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DRAFT FINAL
Site Inspection
Quality Assurance Project Plan Addendum
Biak Training Center Brett Hall
Powell Butte, Oregon

Perfluorooctanesulfonic Acid (PFOS) and
Perfluorooctanoic Acid (PFOA) Impacted Sites
ARNG Installations, Nationwide

January 2022

Prepared for:

Army National Guard Bureau
111 S. George Mason Drive
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Acronyms and Abbreviations

%	percent
˚C	degrees Celsius
˚F	degrees Fahrenheit
AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film forming foam
amsl	above mean sea level
AOI	Area of Interest
APP	Accident Prevention Plan
ARNG	Army National Guard
ASTM	American Society for Testing and Materials
bgs	below ground surface
BLM	Bureau of Land Management
Census	United States Census Bureau
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CoC	chain of custody
COUTES	Central Oregon Unit Training Equipment Site
CPR	cardiopulmonary resuscitation
CSM	conceptual site model
DA	Department of the Army
DEQ	Department of Environmental Quality
DL	detection limit
DO	dissolved oxygen
DoD	Department of Defense
DOGAMI	Department of Geology and Mineral Industries
DQI	data quality indicators
DQO	data quality objectives
DUA	Data Usability Assessment
EDR™	Environmental Data Resources, Inc.™
ELAP	Environmental Laboratory Accreditation Program
ERB	equipment rinsate blank
FBI	Federal Bureau of Investigation
FRB	field reagent blank
FTA	fire training area
GCAL	Gulf Coast Analytical Laboratories, LLC
GPS	global positioning system
HAZWOPER	hazardous waste operations and emergency response
HDPE	high-density polyethylene
HUC	hydrologic unit code
IDQTF	Intergovernmental Data Quality Task Force

66	IDW	investigation-derived waste
67	ISC	instrument sensitivity check
68	LC/MS/MS	liquid chromatography tandem mass spectrometry
69	LOD	limit of detection
70	LOQ	limit of quantitation
71	MAES	Multiple Award Environmental Services
72	MOUT	Military Operations on Urban Terrain
73	MPC	measurement performance criteria
74	MS/MSD	matrix spike/ matrix spike duplicate
75	NELAP	National Environmental Laboratory Accreditation Program
76	ng/L	nanograms per liter
77	NOAA	National Oceanic and Atmospheric Administration
78	OAR	Oregon Administrative Rules
79	OHA	Oregon Health Authority
80	OMD	Oregon Military Department
81	ORANG	Oregon Army National Guard
82	ORP	oxidation-reduction potential
83	OSD	Office of the Secretary of Defense
84	OSHA	Occupational Safety and Health Administration
85	OWRD	Oregon Water Resources Department
86	PA	Preliminary Assessment
87	PFAS	per- and polyfluoroalkyl substances
88	PFBS	perfluorobutanesulfonic acid
89	PFOA	perfluorooctanoic acid
90	PFOS	perfluorooctanesulfonic acid
91	PID	photoionization detector
92	PPE	personal protective equipment
93	PQAPP	Programmatic UFP-QAPP
94	PVC	poly-vinyl chloride
95	QA	quality assurance
96	QAPP	Quality Assurance Project Plan
97	QC	quality control
98	QL	quantitation limit
99	QSM	Quality Systems Manual
100	RI	Remedial Investigation
101	SDG	sample delivery group
102	SI	Site Inspection
103	SL	screening level
104	SOP	standard operating procedure
105	SSHP	Site Safety and Health Plan
106	TCRA	Time Critical Removal Action
107	TO	Task Order

TOC	total organic carbon
TPP	Technical Project Planning
TSA	technical system audit
UCL	upper confidence limit
UCMR3	Unregulated Contaminant Monitoring Rule 3
UFP	Uniform Federal Policy
US	United States
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USEPA	United States Environmental Protection Agency
USFS	United Stated Forest Service
USGS	United States Geological Survey

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1. Introduction

1.1 Project Authorization

This is the Installation-Specific Addendum to the Army National Guard (ARNG) per- and polyfluoroalkyl substances (PFAS) Site Inspection (SI) Programmatic Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP). This SI UFP-QAPP Addendum addresses specific SI activities to be completed at Biak Training Center Brett Hall, Powell Butte, Oregon.

The ARNG G9 is the lead agency in performing *Preliminary Assessments (Pas) and Site Inspections (SIs) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) Impacted Sites at ARNG Facilities Nationwide*. This work is supported by the United States (US) Army Corps of Engineers (USACE) Baltimore District and their contractor AECOM Technical Services, Inc. (AECOM) under Contract Number W912DR-12-D-0014, Task Order (TO) W912DR17F0192, issued 11 August 2017. Programmatically, the ARNG is assessing the potential environmental impacts primarily from aqueous film forming foam (AFFF) and similar chemical releases suspected at their properties related to processes that used PFAS (e.g., fire training, firefighting, and metal plating).

The SI project elements will be performed by AECOM in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; US Environmental Protection Agency [USEPA], 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations [CFR] Part 300; USEPA, 1994), and in compliance with US Department of the Army (DA) requirements and guidance for field investigations, including specific requirements for sampling for PFOA, PFOS, and perfluorobutanesulfonic acid (PFBS), and the group of related compounds known in the industry as PFAS. The term PFAS will be used throughout this plan to encompass all PFAS being evaluated, including PFOA, PFOS, and PFBS, which are the key components of the suspected releases being evaluated, and the other 15 related compounds listed in the TO. This UFP-QAPP Addendum focuses on the SI phase of work specific to Biak Training Center Brett Hall (also referred to as the “facility”) in Powell Butte, Oregon.

1.2 SI Purpose

The objective of this SI effort is to identify whether there has been a release to the environment from the Areas of Interest (AOIs) identified in the PA and determine the presence or absence of PFOA, PFOS, and PFBS at or above screening levels (SLs) at the facility.

As stated in the *Federal Facilities Remedial Site Inspection Summary Guide* (USEPA, 2005), an SI has five goals:

1) Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.
2) Determine the potential need for a removal action (i.e., Time Critical Removal Action [TCRA]; applies to drinking water only).
3) Collect or develop data to evaluate the release.
4) Collect additional data to develop the conceptual site model (CSM) in preparation for an effective Remedial Investigation (RI).

5) Collect data to determine whether the release is more than likely the result of activities associated with the Department of Defense (DoD).

In addition to the USEPA identified goals of an SI, the ARNG SI effort will also aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).

1.3 QAPP Addendum Organization

Elements of every ARNG PFAS SI are addressed in the SI Programmatic UFP-QAPP (PQAPP) (AECOM, 2018). The PQAPP is comprehensive and is consistent with the USEPA's intent that the UFP-QAPP be the primary planning document for an entire project (Intergovernmental Data Quality Task Force [IDQTF], 2005a-c). This QAPP Addendum, in combination with the PQAPP elements, meets the requirements set forth in the UFP for QAPPs (IDQTF, 2005a-c) *and USEPA Requirements for Quality Assurance Project Plans* (USEPA, 2001).

This QAPP Addendum was prepared to include the detailed information specific to the SI at Biak Training Center Brett Hall. For ease of review, material from the PQAPP is included in this deliverable alongside the Biak Training Center Brett Hall-specific worksheets. **Table 1-1** below describes the components that are covered under the PQAPP and those that are covered under this UFP-QAPP Addendum.

Table 1-1: Comparison of PQAPP to QAPP Addendum

QAPP Addendum Worksheets	Applicable Document
Worksheets #1 and #2- Title and Approval Page and QAPP Identifying Information	**Programmatic/Site-Specific**
Worksheets #3 and #5- Project Organization and QAPP Distribution	**Programmatic/Site-Specific**
Worksheets #4, #7, #8- Personnel Qualifications and Sign-off Sheet	**Programmatic/Site-Specific**
Worksheet #6- Communication Pathways	**Programmatic/Site-Specific**
Worksheet #9- Technical Project Planning Session Summary	**Site-Specific**
Worksheet #10- Conceptual Site Model	**Site-Specific**
Worksheet #11- Project/ Data Quality Objectives	**Site-Specific**
Worksheet #12- Measurement Performance Criteria	**Programmatic**
Worksheet #13- Secondary Data Uses and Limitations	**Programmatic**
Worksheets #14 and #16- Project Tasks and Schedule	**Site-Specific**
Worksheet #15- Screening Limits and Laboratory- Specific Detection/ Quantitation Limits	**Programmatic**
Worksheet #17- Sampling Design and Rationale	**Site-Specific**
Worksheet #18- Sampling Locations and Methods	**Site-Specific**

QAPP Addendum Worksheets	Applicable Document
Worksheets #19 and #30- Sample Containers, Preservation and Hold Times	**Programmatic**
Worksheet #20- Field Quality Control Summary	**Programmatic/Site-Specific**
Worksheet #21- Field Standard Operating Procedures	**Programmatic**
Worksheet #22- Field Equipment Calibration, Maintenance, Testing and Inspection	**Programmatic**
Worksheet #23- Analytical Standard Operating Procedures	**Programmatic**
Worksheet #24- Analytical Instrument Calibration	**Programmatic**
Worksheet #25- Analytical Instrument and Equipment Maintenance, Testing and Inspection	**Programmatic**
Worksheets #26 and #27- Sample Handling, Custody and Disposal	**Programmatic**
Worksheet #28- Analytical Quality Control and Corrective Actions	**Programmatic**
Worksheet #29- Project Documents and Records	**Programmatic**
Worksheets #31, #32 and #33- Assessments and Corrective Action	**Programmatic**
Worksheet #34- Data Verification and Validation Inputs	**Programmatic**
Worksheet #35- Data Verification Procedures	**Programmatic**
Worksheet #36- Data Validation Procedures	**Programmatic**
Worksheet #37- Data Usability Assessment	**Programmatic**

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QAPP Worksheets #1 & #2: Title and Approval Page and QAPP Identifying Information

Site Name/Project Name: Army National Guard/ Multiple Award Environmental Services (MAES) Delivery Order 00014/ Preliminary Assessments (PA) and Site Inspections (SI) for Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites, ARNG Installations, Nationwide

Installation: Biak Training Center Brett Hall, Powell Butte, Oregon

Contract Work Assignment Number: USACE Contract No. W912DR-12-D-0014; Delivery Order No. W912DR17F0192

Relevant Plans and Reports from Previous Investigations: Relevant plans and reports from previous investigations are identified in the references cited in the introductory text that precedes these worksheets and in subsequent worksheets, as appropriate.

Investigative Organization Project Manager	Signature / Date
Printed Name / Organization	Claire Mitchell / AECOM Project Manager
Investigative Organization Quality Manager	Signature / Date
Printed Name / Organization	Sarah Gettier / AECOM Project QC Officer
Army National Guard	Signature / Date
Printed Name / Organization	David Connolly / ARNG Program Manager
Oregon Army National Guard	Signature / Date
Printed Name / Organization	James G. Arnold / Environmental Program Manager
Contract Organization Project Manager	Signature / Date
Printed Name / Organization	Timothy Peck / USACE, Baltimore District

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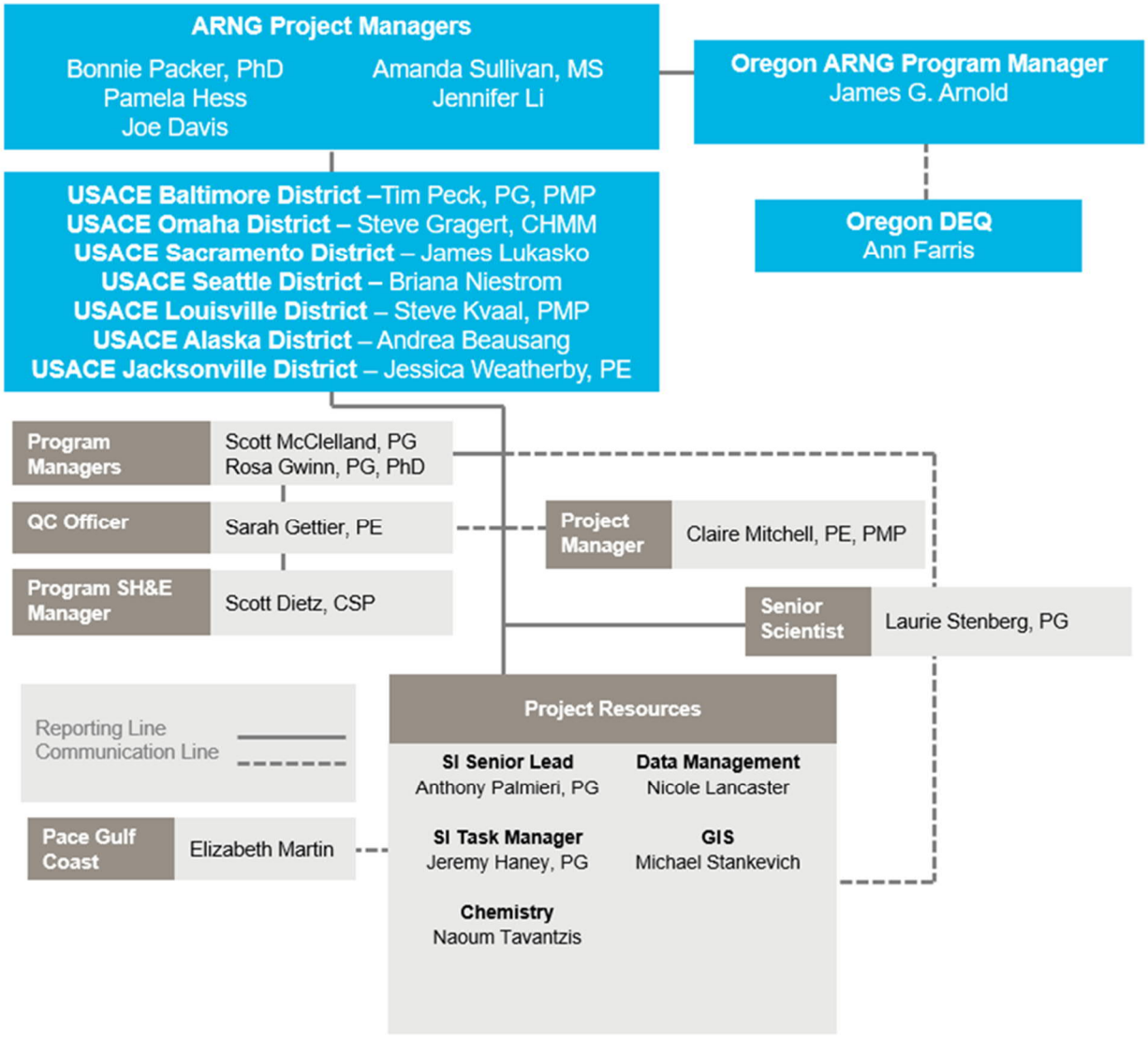
QAPP Worksheets #3 & #5: Project Organization and QAPP Distribution

The organization chart in **Figure 3-1** identifies key project personnel, as well as lines of authority and lines of communication among the ARNG, USACE, and prime contractor (AECOM). The QAPP Addendum will be distributed to all parties noted in the figure below. This organization chart is consistent with the PQAPP with the exception of the state regulatory personnel.

Figure 3-1 Project Organizational Chart



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QAPP Worksheets #4, #7 & #8: Personnel Qualifications and Sign-off Sheet

This worksheet contains a list of the key project personnel who are identified as performing the tasks that are defined in this QAPP Addendum and includes the personnel's organization, project role, education/experience, and specialized training/certifications. The personnel have signed and dated the worksheet to signify that they agree with the information in this QAPP Addendum and agree to implement it.

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Scott McClelland, PG	AECOM	MAES Program Manager	Education: BA, Geology MS, Geology Experience. 30+ years; executing and managing environmental investigation and remediation projects including program management of USACE Baltimore contracts.	Professional Geologist, KY AECOM Certified PM	Signature available upon request.
Rosa Gwinn, PG, PhD	AECOM	ARNG Program Manager	Education: BA, Geology MS, Geology PhD, Geology Experience: 33+ years; managed 4 ORA Phase II TOs of similar scope, complexity, and duration for USACE and ARNG; experience with PFAS investigations.	Professional Geologist, WA, UT AECOM Certified PM OSHA 40hr HAZWOPER OSHA 8hr Refresher AECOM PFAS Sampling Training	Signature available upon request.
Claire Mitchell, PE, PMP	AECOM	Project Manager	Education: BS, Civil Engineering Experience: 10+ years of environmental engineering experience including task management for PFAS investigations for DoD clients.	Professional Engineer, MO PMP Certification AECOM Certified PM OSHA 40hr HAZWOPER OSHA 8hr Refresher First Aid/ CPR AECOM PFAS Sampling Training	Signature available upon request.

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Laurie Stenberg, PG	AECOM	Senior Scientist	Education: BA, Geology Experience: 27+ years; served as senior scientist for ORA Phase II TOs; experience with PFAS investigations.	Professional Geologist, PA AECOM Certified PM OSHA 40hr HAZWOPER OSHA 8hr Refresher AECOM PFAS Sampling Training	Signature available upon request.
Jacquelyn Harrington, CHMM	AECOM	Senior Scientist	Education: BA, Biology Experience: 27+ years; served as senior scientist for ORA Phase II TOs; MMRP RIs, experience with PFAS investigations.	CHMM AECOM Certified PM OSHA 40hr HAZWOPER OSHA 8hr Refresher OSHA 8hr Supervisor First Aid/CPR AECOM PFAS Sampling Training	Signature available upon request.
Sarah Gettier	AECOM	QC Officer	Education: BS, Civil Engineering, MS Environmental Engineering Experience: 15+ years direct experience developing QAPPs and other environmental planning documents as a technical leader.	OSHA 40hr HAZWOPER OSHA 8hr Supervisor OSHA 8hr Refresher First Aid/CPR AECOM PFAS Sampling Training	Signature available upon request.
Scott Dietz, CSP, STSC	AECOM	Health and Safety Officer	Education: BS, Safety Sciences Experience: 23+ years; managing safety, health, and environment on construction, environmental, and remediation projects including government projects requiring compliance with the USACE Engineering Manual 385-1-1.	CSP STSC OSHA 40hr HAZWOPER OSHA 500 Trainer for OSHA for Construction Industry OSHA 510 OSHA Standards for the Construction Industry OSHA 30hr Construction OSHA 10hr Construction OSHA 8hr Refresher	Signature available upon request.

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Anthony Palmieri, PG	AECOM	SI Senior Lead	Education: BS, Geology Experience: 13+ years of managing and conducting environmental site investigations, including PFAS, for DoD clients.	Licensed Geologist and Hydrogeologist, WA Registered Geologist, OR AECOM Certified PM 40hr HAZWOPER OSHA 8hr Refresher 8hr OSHA Supervisor 30hr OSHA Construction AECOM PFAS Sampling Training	Signature available upon request.
Jeremy Haney, PG	AECOM	SI Task Manager	Education: BS, Geology Experience: 17+ years of task management; planning and implementing environmental investigations and remediations; and conducting SIs, RIs, and TCRAs.	Licensed Geologist, WA Registered Geologist, OR 40hr HAZWOPER OSHA 8hr Refresher 8hr OSHA Supervisor AECOM PFAS Sampling Training	Signature available upon request.
Robert Kennedy	AECOM	Senior Chemist	Education: BA, Chemistry Experience: 27+ years; served as senior scientist for ORA Phase II TOs; experience with PFAS investigations.	Auditing/Data Review training	Signature available upon request.
Naoum Tavantzis	AECOM	Project Chemist	Education: BA, Environmental Science Masters of Business Administration Experience: 9+ years; project chemist for ORA Phase II TOs; PFAS investigations, data validation, laboratory coordination.	OSHA 40hr HAZWOPER OSHA 8hr Refresher OSHA 8hr Supervisor AECOM PFAS Sampling Training	Signature available upon request.
Michael Stankevich	AECOM	GIS Specialist	Education: BA, Environmental Studies Experience: 9+ years; completed SDSFIE submittals for multiple ARNG installations.	ArcGIS Training	Signature available upon request.

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Nicole Lancaster	AECOM	Data Management	Education: BS, Marine Biology, MS Chemistry Experience: 10+ years, experience with data validation, data management, laboratory coordination, and field sampling.	OSHA 40hr HAZWOPER OSHA 8hr Refresher First Aid/CPR AECOM PFAS Sampling Training	Signature available upon request.
Gretchen Welshofer	AECOM	Regulatory Specialist	Education: BA, Communication MS, Environmental Science Experience: 27+ years; performing human health risk assessments; expertise in evaluating potential risks and hazards to human health posed by PFAS at DoD facilities; developed technical approach document that helps facilities manage PFAS-affected environmental media and waste streams; expertise in evaluating contaminant fate and transport for validity of exposure pathways.	NA	Signature available upon request.
Sarah Stinger, PG	AECOM	Technical Quality	Education: BS, Geology MS, Geology Experience: 33+ years; performing CERCLA investigations; served as task leader and in QA role for ORA Phase II TOs at multiple ARNG installations.	Professional Geologist, VA, PA, LA AECOM Certified PM OSHA 40hr HAZWOPER OSHA 8hr Refresher	Signature available upon request.
Joe Witte	AECOM	Project Coordinator	Education: BS, Environmental Science and Policy Experience: 4+ years with 2 years direct experience working on ARNG and Army investigations under MMRP and ORA and developing QAPPs.	OSHA 40hr HAZWOPER OSHA 8hr Refresher First Aid/CPR AECOM PFAS Sampling Training	Signature available upon request.
Elizabeth Martin	Pace Gulf Coast (Formerly GCAL)	Laboratory Project Manager	Education: BS, Biology Experience: 11+ years as Project Manager.	NA	Signature available upon request.

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Jacqueline Bendolph	Pace Gulf Coast	Laboratory Quality Manager	Education: BS, Chemistry Experience: 20+ years, organic analysis and sample preparation management.	NA	Signature available upon request.

Notes:
AECOM = AECOM Technical Services, Inc.
ARNG = Army National Guard
BA = Bachelor of Arts
BS = Bachelor of Science
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CHMM = Certified Hazardous Materials Manager
CPR = cardiopulmonary resuscitation
CSP = Certified Safety Professional
DoD = Department of Defense
GCAL = Gulf Coast Analytical Laboratories, LLC.
GIS = Geographic Information System
HAZWOPER = Hazardous Waste Operations and Emergency Response
hr = hour
ITRC= Interstate Technology and Regulatory Council
KY = Kentucky
LA = Louisiana
MAES = Multiple Award Environmental Services
MC = munitions constituents
MMRP = Military Munitions Response Program
MO = Missouri
MS = Master of Science
NA = not applicable
NH = New Hampshire
ORA = Operational Range Assessment
OSHA = Occupational Safety and Health Administration
PA = Pennsylvania
PE = Professional Engineer
PFAS = per- and polyfluoroalkyl substances
PG = Professional Geologist
PhD = Doctor of Philosophy
PM = Project Manager
PMP = Project Management Professional
QA = quality assurance
QAPP = Quality Assurance Project Plan
QC = quality control
QSM = Quality Systems Manual
RI = Remedial Investigation
SDSFIE = Spatial Data Standards for Facilities Infrastructure and Environment
SI = Site Inspection
STSC = Safety Trained Supervisor Construction
TNI = The NELAC Institute
TO = Task Order
USACE = United States Army Corps of Engineers
UT = Utah
VA = Virginia
WA = Washington

QAPP Worksheet #6: Communication Pathways

Worksheet #6 documents the issues (communication drivers) that trigger the need to communicate with other project personnel or stakeholders. The purpose of **Worksheet #6** is to ensure there are procedures in place for providing the appropriate notifications and generating the appropriate documentation when handling important communications, including those involving regulatory interfaces, unexpected events, emergencies, non-conformances, and stop-work orders.

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
Program Manager decisions and modification	USACE, Baltimore District Project Manager	Tim Peck, PG, PMP	410-962-3416 timothy.j.peck@usace.army.mil	Initiate award of work and options. Track project progress through monthly reporting and daily field reporting. Stop work for quality or performance concerns.
	USACE, Omaha District Project Manager	Steve Gragert, CHMM	402-995-2743 steve.p.gragert@usace.army.mil	
	USACE, Sacramento District Project Manager	James Lukasko	916-557-5392 james.j.lukasko@usace.army.mil	
	USACE, Seattle District Project Manager	Briana Niestrom	206-764-3498 Briana.C.Niestrom@usace.army.mil	
	USACE, Louisville District Project Manager	Steve Kvaal, PMP	502-315-6316 Steven.Kvaal@usace.army.mil	
	USACE, Alaska District Project Manager	Andrea Beausang	907-753-2557 Andrea.L.Beausang@usace.army.mil	
	USACE, Jacksonville District Project Manger	Jessica Weatherby, PE	904-232-2178 Jessica.A.Weatherby@usace.army.mil	

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
Program Technical Review	ARNG Project Managers	Bonnie Packer, PhD Pamela Hess Joe Davis Amanda Sullivan, MS Jennifer Li	703-607-7977 bonnie.m.packer.ctr@army.mil 208-880-9734 pamela.s.hess.mil@army.mil 615-791-1139 joe.b.davis36.ctr@army.mil 304-642-6000 Amanda.d.sullivan7.ctr@army.mil 301-717-6939 jennifer.j.li2.ctr@army.mil	The AECOM PM will obtain ARNG technical review and concurrence of the QAPP and project documents and any field modifications/QAPP changes as necessary. All approved modifications will be included in QAPP revisions (prior to field work). ARNG technical review and comments will be incorporated into the QAPP and project documents and a record of ARNG comments saved in project files for documentation.
Installation interface	ORARNG	Kelly Toynton, PE	503-584-3872 kelly.a.toynton.nfg@army.mil	Communicate project scope/schedule and coordinate logistics between project team and installation personnel on an as-needed basis, documented via phone records and emails.
Regulatory agency interface (Oregon Department of Environmental Quality)				Communicate technical approaches and decisions directly to regulatory agencies' representative(s) on an as-needed basis, documented via phone records and emails.
Community/ media interface				Communicate information directly to communities or media on an as-needed basis.
Manage all project phases Field progress reports Field modifications/QAPP changes	AECOM Project Manager	Claire Mitchell, PE, PMP	703-682-9098 claire.mitchell@aecom.com	All materials and information about the project will be forwarded from the AECOM PM to ARNG/ USACE. Any field or laboratory changes will be coordinated with Briana Niestrom (USACE), Joe Davis (ARNG), and Kelly Toynton (ORARNG). The AECOM PM will obtain ARNG/ USACE approval/ concurrence for field modifications/ QAPP changes as necessary. All approved modifications will be included in QAPP revisions (prior to field work) or field change request forms (during field work), and resolution/ corrective action identified.
	AECOM SI Senior Lead	Anthony Palmieri	206-438-2417 anthony.palmieri@aecom.com	Support AECOM PM in implementing SI tasks/procedures. Disseminate programmatic information from PM to SI Task Managers. Serve as lead verifier for SI documents.

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
	AECOM SI Task Manager	Jeremy Haney	971-323-6296 jeremy.haney@aecom.com	Responsible for overseeing preparation of SI QAPP and SI Report. Oversee daily activities and site-related communications. Communicate directly with SH&E manager.
	AECOM QC Officer	Sarah Gettier	301-944-0159 sarah.gettier@aecom.com	Oversee/conduct quality audits to assure field program performed in accordance with approved protocols. Support AECOM PM, Technical Task Manager, and Team Leaders to assure quality reviews are completed on project deliverables, including consistency and conformance with applicable regulatory and DoD guidance and with industry practices. Work with Project Chemist to resolve performance problems with contracted analytical laboratory.
Analytical laboratory modifications and performance problems	AECOM Project Chemist / Data Validator	Naoum Tavantzis	301-267-8761 naoum.tavantzis@aecom.com	Notify AECOM PM and QC Officer in a timely manner of performance problems encountered by the contracted analytical laboratory. PM will secure approval for modifications to the QAPP as necessary from ARNG/ USACE. All approved modifications will be included in Nonconformance and Corrective Action Report.
Data verification issues (e.g., incomplete records) and data validation issues (e.g., non-compliance with procedures)	AECOM Project Chemist / Data Validator	Naoum Tavantzis	301-267-8761 naoum.tavantzis@aecom.com	Verify/validate all analytical chemistry sample results from analytical laboratories with criteria developed in this QAPP and deliver to the PM and the Project QA Managers.
Data review corrective actions	AECOM Project Chemist / Data Validator	Naoum Tavantzis	301-267-8761 naoum.tavantzis@aecom.com	Notify Laboratory PMs to identify resolution/corrective actions.
Sample receipt variances	Pace Gulf Coast	Elizabeth Martin	225-769-4900 (225) 214-7068 (Direct) liz.martin@pacelabs.com	Report all project non-conformances and problems to the AECOM Project Chemist.
Laboratory QC variances				Report all project non-conformances and problems to the AECOM Project Chemist.
Analytical corrective actions				Report all project non-conformances and problems to the AECOM Project Chemist.
Laboratory modifications and performance problems				Report all project non-conformances and problems to the Pace Gulf Coast PM. Pace Gulf Coast PM will report to AECOM Project Chemist.

Notes:
AECOM = AECOM Technical Services, Inc.
ARNG = Army National Guard

ORARNG = Oregon Army National Guard
DoD = Department of Defense
PM = Project Manager
QA = quality assurance
QAPP = Quality Assurance Project Plan

QC= quality control
SH&E = Safety, Health, and Environment
SI = Site Inspection
USACE = United States Army Corps of Engineers

QAPP Worksheet #9: Technical Project Planning Session Summary

This worksheet serves as a record of future Technical Project Planning (TPP) sessions. The intent is to provide a concise record of participants, key decisions or agreements reached, and action items. Minutes will be approved by all participants prior to being implemented into the QAPP Addendum (TPP Meeting Minutes, **Appendix A**).

AECOM will implement the TPP process as listed in Engineer Manual 200-1-2 (USACE, 2016) including facility meetings in a professional and organized manner to obtain consensus on specific Data Quality Objectives (DQOs) for SI work. Three meetings will be held (in person and/ or teleconference) per the Performance Work Statement as described below:

- TPP Meeting 1 – Discuss DQOs (pre-work plan) and CSM
- TPP Meeting 2 – Finalize work plan technical approach
- TPP Meeting 3 – Verify all data gaps have been filled and finalize SI Report

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QAPP Worksheet #10: Conceptual Site Model

The information presented in this section was gathered during the PA at Biak Training Center Brett Hall. The PA process included the following tasks:

- Reviewed data resources to obtain information relevant to suspected PFAS releases;
- Conducted a site visit on 5 October 2018;
- Interviewed current and retired Biak Training Center Brett Hall personnel, including the Oregon Military Department (OMD) Environmental Manager, OMD Natural Resources Conservation Manager, OMD Wildland Fire Manager, OMD (Camp Rilea) Training Site Manager (former State Aviation Officer), OMD Fire Ranger, OMD Base Operations Supervisor, and OMD Real Estate/Property Manager;
- Interviewed current US Forest Service (USFS) personnel, including the Unit Aviation Officer, Central Oregon Fire Management Services, Prineville District Bureau of Land Management (BLM) and the Fire Operations Specialist, Central Oregon Fire Management Services, and Prairie Division BLM;
- Completed visual site inspections at known or suspected PFAS release locations and documented with photographs; and
- Developed CSM(s) to outline the potential release and pathway of PFAS for the AOIs and the ARNG facility.

The findings of the PA are summarized in this worksheet. Additional details about Biak Training Center Brett Hall can be found in the PA Report (AECOM, 2019).

Facility Location and Description

Biak Training Center Brett Hall is located in Powell Butte, Crook County, approximately 4 miles to the southeast of the City of Redmond and approximately 14 miles to the northeast of the City of Bend. Biak Training Center Brett Hall is located approximately 2.5 miles to the south of Highway 126 (**Figure 10-1**). Biak Training Center Brett Hall is occupied and operated by the Oregon ARNG (ORARNG) as a military training center, and it encompasses 4,300 acres of which 100 acres are designated as Biak Training Center Brett Hall (OMD, 2018a).

Biak Training Center Brett Hall includes one building used as the training center, two warehouse buildings, and an exterior training area known as the Military Operations on Urban Terrain (MOUT) range. The facility is primarily unpaved, with the exception of the main road and the parking lot surrounding the building. Numerous shipping containers at the MOUT range are used for military operations and firefighting training; access to the facility is not controlled. Biak Training Center Brett Hall draws drinking water from one well that receives no treatment and has a septic system discharging to an adjacent leach field.

The state mission of Biak Training Center Brett Hall is to provide community and training support for citizens and organizations of the state and US. The federal mission of Biak Training Center Brett Hall is to provide facilities and resources for a training center contributing readiness and military capability for the armed forces of the state and US (OMD, 2018a). Training at Biak Training Center Brett Hall includes military personnel and civilian personnel, such as law enforcement, fire departments, and state agencies.

The USFS Engine Academy conducted annual fire training at the MOUT range from 2010 to 2015. The annual training included local fire departments and local law enforcement agencies (city/county/state agencies), and it was facilitated by OMD. Annual bomb squadron training occurred at the MOUT in 2016 and 2017 and included local law enforcement led by the Federal Bureau of Investigation (FBI). AFFF has been used for training purposes at the Engine Academy fire training area (FTA) and bomb squad training area.

A dedicated Wildland Fire Program is located at the facility and has the mission of providing safety and training resources. The program provides wildland fire suppression and supports military training operations during fire seasons. The OMD collaborates with the BLM Prineville District for ecosystem management (OMD, 2018b). The OMD also collaborates with the USFS and local fire departments for fire response. According to interviews conducted with the OMD Fire Officer, OMD fire rangers respond to fire emergencies in the area as necessary (if other agencies are not available).

The Biak Training Center Brett Hall property is owned by the federal government and was administered by the USACE, with licensing use to the OMD since 2002. Biak Training Center Brett Hall is within the Biak Training Center, which is comprised of 4,300 acres owned by the BLM Prineville and leased to the OMD.

Based on review of historical aerial photographs, development of the installation appears as early as 1994, with the main building, two warehouse structures, and the paved roadway; development of the MOUT range appears by 2006. The facility appears to be in similar configuration as observed during the site visit (Environmental Data Resources, Inc. ™ [EDR™], 2018a; Google Earth, 2018).

Facility Environmental Setting

Biak Training Center Brett Hall is located in the Deschutes Columbia Plateau geologic province of Oregon (Oregon Department of Environmental Quality [DEQ], 2013; US Department of Interior [USDI], 2018) and bordered by undeveloped land along all four sides. Biak Training Center Brett Hall is comprised mostly of undeveloped, vegetated land underlain by volcanic lava flow beds. Paved areas at the facility include the road to enter/exit the facility from the northwest and southwest and the parking area surrounding the main building; the paved areas at the facility are primarily flat. From west to east, elevation at the facility ranges from approximately 3,080 and increases to 3,100 feet above mean sea level (amsl). From north to south, elevation ranges from approximately 3,085 and increases to approximately 3,095 feet amsl. Elevation throughout the facility averages 3,100 feet amsl. Topography at the site follows a northwest gradient (Google Earth, 2018; EDR™, 2018b).

Geology

Biak Training Center Brett Hall is in a geologic area characterized as basalt and basaltic andesite of the Pleistocene to Holocene ages. This geologic feature occurs primarily along the crest of the Cascade Range, located to the west of the facility (US Geological Survey [USGS], 2018a). These basaltic lava flows are the most widespread types of surface geology in the region, with the oldest basalt lava flows exposed west of the Deschutes River (west of the facility). Vents associated with the lava flows are dispersed throughout the region as lava and cinder cones. Known as “Lava Badlands”, basalt from fissure eruptions cover the region, generally as thin sheets of pahoehoe flows where the surface appears ropy. The lava flows were estimated to extend from the land surface to 50 to 100 feet below ground surface (bgs). The Lava Badlands consist of a lava tube system, indicative of a lateral spread of lava. The Redmond Caves is one such lava tube system,

located approximately 4 miles northwest of Biak Training Center Brett Hall (Department of Geology and Mineral Industries [DOGAMI], 1976).

Biak Training Center Brett Hall is underlain by volcanic deposits of the Quaternary period of the Cenozoic era (EDR™, 2018b). These deposits constitute the second major composite stratigraphic unit in the region, which is reported as extending to depths over 2,000 feet in some areas. This composition is comprised of lava flows, domes, vent deposits, pyroclastic deposits, and volcanic sediments (USGS, 2001). The volcanic rocks consist of ash and cinders, while the sedimentary rocks consist of semi-consolidated sand and gravel eroded from volcanic rocks (USGS, 1994, 2018b).

Soils beneath Biak Training Center Brett Hall consist primarily of Stukel-Deschutes complex within most of the facility boundary and Stukel-Rock outcrop-Deschutes complex in the eastern portion of the facility (US Department of Agriculture [USDA], 1999). Both soil series consist of shallow, well-drained soils with moderately rapid permeability located in lava plains that formed in ash (USDA, 1999). The Deschutes complex is characterized as sandy loam in the top 31 inches, followed by basalt at 31 inches. The Stukel complex is characterized as sandy and cobbly sandy loam in the top 11 inches, followed by gravelly sandy loam to 18 inches bgs and basalt at 18 inches bgs. Bedrock of the Deschutes series is reported at 20 to 40 inches bgs, while bedrock of the Stukel series is reported at 10 to 20 inches bgs (USDA, 1999). Boring logs available on at the Oregon Water Resources Department (OWRD) website indicate local soil thickness is highly variable and generally greater than 2 feet thick but potentially up to 20 feet thick (OWRD, 2020).

Hydrogeology

Biak Training Center Brett Hall is situated above the Deschutes Formation, which is the principal aquifer within the Upper Deschutes Basin. The Deschutes Formation comprises flood deposits, alluvium, debris flows, tephra, lava flows, and ignimbrites and ranges in thickness up to 2,000 feet. The hydraulic conductivity ranges from less than 10 to approximately 1,900 feet per day (USGS, 2001). Because of the large amount of rainfall that occurs at the Upper Deschutes Basin and the highly permeable shallow rocks, the Cascade Range is the principal groundwater recharge area for the area. Groundwater from the Cascade Range flows through the permeable volcanic rock towards the east, into the Upper Deschutes Basin, where half of the volume discharges to streams, and the other half of the volume flows through the subsurface of the Deschutes Formation, eventually discharging to streams. Groundwater discharge to streams is the principal mechanism of groundwater losses in the system where stream elevation is lower than the groundwater table. Groundwater discharges to streams occurs to the west of Biak Training Center Brett Hall, surrounding the confluence of the Deschutes River (west of Bend). The Deschutes River maintains substantial flow during dry periods, and stream discharge varies by location and seasonal precipitation. Regionally, the water table fluctuates in association with recharge. Infiltration of precipitation in the region occurs from rainfall, snowmelt, canal and stream leaks, and irrigation water applied to farm fields. The USGS estimated annual recharge from infiltration of precipitation in the area surrounding the facility ranging from 3 to 4.5 inches. Recharge averages 35 to 40% of the annual precipitation measured throughout the Upper Deschutes Basin (USGS, 2001).

Based on regional studies, groundwater flow at the facility is inferred to generally flow to the northwest (USGS, 2001). Biak Training Center Brett Hall obtains drinking water through one onsite water supply well located in the north-central portion of the facility, in the northwest corner of the building (Well #1852) (**Figure 10-2**). The geographic coordinates of the water well are 44°13’23.27”N; 121° 5’56.19”W. This well was completed in January 1985 and drilled to a depth of 492 feet bgs; depth to first water was reported at 370 feet bgs (OWRD, 2018). Shallow or perched groundwater has not been documented at or in the vicinity of the facility but is possible

in complex volcanic formations. Boring logs for nearby wells (within 2 miles of the facility) available at the OWRD website indicated first encountered groundwater ranges from approximately 230 feet bgs to over 480 feet bgs, but the geology is difficult to correlate between locations due to inconsistent lithologic characterization between drillers (OWRD, 2020).

Several drinking water source areas with active public and private groundwater systems were identified near Biak Training Center Brett Hall, as follows:

- Redmond Water Department (PWS ID OR4100693), approximately 2 miles to the northwest, with 9,800 connections serving approximately 30,000 people (DEQ, 2018a).
- Avion WC Red Cloud (PWS ID OR4101203), approximately 2 miles to the northeast, with 177 connections serving approximately 440 people (DEQ, 2018a).
- ORARNG Central Oregon Unit Training Equipment Site (COUTES) private water supply (PWS ID OR41-05957), approximately 3 miles to the northwest, with a single connection (the COUTES facility) serving 20 people. The groundwater well serving the COUTES facility is state regulated (Oregon Health Authority [OHA], 2019).
- Seven privately owned domestic wells located approximately 1 mile to the northwest serving multiple residential properties (OWRD, 2020).

Based on USEPA's Unregulated Contaminant Monitoring Rule 3 (UCMR3) data (samples collected between 2013 and 2016), no PFAS were detected in a public water system above USEPA's lifetime Health Advisories (HAs) within 20 miles of the facility, including the cities of Redmond and Bend, which were sampled in 2013 and 2014 (USEPA, 2017a). PFAS analyses performed in 2016 had method detection limits that were higher than currently achievable. Thus, it is possible that low concentrations of PFAS were not detected during the UCMR3 data analyses but might be detected if analyzed today.

Drinking water from the water well at Biak Training Center Brett Hall were sampled and analyzed for selected PFAS, including PFOS, PFOA, and PFBS, in 2017 and 2020. Drinking water sample and are summarized as follows:

- June 2017 drinking water sample: The water well was sampled on 27 June 2017. The sample wase analyzed by EPA 537 Modified for 20 PFAS, included PFOS, PFOA, and PFBS. The analytical data was validated and indicates all 20 PFAS, including PFOS, PFOA, and PFBS, were not detected above limits of detection (LOD), which ranged from 0.985 ng/L to 14.8 ng/L. PFOS was not detected above 2.83 ng/L and both PFOA and PFBS were not detected above 1.88 ng/L. All LODs were below screening levels presented in the OSD memorandum "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program," September 15, 2021 (Assistant Secretary of Defense, 2021).
- September 2020 drinking water sample: The water well was sampled on 23 September 2020. The sample was analyzed at a NELAP-approved laboratory by EPA 537. An unvalidated laboratory analytical report for one drinking water sample indicates the 14 reported PFAS, including PFOS, PFOA, and PFBS, were not detected above LODs ranging from 2.0 ng/L to 4.0 ng/L. PFOS, PFOA, and PFBS were not detected above 4.0 ng/L. All LODs were below screening levels presented in the OSD memorandum "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program," September 15, 2021 (Assistant Secretary of Defense, 2021).

Hydrology

Biak Training Center Brett Hall is within the Town of O'Neill subwatershed (12-digit hydrologic unit code [HUC]: 170703051006), which is within the Mayfield Pond-Central Oregon Canal watershed (10-digit HUC: 1707030509) of the Lower Crooked subbasin (8-digit HUC: 17070305), of the Deschutes Basin (6-digit HUC: 170703) (**Figure 10-3**). No surface water features are located at the facility. The nearest off-site surface waterbodies are the North Unit Main Canal approximately 2 miles to the west of the facility, which flows northeast, and the Central Oregon Canal about 1.75 miles to the east, which flows northeast. The Deschutes River is located approximately 8 miles to the west of Biak Training Center Brett Hall, flows northeast, and is a major tributary to the Columbia River (located along the Oregon-Washington boarder) (DEQ, 2018b). No wetlands are located at the facility (USFS, 2018).

The facility is primarily unpaved, but existing paved areas include the roadway entering/exiting the facility from the northwest and southwest and the parking area surrounding the building. Surface stormwater runoff from paved areas flows into stormwater catch basins surrounding the building, discharging to the west of the pavement (OMD, 2018c). Stormwater runoff to unpaved areas infiltrates the soil. Surface water runoff at Biak Training Center Brett Hall would only occur during heavy precipitation events where precipitation exceeds the infiltration rate of soil.

Climate

Climate in the Deschutes Basin is considered semiarid: moderate with cool, wet winters and warm, dry summers. The climate is driven by air masses that develop in the Pacific Ocean (approximately 150 miles west of Biak Training Center Brett Hall) and move east over the Cascade Range (approximately 35 miles west of Biak Training Center Brett Hall), dropping up to 200 inches of precipitation (rainfall and snow) annually (mostly snow during the winter). The Deschutes Basin's climate experiences annual and long-term variability. Precipitation decreases east of the Cascade Range significantly (USDA, 1966; USGS, 2001).

Weather data recorded at the Redmond Airport weather station (Station OR USW00024230), located approximately 2 miles to the northwest of Biak Training Center Brett Hall, reported the following climatic measurements from 1990 to 2018: average annual precipitation of 8 inches, average annual snowfall of 9 inches, and average temperature of 49 degrees Fahrenheit (°F) (max of 86 °F) (National Oceanic and Atmospheric Administration [NOAA], 2018).

Current and Future Land Use

Biak Training Center Brett Hall is zoned by Crook County as EFU3 – Exclusive Farm Use (Crook County, 2018). Biak Training Center Brett Hall lies along the western boundary of Crook County, bordering Deschutes County to the east. The nearest urban area is Redmond, approximately 4 miles to the northwest of the facility. The Redmond Airport is located approximately 2 miles to the northwest of the facility. According to the 2017 census conducted by the US Census Bureau (Census), the estimated population of Redmond at the time was 30,011. Based on the population estimates, Redmond's population has increased by nearly 3,800 since 2010 (Census, 2018). Land use surrounding the facility is primarily agricultural and zoned by Crook County as EFU3 – Exclusive Farm Use (Crook County, 2018). Land within 0.25 miles west of Biak Training Center Brett Hall is zoned by Deschutes County as EFUAL – Alfalfa Subzone (Deschutes County, 2018). Highway 126, which travels east/west from Redmond (west) to Prineville (east), is located 2 miles mile to the north of the facility. Future land use at Biak Training Center Brett Hall is not anticipated to change.

Areas of Interest and Conceptual Site Models

Based on the PA findings, two release areas were identified as AOIs at Biak Training Center Brett Hall. The AOI locations are shown on **Figure 10-4**. The following section describes the CSM

components and the specific CSMs developed for the AOIs. A CSM identifies three components necessary for potentially complete exposure pathways related to a site: (1) source, (2) pathway, and (3) receptor. If any of these elements are missing, the pathway is considered incomplete.

In general, the potential routes of exposure to PFAS are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of toxicological study.

PFAS are water soluble and can migrate readily from soil to groundwater via leaching. Because PFAS releases to surface and subsurface soil have occurred, it is possible that PFAS migrated from the surface soil at AOIs to groundwater via leaching. Based on observations conducted during the site visit and online research, no surface water features or wetlands are located within either AOI or the immediate surrounding area downgradient (DEQ, 2018b). Precipitation infiltrating the AOIs may cause PFAS migration from surface and subsurface soil to groundwater, which is estimated to be within 400 feet bgs (OWRD, 2018). Groundwater flow is generally to the northwest. One onsite drinking water well is located in the north-central portion of the facility, approximately 850 feet to the north and downgradient to across gradient from the AOIs. One drinking water source area with public groundwater systems (Redmond Water Department) is located approximately 2 miles to the northwest and downgradient of the AOIs and serves approximately 30,000 people (DEQ, 2018a). One private drinking water source area is located approximately 3 miles to the northwest and downgradient of the AOIs, serving 20 people (OHA, 2019). Seven privately wells owned domestic located approximately 1 mile to the northwest and downgradient of the AOIs, serving multiple residential properties (OWRD, 2020).

Groundwater flow at Biak Training Center Brett Hall is inferred to be to the northwest and, supply wells for drinking water are located downgradient of the AOIs; therefore, the exposure pathway for groundwater via ingestion is potentially complete for site workers, construction workers, trespassers, and off-facility residents.

AOI 1 Engine Academy Training Area

AOI 1 is at the MOUT range approximately 660 feet southwest of the facility building. Releases of PFAS to soil by the USFS Engine Academy occurred at AOI 1 between 2000 and 2011 and between 2013 and 2015. The MOUT range (and surrounding area) is unpaved. According to interviewed facility personnel, no fires were set at this FTA, but AFFF was applied to wooden structures for training exercises to showcase applications of AFFF in fire situations. The concentration and amount of AFFF released during the training events are unknown based on interviews conducted with OMD facility personnel and USFS personnel.

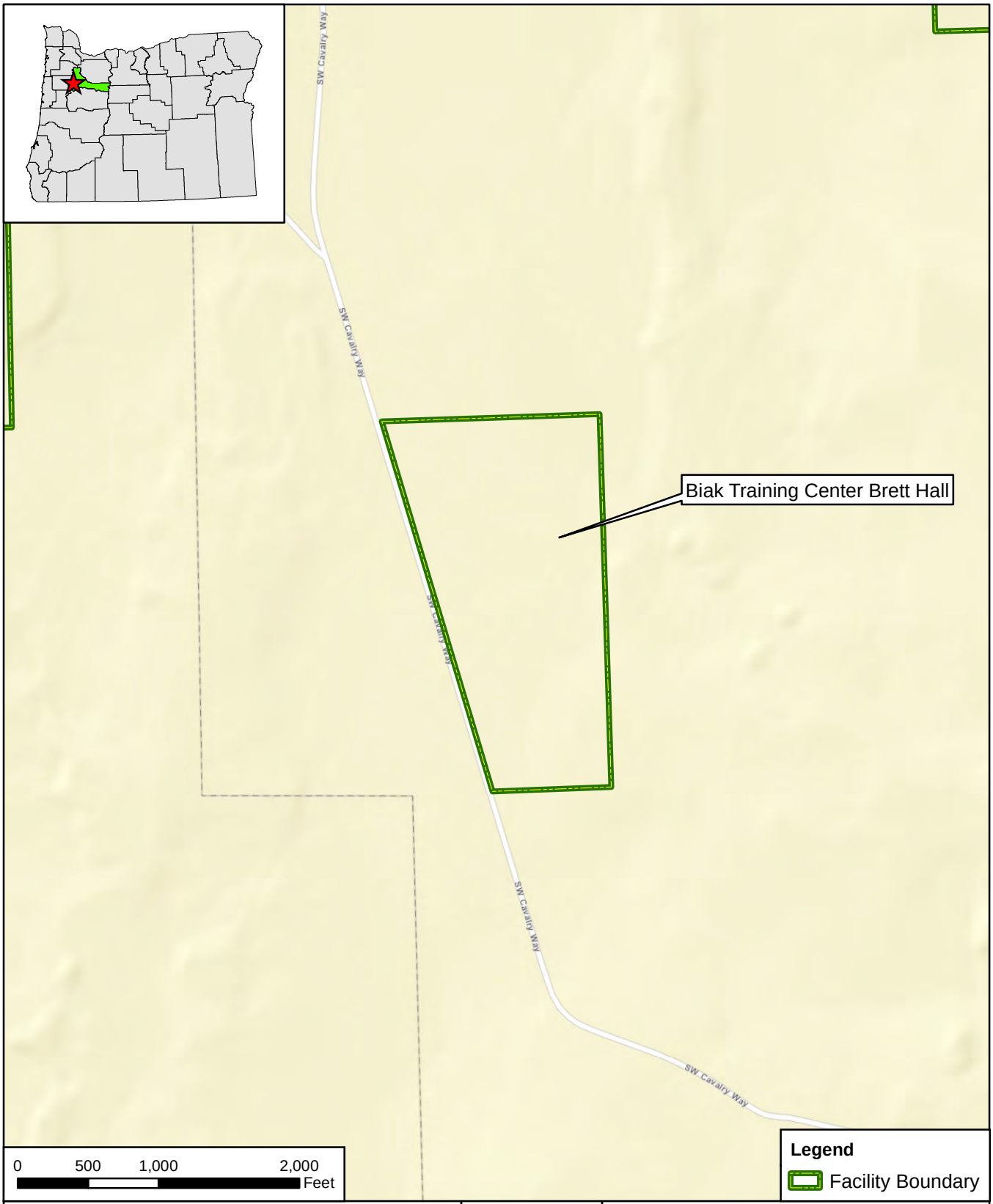
Because potential PFAS releases to surface soil at AOI 1 have occurred, PFAS may have migrated from the surface soil to the subsurface soil and to the groundwater via leaching. Ground-disturbing activities to surface soil at AOI 1 could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust particles or ingestion of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction worker exposure to potential PFAS contamination via inhalation of dust particles or ingestion of subsurface soil. Therefore, the exposure pathways for ingestion of soil are potentially complete for these receptors.

AOI 2 Bomb Squad Training Area

AOI 2 is at the MOUT range approximately 830 feet southwest of the facility building, adjacent to AOI 1. Releases of PFAS to soil occurred at AOI 2 during training events conducted by the FBI between 2016 and 2017. The MOUT range (and surrounding area) is unpaved. According to

582 interviewed facility personnel, no fires were set at this training area, but AFFF was applied during
583 bomb squad training exercises. The concentration and amount of AFFF released during the
584 training events are unknown based on interviews conducted with OMD facility personnel.
585 Interviews with FBI personnel were not conducted.

586 Because potential PFAS releases to surface soil at AOI 2 have occurred, PFAS may have
587 migrated from the surface soil to the subsurface soil and to the groundwater via leaching. Ground-
588 disturbing activities to surface soil at AOI 2 could result in site worker, construction worker, and
589 trespasser exposure to potential PFAS contamination via inhalation of dust particles or ingestion
590 of surface soil. Ground-disturbing activities to subsurface soil could result in site and construction
591 worker exposure to potential PFAS contamination via inhalation of dust particles or ingestion of
592 subsurface soil. Therefore, the exposure pathways for ingestion of soil are potentially complete
593 for these receptors.



CLIENT	ARNG			
Site Inspection for PFAS at Biak Training Center Brett Hall in Powell Butte, OR				
REVISED	1/26/2022	GIS BY	MS	1/26/2022
SCALE	1:12,000	CHK BY	MB	1/26/2022
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	CM	1/26/2022

N

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-1

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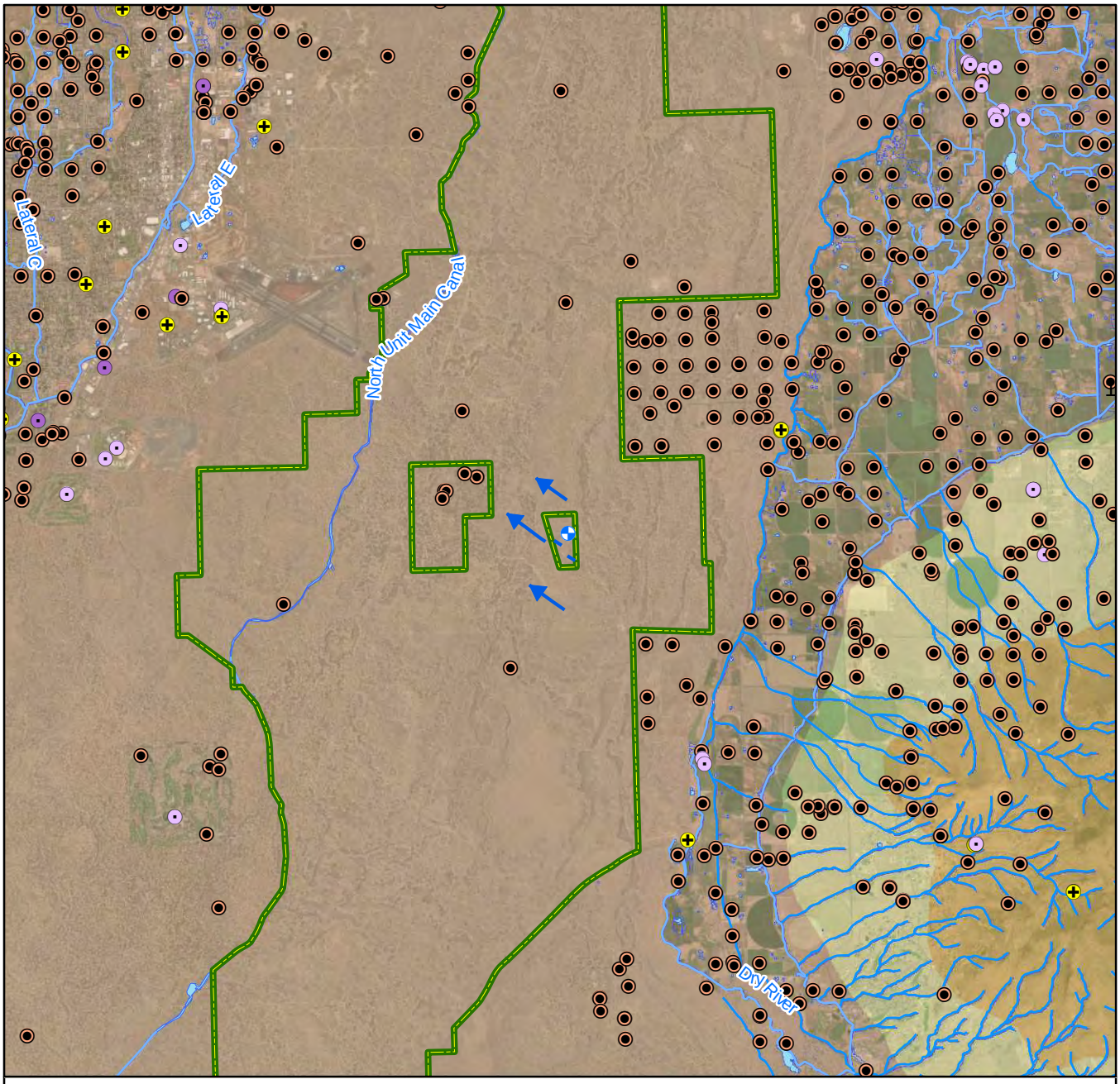

Legend

- Facility Boundary
- Water Body
- Wetland
- River/Stream
- Canal/Ditch
- Inferred Groundwater Flow Direction

Geology

- alluvial fan
- Basalt
- rhyolite

Well

- Domestic Well
- Industrial Well
- Irrigation Well
- Community Well
- Potable Well

0 0.75 1.5 3 Miles

CLIENT	ARNG			
Site Inspection for PFAS at Biak Training Center Brett Hall in Powell Butte, OR				
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SCALE	1:95,040	CHK BY	MB	1/26/2022
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	CM	1/26/2022

N

Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-2

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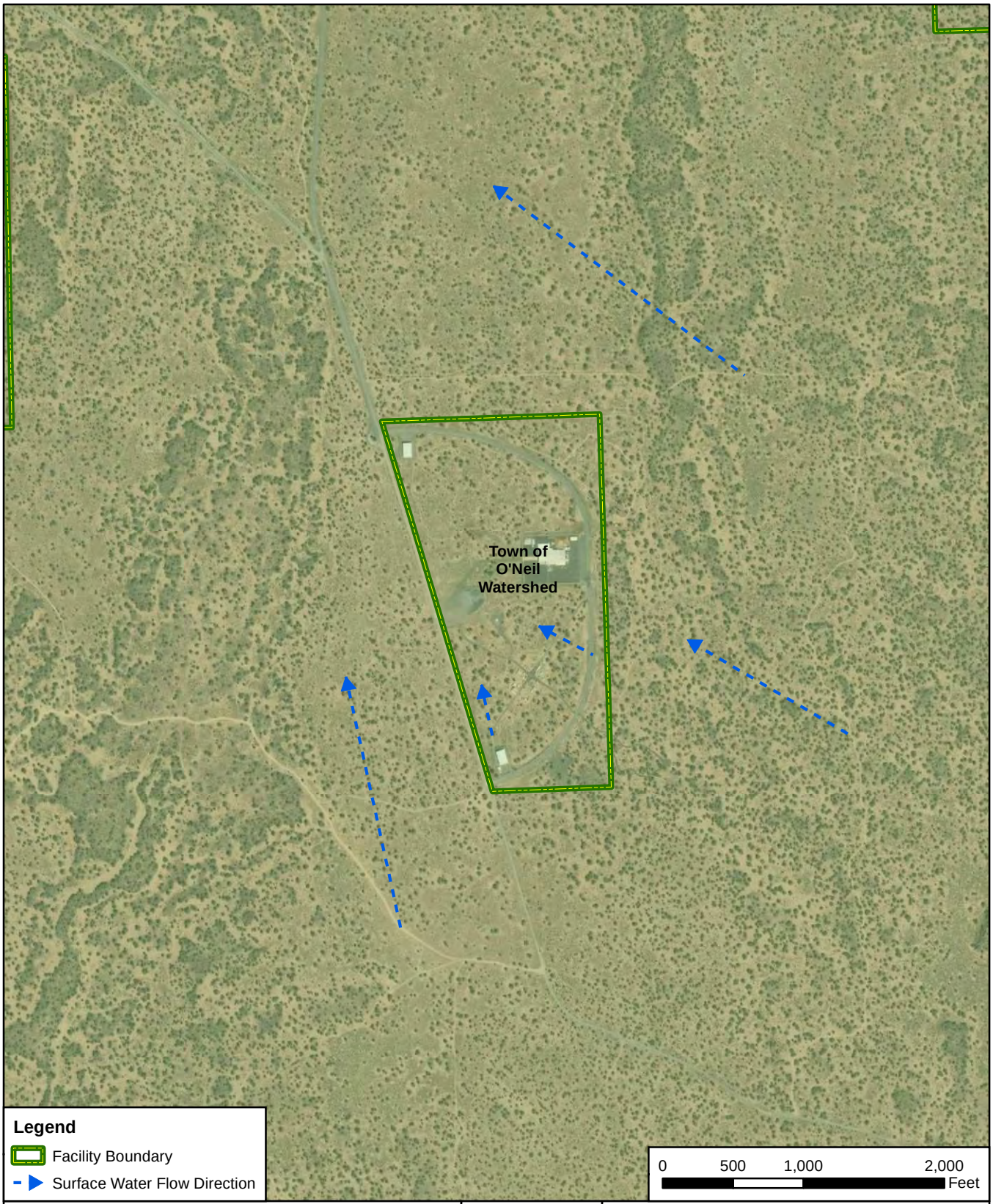

CLIENT	ARNG			
Site Inspection for PFAS at Biak Training Center Brett Hall in Powell Butte, OR				
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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	CM	1/26/2022

Surface Water Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-3

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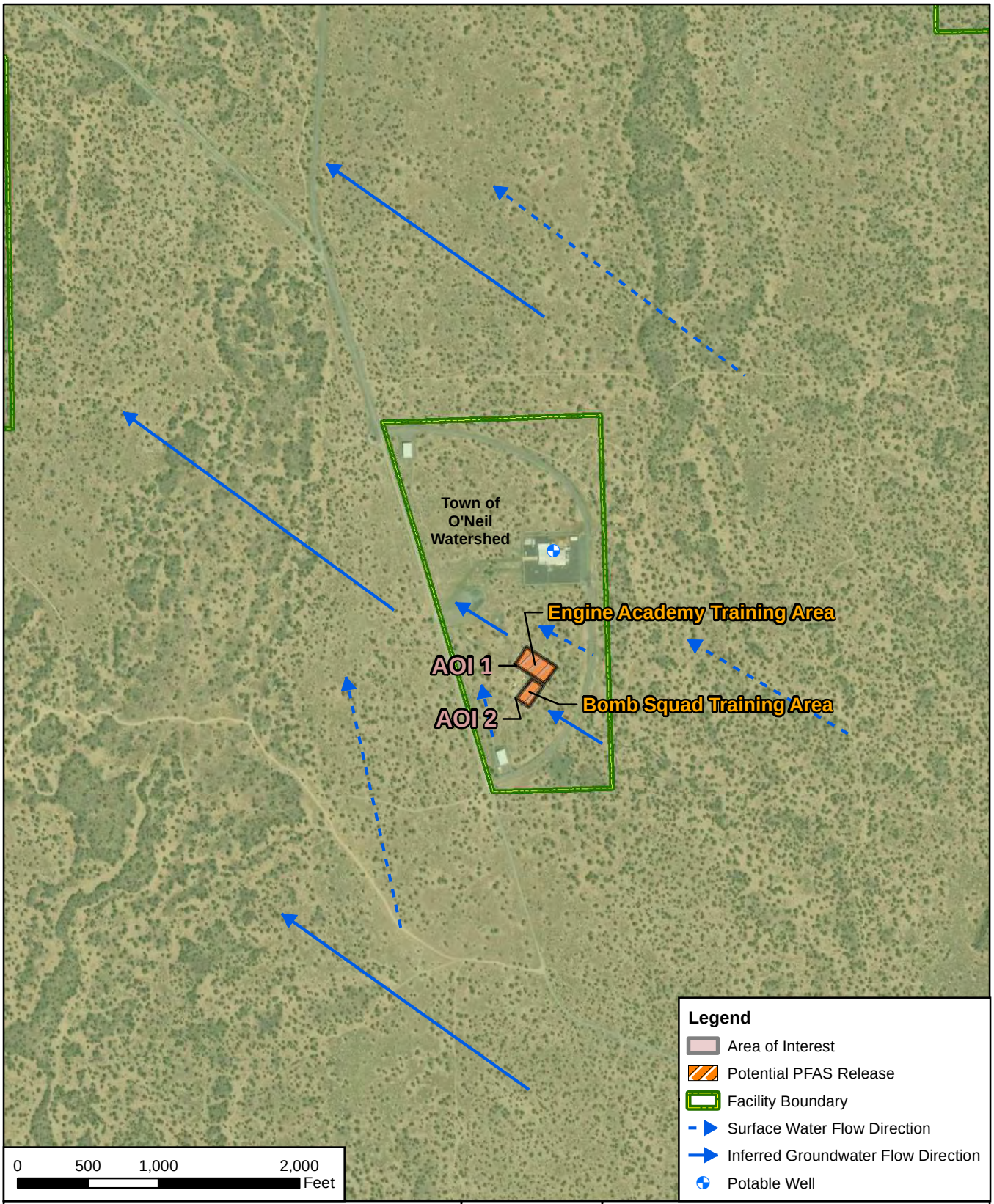

CLIENT	ARNG			
Site Inspection for PFAS at Biak Training Center Brett Hall in Powell Butte, OR				
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SCALE	1:12,000	CHK BY	MB	1/26/2022
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	CM	1/26/2022

Areas of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-4

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QAPP Worksheet #11: Project/Data Quality Objectives

DQOs specify the level of data required to support the decision-making process for a project. Specific DQOs have been established for each facility and are described in this UFP-QAPP Addendum. These DQOs follow the USEPA's seven-step iterative process for DQO development. DQOs are influenced by the ongoing project planning discussions with stakeholders and will be updated if new consensus decisions materialize.

1. State the Problem

The presence of PFAS, which may pose a risk to human health or the environment, in environmental media at the facility is currently unknown. PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. The regulatory framework for managing PFAS at both the federal and state level continues to evolve. The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 September 2021 (Assistant Secretary of Defense, 2021). The ARNG program under which this SI will be performed follows this DoD policy. Should the maximum concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to three compounds: PFOS, PFOA, and PFBS. The SLs are presented in **Worksheet #15** of this QAPP Addendum.

The following quotes from the DA policy documents form the basis for this project (DA, 2016; DA, 2018):

- "The Army will research and identify locations where PFOS and/or PFOA containing products, such as AFFF, are known or suspected to have been used. Installations shall coordinate with installation/facility fire response or training offices to identify AFFF use or storage locations. The Army will consider FTA, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use as possible source areas. In addition, metal plating operations, which used certain PFOS-containing mist suppressants, shall be considered possible source areas."

- "Based on a review of site records…determine whether a CERCLA PA is appropriate for identifying PFOS/PFOA release sites. If the PA determines a PFOS/PFOA release may have occurred, a CERCLA SI shall be conducted to determine presence/absence of contamination."

- "Identify sites where perfluorinated compounds are known or suspected to have been released, with the priority being those sites within 20 miles of the public systems that tested above USEPA HA levels." (USEPA, 2016a; USEPA, 2016b).

2. Identify the Goals of the Study

The goals of the SI include the following:

1. Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs at Biak Training Center Brett Hall.

2. Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.

3. Determine the potential need for a TCRA (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.

4. Collect or develop data to evaluate the release.

5. Collect data to better characterize the release for more effective and rapid initiation of an RI, if determined necessary.

6. If PFOA, PFOS, and PFBS are determined to be present, aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).

3. Identify Information Inputs

Primary information inputs include:

- The PA Report for Biak Training Center Brett Hall;
- Analytical data collected during other environmental sampling efforts at Biak Training Center Brett Hall;
- Groundwater, surface water, soil, and/or sediment (if applicable) sample data collected in accordance with this QAPP Addendum; and
- Field data collected including groundwater elevation and water quality parameters measured using a multi-parameter water quality meter.

4. Define the Boundaries of the Study

The scope of the SI is horizontally bounded by the property limits of Biak Training Center Brett Hall. Off-facility sampling is not included in the scope of this SI; however, if future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with the property owner(s). The scope of the SI is vertically bounded as follows: groundwater (for planning purposes assumed to be 400 feet bgs but anticipated at 370 feet bgs plus or minus 70 feet), subsurface soil (from 2 feet to 20 feet bgs or the bedrock interface, whichever is shallower), and surface soil (from ground surface to 2 feet bgs or the bedrock interface, whichever is shallower). The temporal boundaries of the study are limited by seasonal conditions; the field work for the scope will be performed Spring or Summer 2021.

5. Develop the Analytic Approach

Samples will be analyzed by a DoD Environmental Laboratory Accreditation Program (ELAP) and National Environmental Laboratory Accreditation Program (NELAP) certified laboratory [i.e., Pace Gulf Coast (formerly Gulf Coast Analytical Laboratories, LLC [GCAL])]. Data will be compared to SLs (**Worksheet #15**), and decision rules as defined in the PQAPP will be applied

concerning actions to be taken based on any SL exceedances. Decision rules have been developed for groundwater and soil that will apply to all data collected. These rules will govern response actions based on the results of the SI sampling effort.

The decision rules described in the tables at the end of this section (**Tables 11-1** and **11-2**) identify actions based on the following:

Groundwater:

1. Is there a human receptor within 4 miles of the facility?
2. What is the concentration of PFOA, PFOS, and PFBS at the potential source area?
3. What is the concentration of PFOA, PFOS, and PFBS at the boundary?
4. What does the CSM suggest in terms of source, pathway, and receptor?

Soil:

1. What is the concentration of PFOA, PFOS, and PFBS in shallow surface soil (0-2 feet bgs)?
2. What is the concentration of PFOA, PFOS, and PFBS in soil (i.e., bedrock interface) (4-15 feet bgs)?
3. What does the CSM suggest in terms of source, pathway, and receptor?

Soil samples will be collected from potential source areas identified in **Worksheet #10**. Based on regional groundwater information and the boring log for the facility water well, groundwater is expected to be encountered in the bedrock aquifer no deeper than 440 feet bgs. A groundwater sample will be collected downgradient from the potential source areas identified in **Worksheet #10**. Proposed SI sample locations and depths are defined in **Worksheet #17**.

6. Specify Performance/Acceptance Criteria

See **Worksheet #37**.

7. Develop the Detailed Plan for Obtaining Data

See **Worksheet #17** and **#18**.

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Table 11-1: Groundwater Water Decision Rules

Scenario	PFAS Concentration Range	Response (Off-facility human receptor within 4 miles)	Response (No off-facility human receptor within 4 miles)
Scenario 1	ND	No further action required during SI phase.	No further action required during SI phase.
Scenario 2	> ND (any positive detection) and < SLs	1.) Assess CSM including: - Data reliability and bias - Migration via groundwater flow (i.e., groundwater flow towards potential receptors) - Flow to surface water bodies, drinking water intakes - Distance from boundary to receptor - Aquifer where drinking water well(s) are screened - Estimated timeframe of release(s) 2.) No further action during SI Phase at this time. ARNG may consider need for additional evaluation in the future for groundwater.	1.) Assess CSM as described. 2.) No further action during SI Phase at this time. ARNG may consider need for additional evaluation in the future for groundwater.
Scenario 3	> SLs	1.) Assess CSM as described above and: - Potential off-facility alternative PFAS sources 2.) If exceedance of SLs is near facility boundary and the assessment of the CSM implies unacceptable risk to human health caused by a PFAS release attributable to ARNG activities, ARNG may initiate off-facility sampling protocol. 3.) Proceed to RI.	1.) Assess CSM as described. 2.) Proceed to RI.

Notes:

< = less than
> = greater than
ARNG = Army National Guard
CSM = conceptual site model
ND = non-detect
PFAS = per- and polyfluoroalkyl substances
RI = Remedial Investigation
SI = Site Inspection
SL = screening level

698

Table 11-2: Soil Decision Rules

Scenario	PFAS Concentration Range	Response
Scenario 1	ND	No further action during SI Phase.
Scenario 2	> ND (any positive detection) and < SLs	1.) Assess CSM including: - Potential for particulate runoff (i.e., transport via surface water) - Nearby receptors and land use (residential or industrial/commercial worker) at the source location (i.e., potential for incidental ingestion) - Depth to groundwater; distance to nearby surface water body - Comparison of soil concentrations to groundwater concentrations at the source or nearby surface water body - Data reliability and bias 2.) No further action for soil during SI Phase at this time. ARNG may consider need for additional evaluation in the future.
Scenario 3	> SLs	1.) Assess CSM as above and: - Comparison of soil concentrations to groundwater concentrations at the source and downgradient at the boundary 2.) Proceed to RI.

699 Notes:
700 > = greater than
701 ARNG = Army National Guard
702 CSM = conceptual site model
703 ND = non-detect
704 OSD = Office of the Secretary of Defense
705 PFAS = per- and polyfluoroalkyl substances
706 RI = Remedial Investigation
707 SI = Site Inspection
708 SL = screening level

Final PQAPP Worksheet #12: Measurement Performance Criteria

Matrix Groundwater/ Surface Water/ Potable Wells
Analytical Group PFAS
Concentration Low

Data Quality Indicators	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for S, A or Both (S&A)
Accuracy/Bias	LCS/LCSD and MS/MSD shall be spiked with all analytes. Analyte recovery limits per Worksheet #15	LCS/LCSD, MS/MSD	A
Precision	Laboratory duplicates analysis should have an RPD <30%	LCS/LCSD, MS/MSD	A
Precision	Values > 5X LOQ: RPD must be ≤30% Values ≤ 5X LOQ: Absolute difference ≤ 2x the LOQ	Field Duplicates	S
Accuracy/ Contamination	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank, Field Reagent Blanks, Equipment Rinsate Blanks	A
Sensitivity	Detection limits ≤ to acceptance criteria Instrument Sensitivity Check concentrations must be within ±30% of their true values.	Detection Limits, Instrument Sensitivity Check	A
Completeness	Completeness criteria will be considered met if 100% of all planned sample data (as requested on CoC in lab reports and EDD; including requested reanalyses) are collected	Reported Sample Data	S & A
Comparability	Based on accuracy and media comparison	Use of standardized SOPs in field and laboratory	S & A
Comparability	Serial dilution preparation (allowed due to known high concentrations of PFAS, notation of 'foamed' on CoC is considered documented approval)	Field shake test	S & A
Representativeness	Samples met conditions per Worksheet #19/30.	Laboratory Receipt Checklist, Cooler Temperature Blank	S

Notes:
% = percent
A= analytical
CoC = chain of custody
EDD = electronic data deliverable
LCS/LCSD = laboratory control sample/ laboratory control sample duplicate
LOQ = limit of quantitation
MS/MSD = matrix spike/ matrix spike duplicate
< = less than
> = greater than
≤ = less than or equal to
QC = quality control
RPD = relative percent difference
S = sampling
SOP = standard operating procedure

Matrix Soil and Sediment
Analytical Group PFAS
Concentration Low

Data Quality Indicators	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias	LCS/LCSD and MS/MSD shall be spiked with all analytes. Analyte recovery limits per Worksheet #15	LCS, LCSD, MS, MSD	A
Precision	Laboratory duplicates analysis should have a RPD <30%	LCS/LCSD, MS/MSD	A
Precision	Values > 5X LOQ: RPD must be ≤30% Values ≤ 5X LOQ: Absolute difference ≤ 2x the LOQ	Field Duplicates	S
Accuracy/ Contamination	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank, Field Reagent Blanks, Equipment Rinsate Blanks	A
Sensitivity	Detection limits ≤ to acceptance criteria Instrument Sensitivity Check concentrations must be within ±30% of their true values.	Detection Limits, Instrument Sensitivity Check	A
Completeness	Completeness criteria will be considered met if 100% of all planned sample data (as requested on CoC in lab reports and EDD; including requested reanalyses) are collected	Reported Sample Data	S & A
Comparability	Based on accuracy and media comparison	Use of standardized SOPs in field and laboratory	S & A
Representativeness	Samples met conditions per Worksheet #19/30.	Laboratory Receipt Checklist, Cooler Temperature Blank	S

Notes:
< = less than
> = greater than
≤ = less than or equal to
A= analytical
CoC = chain of custody
EDD = electronic data deliverable
LCS/LCSD = laboratory control sample/ laboratory control sample duplicate
LOQ = limit of quantitation
MS/MSD = matrix spike/ matrix spike duplicate
QC = quality control
RPD = relative percent difference
S = sampling
SOP = standard operating procedure

Final PQAPP Worksheet #13: Secondary Data Uses and Limitations

Secondary data sources, uses, and limitations are tabulated below. Original source documents were reviewed for uncertainty discussions that may identify additional or more suitable data limitations.

Data Type	Source	Data Uses Relative to Current Project	Factors Affecting Reliability of Data and Limitations on Data Use
Meteorological	National Weather Service	Estimates of seasonal fluctuations in precipitation.	Meteorological data is generally for a regional area. Actual site conditions may vary.
Topographic	USGS	Inferred surface water based on local topography at each site. Groundwater flow maps will ultimately rely upon groundwater measurements from monitoring wells.	Topography of some sites may have been altered by building or grading activities.
Soil and groundwater chemistry, groundwater monitoring data, and data gaps identification	Historical site reports	Applicable to the evaluation of historical site conditions in soil and groundwater to supplement data being collected under this delivery order.	The data may not represent current conditions because of the age of some of the data. Reliability of second- or third-party data quality.
Historical site records (i.e., material inventories)	Purchase records, site inventories, onsite records, safety data sheets	Applicable to the evaluation of potential constituents of concern and source areas.	Records may be incomplete or inaccurate.
Periodicals (i.e., news articles)	Local newspapers, magazines or other periodicals	Applicable to the evaluation of the use of potential constituents of concern at off-facility locations or mutual use/ aid agreements with local fire department or other entities.	Records may be incomplete or inaccurate.

Notes:
USGS = United States Geological Survey

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QAPP Worksheet #14 & #16: Project Tasks and Schedule

The following table describes the main tasks and schedule for the SI:

Task	Start Date	End Date
Pre-mobilization	February 2022	February 2022
Mobilization	March 2022*	March 2022*
Field Work	March 2022*	April 2022*
Demobilization	May 2022*	May 2022*
Data Review/Validation	June 2022	July 2022
Reporting	August 2022	January 2023

Notes:
*Weather permitting

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Final PQAPP Worksheet #15: Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater/ Surface Water/ Potable Wells
Analyte Group: PFAS
Method: PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15

Analyte	CAS Number	Laboratory Control Spike Lower Control Limit (%)	Laboratory Control Spike Upper Control Limit (%)	Achievable Laboratory Limits		
				DL (ng/L)	LOD (ng/L)	LOQ (ng/L)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	65	140	0.81	4.0	10
Perfluoroheptanoic acid (PFHpA)	375-85-9	72	130	0.48	4.0	10
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	68	131	0.95	4.0	10
Perfluorononanoic acid (PFNA)	375-95-1	69	130	0.78	4.0	10
Perfluorooctanoic acid (PFOA)	335-67-1	71	133	0.95	4.0	10
Perfluorobutanesulfonic acid (PFBS)	375-73-5	72	130	0.81	4.0	10
Perfluorobutanoic acid (PFBA)	375-22-4	73	129	0.90	4.0	10
Perfluoropentanoic acid (PFPeA)	2706-90-3	72	129	0.85	4.0	10
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	61	135	0.97	8.0	10
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	65	136	0.91	8.0	10
Perfluorodecanoic acid (PFDA)	335-76-2	71	129	0.86	4.0	10
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	71	132	0.98	4.0	10
Perfluorododecanoic acid (PFDoA)	307-55-1	72	134	0.88	4.0	10
Perfluorohexanoic acid (PFHxA)	307-24-4	72	129	0.99	4.0	10
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	65	144	0.99	4.0	10
Perfluoroundecanoic acid (PFUdA)	2058-94-8	69	133	0.95	4.0	10
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	64	140	0.94	4.0	10
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	67	138	0.90	4.0	10

Notes:
% = percent
CAS = Chemical Abstracts Service
DL= detection limit
LC/MS/MS = liquid chromatography tandem mass spectrometry
LOD = limit of detection
LOQ = limit of quantitation
ng/L = nanograms per liter
PFAS = per- and polyfluoroalkyl substances
QSM =Quality Systems Manual
USEPA = United States Environmental Protection Agency

Matrix: Soil/Sediment
Analyte Group: PFAS
Method: PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15

Analyte	CAS Number	Laboratory Control Spike Lower Control Limit (%)	Laboratory Control Spike Upper Control Limit (%)	Achievable Laboratory Limits		
				DL (µg/kg)	LOD (µg/kg)	LOQ (µg/kg)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	68	136	0.194	0.40	1.0
Perfluoroheptanoic acid (PFHpA)	375-85-9	71	131	0.078	0.40	1.0
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	67	130	0.122	0.40	1.0
Perfluorononanoic acid (PFNA)	375-95-1	72	129	0.062	0.40	1.0
Perfluorooctanoic acid (PFOA)	335-67-1	69	133	0.059	0.40	1.0
Perfluorobutanesulfonic acid (PFBS)	375-73-5	72	128	0.071	0.40	1.0
Perfluorobutanoic acid (PFBA)	375-22-4	71	135	0.046	0.40	1.0
Perfluoropentanoic acid (PFPeA)	2706-90-3	69	132	0.054	0.40	1.0
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	61	139	0.097	0.40	1.0
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	63	144	0.196	0.40	1.0
Perfluorodecanoic acid (PFDA)	335-76-2	69	133	0.041	0.40	1.0
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	69	133	0.119	0.40	1.0
Perfluorododecanoic acid (PFDoA)	307-55-1	69	135	0.101	0.40	1.0
Perfluorohexanoic acid (PFHxA)	307-24-4	70	132	0.043	0.40	1.0
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	66	139	0.119	0.40	1.0
Perfluoroundecanoic acid (PFUdA)	2058-94-8	64	136	0.011	0.40	1.0
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	64	140	0.066	0.40	1.0
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	65	137	0.122	0.40	1.0

Notes:
% = percent
µg/kg = micrograms per kilogram
CAS = Chemical Abstracts Service
DL= detection limit
LC/MS/MS = liquid chromatography with tandem mass spectrometry
LOD = limit of detection
LOQ = limit of quantitation
PFAS = per- and polyfluoroalkyl substances
QSM =Quality Systems Manual
USEPA = United States Environmental Protection Agency

Matrix: Soil

Analyte Group: Wet Chemistry

Analyte	Method	Laboratory Control Spike Lower Control Limit (%)	Laboratory Control Spike Upper Control Limit (%)	Achievable Laboratory Limits		
				DL (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Total Organic Carbon	9060A	90	110	150	200	250

Notes:
% = percent
DL= detection limit
LOD = limit of detection
LOQ = limit of quantitation
mg/kg = milligrams per kilogram
NA = not applicable

784 **SLs for Soil and Groundwater**

785 The DoD has adopted a policy to retain facilities in the CERCLA process based on conservative SLs for soil and groundwater, as
786 described in a memorandum from the OSD dated 15 September 2021 (Assistant Secretary of Defense, 2021). The ARNG program
787 under which this SI will be performed follows this DoD policy and should the maximum concentration for sampled media exceed the
788 SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD
789 memorandum apply to three compounds: PFOS, PFOA, and PFBS.
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Analyte	CAS Number	Residential (Soil) (µg/kg)[a,b] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a,b] 2 -15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	130	1,600	40
Perfluoroheptanoic acid (PFHpA)	375-85-9	-	-	-
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	-	-	-
Perfluorononanoic acid (PFNA)	375-95-1	-	-	-
Perfluorooctanoic acid (PFOA)	335-67-1	130	1,600	40
Perfluorobutanesulfonic acid (PFBS)[c]	375-73-5	1,900	25,000	600
Perfluorobutanoic acid (PFBA)	375-22-4	-	-	-
Perfluoropentanoic acid (PFPeA)	2706-90-3	-	-	-
N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	-	-	-
N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	-	-	-
Perfluorodecanoic acid (PFDA)	335-76-2	-	-	-
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	-	-	-
Perfluorododecanoic acid (PFDoA)	307-55-1	-	-	-
Perfluorohexanoic acid (PFHxA)	307-24-4	-	-	-
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	-	-	-
Perfluoroundecanoic acid (PFUdA)	2058-94-8	-	-	-
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	-	-	-
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	-	-	-

791

Notes:

a.) Assistant Secretary of Defense, 2021. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. 15 September 2021.

b.) The SLs for soil are based on incidental ingestion of soil applied to the soil intervals reasonably anticipated to be encountered; surface soil (0 to 2 feet bgs for the residential scenario) and subsurface soil (2 to 15 feet bgs for the industrial/commercial worker scenario).

µg/kg = micrograms per kilogram
bgs = below ground surface
CAS = Chemical Abstracts Service
ng/L = nanograms per liter
OSD= Office of the Secretary of Defense
SL = screening level

QAPP Worksheet #17: Sampling Design and Rationale

Worksheet #17a-f describes the sampling design, basis for its selection, and field investigation details. Field activities will be completed per the Standard Operating Procedures (SOPs) in **Appendix B**.

The objective of the SI is to identify whether there has been a release to soil and groundwater (if present) at each AOI and determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs. As discussed in **Worksheet #10**, two AOIs were identified at Biak Training Center Brett Hall. Regional groundwater flow at the Biak Training Center Brett Hall is predominantly to the northwest.

- AOI 1: Between 2000 and 2011 and between 2013 and 2015, the USFS Engine Academy utilized the FTA at the MOUT range, approximately 660 feet southwest of the facility building, to conduct annual training. Although no fires were set, AFFF was applied to wooden structures during training exercises to showcase applications of AFFF in fire situations. The concentration and amount of AFFF released during the training events are unknown based on interviews conducted with OMD facility personnel and the USFS personnel. Because the FTA is unpaved, application of AFFF to structures could release PFAS to soil.
- AOI 2: Between 2016 and 2017, the FBI conducted bomb squad training events in part of the MOUT range, approximately 830 feet southwest of the facility building, adjacent to AOI 1. Although no fires were set, AFFF was applied during bomb squad training exercises. The concentration and amount of AFFF released during the training events is unknown. Because the bomb squad training area is unpaved, application of AFFF could release PFAS to soil.

Environmental media samples will be collected from the AOI in accordance with the applicable CSM, as summarized in **Table 17-1**. One permanent monitoring well will be installed downgradient of the potential source areas.

In instances where deviations from this sampling design and rationale are made due to unforeseen conditions, a Field Change Request Form will be generated to document the change and request feedback from the AECOM Task and Project Managers, USACE, and ARNG.

Sampling Tasks

The field program will include tasks as detailed in the following Worksheet elements:

- **Worksheet #17a** - Mobilization
- **Worksheet #17b** - Sonic Boring Installation and Soil Sampling
- **Worksheet #17c** - Permanent Groundwater Monitoring Well Installation and Grab Groundwater Sampling
- **Worksheet #17d** - Water Level Measurements
- **Worksheet #17e** - Surveying
- **Worksheet #17f** - Investigation-Derived Waste Management

Table 17-1: Site Inspection Sample Count

AOI	Potential PFAS Release Area	# of Sonic Borings	Approximate Depth (feet bgs)	Groundwater Samples	Soil Samples	Surface Water/Sediment
1	Engine Academy Training Area	2 1	20 400	0 1	6 6	0
2	Bomb Squad Training Area	3	20	0	9	0
--	Sitewide Locations	1 0	400 NA	1 1	3 0	0 0
Total (not including QC)		7	-	3	24	0

Notes:
1) All samples will be analyzed for PFAS.
2) One soil sample per AOI will be analyzed for pH and TOC from a location in the source area. Grain size analysis will be performed in up to one soil sample per AOI where extensive horizontal and vertical clay units are identified by the field geologist, if these conditions are encountered in the field.

AOI = area of interest
bgs = below ground surface
HA = hand auger
NA = Not applicable, existing potable water well
PFAS = per- and polyfluoroalkyl substances
QC = quality control
Sonic = sonic drilling technology

QAPP Worksheet #17a
Sampling Design and Rationale
Mobilization

Site Preparation

The site preparation activities for the SI field investigation operations include mobilization of field team personnel and equipment. No vegetation clearance is planned during field investigation activities.

PFAS Site Water Supply Sampling and Sampling Equipment Acceptability

A sample from the potable water source (i.e., decontamination water) will be collected prior to mobilization to confirm that it is acceptable for use during field activities (i.e., equipment decontamination). The water source is acceptable for use if the detected concentration is less than 1/5 the SL. If the decontamination water has concentrations greater than 1/5 the SL, the project team will determine whether the water is acceptable for its intended use based on site-specific factors (i.e., drilling methodology, relevant sample media). If the water is deemed unacceptable, water will be brought onsite from another source confirmed to be PFAS-free through sampling. Quality control (QC) samples will not be collected for the decontamination water sample.

All materials being purchased or rented for field work will be confirmed as acceptable for use in the PFAS sampling environment. A summary of acceptability of materials for use in the PFAS sampling environment is provided in SOP 3-41 (**Appendix B**). As an additional layer of control, prior to the start of field work each day, a PFAS Sampling Checklist will be completed (SOP 3-41, **Appendix B**). The checklist will serve as a reminder to each field team member regarding the

allowable materials within the sampling environment. An example of the checklist is provided below.

Example PFAS Daily Sampling Checklist

Team Members		
Yes	No	Description
		Has AECOM PFAS Sampling guidance been reviewed by all team members?
		Comments:
Yes	No	Has AECOM field sampling staff received needed training certification?
		Comments:
Yes	No	Was a briefing held for field sampling staff?
		Comments:
Yes	No	Were additional PFAS sampling instructions given to field sampling staff?
		Comments:
Yes	No	Have personal clothing and PPE requirements been followed by all field sampling staff?
		Comments:
Yes	No	Were lotions and sunscreen used for field sampling staff?
		Comment:
Sample Collection		
Yes	No	Has a PFAS-free water source been identified?
		Comment
		Source of PFAS-free water:
Yes	No	Have all sampling items, parts and equipment been inspected to be free of PFAS?
		Comment:
Yes	No	Has sampling location sequence been communicated to avoid cross-contaminations?
		Comment:
Yes	No	Have drilling fluids been evaluated and shown to be free of PFAS?
		Comment:
Yes	No	Use of PFAS-free decontamination solution?
		Brand name of decontamination solution:
Yes	No	Have all field logs, notebooks, pens, labels been inspected, and do they meet AECOM PFAS sampling guidance requirements?
		Comment:
Yes	No	Have all sample shipping materials (ice, Ziploc® bags) been inspected, and do they meet AECOM PFAS sampling guidance requirements?
		Comment:
Yes	No	Have all blanks arrived at the site and will they be collected to verify cross-contamination?
		Comment:
Document Control		
Yes	No	Have all variances from sampling guidance been documented?
		Comment:
Other Comments:		

Personnel Qualifications

All personnel mobilized to the facility will meet applicable Occupational Safety and Health Administration (OSHA) training requirements including hazardous waste operations and emergency response (HAZWOPER) training and medical surveillance requirements as specified in the Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). Personnel will be required to complete the DoD's *Operations Security Awareness for Military Members, DoD Employees, and Contractors* and *Level 1 Antiterrorism Awareness Training*. Additionally, all AECOM employees that will be performing field work will take an internal PFAS sampling guidance training.

Permits and Notifications

Utility clearance will be conducted by a private utility locator under the supervision of the AECOM field team using ground penetrating radar or electromagnetic methods with support from ORARNG (e.g., utility maps, GIS layers, site knowledge, etc.). A minimum of two weeks to coordinate the clearance will be required. AECOM or its drilling subcontractor will contact Oregon 811, the local one-call utility location system. AECOM will arrange for a private utility locating company to identify locations of detectable subsurface utilities. AECOM will escort the private utility locator and coordinate access with the ARNG Environmental Manager. AECOM and the drilling subcontractor will participate in a Biak Training Center Brett Hall orientation prior to initiating work, if required. The determination of the orientation requirement will be made after final intrusive investigation locations are determined. AECOM will also contact the ARNG

Environmental Manager at least five business days prior to the scheduled start of the field activities. A site walk will be scheduled with the appropriate ARNG personnel to mark out locations of the subsurface utilities. As a precaution, the first 5 feet of each boring will be pre-cleared using hand tools (e.g., post-hole diggers, augers, etc.) or air knifing methods. If bedrock is encountered shallower than 5 feet below ground surface during hand clearing, the location will be considered free of utilities and sonic drilling will commence. All field work will be coordinated with the ARNG Environmental Manager and/or his/her designee.

Health and Safety Requirements

Health and safety requirements for SI field activities are provided in the APP. Field personnel will wear PFAS-free Level D personal protective equipment (PPE). Detailed Activity Hazard Analyses identifying the physical, chemical, and biological hazards that may be encountered at the facility and the associated mitigation methods are presented in the SSHP.

All onsite personnel who may be exposed to hazardous conditions will be required to meet training requirements identified in Federal Regulation 29 CFR 1910.120 (HAZWOPER). At least two personnel trained in first aid and cardiopulmonary resuscitation (CPR) will be onsite during field activities. Training certificates for personnel (HAZWOPER 40-hour training; current HAZWOPER 8-hour refresher training; and first aid/CPR) will be maintained onsite by the Site Supervisor.

Personnel and visitors who enter the facility will be required to review the APP and SSHP and sign the acknowledgement form. Site workers will be required to sign the daily tailgate safety meeting form and fill out daily Activity Hazard Analysis forms. Safety issues that arise during implementation of field activities will be addressed during tailgate safety meetings held daily before the workday and will be documented in the daily tailgate safety meeting form.

QAPP Worksheet #17b
Sampling Design and Rationale
Sonic Boring Installation and Soil Sampling

Soil samples will be collected via Sonic drilling methods (SOP 3-17). Hand augers will be used for collection of surface soil samples (0 to 2 feet bgs). Borings will be advanced using sonic drilling at locations designated for subsurface soil sample collection; however, hand augers will be used to clear the top 5 feet of the boring in accordance with AECOM utility clearance protocols. A TerraSonic 150T drill rig will utilize a 6-inch core barrel to collect continuous soil cores to the target depth or bedrock, whichever is shallower. Sonic drilling will be used to collect up to three soil samples per boring, if possible: one surface soil sample (0 to 2 feet bgs), one subsurface soil sample at the bedrock interface, and one subsurface soil sample at the mid-point between the surface and the bedrock interface if the bedrock interface is up to 30 feet bgs or shallower, or from 13 to 15 feet bgs if the bedrock interface is greater than 30 feet deep. If refusal is encountered at 6 feet bgs or shallower, only two samples will be collected per boring: one surface soil sample (0 to 2 feet bgs) and one sample approximately 1 foot above refusal. All drilling materials will be PFAS-free.

Due to the geology of the facility, it is expected that groundwater will not be encountered above bedrock at AOI 1 or AOI 2. At boring locations advanced for permanent groundwater monitoring well installation, additional soil samples will be collected from beneath the bedrock surface if paleosoils or other non-competent, unsaturated interbeds, potentially representing preferential pathways for precipitation infiltration, are encountered (refer to QAPP Worksheet #17c).

The proposed sample locations are shown on **Figures 17-1** and described in **Worksheet #18**. The soil sample rationale and target depths for the borings are provided in **Table 17-2** below.

949 **Table 17-2: Soil Sample Rationale and Target Depths for Borings**

Area of Interest	Number of Borings	Sample Collection Method	Target Depth (feet bgs)	Rationale
AOI 1	3	Sonic	20 / bedrock 400 / groundwater	Two borings at historical locations of former wooden structures within suspected release area. Target depth of boring was determined by the likelihood of bedrock. One boring at historical locations of former wooden structures within suspected release area. Target depth of boring was determined by the anticipated depth to the regional aquifer.
AOI 2	3	Sonic	20 / bedrock	Three borings at within suspected release area. Target depth of boring was determined by the likelihood of bedrock.
Sitewide	1	Sonic	400 / groundwater	One boring regionally downgradient from AOI 1 and AOI 2. Target depth of boring was determined by the anticipated depth to the regional aquifer .

950 Notes:
951 AOI = area of interest
952 bgs = below ground surface
953

954 The soil cores will be continuously logged for lithological descriptions by a field geologist using
955 the Unified Soil Classification System (USCS) per SOP 3-16. A photoionization detector (PID) will
956 be used to screen the breathing zone during boring activities. Observations and measurements
957 will be recorded on field forms and in a non-treated field logbook. Photographs of the boring cores
958 will also be taken. At a minimum, depth interval, recovery thickness, PID concentrations, moisture,
959 relative density, color (using a Munsell soil color chart), and texture (using the USCS) will be
960 recorded. Additional observations to be recorded may organic material or cultural debris.

961 It is anticipated that all borings will be advanced in areas without surface cover; however, if a
962 boring is required in asphalt, it will be abandoned by backfilling with bentonite chips to
963 approximately 6 inches bgs, and the remainder of the borehole will be patched with an asphalt
964 cold patch. Borings into concrete will be avoided, if possible; however, if borings are advanced
965 into concrete, the borings will be abandoned by backfilling with bentonite chips to approximately
966 6 inches bgs, and the remainder of the borehole will be filled with concrete to provide as flush a
967 surface as possible. The surface at each location will be restored to match the surrounding area.

968 QC samples will be collected in accordance with **Worksheet #20**. Field duplicate samples will be
969 collected at a rate of 10% and analyzed for the same parameters as the accompanying samples.
970 Matrix spikes/ matrix spike duplicates (MS/MSDs) will be collected at the rate of 5% and analyzed
971 for the same parameters as the accompanying samples. One Field Reagent Blank (FRB) will be
972 collected per sampling event and will be analyzed for PFAS. For non-dedicated sampling
973 equipment, decontamination will be completed after each use (i.e., downhole tool and hand auger
974 decontaminated between intervals sampled for laboratory analysis), and associated equipment
975 rinsate blanks (ERBs) will be collected at a rate of one per twenty samples. ERBs will be analyzed
976 for the same analytes as the associated samples. A temperature blank will be placed in each
977 cooler to ensure that samples are preserved at or below 6 degrees Celsius (°C) during shipment.

978 Each sample will be collected into laboratory-supplied bottleware and submitted to the laboratory
979 for analysis of selected parameters. Samples will be analyzed for PFAS by liquid chromatography
980 tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.3 Table
981 B-15. Additionally, one soil sample per AOI from a location in the source area will be analyzed for

total organic carbon (TOC) (USEPA Method 9060A) and pH (USEPA Method 9045D). Additionally, up to one soil sample per AOI will be submitted for grain size analysis with sieve and hydrometer (American Society for Testing and Materials [ASTM] D-422) (i.e., clay content). The grain size analysis will be performed where extensive horizontal and vertical clay units are identified by the field geologist if these conditions are encountered in the field. Sample containers will be PFAS-free. The laboratory method detection limits (DLs) for these analytes are presented in **Worksheet #15**. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard chain of custody (CoC) procedures to the laboratory (see SOP 3-04).

QAPP Worksheet #17c
Sampling Design and Rationale
Permanent Groundwater Monitoring Well Installation and Groundwater Sampling

The boreholes for two permanent wells will be advanced using a TerraSonic 150T drill rig utilizing sonic drilling technology and equipped with a 8-inch core barrel and 10-inch drive casing to obtain continuous rock cores for lithologic logging and determine depth to groundwater. Once the boreholes have been advanced to the specified depth or first encountered groundwater, the permanent well will be constructed of a 20-foot section of 4-inch Schedule 80 poly-vinyl chloride (PVC) screen with sufficient casing to reach ground surface. If first encountered groundwater is above the regional aquifer, well screen length will be reduced, if necessary, to suit the saturated zone. Only new PVC pipe will be used. The target screen interval will be the top of the groundwater table, which is expected to be encountered no deeper than 440 feet bgs. The target screen interval and rationale for the sampling location are described in **Table 17-3**. The well will be completed at the surface with a concrete well vault, a flush-mount monument, and protective bollards.

Table 17-3: Groundwater Sample Rationale and Proposed Screen Intervals

Area of Interest	# Permanent wells	Target Screen Interval (feet bgs)	Rationale
AOI 1	1	Top of groundwater table (est. 400)	One permanent well within the suspected release areas. Target boring depth was determined by anticipated depth to the regional aquifer.
Sitewide	1	Top of groundwater table (est. 400)	One permanent well downgradient from suspected release areas. Target boring depth was determined by the anticipated depth to the regional aquifer.
	0	NA	One sample from the down/across gradient facility drinking water well (tap sample).

Notes:
AOI = area of interest
bgs = below ground surface
NA = Not applicable, existing potable water well

A groundwater sample will be collected from the permanent well using a 0.85-inch Geotech bladder pump (or similar) with parts and tubing that has been determined to be PFAS-free (i.e., high-density polyethylene [HDPE] or other PFAS-free material). Prior to sampling, the well will be purged in order to remove sediment, to the extent reasonable, in an effort to minimize the turbidity of the sample (see SOP 3-37: Grab Groundwater Sampling Techniques for additional details). The degree of purging will be dependent on groundwater recharge within the well. If sufficient groundwater recharge is observed, the well will be purged until the turbidity is ≤ 25 nephelometric turbidity units (NTU), stabilizes at a level above 25 NTU, or for a maximum duration of one hour, whichever occurs first. In wells with limited groundwater recharge, the sample will be collected using the available groundwater.

In addition to turbidity, other water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) will be measured and recorded on the field sampling form every 5 minutes until the above turbidity criteria are met. Water quality parameters will be measured using a water quality meter and flow-through cell (see SOP 3-14: Monitoring Well Sampling and SOP 3-24: Water Quality Parameter Testing for more details). In addition, a subsample of each groundwater sample will be collected in a separate container and undergo a shaker test to identify if there is any foaming. If foaming is observed, the observation will be noted on the CoC to notify the laboratory of potentially high PFAS concentrations in the sample prior to analysis. Any non-dedicated sampling materials will be decontaminated between boring locations.

One groundwater sample will be collected from the facility drinking water well from an accessible tap as close to the well as allowable. Because the sample will be collected from a drinking water source, the sample will be collected following SOP 3-42: PFAS Drinking Water Sampling Techniques.

Each sample will be collected into laboratory-supplied bottleware and submitted to the laboratory for analysis of selected parameters (PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15) (DoD, 2019a) as per SOP 3-41. The laboratory method DLs for these analytes are presented in **Worksheet #15**. QC samples will be collected in accordance with **Worksheet #20**. ERBs will be collected at a rate of one per twenty samples and will be analyzed for the same analytes as the associated samples. Sample containers will be PFAS-free, and the aqueous samples will not be filtered. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard CoC procedures to the laboratory (SOP 3-04).

QAPP Worksheet #17d
Sampling Design and Rationale
Water Level Measurements

Groundwater elevation will be compared to expected local groundwater elevation. A water level elevation measurement will be collected from the newly-installed permanent monitoring wells (as shown on **Worksheet #18**). If SI groundwater monitoring wells are screened within the regional aquifer (approximately 400 feet bgs), depth to water will be measured within the facility drinking water well. Depth to groundwater at all wells will be measured using an electronic water level indicator inserted within the well casing or access port. The newly installed monitoring wells and the facility drinking water well access port will be surveyed, and the water level measurement will be taken from the survey mark on the northern side of the well casing.

QAPP Worksheet #17e
Sampling Design and Rationale
Surveying

A small notch will be cut on the northern side of the well casing which will be surveyed by a state-licensed surveyor (see SOP 3-07). The top of casing and ground surface elevation will be surveyed for the newly installed wells and the facility drinking water well access port. Survey data will be collected in the applicable North American Datum 1983 State Plane (horizontal) and North American Vertical Datum 1988 (vertical).

QAPP Worksheet #17f
Sampling Design and Rationale
Investigation-Derived Waste Management

Currently, the disposal of PFAS investigation-derived waste (IDW) is not regulated. As such, the IDW will be managed as follows.

Soil IDW (i.e., soil cuttings) generated during SI activities will be containerized in properly labeled 55-gallon drums (See SOP 3-05), and rock core will be placed in wax-lined carboard core boxes. The IDW will be stored onsite at a location designated by the Biak Training Center Brett Hall Environmental Manager and ORARNG. ARNG will manage disposal of the solid IDW and will coordinate with the Oregon DEQ to ensure proper disposal in accordance with Oregon Administrative Rules (OAR) Chapter 340 and the Army Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

Liquid IDW (i.e., purged groundwater and decontamination fluids) generated during SI activities will be containerized in properly labeled 55-gallon drums (See SOP 3-05). The liquid IDW will not be sampled and will assume the PFAS characteristics of the associated groundwater samples collected from the source locations. The containerized IDW will be temporarily stored onsite at a location designated by the Biak Training Center Brett Hall Environmental Manager and ORARNG until the analytical results for the associated groundwater samples are available. Liquid IDW drums will only be filled 75% full to account for freeze/thaw cycles. ARNG will manage and dispose of the liquid IDW under a separate contract in accordance with *SOP No. 042A for Treating Liquid Investigation-Derived Material (Purge water, drilling water, and decontamination fluids)* (EA Engineering, Science, and Technology, Inc., 2021). ARNG will further coordinate with the Oregon DEQ to ensure proper disposal is in accordance with OAR Chapter 340 and the Army Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

AECOM will collect global positioning system (GPS) points (i.e., polygons) around the location where the IDW drums are stored.

Other solids such as spent PPE, plastic sheeting, tubing, rope, unused monitoring well construction materials, and other environmental media generated during the field activities will be disposed of at a licensed solid waste landfill.

CLIENT	ARNG			
Site Inspection for PFAS at Biak Training Center Brett Hall in Powell Butte, OR				
REVISED	1/26/2022	GIS BY	MS	1/26/2022
SCALE	1:2,400	CHK BY	MB	1/26/2022
Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	CM	1/26/2022

Site Inspection Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 17-1

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QAPP Worksheet #18: Sampling Locations and Methods

The table below describes the samples that will be collected during the SI. Sampling SOPs can be found in **Appendix B**.

AOI	Location Identifier	Sample Identifier	Matrix	Depth (feet bgs)	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
Soil Samples							
All	AOI01-01 AOI01-02 AOI01-03 AOI02-01 AOI02-02 AOI02-03	AOI01-01-SB-[Start Depth]-[End Depth] AOI01-02-SB-[Start Depth]-[End Depth] AOI01-03-SB-[Start Depth]-[End Depth] AOI02-01-SB-[Start Depth]-[End Depth] AOI02-02-SB-[Start Depth]-[End Depth] AOI02-03-SB-[Start Depth]-[End Depth]	Surface Soil	0-2 feet bgs	Hand Auger	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15) Limited Sample Selection (one sample per AOI): TOC (USEPA Method 9060A) pH (USEPA Method 9045D) Limited Sample Selection (up to one sample per AOI): Grain Size/Clay Content (ASTM D-422)	3-21
All	AOI01-01 AOI01-02 AOI01-03 AOI02-01 AOI02-02 AOI02-03	AOI01-01-SB-[Start Depth]-[End Depth] AOI01-02-SB-[Start Depth]-[End Depth] AOI01-03-SB-[Start Depth]-[End Depth] AOI02-01-SB-[Start Depth]-[End Depth] AOI02-02-SB-[Start Depth]-[End Depth] AOI02-03-SB-[Start Depth]-[End Depth]	Subsurface Soil	mid-point or 13-15 feet bgs	Sonic Sampling System	See Above	3-21
All	AOI01-01 AOI01-02 AOI01-03 AOI02-01 AOI02-02 AOI02-03	AOI01-01-SB-[Start Depth]-[End Depth] AOI01-02-SB-[Start Depth]-[End Depth] AOI01-03-SB-[Start Depth]-[End Depth] AOI02-01-SB-[Start Depth]-[End Depth] AOI02-02-SB-[Start Depth]-[End Depth] AOI02-03-SB-[Start Depth]-[End Depth]	Subsurface Soil	Bedrock interface	Sonic Sampling System	See Above	3-21

AOI	Location Identifier	Sample Identifier	Matrix	Depth (feet bgs)	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
All	AOI01-01 AOI01-01 AOI01-01	AOI01-01-SB-[Start Depth]-[End Depth] AOI01-01-SB-[Start Depth]-[End Depth] AOI01-01-SB-[Start Depth]-[End Depth]	Subsurface Soil	Bedrock interbeds	Sonic Sampling System	See Above	3-21
Site-wide	BTC-01 BTC-01 BTC-01	BTC-01- SB-[Start Depth]-[End Depth] BTC-01- SB-[Start Depth]-[End Depth] BTC-01- SB-[Start Depth]-[End Depth]	Subsurface Soil	Bedrock interbeds	Sonic Sampling System	See Above	3-21
Groundwater Samples							
All	AOI01-01	AOI01-01-GW	Groundwater	Mid-screen	Pneumatic or bladder pump	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15)	3-14
Site-wide	BTC-01	BTC-01-GW	Groundwater	Mid-screen	Pneumatic or bladder pump	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15)	3-14
QA/QC Samples							
All	AOI01-01*	AOI01-01-SB-[Start Depth]-[End Depth]-D* AOI01-01-SB-[Start Depth]-[End Depth]-MS* AOI01-01-SB-[Start Depth]-[End Depth]-MSD*	Solid (Soil)	TBD	Hand Auger; Sonic Drilling Method	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15) Limited Sample Selection (one sample per AOI): TOC (USEPA Method 9060A) pH (USEPA Method 9045D)	3-21
Site-wide	BTC-01*	BTC-01-GW-D* BTC-01-GW-MS* BTC-01-GW-MSD*	Aqueous (Groundwater)	Mid-screen	Pneumatic or bladder pump	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15)	3-14
NA	NA	BTC-FRB-01	Water Quality	NA	NA (Pour laboratory-supplied PFAS-free water)	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15)	3-10
NA	NA	BTC-ERB-01 BTC-ERB-02 BTC-ERB-03	Water Quality	NA	NA (Pour laboratory-supplied PFAS-free water)	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15)	3-10

AOI	Location Identifier	Sample Identifier	Matrix	Depth (feet bgs)	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
NA	NA	BTC-DECON-01	Decontamination Water Source	NA	NA (collect from tap or hose)	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15)	3-10

Notes:
* Locations of field quality control samples (duplicates and MS/ MSDs) will be selected in the field at the rates specified in Worksheet #20 of this SI QAPP Addendum. The location and sample identifiers listed in Worksheet #18 are included as examples only.
AOI = area of interest
ASTM = American Society for Testing and Materials
bgs = below ground surface
D = duplicate
ERB = equipment rinsate blank
FRB = field regent blank
GW = groundwater
LC/MS/MS = liquid chromatography tandem mass spectrometry
MS = matrix spike
MSD = matrix spike duplicate
NA = not applicable
PFAS = per- and polyfluoroalkyl substances
QA = quality assurance
QC = quality control
QSM = Quality Systems Manual
SB = soil boring
SOP = standard operating procedure
TBD = to be determined
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

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Final PQAPP Worksheet #19 & #30: Sample Containers, Preservation, and Hold Times

Laboratory: Pace Gulf Coast
7979 Innovation Park Dr.
Baton Rouge, Louisiana 70820
(225) 769-4900
List any required accreditations/certifications: DoD/ELAP; applicable state certification
Back-up Laboratory: NA
Sample Delivery Method: FedEx

Analyte/ Analyte Group	Matrix	Method/SOP	Accreditation Expiration Date	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
PFAS	Aqueous	QSM 5.3 Table B-15/ SOP LCMS-011 (BRTO-0111)	ELAP-01/31/2023 NELAP-6/30/2023	HDPE w/ HDPE screw cap 2 x 125mL	Cool, 0-6°C	14 days from collection to extraction	28 days from extraction to analysis	28 days
PFAS	Solid	QSM 5.3 Table B-15/ SOP LCMS-011 (BRTO-0111)	ELAP-01/31/2023 NELAP-6/30/2023	HDPE w/ HDPE screw cap 1 x 250 mL	Cool, 0-6°C	14 days from collection to extraction	28 days from extraction to analysis	28 days
Total Organic Carbon	Solid	USEPA 9060A, SM 5310 B-2011/WL-057	ELAP-01/31/2023 NELAP-6/30/2023	Polyethylene, Glass 1 x 2oz	Cool, 0-6ºC,	30 days to extraction	7 days from extraction to analysis	28 days
pH	Solid	USEPA 9045D/EXT-032	ELAP-01/31/2023 NELAP-6/30/2023	Polyethylene, Glass 1 x 2oz	None	NA	Immediate	28 days
Grain Size	Solid	ASTM D422/ CA-551	02/01/2022	Polyethylene, Glass 1 x 8oz	Cool, 0-6ºC	None	None	28 days

Notes:
1.) TOC and pH are important for evaluating transport through the soil medium.

°C = degrees Celsius
ASTM = American Society for Testing and Materials
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
HDPE = high-density polyethylene
LCMS = liquid chromatography/ mass spectrometry
mL = milliliter
NA = not applicable
NELAP = National Environmental Laboratory Accreditation Program
oz = ounce
PFAS = per- and polyfluoroalkyl substances
QSM = Quality Systems Manual
SOP = standard operating procedure
USEPA = United States Environmental Protection Agency

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Final PQAPP Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Field Reagent Blanks	Equipment Rinsate Blanks*	Total Samples
Groundwater	PFAS	2	1	1	1	1	1	7
Soil	PFAS	24	3	2	2	0	2**	33
	pH, TOC	2	1	1	1	0	0	5
	Grain Size	2	0	0	0	0	0	2
Decontamination Water	PFAS	1	0	0	0	0	0	1

Notes:
*Applies only if use of non-dedicated sampling equipment is necessary
** Equipment rinsate blanks for solid matrices are aqueous samples
PFAS = per- and polyfluoroalkyl substances
TOC = total organic carbon

Measurement Performance Criteria Table — Field Quality Control Samples				
QC Sample	**Analytical Group**	**Frequency**	**Data Quality Indicators**	**MPC**
Matrix: Aqueous (Groundwater/ Surface Water/ Potable Wells)				
Field Duplicate	PFAS	One per 10 field samples	Precision	Values > 5X LOQ: RPD must be ≤30% Values ≤ 5X LOQ: Absolute difference ≤ 2x the LOQ
Matrix Spike/Matrix Spike Duplicate	PFAS	One per 20 field samples[1]	Bias/Accuracy/Precision (lab)	RPD ≤ 30%; Refer to Worksheet #28 for recovery criteria
Equipment Rinsate Blank	PFAS	One per 20 field samples per type of reusable equipment used[2]	Accuracy/ Bias	No target analytes ≥ ½ LOQ, unless target analytes in field samples are > 10x those in rinsate blank. Laboratory-certified PFAS-free water will be used to collect ERBs.
Reagent Blank	PFAS	One per sampling event[3]	Accuracy/ Bias	No target analytes ≥ ½ LOQ, unless target analytes in field samples are > 10x those in rinsate blank
Cooler Temperature Blank	PFAS	One per cooler	Representativeness	Temperature must be above freezing and ≤ 6 °C
Matrix: Solid (Soil and Sediment)				
Field Duplicate	PFAS, TOC	One per 10 field samples	Precision	Values > 5X LOQ: RPD must be ≤30% Values ≤ 5X LOQ: Absolute difference ≤ 2x the LOQ
Matrix Spike/Matrix Spike Duplicate	PFAS, TOC	One per 20 field samples[1]	Bias/Accuracy/Precision (lab)	RPD ≤ 30%; Refer to Worksheet #28 for recovery criteria
Reagent Blank	PFAS	One per sampling event[3]	Accuracy/ Bias	No target analytes ≥ ½ LOQ, unless target analytes in field samples are > 10x those in rinsate blank
Equipment Rinsate Blank	PFAS	One per 20 field samples per type of reusable equipment used[2]	Accuracy/ Bias	No target analytes ≥ ½ LOQ, unless target analytes in field samples are > 10x those in rinsate blank
Cooler Temperature Blank	PFAS	One per cooler	Representativeness	Temperature must be above freezing and ≤ 6°C

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Notes:
1.) Analyzed more frequently than one per twenty samples or per sample delivery group.
2.) Only for re-usable equipment, not for disposable equipment/ supplies.
3.) Regardless of matrix.

% = percent
≤ = less than or equal to
≥ = greater than or equal to
°C = degrees Celsius
FRB = field reagent blank
LOQ = limit of quantitation
MPC = measurement performance criteria
PFAS = per- and polyfluoroalkyl substances
QC = quality control
RPD = relative percent difference
TOC = total organic carbon

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Final PQAPP Worksheet #21: Field Standard Operating Procedures

A summary of SOPs is provided in the table below, which can be found in **Appendix B**. All field staff will be trained through AECOM's internal PFAS Sampling Training prior to performing any sampling activities. A summary of the acceptability of certain materials for use in the PFAS sampling environment and a PFAS sampling checklist to be completed daily is provided in SOP 3-41.

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Modified for Project Work?	Comments
3-01	*Utility Clearance*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-02	*Logbooks*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-03	*Recordkeeping, Sample Labeling and Chain of Custody*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-04	*Sample Handling, Storage, and Shipping*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-05	*Investigation-Derived Waste Management*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-06	*Equipment Decontamination*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-07	*Land Surveying*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-09	*Geophysics*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-10	*Surface Water Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-12	*Monitoring Well Installation*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-13	*Monitoring Well Development*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-14	*Monitoring Well Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Modified for Project Work?	Comments
3-15	*Monitoring Well and Borehole Abandonment*	AECOM	N	See SOP for detailed procedures
3-16	*Soil and Rock Classification*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-17	*Direct Push Sampling Techniques*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-20	*Operation and Calibration of Photoionization Detector*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-21	*Surface and Subsurface Soil Sampling Procedures*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-22	*Sediment Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-24	*Water Quality Parameter Testing for Groundwater Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-33	*Subsurface Soil Sampling by Split Spoon*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-35	*In-Situ Hydraulic Conductivity Testing via Rising or Falling Head Slug Testing*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-37	*Grab Groundwater Sampling Techniques*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-41	*Per- and Polyfluoroalkyl Substance Field Sampling Protocol*	AECOM	Y	See SOP for detailed procedures

Notes:
AECOM = AECOM Technical Services, Inc.
N = no
NA = not applicable
PFAS = per- and polyfluoroalkyl substances
SOP = standard operating procedure
Y = yes

Final PQAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	Maintenance Activity	SOP Reference	Testing Activity	Inspection Activity	Title or Position of Responsible Person	Frequency	Calibration Acceptance Criteria	Corrective Action
Horiba U-52 Water Quality Standards (pH, ORP, DO, Conductivity, Temperature, Turbidity)	Calibrate with standard solutions	Per page 8 of SOP 3-24	SOP 3-24	Operational equipment check and calibration	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	DO: ±0.3 mg/L of the theoretical oxygen solubility ORP: ±10 mv from the theoretical standard value at that temperature pH: ±0.2 pH Units Specific Conductance: ±5% of the standard Turbidity: 0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard	Minor: Repair Major: Replace instrument
MiniRAE 2000 (PID)	Calibrate with fresh air and isobutylene calibration gas	Per page 4 of SOP 3-20	SOP 3-20	Operational equipment check and calibration	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	0-99 ppm ± 0.1 ppm 100-1,999 ppm ± 1.0 ppm 2000-10,000 ppm ± 10 ppm	Minor: Repair Major: Replace instrument
QED MP10 Controller (Bladder Pump Controller Box)	NA	--	SOP 3-14	Operational equipment check	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	NA	Minor: Repair Major: Replace instrument

Field Equipment	Calibration Activity	Maintenance Activity	SOP Reference	Testing Activity	Inspection Activity	Title or Position of Responsible Person	Frequency	Calibration Acceptance Criteria	Corrective Action
QED SamplePro (Stainless Steel Submersible Bladder Pump)	NA	Per page 7 of SOP 3-14	SOP 3-14	Operational equipment check	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	NA	Minor: Repair Major: Replace instrument

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Field Equipment	Calibration Activity	Maintenance Activity	SOP Reference	Testing Activity	Inspection Activity	Title or Position of Responsible Person	Frequency	Calibration Acceptance Criteria	Corrective Action
Solinst 101 (Water Level Meter)	NA	Per page 5 of SOP 3-14	SOP 3-14	Operational equipment check	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	NA	Minor: Repair Major: Replace instrument
Geotech GeoPump (Peristaltic Pump)	NA	NA	SOP 3-14	Operational equipment check	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	NA	Minor: Repair Major: Replace instrument

Notes:
°C = degrees Celsius
DO = dissolved oxygen
mg/L = milligrams per liter
NA = not applicable
NTU = nephelometric turbidity unit
ORP = oxidation-reduction potential
PID = photoionization detector
ppm = parts per million
SOP = standard operating procedure
Temp = temperature
µS/cm = micro Siemens per centimeter

Final PQAPP Worksheet #23: Analytical Standard Operating Procedures

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
ENV-SOP-BRTO-0111	*PFAS in NPW/SCM by LC-MS/MS with Isotopic Dilution (QSM Table B-15 Compliant) and SPE/DIA Extraction (LCMS-011) (28 Mar 2020)*	Definitive	Water/PFAS Solid/PFAS	Agilent 6460 Triple Quad LC/MS/MS	Pace Gulf Coast	N
ENV-SOP-BTRO-0044	*TOC in Solids and Wastes by Combustion Analyzer (WL-057) (27 Feb 2020)*	Definitive	Solid/TOC	Shimadzu TOC-V CSH or TOC-V CPH analyzer	Pace Gulf Coast	N
ENV-SOP-BTRO-0037	*pH and ORP in Waters, Solids and Wastes by Meter (EXT-032), 1 September 2020, Revision 1*	Definitive	Solid/pH	Orion 720A pH Meter, Combination Electrode	Pace Gulf Coast	N
CA-551	*Grain Size Analysis, 06/20, Revision 3*	Definitive	Solid/Grain Size	Sieve	Katahdin Analytical Services, Inc.	N

Notes:
LCMS = liquid chromatography/ mass spectrometry
LC/MS/MS = liquid chromatography tandem mass spectrometry
N = no
PFAA = perfluorinated alkyl acids
PFAS = per- and polyfluoroalkyl substances
SOP = standard operating procedure
TOC = total organic carbon
Y = yes

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1203 # Final PQAPP Worksheet #24: Analytical Instrument Calibrations

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	Calibration Standards	NA	Prior to sample analysis	For analytes which have both linear and branched isomers and have standards available containing both linear and branched isomers, the analytes are calibrated and quantitated using a single continuous baseline to integrate all identifiable isomers.	NA	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	Tune Check	NA	When the masses fall outside of the ±0.5 amu of the true value (as determined by the product ion formulas).	Mass assignments of tuning standard within 0.5 amu of true value.	Retune instrument and verify. If the tuning will not meet acceptance criteria, an instrument mass calibration must be performed and the tune check repeated.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	Minimum five-point initial calibration for all analytes (ICAL)	5.0 – 100 ppb on column	Initial calibration prior to sample analysis	The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). Commercial PFAS standards available as salts are acceptable providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time or chemical similarity to the analyte must be used for quantitation. (Internal Standard Quantitation) Analytes must be within 70-130% of their true value for each calibration standard. ICAL must meet one of the two options below: Option 1: The RSD of the RFs for all analytes must be ≤ 20%. Option 2: Linear or nonlinear calibrations must have r2 ≥ 0.99 for each analyte.	Repeat calibration if criterion is not met	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	Second source calibration verification	50 ppb on column	Once after each initial calibration	All analytes must calculate to be within 70-130% of true value and extracted internal standard must calculate to be within 50-150% of true value.	Remake standard, recalibrate if necessary	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	Retention Time Windows	NA	Prior to sample analysis	Established with the first CCV of the day or the average of the ICAL on days when calibration is performed. See Table 3 of LCMS-011 for RT Windows.	Perform maintenance on pump or column. Recalibrate, if necessary, to re-establish retention times.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	Tune check	Agilent ESI-L Low Concentration Tuning Mix	Daily, prior to sample analysis, only once per analytical batch. No time constraints.	Manufacturer recommended criteria which include delta and FWHM tolerance checks of 6 m/z's over the spectrum of the detector.	Retune instrument and repeat check tune. Maintenance may be required.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	LOD/LOQ verification	Various, see Table 3 of LCMS-010	Quarterly	LOD meets method qualitative requirements or is at least 3x higher than noise; LOQ is recovered within LCS criteria.	Perform instrument maintenance and repeat failed LOD or LOQ study passing two consecutive tests or perform new DL study.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	ICV	NA	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value.	Correct problem, rerun ICV. If problem persists, repeat ICAL.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	CCV	5ppb and 50ppb on column	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Concentration of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	Mass Spectral Acquisition Rate	NA.	Each analyte, Extracted Internal Standard (EIS) Analyte.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	NA	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	Calibration, Calibration Verification, and Spiking Standards	5ppb and 50ppb on column	Instrument must have a valid mass calibration prior to any sample analysis. Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL).	Standards containing both branched and linear isomers must be used when commercially available. PFAS method analytes may consist of both branched and linear isomers, but quantitative standards that contain the linear and branched isomers do not exist for all method analytes. For PFAS that do not have a quantitative branched and linear standard, identify the branched isomers by analyzing a qualitative standard that includes both linear and branched isomers and determine retention times, transitions and transition ion ratios. Quantitate samples by integrating the total response (i.e., accounting for peaks that are identified as linear and branched isomers) and relying on the initial calibration that uses the linear isomer quantitative standard.	NA	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	ISC	NA.	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	Instrument Blanks	NA.	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ ½ the LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	Retention Time Window	NA	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)
LC/MS/MS	Retention Time (RT Window Width	NA	Every field sample, standard, blank, and QC sample	RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or, on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples.	Analyst, Supervisor, QA Manager	LCMS-011 (BRTO-0111)

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	Ion Transitions (Precursor →Product)	NA	Every field sample, standard, blank, and QC sample	In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	NA	NA	LCMS-011 (BRTO-0111)
Shimadzu TOC-V CSH or TOC-V CPH	ICAL	Various	Analyzed and evaluated before any result can be quantitated.	The correlation coefficient must be 0.995 or greater	Correct problem; recalibrate instrument, new calibration verified	Analyst, Supervisor, QA Manager	WL-057 (BRTO-0044)
Shimadzu TOC-V CSH or TOC-V CPH	ICV	10,000 µg & 20,000 µg	Immediately following the ICAL	±10% (90-110% of true value)	Instrument maintenance, reanalysis of ICV or initial calibration or re-preparation of the standards	Analyst, Supervisor, QA Manager	WL-057 (BRTO-0044)

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
Shimadzu TOC-V CSH or TOC-V CPH	CCV	10,000 µg	Each day that an ICAL is not performed a CCV must be performed before sample analysis. Also analyze every 10 samples ant at the end of analytical batch	±10 % (90-110% of true value)	Instrument maintenance, reanalysis of ICV or initial calibration or re-preparation of the standards	Analyst, Supervisor, QA Manager	WL-057 (BRTO-0044)
Shimadzu TOC-V CSH or TOC-V CPH	CCB	<250 mg/kg	Analyzed after every 10 samples or more frequently and at the end of analytical batch	Concentration must be less than the LOQ	Correct problem; recalibrate instrument	Analyst, Supervisor, QA Manager	WL-057 (BRTO-0044)
Orion 720 pH Meter	Calibrate meter	1.00-13.00	Daily before use	92-108%	Recalibrate meter	Analyst, Supervisor QA Manager	EXT-032
Orion 720 pH Meter	QC Check Buffer	8.00	Immediately after calibration and with every 20 samples	0.05 pH units of the true value	Recalibrate meter	Analyst, Supervisor, QA Manager	EXT-032

Notes:
% = percent
µg = micrograms
amu = atomic mass unit
CCB = continuing calibration blank
CCV = continuing calibration verification
DL = detection limit
ESI = electrospray Ionization
ICAL = initial calibration

ICV = independent calibration verification
ISC = instrument sensitivity check
LCMS = liquid chromatography/ mass spectrometry
LC/MS/MS = liquid chromatography tandem mass spectrometry
LCS = laboratory control spike
LOD = limit of detection
LOQ = limit of quantitation
mg/kg = milligram per kilogram
NA = not applicable
OSD = Office of the Secretary of Defense
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
ppb = parts per billion
QA = quality assurance
QC = quality control
RSD = relative standard deviation
SOP = standard operating procedure
SL = screening level
S/N = signal to noise

Final PQAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LC/MS/MS	Clean ESI Chamber	NA	NA	Weekly or as needed	NA	NA	Analyst	LCMS-011 (BRTO-0111)
LC/MS/MS	Backflush Analytical Column and Hold Column for Solvent Cleaning	NA	Peak Asymmetry	As needed	NA	NA	Analyst	LCMS-011 (BRTO-0111)
Shimadzu TOC-V CSH or TOC-V CPH	Change injection needle, change catalyst	TOC	Monitor instrument performance via Continuing Calibration Verification	As needed or replace as necessary, loss of sensitivity or failing resolutions, erratic response	No maintenance is required as long as instrument QC meets criteria	Perform instrument maintenance, clean injection needle, change catalyst	Analyst, Supervisor, QA Manager	WL-057 (BRTO-0111)

Notes:
ESI = electrospray ionization
LCMS = liquid chromatography/ mass spectrometry
LC/MS/MS = liquid chromatography tandem mass spectrometry
NA = not applicable
QC = quality control
SOP = standard operating procedure
TOC = total organic carbon

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Final PQAPP Worksheet #26 & #27: Sample Handling, Custody, and Disposal

Sampling Organization: AECOM
Laboratory: Pace Gulf Coast
Method of sample delivery (shipper/carrier): FedEx
Number of days from reporting until sample disposal: 60 Days

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	AECOM	SOP 3-03 *Recordkeeping, Sample Labeling and Chain of Custody*
CoC form completion	AECOM	
Packaging	AECOM	SOP 3-04 *Sample Handling, Storage, and Shipping*
Shipping coordination	AECOM	
Sample receipt, inspection, & log-in	Pace Gulf Coast	SAD-001 *Sample Receiving and LIMS Log-In*
Sample custody and storage	Pace Gulf Coast	SAD-002 *Sample Chain of Custody and Sample Integrity*
Sample disposal	Pace Gulf Coast	GEN-009 *Waste Collection, Storage, Disposal*

Notes:
AECOM = AECOM Technical Services, Inc.
CoC = chain of custody
GEN = Quality Control Standard Operating Procedure
LIMS = Laboratory Information Management System
SAD = Sample Administration Standard Operating Procedure
SOP = Standard Operating Procedure

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Final PQAPP Worksheet #28: Analytical Quality Control and Corrective Actions

Matrix: Soil & Aqueous
Analytical Group: PFAS
Analytical Method: PFAS by LC/MS/MS Compliant with QSM 5.3 Table B-15
SOP Reference: LCMS-011 (BRTO-0111)
Certification Status: DoD/ELAP Certification

QC Sample	Frequency/ Number	Method/SOP Acceptance Limits	Corrective Action	Person(s) Responsible	Measurement Performance Criteria
Aqueous Sample Preparation	Each sample and associated batch QC samples.	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations e.g., Aqueous Film Forming Foam (AFFF). Inline SPE is acceptable. Entire sample plus bottle rinsate must be extracted using SPE. Known high PFAS concentration samples require serial dilution be performed in duplicate. Documented project approval is needed for samples prepared by serial dilution as opposed to SPE.	NA	Analyst, Supervisor, QA Manager	As per Table B-15
Solid Sample Preparation	Each sample and associated batch QC samples.	Entire sample received by the laboratory must be homogenized prior to subsampling.	NA	NA	As per Table B-15
Sample Cleanup Procedure	Each sample and associated batch QC samples. Not applicable to AFFF and AFFF Mixture Samples	ENVI-Carb™ or equivalent must be used on each sample and batch QC sample	NA	NA	As per Table B-15

QC Sample	Frequency/ Number	Method/SOP Acceptance Limits	Corrective Action	Person(s) Responsible	Measurement Performance Criteria
Method Blank	One per preparatory batch, maximum of 20 samples	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, re-extract and reanalyze MB and all QC samples and field samples processed with the contaminated blank. Samples may be reextracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Analyst, Supervisor, QA Manager	As per Table B-15
LCS	One per preparatory batch, maximum of 20 samples	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. As Per Worksheet #15 and Table C-44 and 45 of QSM 5.3	Correct problem, then re-extract and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. Samples may be reextracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst, Supervisor, QA Manager	As per Table B-15
Matrix Spike	One per preparatory batch. Not required for aqueous samples prepared by serial dilution instead of SPE.	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. All targets spiked and within the QC limits included in Worksheet #15.	Evaluate the data to determine if the failed criteria are due to sample matrix or laboratory error. Re-prep if sufficient sample is available when lab error is suspected, otherwise, qualify data with narrative.	Analyst, Supervisor, QA Manager	As per Table B-15

QC Sample	Frequency/ Number	Method/SOP Acceptance Limits	Corrective Action	Person(s) Responsible	Measurement Performance Criteria
MSD or MD	For MSD: One per preparatory batch. For MD: Each aqueous sample prepared by serial dilution instead of SPE.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. For MSD: All targets spiked and within the QC limits included in Worksheet #15. RPD ≤ 30% (between MS and MSD or sample and MD).	The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ. The MD is a second aliquot of the field sample that has been prepared by serial dilution.	Analyst, Supervisor, QA Manager	As per Table B-15
Extracted Internal Standards	Every field sample, standard, blank, and QC sample.	Added to solid sample prior to extraction. Added to aqueous samples, into the original container, prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to final dilution of samples prior to analysis. EIS Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-prepped and reanalyzed (greater dilution may be needed). If recoveries are unacceptable for QC samples, correct problem, and reanalyze all associated failed field samples.	Analyst, Supervisor, QA Manager	As per Table B-15
Instrument Internal Standard Analytes (Used for quantitation of drinking water results)	Every field sample, standard, blank, and QC sample.	Added to aliquot of sample dilutions, QC samples, and standards just prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not performed, the peak areas must be within -50% to +50% of the peak area measured in daily initial CCV.	If peak areas are unacceptable, analyze a second aliquot of the extract or sample if enough extract remains. If there is not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags.	Analyst, Supervisor, QA Manager	As per Table B-15

QC Sample	Frequency/ Number	Method/SOP Acceptance Limits	Corrective Action	Person(s) Responsible	Measurement Performance Criteria
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of "<LOQ" for analyte(s).	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of "<LOQ" in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the "<LOQ" value). When analyte concentrations are calculated as "<LOQ", the spike must recover within 70-130% of its true value.	When analyte concentrations are calculated as "<LOQ", and the spike recovery does not meet the 70-130% acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	Analyst, Supervisor, QA Manager	As per Table B-15

QC Sample	Frequency/ Number	Method/SOP Acceptance Limits	Corrective Action	Person(s) Responsible	Measurement Performance Criteria
Sample PFAS Identification	All analytes detected in a sample.	The chemical derivation of the ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation. Exception is made for analytes where two transitions do not exist (PFBA and PFPeA). Documentation of the primary and confirmation transitions and the ion ratio is required. In-house acceptance criteria for evaluation of ion ratios must be used and must not exceed 50-150%. Signal to Noise Ratio (S/N) must be ≥ 10 for all ions used for quantification and must be ≥ 3 for all ions used for confirmation. Quant ion and confirmation ion must be present and must maximize simultaneously (±2 seconds).	NA	Analyst, Supervisor, QA Manager	As per Table B-15

Notes:

% = percent
< = less than
> = greater than
≤ = less than or equal to
≥ = greater than or equal to
AFFF = aqueous film forming foam
CCV = continuing calibration verification
ICAL = initial calibration
LC/MS/MS = liquid chromatography tandem mass spectrometry
LCS = laboratory control spike
LOD = limit of detection
LOQ = limit of quantitation
MD = matrix duplicate
MS/MSD = matrix spike/matrix spike duplicate
NA = not applicable
QA = quality assurance
QC = quality control
RPD = relative percent difference
SOP = standard operating procedure
SPE = solid phase extraction

Matrix: Soil
Analytical Group: Total Organic Carbon
Analytical Method: USEPA 9060A
SOP Reference: BRTO-0044
Certification Status: DoD/ELAP Certification

QC Sample	Frequency/ Number	Method/SOP Acceptance Limits	Corrective Action	Person(s) Responsible	Measurement Performance Criteria
Method Blank	One per preparatory batch, maximum of 20 samples	Concentration shall not be > 1/2 the LOQ or 1/10 the amount of sample	The source of contamination should be investigated and samples should be reanalyzed. If, additional sample is not available, report with narrative.	Analyst, Supervisor, QA Manager	As per method
LCS	One per preparatory batch, maximum of 20 samples	90-110%	If LCS fails to meet lab criteria, the source of inaccuracy should be investigated and samples reanalyzed. If additional sample is not available, report in a narrative.	Analyst, Supervisor, QA Manager	As per method
MS	One pair per batch (assuming sufficient volume exists) or as specified by client request.	80-120%	If recovery is outside control limits and a lab error suspected, repeat the MS determination. If the LCS is within control limits and the matrix interference is indicated, analyze a post digestion spike and report results with a narrative.	Analyst, Supervisor, QA Manager	As per method
Duplicate/ MSD	One pair per batch (assuming sufficient volume exists) or as specified by client request.	RPD should be ≤20	Investigate the source of the precision error. A source of precision error in the duplicate /MSD may be the homogenous nature of the sample. If lab error is suspected, repeat analysis. If matrix issue is indicated, report with a narrative.	Analyst, Supervisor, QA Manager	As per method

Notes:
% = percent
< = less than
≤ = less than or equal to
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
LCS = laboratory control spike
LOQ = limit of quantitation
MS/MSD = matrix spike/matrix spike duplicate
QA = quality assurance
QC = quality control
RPD = relative percent difference
SOP = standard operating procedure

Matrix: Soil
Analytical Group: pH
Analytical Method: USEPA 6045D
SOP Reference: EXT-032
Certification Status: DoD/ELAP Certification

QC Sample	Frequency/ Number	Method/SOP Acceptance Limits	Corrective Action	Person(s) Responsible	Measurement Performance Criteria
QC Check Buffer	Before sample analysis, after every 20 samples and at the end of analysis	Within ±0.05 pH of true value	Do not analyze samples without a daily LCS that meets criteria.	Analyst, Supervisor, QA Manager	As per method
Duplicate	One per batch, maximum of 20 samples	Within 0.1 pH unit	Repeat if sample volume allows or narrate results	Analyst, Supervisor, QA Manage	As per method

Notes:
% = percent
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
LCS = laboratory control spike
QA = quality assurance
QC = quality control
SOP = standard operating procedure

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Final PQAPP Worksheet #29: Project Documents and Records

Sample Collection Documents and Records	Onsite Analysis Documents and Records	Offsite Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Logbook	Field Logbook	Sample receipt, custody, and tracking records	Field sampling audit records	NA
CoC Records	Field Sampling Forms	Sample prep logs	Laboratory audit records	
Air Bills	Equipment Inspection Forms	Equipment calibration logs	Data validation reports	
Custody Seals	Boring Logs	Run logs	Data usability assessment reports	
Corrective Action Forms	Corrective Action Forms	Equipment maintenance test, and inspection logs	Corrective Action Forms	
Field Sampling Forms	Daily Tailgate SH&E Sign In Sheet	Corrective Action Forms	Field Change Request Form	
Sample location and depth data	APP/SSHP Acknowledgement	Reported analytical results		
Field equipment calibration logs	Dig Permits	Data package completeness checklists		
		Sample disposal records		
		Extraction/cleanup records		
		Raw data		
		EQuIS™		
		ROE Agreements		
		Photographic Logs		

Notes:
APP/SSHP = Accident Prevention Plan/ Site Safety and Health Plan
CoC = chain of custody
EQuIS = Environmental Quality Information System
SH&E = Safety, Health, and Environment
NA = not applicable
ROE = right of entry

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Final PQAPP Worksheet #31, #32 & #33: Assessments and Corrective Action

This worksheet is used to document responsibilities for conducting project assessments, responding to assessment findings, and implementing corrective action. Appropriately scheduled assessments allow management to implement corrective action in a timely manner, thereby correcting non-conformances and minimizing their impact on DQOs/Project Quality Objectives.

Assessments:

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
Project Manager Review	Monthly (for field efforts that are longer than one month)	Internal	AECOM	Project Manager/ AECOM	Field Sampling Team Leader/ AECOM	Field Sampling Team Leader/ AECOM	Project Manager/ AECOM
Review of CoC forms	Daily	Internal	AECOM	Project Chemist/ AECOM	Field Sampling Team Leader/ AECOM	Field Sampling Team Leader/ AECOM	Project Chemist/ AECOM
Laboratory Data Assessment (validation)	Once	Internal	AECOM	Data Validator	Project Chemist/ AECOM	Data Validator	Project Chemist/ AECOM
Daily Quality Control Audits	Daily	Internal	AECOM	Field Sampling Team Leader/ AECOM	Field Sampling Team Leader/ AECOM	Field Sampling Team Leader/ AECOM	QA Officer/ AECOM
Field TSAs	Daily	Internal	AECOM	Field Sampling Team Leader/ AECOM	Field Sampling Team Leader/ AECOM	Field Sampling Team Leader/ AECOM	QA Officer/ AECOM
Field Performance Audits	Weekly	Internal	AECOM	Project Manager/ AECOM or representative	Field Sampling Team Leader/ AECOM	Field Sampling Team Leader/ AECOM	Project Manager/ AECOM

Assessment Response and Corrective Action:

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Audit	Email	Field Sampling Team Leader/AECOM Project Manager	Immediate	Daily QC Report/ Email	Project Quality Manager/ Project Manager	24 hours after notification
Project Manager Review	Email	Field Sampling Team Leader/ AECOM	Immediate	Daily QC Report/ Email	AECOM Project Manager	24 hours after notification
Review of CoC forms	Email	Field Sampling Team Leader/AECOM Project Manager	Immediate	Daily QC Report/ Email	Project Chemist	24 hours after notification
Laboratory Data Assessment (validation)	Written Audit Report	Laboratory QA Manager; AECOM Project Chemist	Within 24 hours after audit	Email	Data Validator	Up to 1 week after notification
Daily Quality Control Audits	Email/ Daily QC Report	Field Sampling Team Leader/AECOM Project Manager	Immediate	Daily QC Report/ Email	AECOM Project Manager	24 hours after notification
Field TSAs	Email/ Daily QC Report	Field Sampling Team Leader/AECOM Project Manager	Immediate	Daily QC Report/ Email	AECOM Project Manager	24 hours after notification
Field Performance Audits	Email	Field Sampling Team Leader	Immediate	Daily QC Report/ Email	AECOM Project Manager	24 hours after notification

Laboratory Assessments: Pace Gulf Coast

Assessment Type	Responsible Party & Organization	Number/ Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
DoD/ELAP Accreditation	PJLA	Every Two Years	NA	Certification	NA
PT samples	Laboratory QAM	Accreditation	Per Accrediting Authority	Per Accrediting Authority	Per Accrediting Authority
Data Review	Naoum Tavantzis, AECOM	Once	45 days after receipt of data	Validation Report	45 days after receipt of data
External Laboratory Audit	PJLA	Bi-annually	NA	Written Audit Report	NA
Internal Laboratory Audit	Pace Gulf Coast	Annually	NA	Written Audit Report	NA

Notes:
AECOM = AECOM Technical Services, Inc.
CoC = chain of custody
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
NA = not applicable
PJLA = Perry Johnson Laboratories Accreditation
PT = proficiency testing
QA = quality assurance
QAM = Quality Assurance Manager
QC = quality control
TSA = technical system audit

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Final PQAPP Worksheet #34: Data Verification and Validation Inputs

Item	Description	Verification (Completeness)	Validation (Conformance to Specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Contract	X	
4	Field SOPs	X	
5	Laboratory SOPs	X	
Field Records			
6	Field logbooks	X	
7	Equipment calibration records	X	
8	CoC Forms	X	X
9	Sampling diagrams/surveys	X	
10	Drilling logs	X	
11	Relevant correspondence	X	
12	Change orders/deviations	X	
13	Field audit reports	X	
14	Field change request forms	X	
Analytical Data Package			
16	Cover sheet (laboratory identifying information)	X	X
17	Case narrative	X	X
18	Internal laboratory CoC	X	X
19	Sample receipt records	X	X
20	Sample chronology (i.e., dates and times of receipt, preparation, and analysis)	X	X
21	Communication records	X	
22	LOD/LOQ establishment and verification	X	
23	Standards traceability	X	
24	Instrument calibration records	X	X
25	Definition of laboratory qualifiers	X	
26	Results reporting forms	X	X
27	QC sample results	X	X
28	Corrective action reports	X	X
29	Raw data	X	X
30	Electronic data deliverable	X	X

Notes:
CoC = chain of custody
LOD = limit of detection
LOQ = limit of quantitation
QAPP = Quality Assurance Project Plan
QC = quality control
SOP = standard operating procedure

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Final PQAPP Worksheet #35: Data Verification Procedure

This worksheet documents procedures that will be used to verify project data. The procedures apply to both field and laboratory records. Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. As illustrated in the following example, verification often is performed at more than one step by more than one person.

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
CoC forms and shipping forms	CoC, Shipping Documents	CoC forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the CoC should be initialed by the reviewer, a copy of the CoC retained in the facility file, and the original and remaining copies taped inside the cooler for shipment.	Appropriate Field Sampling Team Leaders for the individual medias
Review of field logbooks	Field Logbooks	Review for completeness and accuracy.	Appropriate field Sampling Team Leaders
Field sampling TSAs	TSA Reports	Assessment of field sampling process prior to start of, or as close to the start of sampling as possible.	QA Manager or designee
Fixed laboratory analytical data review	Laboratory Data Package	Data controls are compared to this QAPP and DoD QSM v 5.3 (and PFAS by LC/MS/MS compliant with QSM 5.3 Table B-15) in a Three-Tiered process using a minimum 100% peer review.	PM or QA Manager
Fixed laboratory TSAs	Laboratory Data Package	ELAP audit and internal quality audits.	QA Manager
Fixed laboratory data verification	Data Validation Reports	100% data verification/validation for water and soil.	AECOM Project Chemist
Fixed laboratory data validation	Data Validation Reports	Calculate and assess laboratory DQIs.	QA Manager, or designee

Notes:
AECOM = AECOM Technical Services, Inc.
CoC = chain of custody
DoD = Department of Defense
DQI = data quality indicator
ELAP = Environmental Laboratory Accreditation Program
PFAS = per- and polyfluoroalkyl substances
PM = Project Manager
QA = quality assurance
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
TSA = technical system audit
USEPA = United States Environmental Protection Agency

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Final PQAPP Worksheet #36: Data Validation Procedures

Data Validator: AECOM

Analytical Group/Method	All Analytical Data
Analytical specifications	WS#24, WS #28 & Laboratory SOPs
Measurement performance criteria	WS #12, WS#15, and WS#28
Percent of data packages to be validated	100%
Percent of raw data reviewed	100%
Percent of results to be recalculated	0%
Validation procedure and qualification	National Functional Guidelines for Organic Superfund Data Review, January 2017 (USEPA, 2017b); Department of Defense General Data Validation Guidelines, November 2019 (DoD, 2019b); Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (DoD, 2020).
Validation code	S2bVEM/S2bVM
Electronic validation program/version	AECOM EarthSoft EQuIS™ Automated Validation Assistant

Notes:
% = percent
AECOM = AECOM Technical Services, Inc.
DoD = Department of Defense
EQuIS = Environmental Quality Information System
SOP = standard operating procedure
USEPA = United States Environmental Protection Agency
WS = worksheet

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Final PQAPP Worksheet #37: Data Usability Assessment

The Data Usability Assessment (DUA) is an evaluation at the conclusion of data collection activities that uses the results of both data verification and validation in the context of the overall project decisions or objectives. Using both quantitative and qualitative methods, the assessment will determine whether project execution and the resulting data the DQOs established in **Worksheet #11** were achieved. Both sampling and analytical activities will be considered with the ultimate goal to assess whether the final, qualified results support the decisions to be made with the data.

The following personnel are responsible for participating in the DUA:

- AECOM Project Manager: Claire Mitchell
- AECOM Project Chemist: Naoum Tavantzis
- AECOM SI Task Manager: Jeremy Haney

The DUA will be documented as a discussion within the SI report and refer to the Data Validation Report that will appear in an appendix of the SI Report. The SI Report and DUA will be reviewed by the USACE. The Data Validation Report will follow the procedures given in **Worksheet #36**.

The following steps summarize the processes used to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision-making for ARNG related to PFAS contamination at certain installations and describe how data quality issues will be addressed and how limitations on the use of the data will be handled.

Step 1	**Review the project's objectives and sampling design.** The key components established in the DQOs (**Worksheet #11**) will be reviewed to ensure that they are still applicable. Also, the sampling design and how it was implemented in the field will be reviewed for consistency with the stated objectives. For example, this step in the DUA will: • Reevaluate whether comparison criteria (i.e., SL; **Worksheet #15**) were updated since PQAPP generation and if laboratory quantitation limits (QLs) were sensitive enough for those changes (e.g., QLs remain lower than new criteria). It is important to note several states are in various stages of developing or finalizing limits for PFAS chemicals for different media; therefore, it is critical that SLs are regularly evaluated over the course of the project to ensure the SLs remain current. Additionally, project data must meet the measurement performance criteria (MPC) for sensitivity and project QLs specified in **Worksheets #15 & 28**. • Discuss the limitations and impact on the use of project data if validation reports indicate that project specific sensitivity goals or QLs were not achieved for a specific sampling or laboratory group, dataset or sample delivery group (SDG), matrix, analytical group, or concentration level.
Step 2	**Review the data verification and data validation outputs** Available Quality Assurance (QA) reports, including both field and laboratory generated forms, will be reviewed for deviations from planned activities identified in Step 1 (e.g., number and locations of samples, holding time exceedances, damaged samples, non-compliant proficiency testing sample results, and SOP deviations) and determine their impacts on the data usability. Validated data will be summarized and/or compiled to identify patterns, trends, and anomalies as they relate to the Data Quality Indicators (DQIs) precision, accuracy/bias,

	representativeness, comparability, completeness, and sensitivity. Descriptions of each DQI and examples of how each may be incorporated into the usability report follow.
Step 2 (cont.)	**Precision** Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms. Quality Control (QC) measures for precision include field duplicates, laboratory duplicates, MSDs, analytical replicates, and surrogates. To meet the needs of the data users, SI project data must meet the MPC for precision specified in **Worksheet #12** of this QAPP. Precision errors may be the result of one or more of the following: PFAS cross-contamination, field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or spatial variation (heterogeneous sample matrices). To identify the cause of imprecision, the field sampling design rationale and sampling techniques will be evaluated by the reviewer, and both field and analytical duplicate/replicate sample results will be compared. For example, if poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the sampling technique, PFAS contamination, field instrument variation, sample transport, medium inhomogeneity, or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular dataset or SDG, then the impact of that imprecision on usability will be discussed in the usability report.
	Accuracy/Bias Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) due to sampling and analytical operations. Examples of QC measures for accuracy include Matrix Spikes, Laboratory Control Samples, and ERBs. A measurement is accurate when the reported value does not differ from the true value or known concentration of the spike or standard. To meet the needs of the data users, project data must meet the MPC for accuracy/bias specified in **Worksheet #12** of this QAPP. The usability report for each installation will: • Discuss and compare data on contamination and accuracy/bias (when bias is observable) for each matrix, analytical group, and concentration level. • Describe the limitations on the use of project data if extensive contamination, inaccuracy, or bias exists, or when inaccuracy is limited to a specific sampling or laboratory group, dataset or SDG, matrix, or concentration level. • Discuss the impact of any qualitative and quantitative trends in bias on the sample data.
	Representativeness Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition, and it is achieved through a well-designed sampling program and by using standardized sampling strategies, techniques, and analytical procedures. To meet the needs of the data users, project data must meet the MPC for sample representativeness specified in **Worksheet #12** of this QAPP. **Worksheet #28 & 35** discusses how the QA/QC activities (e.g., review of sampling design and SOPs, field sampling Technical System Audits (TSAs), and analysis audits) and QC sample data will be reviewed to assess sample representativeness. For example, if field duplicate precision checks indicate potential spatial variability, additional scoping meetings and subsequent resampling may be needed to collect data that are more representative of a nonhomogeneous site. The usability report for each installation will:

	• Discuss the impact of field duplicate imprecision on site representativeness. For example, when data variability is high among field duplicate datasets (i.e., high relative standard deviation), calculation of the 95% upper confidence limit (UCL) of the population mean is more likely to overestimate the true mean and therefore achieve better statistical coverage. • Discuss the impact of laboratory and field sampling methods on sampling results and how they reflect site conditions.
Step 2 (cont.)	• Discuss the effect of site heterogeneity on sampling results in light of sampling methods used. • Describe the limitations on the use of project data when sampling results are non-representative for all data or for a specific sampling, group, dataset or SDG, matrix, analytical group, or concentration level.
	Comparability Comparability is the degree to which different methods, datasets, and decisions agree or can be represented as similar. Comparability describes the confidence (expressed qualitatively or quantitatively) that two datasets can contribute to a common analysis and interpolation. The SI results will be used as benchmarks for determining comparability for data collected during any future sampling events at the various installations using the same or similar sampling and analytical SOPs. At this time, data will not be compared to other datasets or data using different sampling or analytical SOPs. To ensure future comparability of data generated for the installations, standard sample collection procedures and approved analytical methods will be used. Sample analyses will be performed by the laboratory using approved methods and procedures. Comparability criteria will be considered met for the project if, based on data reviewed, the sample collection and analytical procedures (such as use of alternate preparation if indicated by a positive field shake test) are determined to have been followed or defined to show that variations did not affect the values reported. Deviations to sampling scope will be documented in sampling nonconformance reports which may contain some of the discussion of comparability. The usability reports will describe the limitations on the use of project data when project-required data comparability is not achieved for the overall project or is limited to a specific sampling or laboratory group, dataset or SDG, matrix, analytical group, or concentration level.
	Completeness Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct, normal circumstances. To meet the needs of the data users, project data must meet the MPC for data completeness. Completeness criteria will be considered met if 100% of all planned sample data are collected. As applicable, the usability report may also: • Describe how the amount of valid data will be determined as a percentage of the number of valid measurements for each matrix, analytical group, and concentration level. • Describe how critical data were assessed for completeness when certain sample locations or analytes and matrices are more critical than others in making project decisions. • Evaluate the impact of missing information. Ensure that enough information was obtained for the data to be usable to meet the DQOs (**Worksheet #11**).
	Sensitivity Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a DL study, Limit of Detection (LOD)/Limit of Quantitation (LOQ) Verifications, and Instrument Sensitivity Checks (ISC). To meet the needs of the data users, project data must meet the MPC for sensitivity and project QLs specified in **Worksheets #15 & 28** of this QAPP. If appropriate, the usability report may also:

	• Discuss and compare sensitivity and DL/LOD/LOQ from the datasets collected for the project for each matrix, analytical group, and concentration level. • Discuss the impact of a lack of sensitivity or higher DL/LOD/LOQ on data usability, if validation reports indicate that sensitivity goals or DL/LOD/LOQ goals were not achieved.
Step 2 (cont.)	• Describe the limitations on the use of project data when sampling results are non-representative for all data or for a specific sampling, group, dataset or SDG, matrix, analytical group, or concentration level.
Step 3	**Verify the assumptions of the selected statistical method** The use of statistical methods for data assessment for this project will be limited to estimating a 95% UCL (or mean as appropriate for the analyte) for the assessment of risks.
Step 4	**Implement the statistical method** Where statistical methods are used, the underlying assumptions will be assessed during the DUA. The consequences of selecting the incorrect alternative will be discussed, and uncertainty tolerances will be considered.
Step 5	**Document data usability and draw conclusions** The DUA will determine and document whether the data can be used as intended given any deviations and corrective actions that may have occurred. Limitations on data use will be considered and discussed as appropriate, and the performance of the sampling design assessed. Conclusions will be drawn taking any data limitations into consideration and documented in the SI report.

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Appendix A – Technical Project Planning Meeting Minutes (TPP1 and TPP2)

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Appendix B – Standard Operating Procedures

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SOPs available upon request.

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