficiently sensitive (protective of human health) for addressing sediment concentrations. However, we understand DEC obtained the organic carbon partition coefficient (K_{oc}) values used for calculating the MTGW soil cleanup level for PFOS and PFOA from a peer-reviewed study of PFAS surfactants on sediment. PFOS was detected above the MTGW soil cleanup level in three sediment samples (*SW-19-03, SW-19-06*, and *SW-19-08*); PFOA was not detected above the MTGW soil cleanup level in the sediment samples. The sediment samples with PFOS exceedances are in drainage ditches diverting water from the "new" and "old" fire training areas.

Reviewing the data from site characterization activities in conjunction with previous private well samples suggests surface water has one of the largest influences on transporting PFAS off the GST. Conversations with a long-time resident who resides nearby the airport property indicated AFFF training may have occurred near or at the "duck pond" area.

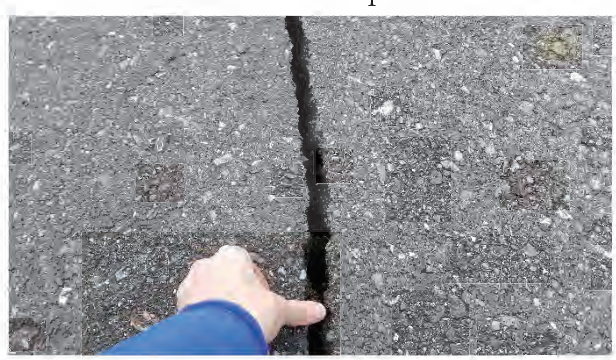

Exhibit 5-1: Asphalt cracks in known release area at north end of runway 02/20.

We observed several pathways for PFAS to enter the surface water drainage ditches and/or groundwater from the "new" fire training area. Several cracks are present in the asphalt, as shown in Exhibit 5-1. Additionally, water and other liquids from this area are gravity fed into a drainage system that releases its contents at three culvert outfalls into a drainage ditch. The highest concentrations of PFOS and PFOA reported in soil samples collected for this project were in surface soil samples collect near the three culverts. We understand DOT&PF plans to reconstruct the airport apron in this area in the upcoming field season/s.

Contributions to the groundwater from the "duck pond" and drainage ditches leading from the "new" fire training area are likely the biggest contributor to private-well contamination west of the airport.

5.2 Recommendations

Based on our previous work and our current site characterization we recommend the DOT&PF to continue:

- investigating the impact and flow of surface water;
- attempting to locate potential AFFF source areas;
- working with the DEC and DHSS to educate the public regarding the potential health effects of exposure to PFAS-containing water; and
- refraining from discharging PFAS-containing AFFF to the ground, surface water bodies or groundwater from ARFF training areas, equipment testing, or emergency response, where possible.

We also recommend:

- expanding the monitoring-well network, specifically on airport property and near the DOT&PF building and airport terminal wells;
- collecting analytical samples from the current monitoring-well network on a quarterly basis for a minimum of one year;
- further investigating the groundwater elevations and gradient along the portions of Gustavus Road that runs southwest to northeast from the airport terminals (Figure 4);
- completing a soil management plan for the construction work planned near the "new" fire training area;
- further investigating surface-water bodies originating at the airport and mapping the surface water/storm drainage features to determine where stagnant water may infiltrate, based on site visits, and locally available information; and
- excavating surface soils with concentrations exceeding the DEC MTGW soil cleanup levels.

Our recommendations are based on:

- Groundwater conditions inferred through private-well, monitoring-well, temporary-well-point and surface-water samples collected from August 27, 2018 through October 15, 2019.
- Soil conditions observed on, near and downgradient of the GST.

- The results of testing performed on soil and water samples we collected from the private wells, monitoring wells, temporary well points and surface water on, near, and downgradient from the GST.
- Publicly available literature and data we reviewed for this project, including USGS, 2018.
- Our understanding of the project and information provided by the DOT&PF, DRM, and other members of the project team.
- The limitations of our approved scope described in our Work Plan dated July 2019 and August 2019 Proposed Scope of Services.

The information included in this report is based on limited sampling and should be considered representative of the times and locations at which the sampling occurred. Regulatory agencies may reach different conclusions than Shannon & Wilson. We have prepared and included in, "Important Information about your Geotechnical/Environmental Report," to assist you and others in understanding the use and limitations of this report.

6 REFERENCES

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Table 1 - Groundwater Elevations

Well Name	Elevation of Ground Surface	Elevation of Casing	Depth to Water	Elevation of Water	Northing	Easting
MW-1-15	19.27	19.05	7.15	11.90	2407620.248	2289623.196
MW-1-40	19.16	19.00	7.13	11.87	2407622.108	2289617.430
MW-2-20	23.69	23.30	13.36	9.94	2409261.801	2288614.798
MW-2-30	23.79	23.57	13.58	9.99	2409258.163	2288614.577
MW-3-15	23.26	22.93	8.42	14.51	2408922.502	2289839.256
MW-3-40	23.16	22.92	8.46	14.46	2408922.125	2289835.560
MW-4-20	25.22	25.02	1.21	23.81	2410099.560	2294867.055
MW-5-20	23.42	23.20	7.63	15.57	2410646.767	2289471.621
MW-6-20	29.39	29.23	7.16	22.07	2409731.495	2293028.194
MW-7-20	29.46	29.25	6.87	22.38	2411453.445	2295289.432
MW-8-20	27.58	27.38	4.60	22.78	2411196.613	2290886.673
MW-9-30	25.06	24.93	4.92	20.01	2409604.104	2290908.154
MW-10-20	25.62	25.68	3.40	22.28	2410131.794	2290923.201
MW-11-15	29.14	28.97	3.98	24.99	2413101.475	2294641.146
MW-12-10	19.24	19.28	0.31	18.97	2411546.696	2298074.245
TWP-01	28.82	31.77	7.84	23.93	2412506.535	2290957.722
TWP-02	26.59	29.31	9.09	20.22	2408890.820	2291623.826
TWP-03	26.49	29.73	7.72	22.01	2411344.367	2296587.940
TWP-04	25.01	28.09	8.52	19.57	2410284.712	2298006.999
TWP-05	24.67	27.48	6.53	20.95	2410861.435	2298646.126
TWP-06	33.51	38.14	10.00	28.14	2415555.178	2293139.200
TWP-07	29.67	31.16	1.82	29.34	2416890.076	2292829.369
TWP-08	27.09	31.95	8.29	23.66	2410607.399	2291564.030

Table 2 - Summary of Gustavus Airport Site Characterization Groundwater Analytical Results

Analytes	LHA	Units	MW-1-15	MW-1-40	MW-2-20	MW-2-30	MW-3-15	MW-3-40		MW-4-20
								MW-3-40	MW-103-40 (DUP)	
			10/10/19 17:41	10/10/19 14:47	10/11/19 15:45	10/11/19 14:40	10/12/19 15:02	10/12/19 13:11	10/12/19 13:01	10/10/19 10:00
Perfluorohexansulfonic acid (PFHxS)	—	ppt	1.1 J	<1.9	3.9	1.4 J	3.7	31	32	<1.9
Perfluorohexanoic acid (PFHxA)	—	ppt	<1.8	<1.9	4.6	<1.8	<1.8	5.3	5.2 J*	<1.9
Perfluoroheptanoic acid (PFHpA)	—	ppt	<1.8	<1.9	0.95 J	<1.8	<1.8	1.1 J	<1.9	<1.9
Perfluorononanoic acid (PFNA)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
Perfluorobutanesulfonic acid (PFBS)	—	ppt	<1.8	<1.9	<1.9	1.5 J	<1.8	3.2	2.9	<1.9
Perfluorodecanoic acid (PFDA)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
Perfluoroundecanoic acid (PFUnA)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
Perfluorododecanoic acid (PFDoA)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
Perfluorotridecanoic acid (PFTrDA)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
Perfluorotetradecanoic acid (PFTeA)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	ppt	<18	<19	<19	<18	<18	<19	<19	<19
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	ppt	<18	<19	<19	<18	<18	<19	<19	<19
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	ppt	<1.8	<1.9	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	ppt	<3.7	<3.8	<3.8	<3.7	<3.7	<3.7	<3.8	<3.8
Perfluorooctanesulfonic acid (PFOS)	70	ppt	<1.8	<1.9	3.8	<1.8	9.5	9.0 J*	8.5 J*	<1.9
Perfluorooctanoic acid (PFOA)	70	ppt	<1.8	<1.9	1.5 J	<1.8	<1.8	2.1	2.8	<1.9
LHA Combined (PFOS + PFOA)	70	ppt	n/a	n/a	5.3 J	n/a	9.5 ‡	11 J*	11 J*	n/a
LHA Combined (PFOS + PFOA) 2xDL	70	ppt	2.6 µ	2.6 µ	5.3	2.6 µ	11 µ	11 J*	11 J*	2.6 µ

ppt parts per trillion, equivalent to nanograms per liter
EPA Environmental Protection Agency
LHA Lifetime Health Advisory
† EPA LHA level is 70 ppt for PFOS and PFOA combined.
µ The summed concentration was calculated using a value two times the laboratory detection limit for non-detect analytes, per ADEC's March 2019 Technical Memorandum.
< Analyte not detected; listed as less than the reporting limit (RL) unless otherwise flagged due to quality-control (QC) failures.
Bold Detected concentration exceeds LHA level.
DUP field-duplicate sample
J Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.
JH* Result consided estimated due to a QC failure, and is biased high. Flag applied by Shannon & Wilson, Inc.
J* Result considered estimated due to a QC failure. Flag applied by Shannon & Wilson, Inc.
B* Result is included in the same preparatory batch as a blank detection for the associated analyte. Flag applied by Shannon & Wilson, Inc.
‡ Minimum concentration, the LHA Combined oconcentration includes one or more result that is not detected greater than the MDL.
— LHA level not established

Table 2 - Summary of Gustavus Airport Site Characterization Groundwater Analytical Results

Analytes	MW-5-20	MW-6-20	MW-7-20	MW-8-20	MW-9-30	MW-10-20	MW-11-15		MW-12-10	TWP-01
							MW-11-15	MW-111-15 (DUP)		
	10/11/19 18:10	10/12/19 17:47	10/13/19 11:29	10/13/19 18:09	10/13/19 13:47	10/13/19 16:04	10/14/19 11:29	10/14/19 11:19	10/14/19 13:27	10/11/19 13:49
Perfluorohexansulfonic acid (PFHxS)	3.1	2.9	1.5 JH*	<1.9 B*	15 B	12	12 B	12 B	52 B	1.1 J
Perfluorohexanoic acid (PFHxA)	<1.9	<1.9	1.1 J	<1.9	5.5	5.6	18	18	17	<1.9
Perfluoroheptanoic acid (PFHpA)	<1.9	<1.9	0.56 J	<1.9	2.2	2.3	4.8	4.8	10	<1.9
Perfluorononanoic acid (PFNA)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	1.0 J	0.88 J	0.83 J	<1.9
Perfluorobutanesulfonic acid (PFBS)	0.31 J	<1.9	0.35 J	<1.9	1.2 J	0.75 J	1.2 J	1.3 J	3.1	<1.9
Perfluorodecanoic acid (PFDA)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	1.7 J	1.8 J	<1.9	<1.9
Perfluoroundecanoic acid (PFUnA)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	1.4 J	1.2 J	<1.9	<1.9
Perfluorododecanoic acid (PFDoA)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	0.68 J	0.68 J	<1.9	<1.9
Perfluorotridecanoic acid (PFTrDA)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
Perfluorotetradecanoic acid (PFTeA)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	<19	<19	<19	<19	<19	<19	<19	<19	<19	<19
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
Hexafluoropropylene oxide dimer acid (HFPO-DA)	<3.8	<3.8	<3.8	<3.9	<3.8	<3.8	<3.7	<3.7	<3.7	<3.7
Perfluorooctanesulfonic acid (PFOS)	<1.9	<1.9	1.3 J	0.81 J	**97**	49	39	38	**180**	<1.9
Perfluorooctanoic acid (PFOA)	<1.9	<1.9	1.4 J	<1.9	1.5 J	1.2 J	1.9	1.8 J	8.4	<1.9
LHA Combined (PFOS + PFOA)	n/a	n/a	2.7 J	0.81 J‡	**99 J**	50 J	41	40 J	**188**	n/a
LHA Combined (PFOS + PFOA) 2xDL	2.6 µ	2.7 µ	2.7	2.5 µ	**99**	50	41	40	**188**	2.6 µ

Table 2 - Summary of Gustavus Airport Site Characterization Groundwater Analytical Results

Analytes	TWP-02	TWP-03	TWP-04	TWP-05	TWP-06	TWP-07		TWP-08
						TWP-07	TWP-107 (DUP)	
	10/11/19 16:00	10/11/19 17:09	10/13/19 17:02	10/13/19 17:55	10/14/19 16:24	10/14/19 17:15	10/14/19 17:05	10/13/19 14:47
Perfluorohexansulfonic acid (PFHxS)	1.4 J	0.91 J	<2.0 B*	2.6 B	<1.9 B*	11 B	11 B	15 B
Perfluorohexanoic acid (PFHxA)	<1.9	<1.9	<2.0	0.62 J	<1.9	<1.9	<1.9	5.8
Perfluoroheptanoic acid (PFHpA)	<1.9	<1.9	<2.0	0.36 J	0.30 J	<1.9	<1.9	2.3
Perfluorononanoic acid (PFNA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
Perfluorobutanesulfonic acid (PFBS)	<1.9	0.50 J	<2.0	0.23 J	<1.9	0.71 J	0.73 J	1.1 J
Perfluorodecanoic acid (PFDA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
Perfluoroundecanoic acid (PFUnA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
Perfluorododecanoic acid (PFDoA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
Perfluorotridecanoic acid (PFTrDA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
Perfluorotetradecanoic acid (PFTeA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	<19	<19	<20	<19	<19	<19	<19	<20
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	<19	<19	<20	<19	<19	<19	<19	<20
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	<2.0
Hexafluoropropylene oxide dimer acid (HFPO-DA)	<3.8	<3.8	<3.9	<3.7	<3.8	<3.8	<3.8	<3.9
Perfluorooctanesulfonic acid (PFOS)	2.0	<1.9	<2.0	1.4 J	0.57 J	1.5 J	1.5 J	22
Perfluorooctanoic acid (PFOA)	<1.9	<1.9	<2.0	<1.9	<1.9	<1.9	<1.9	1.3 J
LHA Combined (PFOS + PFOA)	2.0 ‡	n/a	n/a	1.4 J‡	0.57 J‡	1.5 J‡	1.5 J‡	23 J
LHA Combined (PFOS + PFOA) 2xDL	3.6 µ	2.6 µ	2.7 µ	3.0 µ	2.2 µ	3.1 µ	3.1 µ	23

Table 3 - Summary of Gustavus Airport Site Characterization Surface Water Analytical Results

Analyte	LHA	Units	SW-19-01 10/9/19 14:10	SW-19-02 10/9/19 15:01	SW-19-03 10/9/19 15:40	SW-19-04 10/9/19 16:42	SW-19-05 10/10/19 9:31	SW-19-06 10/10/19 9:52	SW-19-07 10/10/19 10:37	SW-19-08 10/10/19 11:50
Perfluorohexansulfonic acid (PFHxS)	—	ppt	<1.9 B*	8.2	54	15	0.46 J	64	61	25
Perfluorohexanoic acid (PFHxA)	—	ppt	<1.9	4.1	16	8.5	<1.9	27	4.8	11
Perfluoroheptanoic acid (PFHpA)	—	ppt	0.40 J	1.4 J	3.8	3.7	0.61 J	7.1	1.6 J	5.6
Perfluorononanoic acid (PFNA)	—	ppt	<1.9	0.30 J*	0.37 J	<1.9	<1.9	1.1 J	<2.0	<1.9
Perfluorobutanesulfonic acid (PFBS)	—	ppt	<1.9	0.86 J	5.8	0.90 J	<1.9	7.8	1.9 J	1.2 J
Perfluorodecanoic acid (PFDA)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
Perfluoroundecanoic acid (PFUnA)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
Perfluorododecanoic acid (PFDoA)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
Perfluorotridecanoic acid (PFTrDA)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
Perfluorotetradecanoic acid (PFTeA)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	ppt	<19	<18	<18	<19	<19	<19	<20	<19
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	ppt	<19	<18	<18	<19	<19	<19	<20	<19
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	ppt	<1.9	<1.8	<1.8	<1.9	<1.9	<1.9	<2.0	<1.9
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	ppt	<3.9	<3.6	<3.7	<3.8	<3.8	<3.8	<4.0	<3.8
Perfluorooctanesulfonic acid (PFOS)	70	ppt	<1.9	41	**220**	49	0.53 J*	**370 J***	**120**	61
Perfluorooctanoic acid (PFOA)	70	ppt	<1.9	1.5 J	5.1	1.5 J	<1.9	8.7	4.2	2.3
LHA Combined (PFOS + PFOA)	70	ppt	n/a	43 J	**225**	51 J	0.53 J*‡	**379 J***	**124**	63
LHA Combined (PFOS + PFOA) 2xDL	70	ppt	2.7 µ	43	**225**	51	2.1 J*µ	**379 J***	**124**	63

ppt parts per trillion, equivalent to nanograms per liter
EPA Environmental Protection Agency
LHA Lifetime Health Advisory
† EPA LHA level is 70 ppt for PFOS and PFOA combined.
µ The summed concentration was calculated using a value two times the laboratory detection limit for non-detect analytes, per ADEC's March 2019 Technical Memorandum.
< Analyte not detected; listed as less than the reporting limit (RL) unless otherwise flagged due to quality-control (QC) failures.
Bold Concentration exceeds LHA level.
DUP Field-duplicate sample
J Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.
JH* Result consided estimated due to a QC failure, and is biased high. Flag applied by Shannon & Wilson, Inc.
J* Result considered estimated due to a QC failure. Flag applied by Shannon & Wilson, Inc.
B* Result is included in the same preparatory batch as a blank detection for the associated analyte. Flag applied by Shannon & Wilson, Inc.
‡ Minimum concentration, the LHA Combined oconcentration includes one or more result that is not detected greater than the MDL.

Table 3 - Summary of Gustavus Airport Site Characterization Surface Water Analytical Results

Analyte	SW-19-09	SW-19-10	
		SW-19-10	SW-19-11 (DUP)
	10/10/19 12:50	10/14/19 13:43	10/14/19 13:30
Perfluorohexansulfonic acid (PFHxS)	2.5	38 B	38 B
Perfluorohexanoic acid (PFHxA)	<1.9	19	19
Perfluoroheptanoic acid (PFHpA)	0.28 J	7.3	7.5
Perfluorononanoic acid (PFNA)	<1.9	1.3 J	1.4 J
Perfluorobutanesulfonic acid (PFBS)	<1.9	3.2	3.2
Perfluorodecanoic acid (PFDA)	<1.9	0.36 J	0.47 J
Perfluoroundecanoic acid (PFUnA)	<1.9	<2.0	<1.9
Perfluorododecanoic acid (PFDoA)	<1.9	<2.0	<1.9
Perfluorotridecanoic acid (PFTrDA)	<1.9	<2.0	<1.9
Perfluorotetradecanoic acid (PFTeA)	<1.9	<2.0	<1.9
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	<19	<20	<19
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	<19	<20	<19
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	<1.9	<2.0	<1.9
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	<1.9	<2.0	<1.9
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	<1.9	<2.0	<1.9
Hexafluoropropylene oxide dimer acid (HFPO-DA)	<3.9	<4.0	<3.8
Perfluorooctanesulfonic acid (PFOS)	<1.9	**170**	**170**
Perfluorooctanoic acid (PFOA)	<1.9	6.0	6.0
LHA Combined (PFOS + PFOA)	n/a	**176**	**176**
LHA Combined (PFOS + PFOA) 2xDL	2.7 µ	**176**	**176**

Table 4 - Summary of Gustavus Site Characterization Soil Boring Analytical Results

Analyte	Cleanup Level	Units	SB-11-1	SB-11-3.5	SB-11-12	SB-11-19	SB-12-0		SB-12-1.5	SB-12-7
							SB-12-0	SB-112-0 (DUP)		
			10/12/19 8:25	10/12/19 8:27	10/12/19 8:30	10/12/19 8:32	10/12/19 10:10	10/12/19 10:00	10/12/19 10:12	10/12/19 10:15
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	0.16 J	<0.30	0.29	0.049 J	2.3 J*	0.80 J*	0.95	0.063 J
Perfluorohexanoic acid (PFHxA)	—	µg/kg	0.26 J	<0.30	0.049 J	<0.26	4.4 J*	0.75 J*	0.28	<0.24
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	0.24 J	<0.30	<0.23	<0.26	0.60 J*	0.15 J*	0.041 J	<0.24
Perfluorononanoic acid (PFNA)	—	µg/kg	0.12 J	<0.30	<0.23	<0.26	0.30 J*	0.094 J*	<0.23	<0.24
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	0.13 J*	0.055 J*	0.039 J	<0.24
Perfluorodecanoic acid (PFDA)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	0.95 J*	0.22 J*	<0.23	<0.24
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	0.056 J	<0.30	<0.23	<0.26	0.60	0.63 J*	<0.23	<0.24
Perfluorododecanoic acid (PFDoA)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	0.22 J	0.34	<0.23	<0.24
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	<0.24	<0.24	<0.23	<0.24
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	0.15 J	0.094 J	<0.23	<0.24
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<2.8	<3.0	<2.3	<2.6	<2.4	<2.4	<2.3	<2.4
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<2.8	<3.0	<2.3	<2.6	<2.4	<2.4	<2.3	<2.4
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	<0.24	<0.24	<0.23	<0.24
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	<0.24	<0.24	<0.23	<0.24
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<0.28	<0.30	<0.23	<0.26	<0.24	<0.24	<0.23	<0.24
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<0.35	<0.37	<0.29	<0.32	<0.30	<0.30	<0.29	<0.30
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	**3.6**	<0.74	1.3	0.43 J	**14**	**8.6**	**5.3**	0.30 J
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	<0.28	<0.30	<0.23	<0.26	**1.9 J***	0.38 J*	0.14 J	<0.24

µg/kg micrograms per kilogram
< Analyte not detected; listed as less than the reporting limit (RL) unless otherwise flagged due to quality-control (QC) failures.
J Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.
J* Result considered estimated due to a QC failure. Flag applied by Shannon & Wilson, Inc.
Bold Detected concentration exceeds regulatory limit.
— Cleanup level not established
SB-XX-Y XX is boring number; Y is shallowest depth of analytical sample

Table 4 - Summary of Gustavus Site Characterization Soil Boring Analytical Results

Analyte	Cleanup Level	Units	SB-12-13	SB-12-17
			10/12/19 10:20	10/12/19 10:22
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	<0.22	<0.23
Perfluorohexanoic acid (PFHxA)	—	µg/kg	<0.22	<0.23
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	<0.22	<0.23
Perfluorononanoic acid (PFNA)	—	µg/kg	<0.22	<0.23
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	<0.22	<0.23
Perfluorodecanoic acid (PFDA)	—	µg/kg	<0.22	<0.23
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	<0.22	<0.23
Perfluorododecanoic acid (PFDoA)	—	µg/kg	<0.22	<0.23
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	<0.22	<0.23
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	<0.22	<0.23
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<2.2	<2.3
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<2.2	<2.3
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<0.22	<0.23
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<0.22	<0.23
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<0.22	<0.23
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<0.27	<0.29
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	<0.55	<0.58
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	<0.22	<0.23

Table 5 - Summary of Gustavus Site Characterization Surface Soil and Sediment Analytical Results

Analyte	Cleanup Level	Units	SS-19-01 10/14/19 8:09	SS-19-02 10/14/19 8:28	SS-19-03 10/14/19 8:40	SS-19-04 10/14/19 8:51	SS-19-05 10/14/19 8:54	SS-19-06 10/14/19 9:01	SS-19-07 10/14/19 9:13	SS-19-08 10/14/19 9:43
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	<0.21	0.25	0.063 J	0.038 J	2.2	0.32	0.043 J	0.54
Perfluorohexanoic acid (PFHxA)	—	µg/kg	<0.21	0.052 J	0.11 J	0.068 J	0.74	0.18 J	0.059 J	0.15 J
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	<0.21	<0.21	0.18 J	0.088 J	0.29	0.17 J	0.097 J	0.13 J
Perfluorononanoic acid (PFNA)	—	µg/kg	<0.21	<0.21	0.16 J	0.070 J	0.23	0.16 J	0.075 J	0.12 J
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	<0.21	<0.21	<0.20	<0.21	0.070 J	<0.20	<0.21	<0.21
Perfluorodecanoic acid (PFDA)	—	µg/kg	<0.21	<0.21	0.10 J	0.050 J	0.99	1.2	0.047 J	0.20 J
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	<0.21	<0.21	0.068 J	0.054 J	0.61	0.13 J	0.072 J	<0.21
Perfluorododecanoic acid (PFDoA)	—	µg/kg	<0.21	<0.21	<0.20	<0.21	0.34	<0.20	<0.21	0.075 J
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	<0.21	<0.21	<0.20	<0.21	0.062 J	<0.20	<0.21	<0.21
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	<0.21	<0.21	<0.20	<0.21	0.067 J	<0.20	<0.21	<0.21
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<2.1	<2.1	<2.0	<2.1	<2.1	<2.0	<2.1	<2.1
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<2.1	<2.1	<2.0	<2.1	<2.1	<2.0	<2.1	<2.1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<0.21	<0.21	<0.20	<0.21	<0.21	<0.20	<0.21	<0.21
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<0.21	<0.21	<0.20	<0.21	<0.21	<0.20	<0.21	<0.21
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<0.21	<0.21	<0.20	<0.21	<0.21	<0.20	<0.21	<0.21
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<0.26	<0.27	<0.25	<0.26	<0.26	<0.25	<0.26	<0.26
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	<0.52	**3.8**	0.53	<0.52	**29 J***	**3.3**	0.26 J	**8.9**
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	<0.21	<0.21	0.17 J	<0.21	0.71	0.20	<0.21	0.28

µg/kg micrograms per kilogram
< Analyte not detected; listed as less than the reporting limit (RL) unless otherwise flagged due to quality-control (QC) failures.
J Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.
JH* Result consided estimated due to a QC failure, and is biased high. Flag applied by Shannon & Wilson, Inc.
J* Result considered estimated due to a QC failure. Flag applied by Shannon & Wilson, Inc.
B* Result is included in the same preparatory batch as a blank detection for the associated analyte. Flag applied by Shannon & Wilson, Inc.
Bold Detected concentration exceeds regulatory limit.
DUP field-duplicate sample
— Cleanup level not established

Table 5 - Summary of Gustavus Site Characterization Surface Soil and Sediment Analytical Results

Analyte	Cleanup Level	Units	SS-19-09	SS-19-10	SS-19-11	SS-19-12	SS-19-13		SS-19-15	SS-19-16
							SS-19-13	SS-19-14 (DUP)		
			10/14/19 9:48	10/14/19 9:51	10/14/19 9:59	10/14/19 10:07	10/14/19 10:13	10/14/19 10:00	10/14/19 10:23	10/14/19 10:29
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	0.53	0.36	0.31	0.79	0.94	1.5	0.38	0.58
Perfluorohexanoic acid (PFHxA)	—	µg/kg	0.96	0.14 J	0.079 J	0.23 J	0.32	0.43	0.13 J	0.094 J
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	1.8	0.099 J	0.091 J	0.11 J	0.085 J	0.11 J	0.087 J	0.053 J
Perfluorononanoic acid (PFNA)	—	µg/kg	0.93	0.10 J	0.050 J	0.079 J	0.079 J	0.089 J	0.047 J	<0.25
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	<0.25	<0.20	<0.22	<0.25	0.054 J	0.049 J	<0.25	0.037 J
Perfluorodecanoic acid (PFDA)	—	µg/kg	3.1	0.30	0.077 J	0.099 J	0.076 J	0.089 J	<0.25	0.034 J
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	3.9	0.29	0.089 J	0.14 J	<0.25	<0.25	0.055 J	<0.25
Perfluorododecanoic acid (PFDoA)	—	µg/kg	1.3	0.11 J	<0.22	<0.25	<0.25	<0.25	<0.25	<0.25
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	<0.25	<0.20	<0.22	<0.25	<0.25	<0.25	<0.25	<0.25
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	0.13 J	<0.20	<0.22	0.082 J*	<0.25	<0.25	<0.25	<0.25
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<2.5	<2.0	<2.2	<2.5	<2.5	<2.5	<2.5	<2.5
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<2.5	<2.0	<2.2	<2.5	<2.5	<2.5	<2.5	<2.5
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<0.25	<0.20	<0.22	<0.25	<0.25	<0.25	<0.25	<0.25
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<0.25	<0.20	<0.22	<0.25	<0.25	<0.25	<0.25	<0.25
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<0.25	<0.20	<0.22	<0.25	<0.25	<0.25	<0.25	<0.25
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<0.31	<0.25	<0.27	<0.32	<0.31	<0.31	<0.31	<0.31
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	2.0	1.5	1.8	**5.0**	**6.8**	**9.2**	0.76	2.5
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	1.0	0.35	0.12 J	0.29	0.22 J	0.27	0.13 J	0.17 J

Table 5 - Summary of Gustavus Site Characterization Surface Soil and Sediment Analytical Results

Analyte	Cleanup Level	Units	SS-19-17		SS-19-19	SS-19-20	SS-19-21	SS-19-22		SS-19-24
			SS-19-17	SS-19-18 (DUP)				SS-19-22	SS-19-23 (DUP)	
			10/14/19 10:34	10/14/19 10:20	10/14/19 10:46	10/14/19 12:16	10/14/19 12:28	10/14/19 12:35	10/14/19 12:00	10/14/19 12:49
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	0.86	0.78	2.4	<0.21	0.032 J*	0.033 J	<0.20	<0.23
Perfluorohexanoic acid (PFHxA)	—	µg/kg	0.34	0.38	0.27	<0.21	0.057 J	0.059 J*	0.051 J	<0.23
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	0.074 J	0.069 J	0.072 J	<0.21	0.030 J	0.034 J	<0.20	<0.23
Perfluorononanoic acid (PFNA)	—	µg/kg	<0.26	<0.24	0.044 J	<0.21	<0.20	<0.20	<0.20	<0.23
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	<0.26	<0.24	0.055 J*	<0.21	<0.20	0.033 J	0.035 J*	<0.23
Perfluorodecanoic acid (PFDA)	—	µg/kg	0.062 J	0.073 J	0.073 J	<0.21	<0.20	<0.20	<0.20	<0.23
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	0.060 J	0.061 J	0.091 J	<0.21	<0.20	<0.20	<0.20	<0.23
Perfluorododecanoic acid (PFDoA)	—	µg/kg	<0.26	<0.24	<0.24	<0.21	<0.20	<0.20	<0.20	<0.23
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	<0.26	<0.24	<0.24	<0.21	<0.20	<0.20	<0.20	<0.23
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	<0.26	<0.24	<0.24	<0.21	<0.20	<0.20	<0.20	<0.23
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<2.6	<2.4	<2.4	<2.1	<2.0	<2.0	<2.0	<2.3
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<2.6	<2.4	<2.4	<2.1	<2.0	<2.0	<2.0	<2.3
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<0.26	<0.24	<0.24	<0.21	<0.20	<0.20	<0.20	<0.23
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<0.26	<0.24	<0.24	<0.21	<0.20	<0.20	<0.20	<0.23
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<0.26	<0.24	<0.24	<0.21	<0.20	<0.20	<0.20	<0.23
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<0.32	<0.30	<0.30	<0.26	<0.25	<0.26	<0.25	<0.29
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	**3.8**	**3.3**	**3.2**	<0.52	<0.84 B*	<0.56 B*	<0.50 B*	<0.57 B*
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	0.34	0.30	0.26	<0.21	<0.20	<0.20	<0.20	<0.23

Table 5 - Summary of Gustavus Site Characterization Surface Soil and Sediment Analytical Results

Analyte	Cleanup Level	Units	SS-19-25 10/14/19 12:59	SS-19-26 10/14/19 13:06	SS-19-27 10/14/19 13:18	SS-19-28 10/14/19 13:26	SS-19-29 10/14/19 13:38	SS-19-30 10/14/19 14:50	SS-19-31 10/14/19 15:12	SS-19-32 10/14/19 14:47
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	<0.20	0.046 J	0.034 J	<0.20	0.045 J	17	12	17
Perfluorohexanoic acid (PFHxA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	23	6.5	3.3
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	1.4	1.6	0.61
Perfluorononanoic acid (PFNA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	0.48	0.72	<0.24
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	0.027 J	<0.21	<0.20	<0.20	<0.21	2.7	1.7	2.8
Perfluorodecanoic acid (PFDA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	0.90	1.6	0.10 J
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	<0.20	<0.21	0.036 J	<0.20	<0.21	1.7	1.6	0.19 J
Perfluorododecanoic acid (PFDoA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	1.5	2.0	0.15 J
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	0.86	1.1	0.098 J
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	3.0	1.9	0.16 J
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<2.0	<2.1	<2.0	<2.0	<2.1	<3.4	1.3 J	<2.4
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<2.0	<2.1	<2.0	<2.0	<2.1	<3.4	<3.1	<2.4
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	<0.34	<0.31	<0.24
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	<0.34	<0.31	<0.24
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	<0.34	<0.31	<0.24
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<0.25	<0.26	<0.25	<0.25	<0.26	<0.43	<0.39	<0.31
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	<0.51 B*	<0.87 B*	<0.50 B*	<0.50 B*	<0.75 B*	**130 JH***	**160 JH***	**100 JH***
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	<0.20	<0.21	<0.20	<0.20	<0.21	**2.2**	**4.5**	1.4

Table 5 - Summary of Gustavus Site Characterization Surface Soil and Sediment Analytical Results

Analyte	Cleanup Level	Units	Culvert 1 10/14/19 14:40	Culvert 2 10/14/19 14:55	Culvert 3 10/14/19 15:10	SW-19-01 10/9/19 14:17	SW-19-02 10/9/19 15:03	SW-19-03 10/9/19 15:46	SW-19-04 10/9/19 16:50	SW-19-06 10/10/19 9:58
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	53	5.7	5.8	<0.28	0.049 JH*	0.31 JH*	0.13 JH*	0.13 J
Perfluorohexanoic acid (PFHxA)	—	µg/kg	23	3.2	1.5	<0.28	<0.25	0.18 J	<0.35	0.089 J
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	1.8	<0.30	0.41	<0.28	<0.25	0.15 J	<0.35	0.041 J
Perfluorononanoic acid (PFNA)	—	µg/kg	<1.5	<0.30	0.24 J	<0.28	<0.25	0.11 J	<0.35	<0.27
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	12	<0.30	0.60	<0.28	<0.25	0.10 J	<0.35	<0.27
Perfluorodecanoic acid (PFDA)	—	µg/kg	0.43 J	<0.30	0.43	<0.28	<0.25	0.14 J	<0.35	0.058 J
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	<1.5	<0.30	0.59	<0.28	<0.25	0.15 J	<0.35	<0.27
Perfluorododecanoic acid (PFDoA)	—	µg/kg	0.91 J	0.54	0.39	<0.28	<0.25	0.14 J	<0.35	<0.27
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	0.57 J	0.43 J*	0.33	<0.28	<0.25	0.13 J	<0.35	<0.27
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	1.6	0.79	0.49	<0.28	<0.25	0.16 J	<0.35	<0.27
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<15	<3.0	<3.1	<2.8	<2.5	<2.6	<3.5	<2.7
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<15	<3.0	<3.1	<2.8	<2.5	<2.6	<3.5	<2.7
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<1.5	<0.30	<0.31	<0.28	<0.25	0.11 J	<0.35	<0.27
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<1.5	<0.30	<0.31	<0.28	<0.25	0.081 J	<0.35	<0.27
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<1.5	<0.30	<0.31	<0.28	<0.25	0.11 J	<0.35	<0.27
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<1.9	<0.37	<0.39	<0.35	<0.31	<0.32 B*	<0.44	<0.34
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	**520 JH***	**69 JH***	**63 JH***	0.30 J	<0.63	**3.4**	0.50 J	**5.6**
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	**3.9**	0.87	1.5	<0.28	<0.25	0.14 J	<0.35	<0.27

Table 5 - Summary of Gustavus Site Characterization Surface Soil and Sediment Analytical Results

Analyte	Cleanup Level	Units	SW-19-07	SW-19-08	SW-19-09	SW-19-10	
						SW-19-10	SW-19-11 (DUP)
			10/10/19 10:40	10/10/19 11:54	10/10/19 12:54	10/14/19 13:50	10/14/19 13:40
Perfluorohexansulfonic acid (PFHxS)	—	µg/kg	0.17 J	2.9	0.18 J	0.15 J	0.12 J
Perfluorohexanoic acid (PFHxA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	0.059 J
Perfluoroheptanoic acid (PFHpA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
Perfluorononanoic acid (PFNA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
Perfluorobutanesulfonic acid (PFBS)	—	µg/kg	<0.28	<1.1	<0.62	0.036 J*	<0.23
Perfluorodecanoic acid (PFDA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
Perfluoroundecanoic acid (PFUnA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
Perfluorododecanoic acid (PFDoA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
Perfluorotridecanoic acid (PFTrDA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
Perfluorotetradecanoic acid (PFTeA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	µg/kg	<2.8	<11	<6.2	<2.6	<2.3
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	µg/kg	<2.8	<11	<6.2	<2.6	<2.3
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	µg/kg	<0.36	<1.3	<0.77	<0.33	<0.29
Perfluorooctanesulfonic acid (PFOS)	3.0	µg/kg	1.7	**13**	1.6	<1.6 B*	<1.5 B*
Perfluorooctanoic acid (PFOA)	1.7	µg/kg	<0.28	<1.1	<0.62	<0.26	<0.23

Table 6 - Summary of Gustavus Airport Site Characterization GAC Confrimation Sample Analytical Results

Analyte	LHA	Units	GAC #1 10/15/19 7:30	GAC #2 10/15/19 10:05
Perfluorohexansulfonic acid (PFHxS)	—	ppt	<1.9 B*	<1.9 B*
Perfluorohexanoic acid (PFHxA)	—	ppt	<1.9	<1.9
Perfluoroheptanoic acid (PFHpA)	—	ppt	<1.9	<1.9
Perfluorononanoic acid (PFNA)	—	ppt	<1.9	<1.9
Perfluorobutanesulfonic acid (PFBS)	—	ppt	<1.9	<1.9
Perfluorodecanoic acid (PFDA)	—	ppt	<1.9	<1.9
Perfluoroundecanoic acid (PFUnA)	—	ppt	<1.9	<1.9
Perfluorododecanoic acid (PFDoA)	—	ppt	<1.9	<1.9
Perfluorotridecanoic acid (PFTrDA)	—	ppt	<1.9	<1.9
Perfluorotetradecanoic acid (PFTeA)	—	ppt	<1.9	0.50 J
N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	—	ppt	<19	<19
N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	—	ppt	<19	<19
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	—	ppt	<1.9	<1.9
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	—	ppt	<1.9	<1.9
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	—	ppt	<1.9	<1.9
Hexafluoropropylene oxide dimer acid (HFPO-DA)	—	ppt	<3.9	<3.8
Perfluorooctanesulfonic acid (PFOS)	70	ppt	<1.9	0.53 J
Perfluorooctanoic acid (PFOA)	70	ppt	<1.9	<1.9
LHA Combined (PFOS + PFOA)	70	ppt	n/a	0.53 J‡
LHA Combined (PFOS + PFOA) 2xDL	70	ppt	2.7 µ	2.2 µ

ppt parts per trillion, equivalent to nanograms per liter
LHA Lifetime Health Advisory
† EPA LHA level is 70 ppt for PFOS and PFOA combined.
µ The summed concentration was calculated using a value two times the laboratory detection limit for non-detect analytes, per ADEC's March 2019 Technical Memorandum.
< Analyte not detected; listed as less than the reporting limit (RL) unless otherwise flagged due to quality-control (QC) failures.
J Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.
B* Result is included in the same preparatory batch as a blank detection for the associated analyte. Flag applied by Shannon & Wilson, Inc.
‡ Minimum concentration, the LHA Combined oconcentration includes one or more result that is not detected greater than the MDL.

Source: *Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community*

0 0.5 1

Miles

LEGEND

Airport Property Boundary

Potential AFFF Use

N

Gustavus Airport PFAS
Site Characterization
Gustavus, Alaska

SITE MAP

April 2020 102599-008

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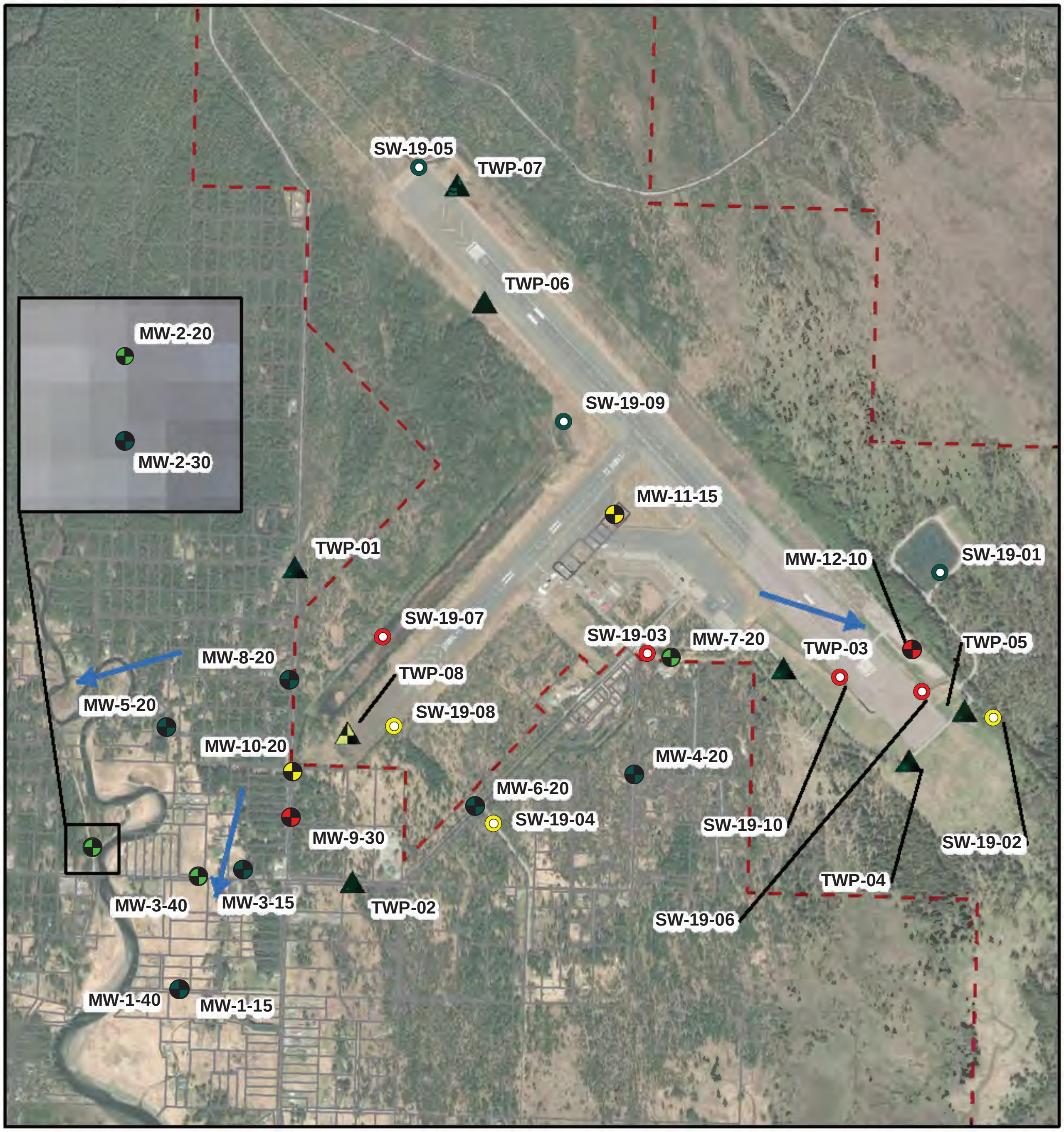
Figure 1



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

Analytical Results

- ≤2.0 ppt
- 2.1 to 17.4 ppt
- 17.5 to 34 ppt
- 35 to 69 ppt
- ≥70 ppt

- Monitoring Well
- Temporary Well Point
- Surface Water Sample
- Airport Property Boundary
- Property Lines
- EPA Calculator Hydraulic Gradient

0 2,000 4,000
Feet

N

Gustavus Airport PFAS
Site Characterization
Gustavus, Alaska

SITE CHARACTERIZATION WATER RESULTS

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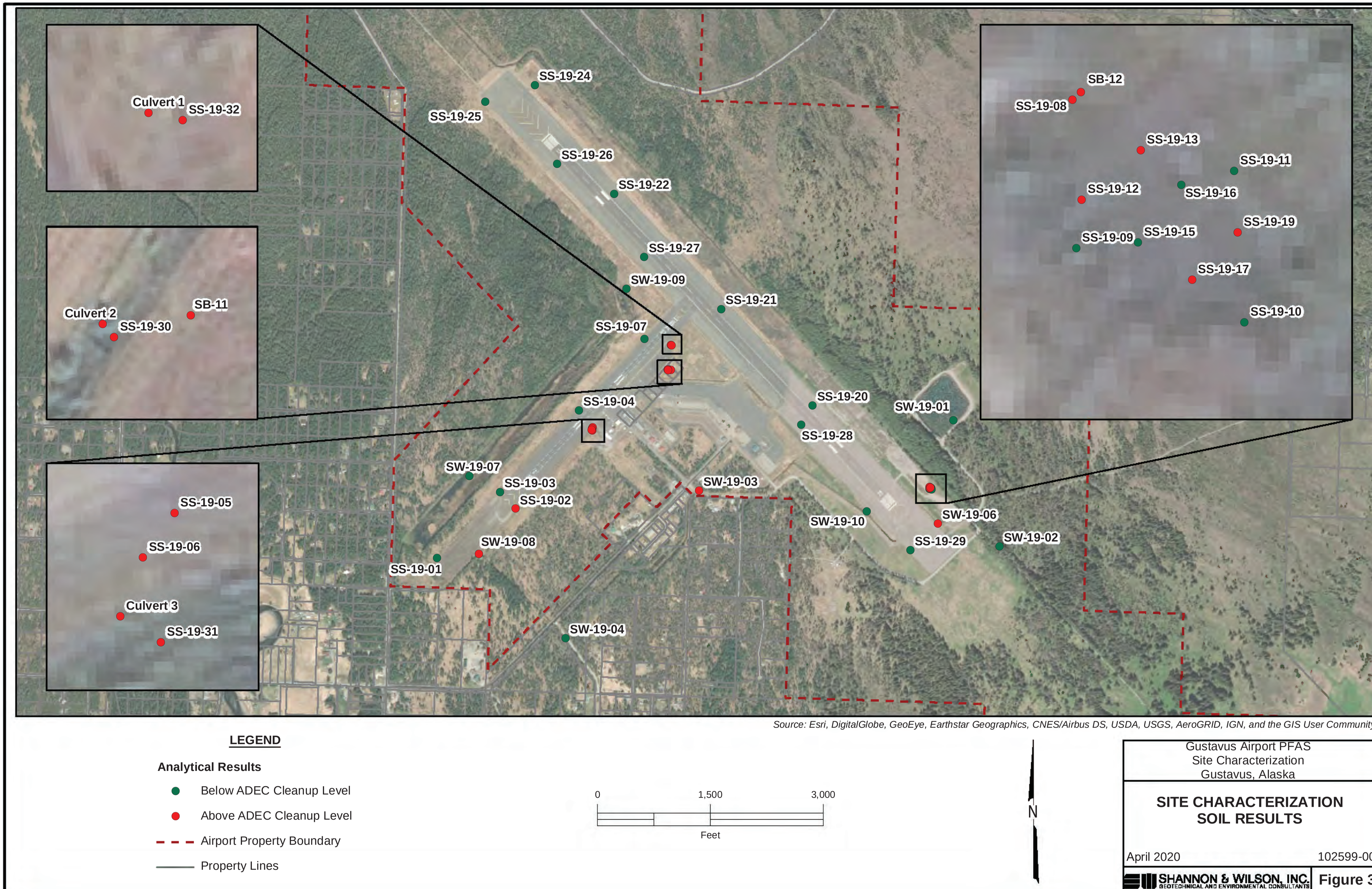
Figure 2



Gustavus Airport PFAS
Site Characterization
Gustavus, Alaska

SITE CHARACTERIZATION SOIL RESULTS

April 2020 | 102599-008

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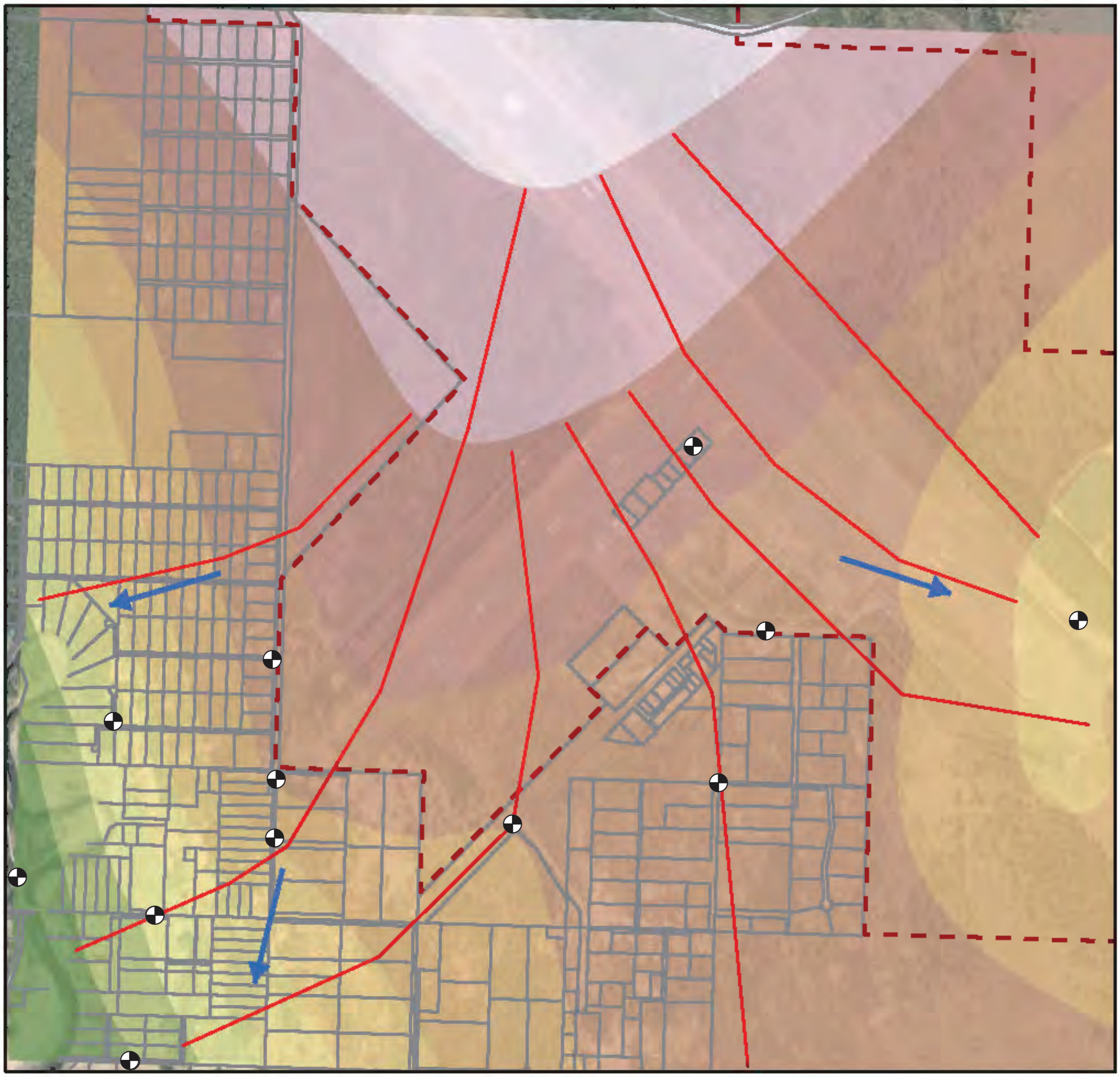
Figure 3



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

Groundwater Elevations

- 10 - 12 feet
- 12 - 14 feet
- 14 - 16 feet
- 16 - 18 feet
- 16 - 20 feet
- 20 - 22 feet
- 22 - 24 feet
- 24 - 26 feet
- 26 - 28 feet
- 28 - 30 feet

- Monitoring Well
- Airport Property Boundary
- Property Lines
- Interpolated Hydraulic Gradient
- EPA Calculator Hydraulic Gradient

0 2,000
Feet

N

Gustavus Airport
Gustavus, Alaska

GROUNDWATER GRADIENT AND WELL MONITORING NETWORK

April 2020 102599-008

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Figure 4

APPENDIX A: BORING LOGS

Appendix A
Boring Logs

CONTENTS