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DRAFT FINAL BACKCHECK
Site Inspection
Quality Assurance Project Plan Addendum
Raymond F. Rees Training Center
Hermiston, Oregon

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

August 2022

Prepared for:

Army National Guard Bureau
111 S. George Mason Drive
Arlington, VA 22204

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Acronyms and Abbreviations

˚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
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGA	Critical Groundwater Area
CoC	chain of custody
CPR	cardiopulmonary resuscitation
CSM	conceptual site model
DA	Department of the Army
DL	detection limit
DO	dissolved oxygen
DoD	Department of Defense
DQI	data quality indicators
DQO	data quality objectives
DUA	Data Usability Assessment
ELAP	Environmental Laboratory Accreditation Program
ERB	equipment rinsate blank
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
IDQTF	Intergovernmental Data Quality Task Force
IDW	investigation-derived waste
ISC	instrument sensitivity check
LC/MS/MS	liquid chromatography tandem mass spectrometry
LOD	limit of detection
LOQ	limit of quantitation
MAES	Multiple Award Environmental Services
MDL	method detection limit

67	MPC	measurement performance criteria
68	MRL	method reporting limit
69	MS/MSD	matrix spike/ matrix spike duplicate
70	NELAP	National Environmental Laboratory Accreditation Program
71	ng/L	nanograms per liter
72	NPDES	National Pollutant Discharge Elimination System
73	NTU	nephelometric turbidity units
74	OAR	Oregon Administrative Rules
75	OMD	Oregon Military Department
76	ONG	Oregon National Guard
77	ORARNG	Oregon Army National Guard
78	ORDEQ	Oregon Department of Environmental Quality
79	ORP	oxidation-reduction potential
80	OSD	Office of the Secretary of Defense
81	OSHA	Occupational Safety and Health Administration
82	OWRD	Oregon Water Resources Department
83	PA	Preliminary Assessment
84	PFAS	per- and polyfluoroalkyl substances
85	PFBS	perfluorobutanesulfonic acid
86	PFOA	perfluorooctanoic acid
87	PFOS	perfluorooctanesulfonic acid
88	PFHxA	perfluorohexanoic acid
89	PFUdA	perfluoroundecanoic acid
90	PID	photoionization detector
91	PPE	personal protective equipment
92	PQAPP	Programmatic UFP-QAPP
93	PVC	poly-vinyl chloride
94	PWS ID	Public Water Service Identification
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	RTC	Raymond F. Rees Training Center
102	RTI	Regional Training Institute
103	SDG	sample delivery group
104	SDT	sonic drilling technology
105	SI	Site Inspection
106	SL	screening level
107	SOP	standard operating procedure
108	SSHP	Site Safety and Health Plan

109	TCRA	Time Critical Removal Action
110	TO	Task Order
111	TOC	total organic carbon
112	TPP	Technical Project Planning
113	TSA	technical system audit
114	UCL	upper confidence limit
115	UCMR 3	Unregulated Contaminant Monitoring Rule 3
116	UFP	Uniform Federal Policy
117	UCD	Umatilla Chemical Depot
118	US	United States
119	USACE	United States Army Corps of Engineers
120	USCS	Unified Soil Classification System
121	USEPA	United States Environmental Protection Agency
122	USGS	United States Geological Survey
123	WWTP	wastewater treatment plant

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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 Raymond F. Rees Training Center (RTC) in Hermiston, 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, 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, perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), and perfluorobutanesulfonic acid (PFBS), which are the key components of the suspected releases being evaluated, and the other 12 related compounds listed in the TO. This UFP-QAPP Addendum focuses on the SI phase of work specific to RTC (also referred to as the "facility") in Hermiston, 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, PFHxS, PFNA, 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 RTC. For ease of review, material from the PQAPP is included in this deliverable alongside the RTC-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**
Worksheets #19 and #30- Sample Containers, Preservation and Hold Times	**Programmatic**

QAPP Addendum Worksheets	Applicable Document
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: Raymond F. Rees Training Center, Hermiston, 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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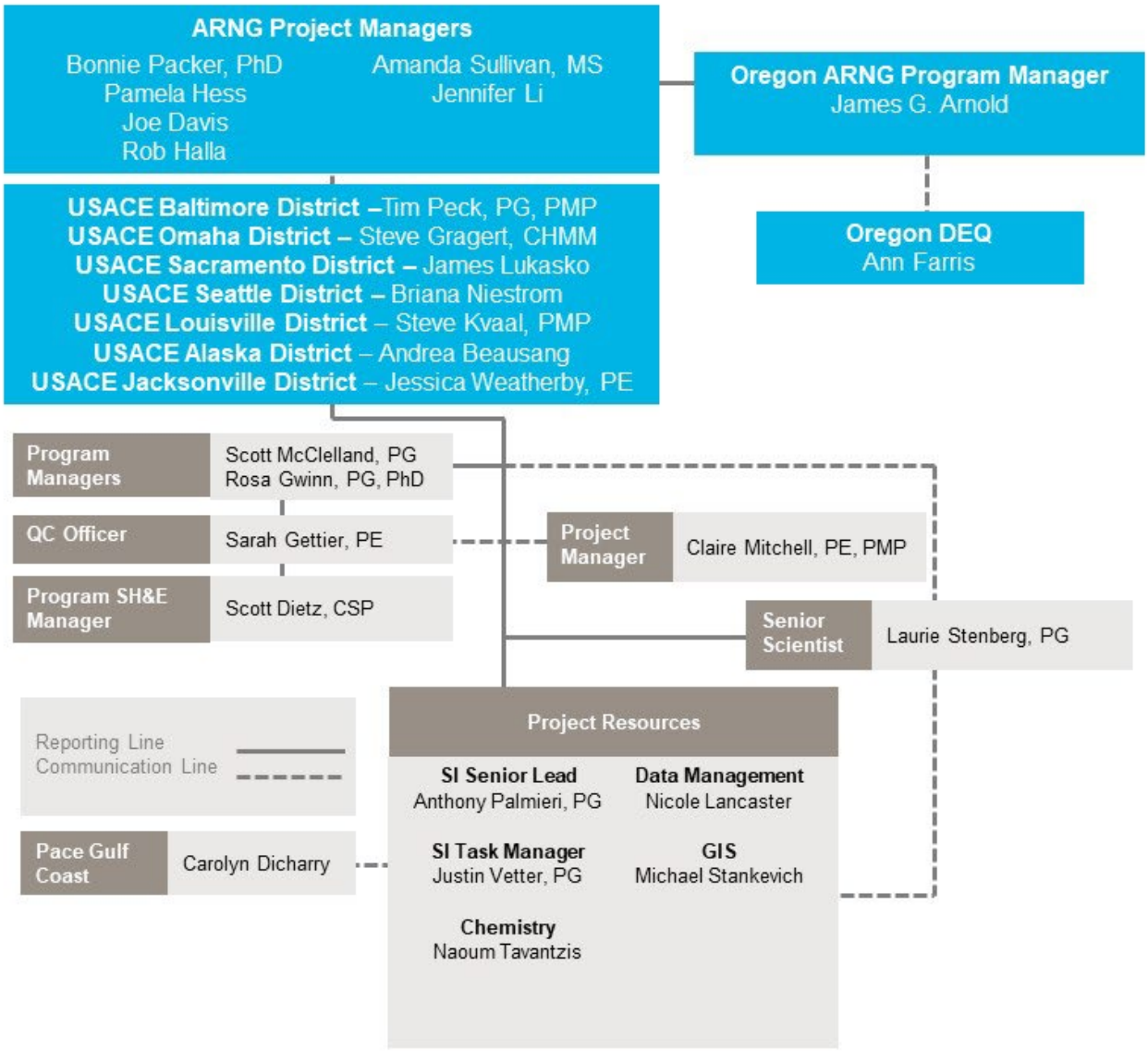
QAPP Worksheets #3 & #5: Project Organization and QAPP Distribution

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: 15+ years of managing and conducting environmental site investigations, including PFAS, for DoD clients.	Professional Geologist, OR, WA AECOM Certified PM 40hr HAZWOPER OSHA 8hr Refresher 8hr OSHA Supervisor 30hr OSHA Supervisor	Signature available upon request.
Justin Vetter, PG	AECOM	SI Task Manager	Education: BS, Geology MS, Geology Experience: 9+ years; served as geologist for Phase IIs, RI/FSs, and cleanup actions, including federal projects and large-scale private sector projects and portfolios.	Licensed Geologist, WA OSHA 40hr HAZWOPER OSHA 8hr Refresher OSHA 8hr Supervisor EM-385-1-1 Certified 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.
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.

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
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.
Carolyn Dicharry	Pace Gulf Coast (Formerly GCAL)	Laboratory Project Manager	Education: BS, Geology, post-Baccalaureate in Education Experience: 30 years in the environmental lab industry – 15 years experience in Quality Assurance; 7 years experience as a Project Manager/client services; 2 years in Data Validation; 2 years as Safety Manager and Waste Coordinator; 8 years in Asbestos laboratory	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
OR = Oregon
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

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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 Manager	Jennifer Tyler	561-379-2854 Jennifer.L.Tyler@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 Rob Halla 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 703-607-7995 Walter.r.hall2.civ@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	503-559-2775 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.

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
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, PG	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.
	AECOM SI Task Manager	Justin Vetter, PG	206-403-4230 justin.vetter@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.

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
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	Carolyn Dicharry	225-769-4900 carolyn.dicharry@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
DoD = Department of Defense
PM = Project Manager
ORARNG = Oregon Army National Guard
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 RTC. The PA process included the following tasks:

- Reviewed data resources to obtain information relevant to suspected PFAS releases;
- Conducted a site visit on 1 and 2 October 2018;
- Interviewed current RTC personnel, including Oregon ARNG (ORARNG) and Oregon Military Department (OMD) personnel during the site visit, ORARNG environmental managers, operations staff, the OMD Environmental Manager, OMD Cultural Resources Manager, OMD Wildland Fire Manager, OMD RTC Training Site Manager (former State Aviation Officer), and OMD Real Estate/Property Manager;
- Completed visual site inspections at known or suspected PFAS release locations and documented with photographs;
- 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 RTC can be found in the PA Report (AECOM, 2020).

Facility Location and Description

RTC is located in Morrow and Umatilla Counties, approximately one mile northwest of the Interstate 82 and Interstate 84 intersection in the City of Hermiston, Oregon, and approximately eight miles southwest of the City of Umatilla (**Figure 10-1**). The installation encompasses 7,500 acres, including a 170-acre cantonment area used to support the Oregon National Guard's (ONG) mission of military training (the cantonment area encompasses 170 acres) (State of Oregon, 2021; ONG, 2018). RTC is situated in the southeastern corner of the former Umatilla Chemical Depot (UCD), which comprises 19,729 acres and spans west into Morrow County (ONG, 2018).

The ORARNG has operated an enclave within the UCD since the 1980s for training and administrative purposes. The fenced-in UCD was formerly an Army Ordnance Depot in operation from 1941 to 2011, designated as a military munitions and supply depot for World War II, developed with ammunition storage igloos, warehouses, administrative buildings and barracks, and has miles of railroad (ONG, 2018). In 1962, the purpose of the UCD changed to receiving, storing, issuing, and maintaining chemical munitions, resulting in a name change to Umatilla Army Depot. In 1988, the Base Realignment and Closure (BRAC) Commission listed the UCD for realignment. From 1990 to 1994, the facility reorganized in preparation for eventual closure, shipping all conventional ammunition and supplies to other installations. The UCD, at one time, stored 12 percent (%) of the nation's stockpile of chemical weapons, but no chemical weapons were used, manufactured, or tested at the UCD.

In 1996, the Umatilla Chemical Agent Disposal Facility was constructed to demilitarize chemical weapons stored at the UCD. In 2005, the UCD was placed on the BRAC list again. In 2011, chemical weapon incineration was completed, and the incineration plant was demolished. In 2012, the UCD was closed and transferred to inactive operational status in accordance with the Defense Base Closure and Realignment Act of 1990, Public Law 101–510, as amended, and the National Defense Authorization Act for Fiscal Year 2012, Public Law 112-81 (Doyle, 2018). The UCD was reassigned to the US Army Installation Management Command for management. The US Army Garrison Commander, Joint Base Lewis-McChord, assumed command authority for the

UCD and property accountability pending disposal of excess property. Since the UCD's official closure in 2012, a BRAC-contracted caretaker oversees the UCD pending disposal of multiple parcels to new owners (planned for commercial and public development and designated wildlife habitat).

In December 2017, the Adjutant General of Oregon and the USACE signed over 7,500 acres of the former UCD's 19,729 acres to ORARNG to develop Camp Umatilla Oregon, an installation accommodating weekend and annual training requirements in addition to military units from other services supporting the ORANRG's federal and state missions in achieving the Army's mission. Camp Umatilla includes areas for live-fire weapons training, maneuver training, and classroom/simulations training for units up to battalion size. Camp Umatilla is also home to the 249th Regional Training Institute (RTI) (ONG, 2018).

Facility Environmental Setting

RTC is located in north central Oregon and is situated on the southern edge of the Columbia Plateau, which extends north into Washington State (approximately three miles to the north of the facility). The Oregon portion of the plateau is made up entirely of lowlands, extending from the western Cascade Mountains to the southeastern Blue Mountains. With a generally flat to gently rolling topography, permeable soil, and minimal precipitation in the region, little to no stormwater runoff occurs on RTC. The surface elevation at the geographic center of RTC is 570 feet above mean sea level (amsl); however, the elevation ranges from 400 feet amsl in the north to 677 feet amsl in the south (ONG, 2018).

The prominent surface feature at RTC is the Coyote Coulee, a valley that cuts across the facility. Land use in the vicinity of RTC is almost exclusively zoned agricultural, with rural-residential areas located to the northwest, in the City of Irrigon, and east, in the City of Hermiston (USACE, 2013).

Geology

During late Miocene and early Pliocene times (between 14 and 16 million years ago), a fissure volcanic eruption lead to a series of flood basalts that engulfed the Pacific Northwest, forming a large igneous province called the Columbia River Basalt Group. The rock group consists of five major basalt flows, including the Steens Basalt, Imnaha Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. As the molten rock came to the surface, the Earth's crust gradually sank into the space left by the rising lava, forming the down-warped bedrock surface of the Dalles-Umatilla Syncline. RTC is near the base of the south flanks of this broad syncline. The underlying basalt is composed of layers of separate basaltic lava flows, each of which is as much as 100 feet thick (Whitehead, 1994).

The crust subsidence produced a large plateau, slightly depressed lava plain known as the Columbia Plateau, which covers more than 60,000 square miles. The northwesterly advancing lava forced the Columbia River into its present course. The Oregon portion of the plateau is made up entirely of lowlands, extending from the eastern slopes of the Cascade Mountains to the southern Blue Mountains.

These basalts are overlain by as much as 200 feet of Pleistocene alluvial gravel deposits. These surface deposits are known as the Ordnance Gravels and are comprised of permeable silts, sands, and gravels, with some cobbles to the west of Coyote Coulee. Much coarser permeable deposits containing considerable quantities of boulders occur along the east wall of the Coulee and toward the east side of RTC (USACE, 2013).

Soils at RTC consist of very deep, excessively drained sandy loam and coarse sand (**Figure 10-2**). Soil series include Burbank loamy fine sand, Quincy fine sand, and Quincy loamy fine sand.

Hydrogeology

The Columbia Plateau Basaltic Aquifer system is a regional groundwater resource that occupies about 50,600 square miles and extends across a small part of northern Idaho, northeastern Oregon, and a large part of southeastern Washington. The aquifer system is a layered series of fractured basalt formations of the Columbia River Basalt Group, separated by confining units and unconsolidated deposits of loose material, all underlain by pre-Miocene rocks (Whitehead, 1994).

The groundwater occurs beneath RTC in a number of distinct hydrogeologic units, starting with a near-surface unconsolidated-deposit aquifer overlying a series of confined basalt aquifers: Saddle Mountain Basalt, confining unit, Wanapum Basalt, confining unit, Grand Ronde Basalt, and pre-Miocene rocks (USACE, 2013). Additionally, there is a highly productive permeable unconfined aquifer to the south of RTC that consists of alluvial deposits and the weathered surface of the Elephant Mountain Member, basaltic flow of the Saddle Mountain Basalt group. This unit is overlain by approximately 20 to 125 feet of unsaturated alluvial sand and gravel. Based on a review of nearby well logs and other available information, depth to groundwater beneath RTC ranges from approximately 60 to 100 feet below ground surface (bgs) (ambient depth to groundwater ranges from approximately 50 to 120 feet bgs from the unsaturated alluvial sand and gravel overlying the unconfined aquifer) (OWRD, 2022; USACE, 2013). Groundwater flow beneath RTC exhibits seasonal variation due to groundwater extraction for irrigation and recharge from agricultural canals in the vicinity. In the summer and fall, groundwater flow direction is generally to the east and south, while in the winter and early spring, groundwater flow direction is generally to the northwest, towards the Columbia River (USACE, 2013) (**Figure 10-2**).

RTC is situated within the Oregon Water Resources Department (OWRD) Ordnance Gravel Critical Groundwater Area (CGA) and the Ordnance Basalt CGA, both water allocation restrictions due to overdraft since the 1950s and 1970s, respectively (IRZ Consulting, 2009; OWRD, 2018b). The Ordnance Gravel CGA within Morrow and Umatilla Counties protects an overlying shallow sand and gravel aquifer and comprises approximately 82 square miles (OWRD, 2018b). The Ordnance Basalt CGA, which is situated within Morrow and Umatilla Counties and is centered on the former Umatilla Ordnance Depot, protects the underlying Columbia River Basalt aquifer and comprises approximately 175 square miles (OWRD, 2018b). Groundwater levels within the Ordnance Gravel and Basalt CGAs declined during groundwater development in the 1950s and 1970s, respectively, but have been relatively stable as of recent (OWRD, 2018b). In 2009, the OWRD, working in conjunction with other state agencies and local planning groups, proposed increasing water availability within the Ordnance Gravel and Basalt CGAs through the Umatilla Basin Aquifer Recharge Project that would involve pumping surface water from the Columbia River and storing it in the CGA aquifer for use during seasonal higher water demand (IRZ Consulting, LLC, 2009).

RTC drinking water is supplied by two groundwater wells withdrawing water from a confined basalt aquifer at depths ranging from 679 feet bgs to 709 feet bgs (USACE, 2013) (**Figure 10-2**). The drinking water system serving the UCD Administration Area (Public Water Service Identification [PWS ID] OR4101136) serves at least 25 residential connections and a population of 124 (USACE, 2013). The drinking water system serving the northern portion of the UCD (PWS ID OR4194664) serves up to 10 residential connections and a population of 662 (USACE, 2013). As of 2018, however, the two domestic groundwater wells were not in use (ONG, 2018). The pumping capacity of these drinking water wells range from 30 to 1,000 gallons per minute, with approximately 20% of the total capacity of the wells being used for domestic water, and the remainder used for fire protection (US Fish and Wildlife Service, 2007). According to OMD, plans have been established to utilize three on-site wells and re-drill two additional wells in the immediate future for additional drinking water.

A total of 120 groundwater monitoring wells have been installed at the facility to-date (**Figure 10-2**) (USACE, 2013). Groundwater monitoring well data suggest groundwater flow direction beneath the facility is northward, toward the Columbia River; however, irrigation pumping of the shallow alluvial aquifer causes groundwater in the south and central portions of facility to flow in a southern direction during the summer and fall. Historical disposal practices at the Explosives Washout Lagoons resulted in dissolved-phase explosives constituents in groundwater, which is currently being remediated by a groundwater pump and treat system (**Figure 10-2**). Groundwater flow direction north of the cantonment area is locally affected in the vicinity of treatment system extraction wells and in the vicinity of the treated effluent infiltration field. In general, groundwater within an extraction well's radius of influence flows radially towards extraction and flows radially outward from the infiltration field.

The alluvial and most shallow basalt aquifers are the main sources of domestic water in the region, with many irrigation and municipal wells are located more than 500 feet bgs (US Geological Survey [USGS], 2016). Three municipal water supply systems withdraw groundwater for drinking water in the vicinity of RTC and include the City of Hermiston (to the east), City of Umatilla (to the northeast), and City of Irrigon (to the north) (OWRD, 2018a). The City of Hermiston obtains its drinking water supply from groundwater (shallow and deep wells; deep wells withdraw water from the Columbia River Basalt aquifer) and surface water (sourced the Lake Walulla segment of the Columbia River) (City of Hermiston, 2020). The City of Umatilla obtains its drinking water supply from groundwater (four deep basalt wells) located within the city limits, approximately 6 miles to the northwest and hydrologically downgradient of RTC (Umatilla, 2019; Umatilla, 2008). The City of Irrigon obtains its drinking water supply from two groundwater wells located along the Columbia River, located to the north of RTC (City of Irrigon, 2018). Approximately 1,500 wells are located within a 4-mile radius of RTC and are mostly used for domestic and irrigation purposes (**Figure 10-2**) (USACE, 2013). The Columbia River is a major source of potable and irrigation water in the region, and is also used for recreation, fishing, and the generation of hydroelectric power. The Umatilla River, a tributary to the Columbia River, is principally used for irrigation (USACE, 2013).

The snowmelt water from the Blue Mountains of Eastern Oregon contributes to the recharge of deep basalt aquifers underlying the Columbia River Plateau. Overall, recharge is slow due to low annual precipitation rates in the region, and recharge areas are small relative to the expanse of the Columbia Plateau. Historically, surface water withdrawals from the Columbia River have been greater than recharge in many areas, and restrictions have been placed on groundwater in some parts of this aquifer system as previously described.

The Unregulated Contaminant Monitoring Rule (UCMR) sampling program was an addition to the 1996 Safe Drinking Water Act, which requires USEPA issue a new list of no more than 30 unregulated contaminants to be monitored by public water systems every five years (USEPA, 2020). PFAS were added as part of the UCMR 3 list in 2012 (USEPA, 2016a). The UCMR 3 dataset was evaluated to determine which public water systems were sampled for PFAS within a 20-mile radius of the facility. Based on this rule, public drinking water for the cites of Hermiston and Boardman was sampled in 2014 and 2015, and analytical results for the six PFAS compounds sampled were non-detect. No other public water system was sampled within 20 miles of the facility (USEPA, 2017a). PFAS analyses performed in 2014 and 2015 had method detection limits (DLs) that were higher than currently achievable.

Drinking water from water wells at RTC were sampled and analyzed for selected PFAS, including PFOS, PFOA, PFBS, PFHxS, and PFNA, in 2016 and 2021 and are summarized as follows:

- October 2016 drinking water samples: Three water wells were sampled on 24 October 2016. Samples were analyzed by EPA 537. An unvalidated laboratory analytical report, reporting 23 PFAS compounds including PFOS, PFOA, PFHxS, PFNA, and PFBS, indicated that

PFOA and PFHxS were detected in all three samples, but at concentrations below the screening levels presented in the OSD memorandum "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program," July 6, 2022 (Assistant Secretary of Defense, 2022).

- August 2019 drinking water samples: Two water wells were sampled on 22 August 2019. Samples were analyzed by EPA 537 Version 1.1. An unvalidated laboratory analytical report for four water samples and one field duplicate indicates the 14 reported PFAS, including PFOS, PFOA, PFHxS, PFNA, and PFBS, were not detected above LOQs ranging from 1.7 ng/L to 1.9 ng/L. All LOQs were below screening levels presented in the OSD memorandum "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program," July 06, 2022 (Assistant Secretary of Defense, 2022).

- December 2021 drinking water samples: Two water wells were sampled on 14 December 2021. Samples were analyzed by EPA 537.1 Version 1.0. An unvalidated laboratory analytical, reporting 18 PFAS compounds including PFOS, PFOA, PFHxS, PFNA, and PFBS, indicated that PFOS was detected in one sample, but at a concentration below the screening levels presented in the OSD memorandum "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program," July 6, 2022 (Assistant Secretary of Defense, 2022). All other results were not detected above LOQs ranging from 1.4 ng/L to 1.5 ng/L.

Hydrology

Surface waters infiltrate into permeable soils and may run off onto lower surrounding lands; therefore, no standing surface water is found at RTC. The nearest surface water features are the Umatilla River, located approximately 2.5 miles to the east, and the Columbia River, located approximately 3.5 miles to the north of RTC (**Figure 10-3**).

The Umatilla River is an 89-mile tributary of the Columbia River, with headwaters in the Blue Mountains. Draining a basin of 2,450 square miles, the Umatilla River enters the Columbia River in the City of Umatilla, approximately 4.5 miles to the northeast of RTC. The Columbia River is the largest river in the Pacific Northwest. With a drainage area of 258,000 square miles and a length of 1,243 miles, the Columbia River extends into seven US states and a Canadian province (British Columbia). Beginning in the Rocky Mountains of British Columbia, Canada, the Columbia River flows northwest and then south into Washington State, then turns west forming the border between Washington and Oregon, ultimately discharging into the Pacific Ocean further west.

Multiple canal systems surround RTC, including the West Extension Irrigation Canal to the north, High Line Canal to the south, and Westland Canals F, A, and I to the east. These canals remove water from the Umatilla River for irrigation of the local agriculture.

The central part of RTC lacks well-defined drainage patterns. Minimal stormwater runoff is generated at RTC; stormwater generally flows into the numerous shallow depressions found in the flat and gently rolling topography characterized within the region. The most significant depressions are located at the base of the west-facing bluff of Coyote Coulee, which creates a natural divide along a portion of the boundary between Patterson Slough – Lake Umatilla Watershed and the Umatilla River Watershed (**Figure 10-3**). Drainage from several buildings located at the top of the bluff discharges into these depressions. Surface runoff in the area east of Coyote Coulee is toward the southern boundary into a shallow, elongated depression running parallel to the Union Pacific Railroad and Interstate 84 (USACE, 2013).

RTC handles and treats all wastewater produced within the facility; a sewage treatment plant, septic tanks, and drain field systems are located at the facility. RTC operates the wastewater

systems in accordance with a National Pollutant Discharge Elimination System (NPDES) permit and two water pollution control permits issued by the Oregon Department of Environmental Quality (ORDEQ) (USACE, 2013). Domestic wastewater is run through an oil water separator and routed to the sewage treatment plant at the south-central part of the facility.

Climate

The climate at RTC is characterized as a dry continental (Canestorp, 2007). Temperatures are moderated year-round by the Pacific Ocean, with seasonal temperatures at RTC averaging 75 degrees Fahrenheit (°F) in the summer and 35°F in the winter. High temperatures can reach 100°F when air from the Pacific is hindered by predominating stagnant, high-pressure systems in the north or east in the summer or early fall. The resulting dry and hot southerly air allows for increased risk of wildfires in the region. Wind in the area tends to be channeled along the Columbia River valley, in conjunction with a prevailing westerly wind, resulting in a prevailing west-southwest wind at RTC.

Average annual precipitation in the region is 8.85 inches, 60% of which occurs between November and March. Annual snowfall is approximately 10 inches, with the majority falling between December and March. Although summer precipitation is unusual, when it does occur, it is usually in the form of thunderstorms, which can sometimes cause flash flooding.

Current and Future Land Use

During a BRAC meeting to reassess the land space and training needs of the former UCD, a plan was developed to divide the installation into four parcels: one parcel would be converted into a wildlife conservation refuge; the second parcel would become an industrial zone to aid in the economic growth of the area; the third parcel would be taken over by the Oregon Department of Transportation; and the fourth parcel would be used by the ORARNG as a premier training facility, known as Camp Umatilla Oregon (now RTC). The OMD invested $2 million in infrastructure improvements to the 1940s era installation (Ingersoll, 2018).

RTC is currently used for weekend and annual training requirements for the ONG and other military branches. RTC is home to the ORARNG's 1st Infantry Training Battalion of the 249th Regional Training Institute and the only certified Army infantry training academy west of the Mississippi River in the continental US (Koester, 2016).

OMD intends to invest in facility improvements including sewer line repairs, a new water distribution system, road realignments, security fencing, administration and office space enhancements, new classrooms, as well as barracks for more than 320 soldiers and dining facility improvements (Ingersoll, 2018). After these improvements, OMD intends to build an infantry training schoolhouse (McDowell, 2018). RTC is anticipated to remain used for military training purposes in the future.

Areas of Interest and Conceptual Site Models

PFAS-containing materials were potentially released to soil and groundwater within the boundary of RTC through fire training exercises and stormwater conveyance. Three AOIs were identified based on preliminary data and assumed groundwater flow directions. These AOIs are described below and presented on **Figure 10-4**.

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.

AOI 1 Former Fire Training Areas

AOI 1 includes the two Former Fire Training Areas (FTAs) within the cantonment area at RTC. The FTAs, designated FTA 01 and Burn Pit, are both locations where activities occurred that involved potential PFAS-containing materials. Interviews with facility personnel confirmed AFFF may have been used at the former FTAs, which are located approximately 300 feet apart from one another. Based on close proximity and similar historical use, the two FTAs were grouped into a single AOI (AOI 1).

FTA 01 was an area designated for fire training and nozzle practice; however, interviewees could not confirm whether the foam used during these trainings contained PFAS. It is estimated that the FTA was used for training occurred between 2003 and 2008; however, the exact duration and time period are unknown.

The Burn Pit area was formerly used regularly throughout the year to conduct controlled burns of wood and other organic debris. Interviewees recall foam being used during the burns to suppress flames; however, they could not confirm if the foam used during the burns contained PFAS.

Ground-disturbing activities to surface soil at AOI 1 could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via ingestion of surface soil or inhalation of soil particles (dust). Ground-disturbing activities to subsurface soil could result in site and construction worker exposure. Therefore, the inhalation and ingestion pathways for these receptors are considered potentially complete for AOI 1.

PFAS are water soluble and can migrate readily from soil to the groundwater, which is estimated to be 60 to 100 feet bgs (USACE, 2013). Because potential PFAS releases to surface soil at AOI 1 have occurred, PFAS may migrate from surface soil to groundwater via leaching. As shown on **Figure 10-2**, because drinking water wells are located within the facility boundary (a domestic well is located approximately 1,000 feet to the northwest and hydrologically downgradient of AOI 1), an irrigation well is located outside the facility boundary (approximately 2,000 feet south of AOI 1), and given seasonal variation affecting groundwater flow direction, the ingestion exposure pathway for groundwater to site workers, construction workers, and off-facility receptors is considered potentially complete. No surface water features flow through AOI 1; therefore, surface water and sediment exposure pathways are incomplete.

AOI 2 Fire Station

AOI 2 is the Fire Station, which was constructed in 1941 (ORNG, 2018), within the cantonment area of RTC known to store PFAS-containing materials. During the site visit on 2018, one 5-gallon bucket of concentrated AFFF was observed at the Fire Station. AFFF-capable firetrucks were previously located at RTC, and the AFFF tanks on the firetrucks were refilled using 5-gallon buckets at the Fire Station. Allegedly, there was no designated staging area for refilling AFFF into the firetrucks. Additionally, firetrucks were washed outside the Fire Station. The exact location is unknown; however, the activity likely occurred in the paved area east of the Fire Station or adjacent to a water spigot northeast of the Fire Station. The time period in which AFFF was stored or used at the Fire Station is unknown; however, given the history of AFFF use by the military, AFFF use at the Fire Station dates back to at least 1969 (Interstate Technology and Regulatory Council, 2020). A stormwater conveyance line is located east of Fire Station with catch basins southeast and southwest of the Fire Station building. The Fire Station and a floor drain within the firetruck bay are connected to the sanitary sewer which routes domestic wastewater to the wastewater treatment plant (WWTP) located approximately one mile to the west of the Fire Station (OMD, 2018). Stormwater conveyance lines discharge to a ditch near the WWTP.

Ground-disturbing activities to surface soil at AOI 2 could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via ingestion of surface soil or inhalation of soil particles (dust). Ground-disturbing activities to subsurface soil could result in site and construction worker exposure. Therefore, the inhalation and ingestion pathways for these receptors are considered potentially complete for AOI 2.

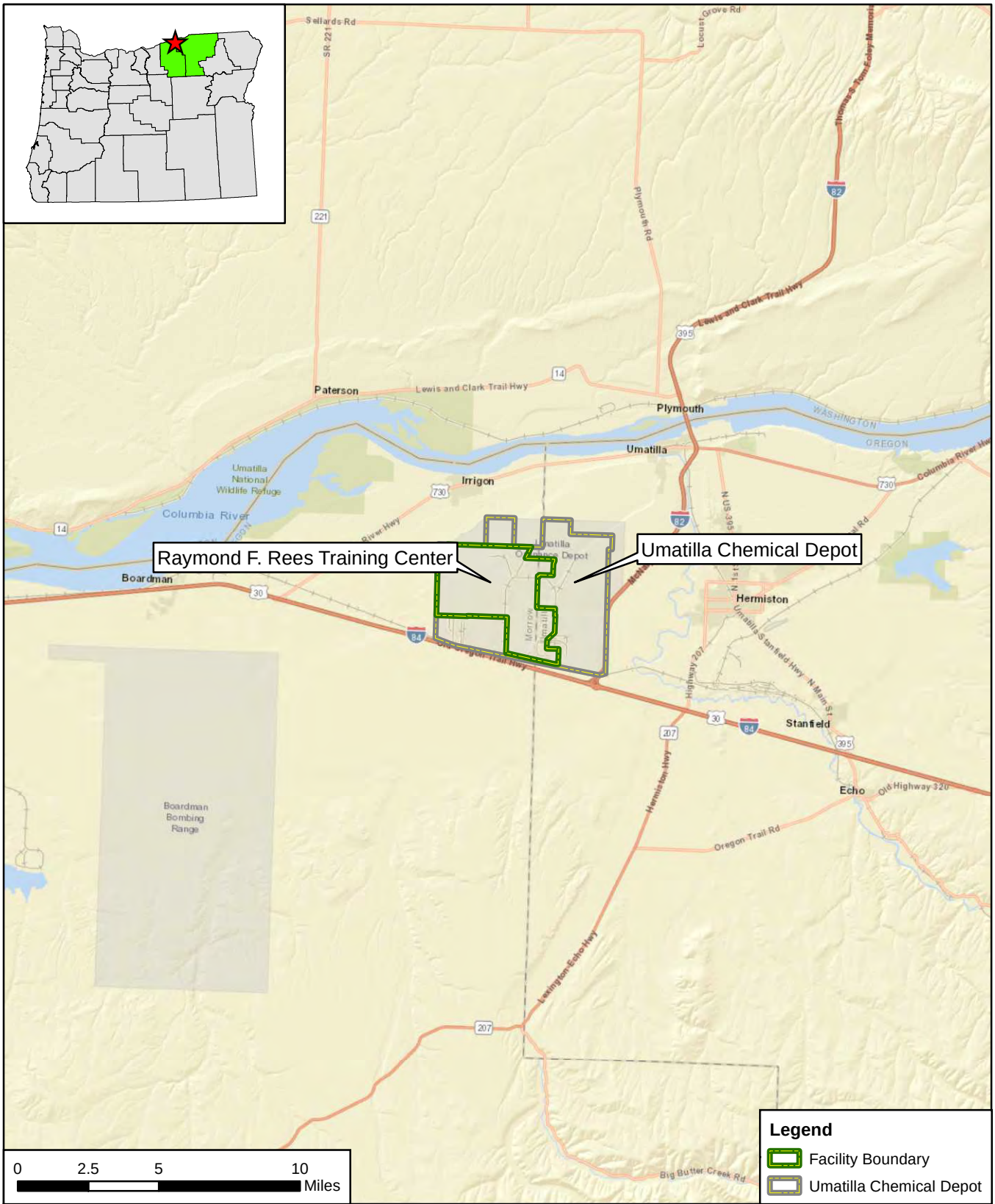
Because potential PFAS releases to surface soil at AOI 2 have occurred, PFAS may migrate from the surface soil to the groundwater via leaching. PFAS are water soluble and can migrate readily from soil to the groundwater, which is estimated to be 60 to 100 feet bgs (USACE, 2013). As shown on **Figure 10-2**, because drinking water wells are located within the facility boundary (a domestic well is located approximately 900 feet to the northwest and hydrologically cross-gradient of AOI 2), and an irrigation well is located outside the facility boundary (approximately 2,000 feet south of AOI 2), and given seasonal variation affecting groundwater flow direction, the ingestion exposure pathway for groundwater to site workers, construction workers, and off-facility receptors is considered potentially complete. No surface water features flow through AOI 2; therefore, surface water and sediment exposure pathways are incomplete.

AOI 3 Wastewater Treatment Plant

AOI 3 is the former WWTP west of the RTC cantonment area. RTC managed wastewater via septic systems, leach fields, and the WWTP in accordance with NPDES and two Water Pollution Control Facility permits issued by the ORDEQ (USACE, 2013). Domestic wastewater generated in the cantonment area and all steam cleaning wastewater generated throughout the facility was formerly discharged into the underground sanitary sewer piping routed to the WWTP (USACE, 2013; OMD, 2018). Steam-cleaning wastewater was pre-treated through an oil/water separator prior to being routed to the WWTP. The WWTP infrastructure included an Imhoff tank, a standby Imhoff tank, a sludge drying bed, and a tile field percolation system (AMEC, 2012). Prior to the WWTP's decommissioning, treated wastewater discharged to the tile field where it dissipated by evapotranspiration and controlled seepage in accordance with discharge permits. Additionally, the stormwater conveyance system servicing the cantonment area discharged to an open ditch near the WWTP USACE, 2013).

Ground-disturbing activities to surface soil at AOI 3 could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via ingestion of surface soil or inhalation of soil particles (dust). Ground-disturbing activities to subsurface soil could result in site and construction worker exposure. Therefore, the inhalation and ingestion pathways for these receptors are considered potentially complete for AOI 3.

Because potential PFAS releases to surface soil at AOI 3 have occurred, PFAS may migrate from the surface soil to the groundwater via leaching. PFAS are water soluble and can migrate readily from soil to the groundwater, which is estimated to be 60 to 100 feet bgs (USACE, 2013). As shown on **Figure 10-2**, because drinking water wells are located within the facility boundary (a domestic well is located approximately 1 mile to the east and hydrologically cross-gradient of AOI 3), an irrigation well is located outside the facility boundary (approximately 2,500 feet southeast of AOI 3), and groundwater flow direction seasonal variations , the ingestion exposure pathway for groundwater to site workers, construction workers, and off-facility receptors is considered potentially complete. No surface water features flow through AOI 3; therefore, surface water and sediment exposure pathways are incomplete.



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Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	CM	3/31/2022

N

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-1

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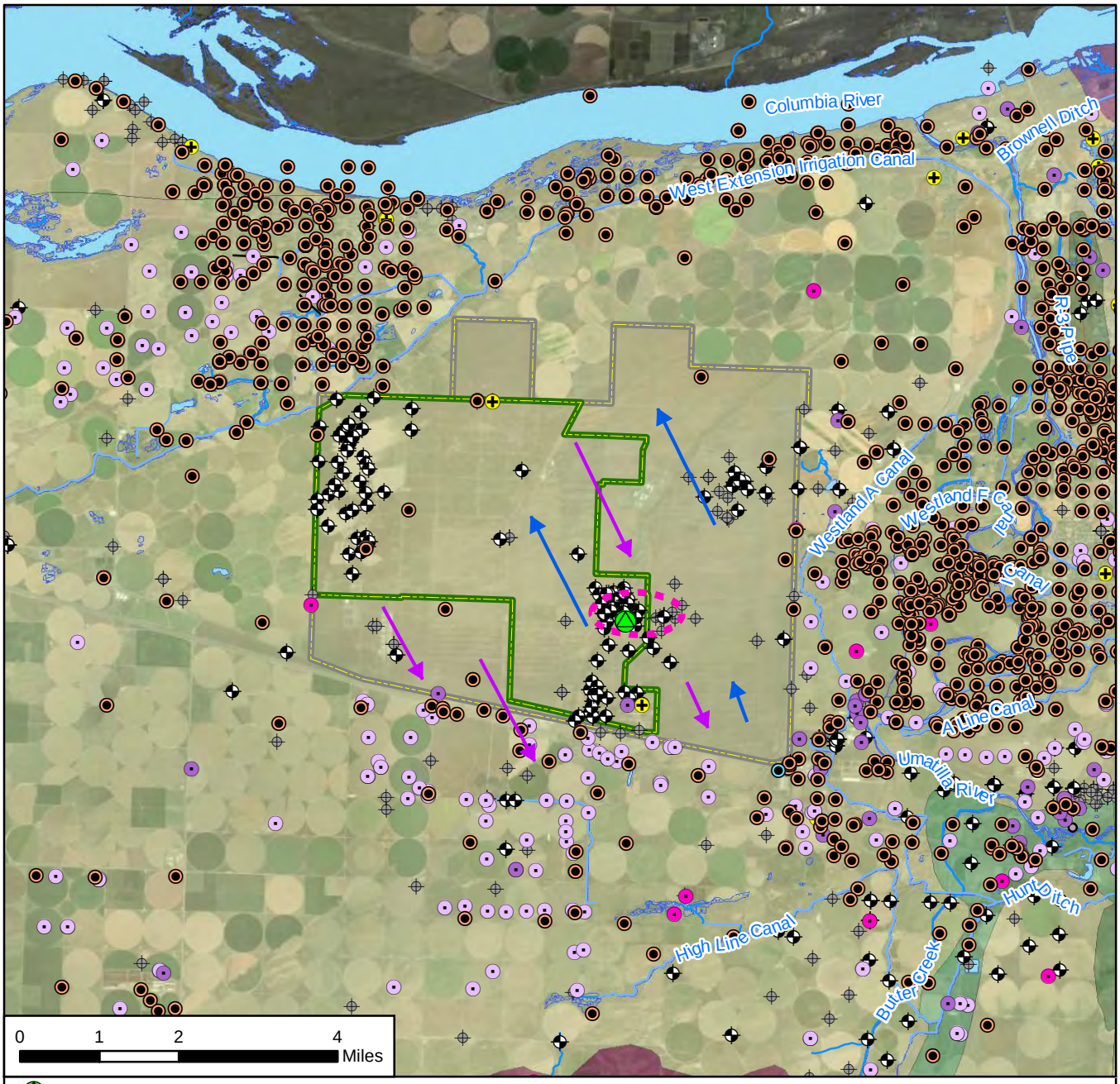

- Treatment System
- Pump and Treat system approximated radius of influence (extraction and infiltration)
- Facility Boundary
- Umatilla Chemical Depot
- Water Body
- Wetland
- River/Stream
- Canal/Ditch
- Pipeline
- Summer/Fall Inferred Groundwater Flow Direction
- Winter/Spring Inferred Groundwater Flow Direction

Geology

- Qal - Alluvial
- Qgs - Glaciofluvial, Lacustrine, and Pediment Sedimentary Deposits
- Ts - Tuffaceous sedimentary rocks, undifferentiated

Wells

- Domestic Well
- Commercial Well
- Industrial Well
- Irrigation Well
- Livestock Well
- Municipal/Community Well
- Monitoring/Observation Well
- Other/Unknown Well

CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Raymond F. Rees Training Center, OR			
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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	CM	3/31/2022

N

Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-2

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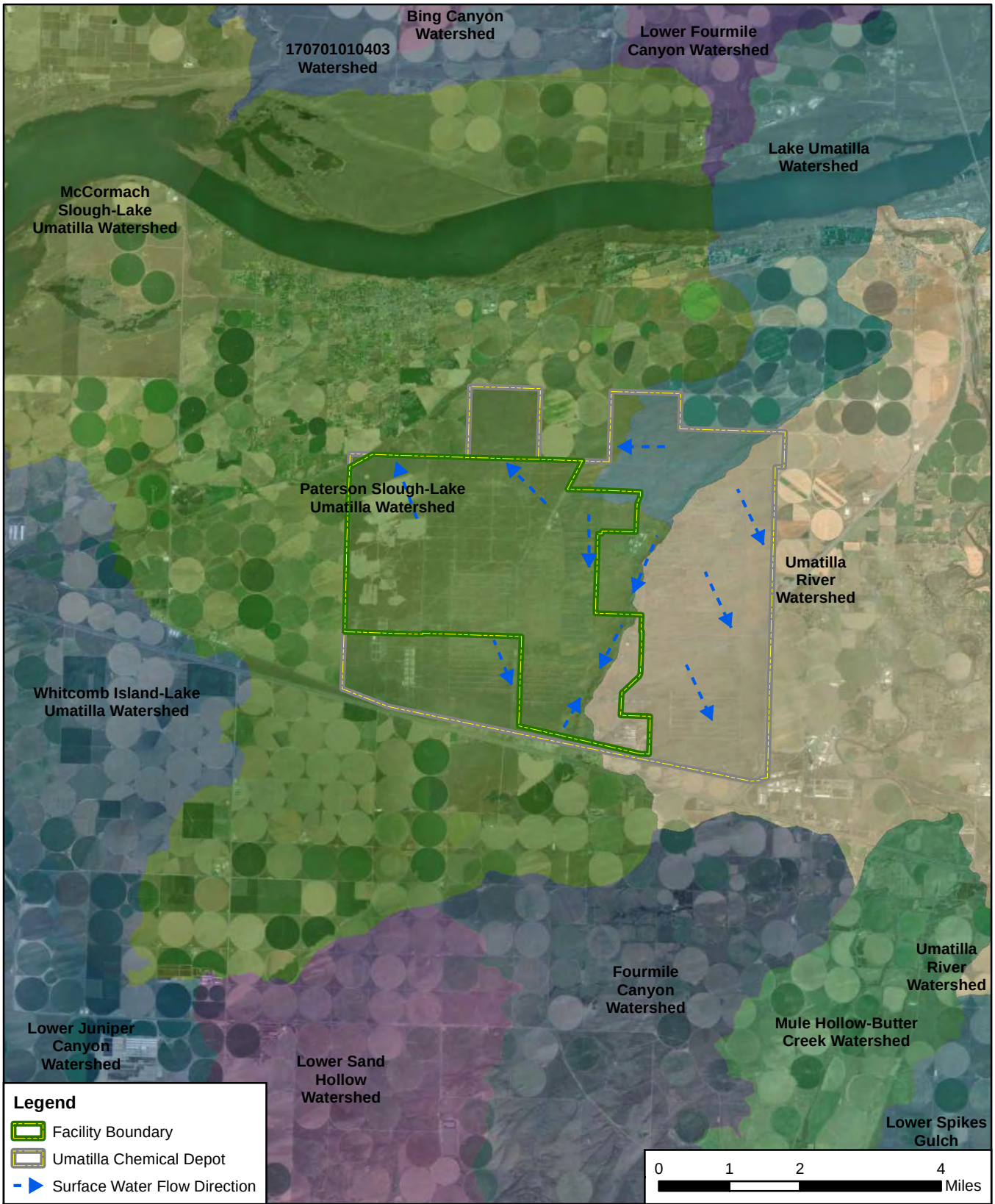

CLIENT	ARNG			
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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,		PM	CM	3/31/2022

Surface Water Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-3

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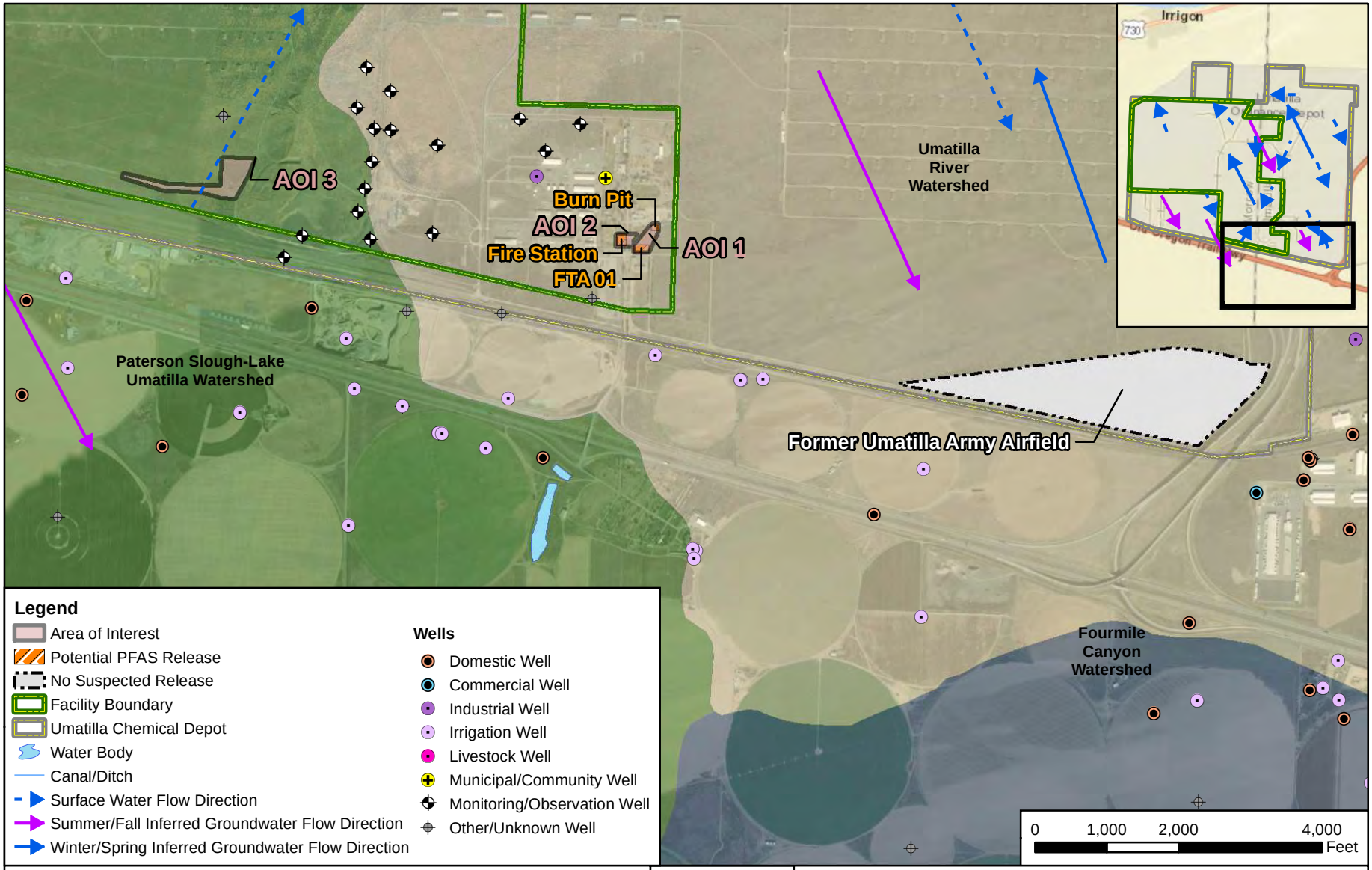

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Base Map: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	CM	3/31/2022

TITLE

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 6 July 2022 (Assistant Secretary of Defense, 2022). 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 six compounds: PFOS, PFOA, PFBS, PFHxS, PFNA, and hexafluoropropylene oxide dimer acid (HFPO-DA). The SLs are presented in **Worksheet #15** of this QAPP Addendum. Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) is not included as an analyte for this SI. HFPO-DA has primarily been used as a replacement for PFOA in the manufacturing of fluoropolymers, so it is not likely to have been released at the vast majority of DoD properties. However, ARNG will add HFPO-DA to the list of constituents sampled during the next phase of CERCLA if warranted.

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 fire training areas, 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 Health Advisory levels." (USEPA, 2016a, 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, PFBS, PFHxS, and PFNA at or above SLs at RTC.
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, PFBS, PFHxS, and PFNA 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 Camp Umatilla (now RTC);
- Analytical data collected during other environmental sampling efforts at RTC;
- 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 facility limits of RTC. 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). Although historical data indicates groundwater may be encountered between 60 to 100 feet bgs, recent drought conditions in the region could result greater depths to groundwater. For planning purposes, an average depth to groundwater of 150 feet bgs is assumed for the AOCs. The scope of the SI is vertically bounded as follows: groundwater (150 feet bgs), subsurface soil from sonic drilling technology (SDT) borings (15 feet bgs and 150 feet bgs) and surface soil (0 to 2

feet bgs). The temporal boundaries of the study are limited by seasonal conditions; the field work for the scope will be performed Summer/Fall 2022.

5. Develop the Analytic Approach

Samples will be analyzed by a DoD Environmental Laboratory Accreditation Program (ELAP) and 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, PFBS, PFHxS, and PFNA at the potential source area?
3. What is the concentration of PFOA, PFOS, PFBS, PFHxS, and PFNA 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, PFBS, PFHxS, and PFNA in shallow surface soil (0-2 feet bgs)?
2. What is the concentration of PFOA, PFOS, PFBS, PFHxS, and PFNA in soil (i.e., capillary fringe) (60-95 feet bgs)?
3. What does the CSM suggest in terms of source, pathway, and receptor?

Soil and groundwater samples will be collected from potential source areas identified in **Worksheet #10**. Based on hydrogeologic information and recent drought conditions, groundwater is expected to be encountered at approximately 150 feet bgs. The regional aquifer is significantly deeper (greater than 500 feet bgs) and will not be subject to drilling during this investigation. 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 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

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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	15.) 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.

779 **Notes:**
780 < = less than
781 > = greater than
782 ARNG = Army National Guard
783 CSM = conceptual site model
784 ND = non-detect
785 PFAS = per- and polyfluoroalkyl substances
786 RI = Remedial Investigation
787 SI = Site Inspection
788 SL = screening level

Final PQAPP Worksheet #12: Measurement Performance Criteria

Matrix Groundwater/ 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 > ½ 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 spike/ laboratory control spike 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 > ½ 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 spike/ laboratory control spike 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	July 2022	July 2022
Mobilization	July 2022*	July 2022*
Field Work	July 2022*	July 2022*
Demobilization	August 2022*	August 2022*
Data Review/Validation	September 2022	September 2022
Reporting	October 2022	February 2023

Notes:
* Weather permitting

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

Matrix: Groundwater/ 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

862 **SLs for Soil and Groundwater**

863 The DoD has adopted a policy to retain facilities in the CERCLA process based on conservative SLs for soil and groundwater, as
864 described in a memorandum from the OSD dated 6 July 2022 (Assistant Secretary of Defense, 2022). The ARNG program under which
865 this SI will be performed follows this DoD policy and should the maximum concentration for sampled media exceed the SLs established
866 in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply
867 to six compounds: PFOA, PFOS, PFBS, PFHxS, PFNA, and HFPO-DA.

Analyte	CAS Number	Residential (Soil) (µg/kg)[a,b,c] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a,b,c] 2 -15 feet bgs	Tap Water (Groundwater) (ng/L)[a,c]
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	13	160	4
Perfluoroheptanoic acid (PFHpA)	375-85-9	-	-	-
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	130	1,600	39
Perfluorononanoic acid (PFNA)	375-95-1	19	250	6
Perfluorooctanoic acid (PFOA)	335-67-1	19	250	6
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,900	25,000	601
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	-	-	-

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Notes:

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using USEPA's Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

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).

c.) Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte for this SI. However, ARNG will add HFPO-DA to the list of constituents sampled during the next phase of CERCLA if warranted.

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

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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, PFBS, PFHxS, and PFNA at or above SLs. As discussed in **Worksheet #10**, three AOIs were identified at RTC. Regional groundwater flow at RTC is generally to the northwest; however, seasonal variation exists: in the summer and fall, groundwater flow direction is generally to the east and south, while in the winter and early spring, groundwater flow direction is generally to the northwest towards the Columbia River.

- AOI 1: Sometime between 2003 and 2008 (exact time period is unknown), AFFF was used at former FTA 01 and a Burn Pit located approximately 100 yards from one another. FTA 01 was designated for fire training and nozzle practice, and the Burn Pit was used regularly throughout the year for controlled burns of wood and other organic debris. Interviewees recall foam being used during the burns to suppress flames; however, it could not be confirmed if the foam used during the burns contained PFAS.

- AOI 2: Since approximately 1969, AFFF was stored at the Fire Station in 5-gallon buckets. AFFF tanks on firetrucks at the Fire Station were manually refilled with concentrated AFFF from 5-gallon buckets in a non-designated location. Firetrucks were also washed outside the Fire Station. The exact locations are unknown but are likely to have occurred in front (east) of the Fire Station or near a water spigot northeast of the Fire Station.

- AOI 3: Since 1941 and prior to its decommissioning, the WWTP had handled domestic wastewater from the cantonment area and steam cleaning wastewater generated throughout the facility (AMEC, 2012). Steam-cleaning wastewater was treated through an oil/water separator prior to being routed to the WWTP via underground sanitary sewer. The WWTP infrastructure included an Imhoff tank, a standby Imhoff tank, a sludge drying bed, and a tile field percolation system (AMEC, 2012). Treated wastewater was discharged to the tile field, where it dissipated by evapotranspiration and controlled seepage. PFAS-containing wastewater discharged to the WWTP has not been confirmed; however, potential PFAS-containing liquids were likely discharged into floor drains and sinks connected to the sanitary sewer piping routed to the WWTP (AMEC, 2012). Additionally, the stormwater conveyance system service the cantonment area discharged to an open ditch adjacent to the WWTP. Potential AFFF releases at the Fire Station could have been captured as domestic wastewater or stormwater and discharged to the tile field or ditch.

Environmental media samples will be collected from the AOIs in accordance with the applicable CSM, as summarized in **Table 17-1**. Permanent monitoring wells will be installed at and within the vicinity where PFAS were potentially released.

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 Drilling Boring Installation and Soil Sampling
- **Worksheet #17c** – Permanent Groundwater Monitoring Well Installation and Groundwater Sampling
- **Worksheet #17d** – Synoptic 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 SDT Boring Locations	# of HA Boring Locations	Approximate Depth (feet bgs)	Groundwater Samples	Soil Samples	Surface Water/Sediment
1	Former FTAs	3	25	150 (2 locations) 15 (1 location)	2	72	0
2	Fire Station	3	1	150 (2 locations) 15 (1 location)	2	10	0
3	Former WWTP	4	12	150 (4 locations)	4	38	0
Total (not including QC)		10	38	--	8	120	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
PFAS = per- and polyfluoroalkyl substances
QC = quality control
SDT = sonic drilling technology
WWTP = wastewater treatment plant

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 for 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 and the drilling subcontractor will participate in an RTC 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. 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.

All site workers will adhere to current DoD COVID-19 guidance.

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

Soil samples will be collected via hand auger and SDT (SOP 3-21). Hand augers will be used to collect surface soil samples. Borings will be advanced using SDT 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, and collect surface soil samples. A Terra Sonic Tsi 150cc or similar will be used to collect continuous soil cores to the target depth, anticipated to utilize a 7-inch diameter core barrel with an 8-inch diameter override casing. All drilling materials will be PFAS-free.

Due to the geology and recent drought conditions at the facility, depth to groundwater at the facility is not currently known, but it is expected that groundwater will be encountered at up to

approximately 150 feet bgs at AOIs 1 through 3. Therefore, it may not be possible to target subsurface soil sample intervals based on depth to the groundwater table, and a combination of hand augers and SDT will be used to collect up to three soil samples per boring as follows:

- one surface soil sample (0 to 2 feet bgs – hand auger) – see further discussion below regarding depth intervals.
- If the boring is intended to be advanced to up to approximately 150 feet bgs and to be completed as a monitoring well, one subsurface soil sample approximately 2 feet above the groundwater table (capillary fringe) or the bottom of the boring. If the boring is intended to be advanced to approximately 15 feet bgs and not be completed as a monitoring well, one subsurface sample at the approximate mid-point between the surface and the bottom of the boring (SDT).
- one subsurface soil sample from 13 to 15 feet bgs (SDT).

The surface soil samples will be collected using a hand auger during utility preclearance (SOP 3-17). Surface soil samples will be sampled at either a single-depth interval or a multi-depth interval. Samples from monitoring well and boring locations and selected surface soil sampling locations will be collected from a single-depth interval, from approximately 0 to 2 feet bgs. The remaining surface soil samples will be collected from a multi-depth interval, from approximately 0 to 6 inches bgs, 6 to 12 inches bgs, and 12 to 24 inches bgs.

The proposed sample locations are shown on **Figures 17-1** and **17-2** and described in **Worksheet #18**. The soil sample rationale and target depths are provided in **Table 17-2** below. Borings advanced up to 150 feet bgs will be converted into permanent groundwater monitoring wells, as described in **Worksheet #17c**.

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

Area of Interest	Number of Sampling Locations	Sample Collection Method	Target Depth (feet bgs)	Rationale
AOI 1	3	SDT	15 and 150	Surface and subsurface soil samples will be collected within the vicinity of each identified potential release area within AOI 1: the Burn Pit and FTA 01. Documented use of an unknown foam to control and suppress fires at the Burn Pit provides the highest probability for encountering PFAS, if PFAS-containing foam was used in AOI 1. Due to the anticipated depth to groundwater, subsurface soil samples (capillary fringe) will be collected from only three locations: one boring within the Burn Pit area and two borings within the FTA 01. The boring within the Burn Pit area will be completed to up to approximately 150 feet bgs to collect surface soil (hand auger), subsurface soil (15 feet bgs), and subsurface soil (capillary fringe) samples. One boring within FTA 01 will be completed as described above, and the other will be completed to 15 feet bgs to collect surface soil (hand auger) and subsurface soil (SDT) samples.
	8 19	Hand Auger, single-depth Hand Auger, multi-depth	2	

Area of Interest	Number of Sampling Locations	Sample Collection Method	Target Depth (feet bgs)	Rationale
AOI 1 (cont.)	8 19	Hand Auger, single-depth Hand Auger, multi-depth	2	A hand auger will be used to collect a single-depth interval surface soil sample at each SDT boring location prior to hand clearing, or immediately adjacent to the SDT boring. A total of two additional single-depth interval and seven multi-depth interval surface soil sample locations will be collected within the Burn Pit. A total of four additional single-depth interval and twelve multi-depth interval surface soil sample locations will be collected within FTA 01.
AOI 2	3	SDT	15 and 150	Surface and subsurface soil samples will be collected within the vicinity of the identified potential release area within AOI 2: the Fire Barn. The grassy area north of the Fire Station driveway is the most likely location where a potential AFFF release not captured by a floor drain or stormwater catch basin would infiltrate into soil and migrate to groundwater. Due to the anticipated depth to groundwater, subsurface soil samples (capillary fringe) will be collected from only three locations: one boring north of the Fire Station driveway, one boring adjacent to a water spigot northeast of the Fire Station, and one boring approximately between AOI 1 and AOI 2 to address potential seasonal variability of groundwater flow direction. The boring adjacent to the water spigot will be completed to 15 feet bgs to collect surface soil (hand auger) and subsurface soil (SDT) samples. The remaining two borings will be completed to approximately 150 feet bgs to collect surface soil (hand auger), subsurface soil (15 feet bgs), subsurface soil (capillary fringe) samples. A hand auger will be used to collect a single-depth interval surface soil sample at each SDT boring locations prior to hand clearing, or immediately adjacent to the SDT boring. A total of one additional single-depth interval surface soil sample location will be collected within the vicinity between the Fire Station and the water spigot.
	4	Hand Auger, single-depth	2	

Area of Interest	Number of Sampling Locations	Sample Collection Method	Target Depth (feet bgs)	Rationale
AOI 3	3	SDT	150	Surface and subsurface soil samples will be collected within the vicinity of each identified potential release area within AOI 3: the former WWTP. Potential PFAS-containing material conveyed to the former WWTP via the sanitary sewer pipes was discharged as treated wastewater beneath the ground surface. Based on season groundwater pumping and assumed groundwater direction(s), subsurface soil samples will be collected from four locations: two within the footprint of the tile field, one adjacent to the nearby plant building, and one adjacent to the stormwater infiltration ditch. Subsurface soil samples (15 feet bgs and capillary fringe) will be collected at each boring location. A hand auger will be used to collect a single-depth interval surface soil sample at each boring location prior to hand clearing, or immediately adjacent to the SDT boring. A total of five additional single-depth interval samples will be collected within the tile field, as well as six multi-depth interval surface soil sample locations within the tile field and at the nearby plant building, and one multi-depth interval sample at the stormwater infiltration ditch.
	9 7	Hand Auger, single-depth Hand Auger, multi-depth	2	

Notes:
AOI = area of interest
bgs = below ground surface
SDT = sonic drilling technology
WWTP = wastewater treatment plant

The soil cores will be continuously logged for lithological descriptions by a field geologist using the Unified Soil Classification System (USCS) per SOP 3-16. A photoionization detector (PID) will be used to screen the breathing zone during boring activities. Observations and measurements will be recorded on field forms and in a non-treated field logbook. Photographs of the boring cores will also be taken. At a minimum, depth interval, recovery thickness, PID concentrations, moisture, relative density, color (using a Munsell soil color chart), and texture (using the USCS) will be recorded. Additional observations to be recorded may include groundwater or perched water depth, organic material, or cultural debris. If a continuous, competent clay is observed in a boring with a thickness in excess of 3 feet, measures will be taken to avoid completely penetrating this potential confining unit.

It is anticipated that all borings will be advanced in areas without surface cover; however, if a boring is required in asphalt, locations not completed as a monitoring well will be abandoned by backfilling with bentonite chips to approximately 6 inches bgs, and the remainder of the borehole will be patched with an asphalt cold patch. Borings into concrete will be avoided, if possible; however, if borings are advanced into concrete, locations not completed as a monitoring well will be abandoned by backfilling with bentonite chips to approximately 6 inches bgs, and the remainder of the borehole will be filled with concrete to provide as flush a surface as possible. The surface at each location will be restored to match the surrounding area.

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

Each sample will be collected into laboratory-supplied bottleware and submitted to the laboratory for analysis of selected parameters. Samples will be analyzed for PFAS by liquid chromatography tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.3 Table 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 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

As discussed in **Worksheet #17b**, boreholes for permanent monitoring wells will be created using a Terra Sonic TSi 150cc (or equivalent). Once the borehole has been advanced to the specified depth, if groundwater is encountered, a well will be installed according to *SOP 3-12, Monitoring Well Installation* (**Appendix B**). The well will be constructed of either 2-inch or 4-inch diameter, flush-threaded Schedule 40 or Schedule 80 PVC that will have a sand trap at the bottom with an estimated 10 to 20 feet of 0.010 slot well screen and blank well casing to ground surface and sealed with a lockable compression cap. Diameter of borehole will be a minimum of 2 inches greater than the outside diameter of the well screen. The filter pack within the annular space around the screen will consist of 2/12 Monterrey sand and will be placed at least 1 foot above the top of the well screen. A well seal consisting of hydrated bentonite chips or bentonite grout will be installed above the sand pack. The screened interval of each well will target the top of the groundwater table. Surface completion will include installation of flush mount well vaults or stickup well casings, depending on anticipated traffic or likeliness of standing water. Bollards may be installed around well monuments requiring additional protection from surface activities. Wells will be installed, completed, and developed accordance with Oregon Administrative Rules (OAR) Chapter 690 Division 240.

The proposed sample locations are shown on **Figures 17-1** and **17-2** and are described in **Worksheet #18**. Based on a review of nearby well logs and other available information, depth to groundwater beneath RTC ranges from approximately 60 to 100 feet bgs (OWRD, 2022; USACE, 2013), with a maximum investigation depth of approximately 150 feet bgs. The target screen intervals and further rationale for the sampling locations are described in **Table 17-3** below.

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

Area of Interest	# of Permanent Wells	Target Screen Interval	Rationale
AOI 1	2	Top of groundwater table (up to an est. 150 feet bgs)	One monitoring well proposed at the Burn Pit and one monitoring well proposed at FTA 01. No additional wells proposed due the anticipated depth to groundwater.
AOI 2	2	Top of groundwater table (up to an est. 150 feet bgs)	One monitoring well proposed adjacent to the Fire Station and one monitoring well proposed within the vicinity between AOI 1 and AOI 2. No additional wells proposed due to the anticipated depth to groundwater.
AOI 3	4	Top of groundwater table (up to an est. 150 feet bgs)	Two monitoring wells proposed within the tile field of the former WWTP, one adjacent to the plant building, and one adjacent to the stormwater infiltration ditch.

Notes:
AOI = area of interest
bgs = below ground surface

Once the borehole for each permanent groundwater monitoring well has been advanced to the desired depth, a monitoring well will be installed as described above. Prior to sampling, each newly installed permanent monitoring well will be developed to establish a hydraulic connection between the well and the surrounding saturated formation. Standard methods for monitoring well development are described in SOP 3-13 (**Appendix B**). The goals of this well development are to settle the filter pack and to remove accumulated sediment/suspended solids that may enter the well during installation. Well development will be performed a minimum of 24 hours after well construction to allow time for the bentonite or grout seal to cure. Development will be performed by first using a surge block followed by a bailer (PVC or stainless steel) or pneumatic pump to remove sediments from the well and surrounding filter pack. Multiple iterations of surging and bailing may be required, dependent on the aquifer characteristics.

Once the bailed water is visually free of sediment, development will continue using high-flow pumping techniques (greater than 0.5 liter per minute) until the water quality parameters (temperature, pH, specific conductance, oxidation-reduction potential [ORP], and turbidity) stabilize to within 10% of the previous reading for three consecutive measurements, or until five borehole volumes (well casing plus annular space) have been removed. Dissolved oxygen (DO) readings may be recorded but will not be used as development completion criteria. Water quality instruments will be calibrated in accordance with SOP 3-24 (**Appendix B**).

Monitoring wells may be screened in silty material, water quality parameters, and notably, turbidity may not stabilize using high-flow pumping techniques. If water quality parameters do not stabilize to within 10% after five well volumes, low-flow pumping techniques (less than 0.5 liter per minute) will be performed for an additional well volume to better document groundwater conditions encountered during low-flow groundwater sampling. If necessary, well development water will be contained in labeled DOT-approved containers and managed as described in **Worksheet #17f**.

The following information will be recorded during the development of each permanent well:

- Date, time, personnel, and well designation;
- Static groundwater levels;
- Volume of water in well prior to development;
- Volume of water removed;

- Water Quality Parameters;
- Observations of water characteristics (e.g., color, odor, turbidity); and
- Description of development technique.

A low-flow groundwater sample will be collected at each well using a peristaltic pump with tubing that has been determined to be PFAS-free (i.e. high-density polyethylene [HDPE] or other PFAS-free material). If the peristaltic pump cannot generate enough hydraulic lift to bring the groundwater to the surface, groundwater samples will be collected at each well using a bladder pump with a bladder and tubing that have been determined to be PFAS-free (i.e., HDPE or other PFAS-free material). Groundwater samples will be collected using a PFAS-free 1.75-inch Geotech Bladder pump or other sampling device. Alternatively, a PFAS-free bailer may be used to collect groundwater samples at locations at which the use of a pump is impractical.

Prior to sample collection, turbidity and 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 measurements have stabilized. 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 wells.

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**. For non-dedicated sampling equipment, decontamination will be completed after each use (i.e., bladder pump decontaminated between temporary well locations), and associated ERBs will be collected at a rate of one per twenty samples. ERBs will be collected at a rate of one per twenty samples and will be analyzed for the same analytes as the associated samples. A temperature blank will be placed in each cooler to ensure that samples are preserved at or below 6 °C during shipment. 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
Synoptic Water Level Measurements

Groundwater levels will be used to monitor site-wide groundwater elevations and assess groundwater flow. Synoptic water level elevation measurements will be collected from the newly-installed monitoring wells (as shown on **Worksheet #18**). The wells 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 each newly installed well. Survey data will be collected in the applicable Universal Transverse Mercator zone projection with WGS84 datum (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:

Non-hazardous solid IDW (i.e., soil cuttings) generated during SI activities will be containerized in properly labeled 55-gallon drums (see SOP 3-05). This IDW will not be sampled and will assume the PFAS characteristics of the associated soil samples collected from that source location. The IDW will be stored at a location designated by the RTC Environmental Manager and ORARNG. ARNG will manage disposal of the solid IDW and will coordinate with ORDEQ 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 generated during SI activities (i.e., purged groundwater and decontamination fluids) will be containerized in 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 that source location. The containerized IDW will be temporarily stored onsite at a location designated by the RTC 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 ORDEQ 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.

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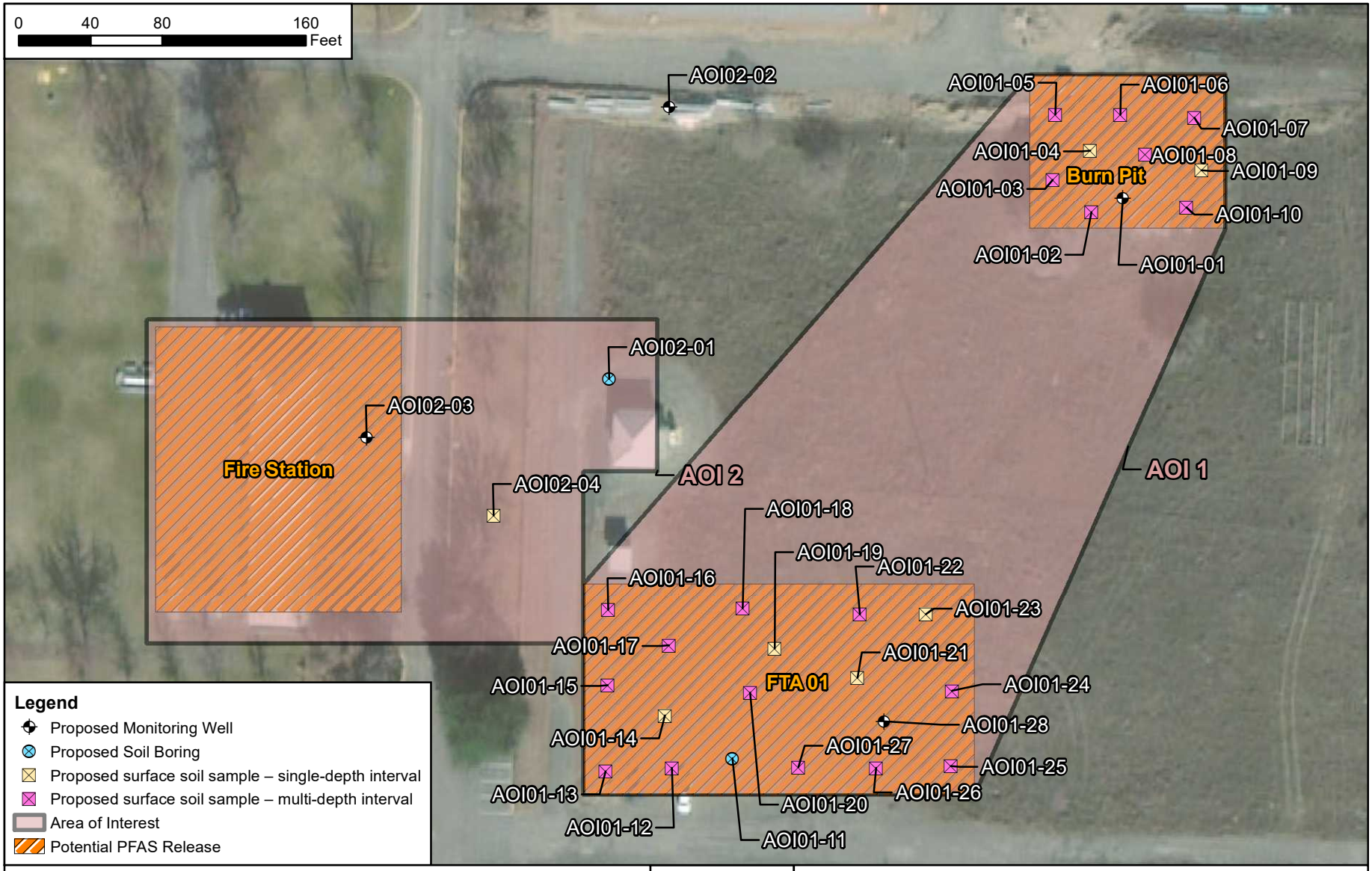

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Raymond F. Rees Training Center, OR			
REVISED	7/12/2022	GIS BY	MS	7/12/2022
SCALE	1:960	CHK BY	JH	7/12/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	7/12/2022

N

Proposed SI Sample Locations - AOI 1 and AOI 2

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 17-1

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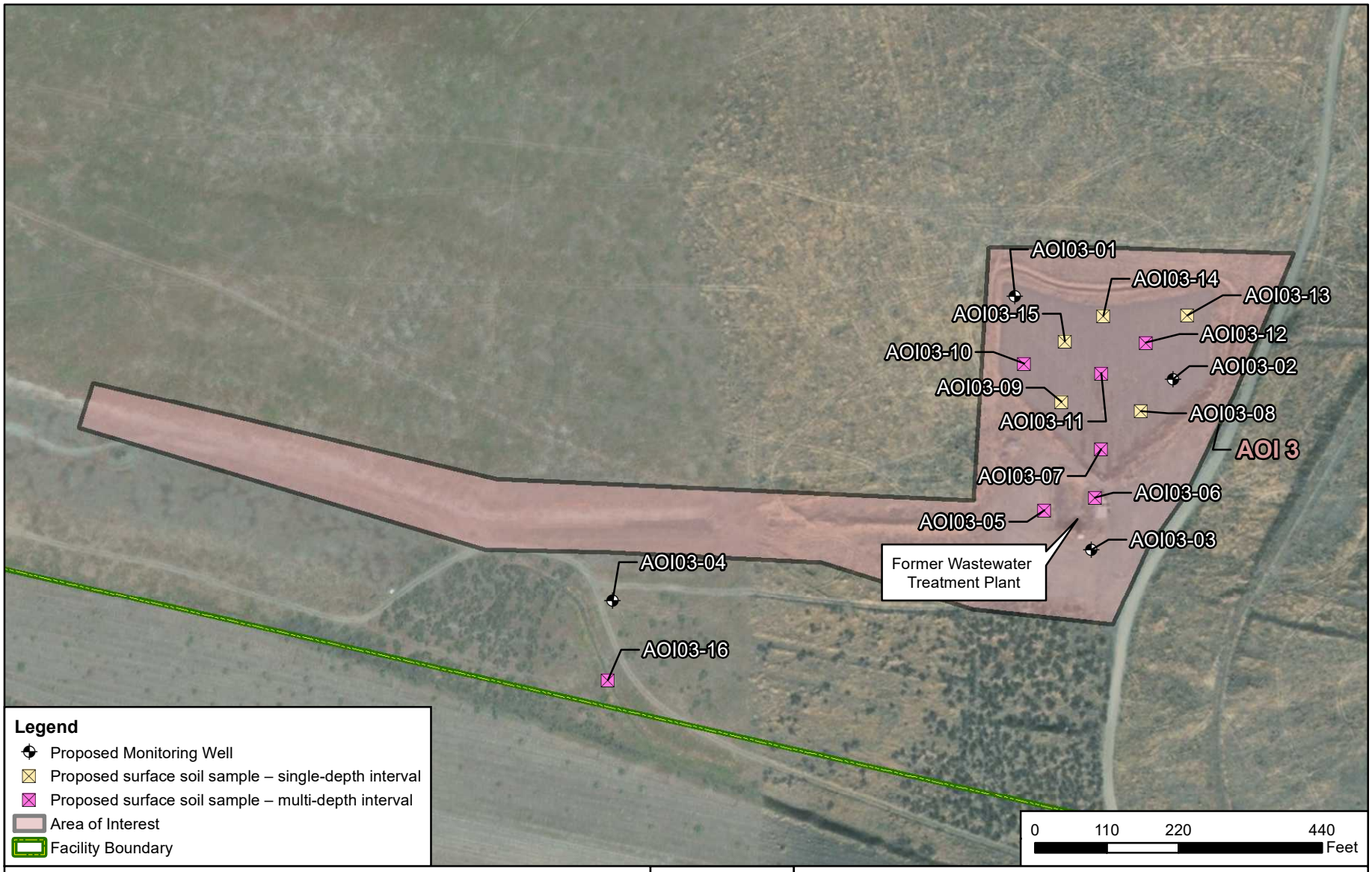

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Raymond F. Rees Training Center, OR			
REVISED	7/12/2022	GIS BY	MS	7/12/2022
SCALE	1:2,640	CHK BY	JH	7/12/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	7/12/2022

N

Proposed SI Sample Locations - AOI 3

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 17-2

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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	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
Soil Samples							
All	AOI01-01 AOI01-04 AOI01-09 AOI01-11 AOI01-14 AOI01-19 AOI01-21 AOI01-23 AOI01-28 AOI02-01 AOI02-02 AOI02-03 AOI02-04 AOI03-01 AOI03-02 AOI03-03 AOI03-04 AOI03-08 AOI03-09 AOI03-13 AOI03-14 AOI03-15	AOI01-01-SB-[Start Depth]-[End Depth] AOI01-04-SB-[Start Depth]-[End Depth] AOI01-09-SB-[Start Depth]-[End Depth] AOI01-11-SB-[Start Depth]-[End Depth] AOI01-14-SB-[Start Depth]-[End Depth] AOI01-19-SB-[Start Depth]-[End Depth] AOI01-21-SB-[Start Depth]-[End Depth] AOI01-23-SB-[Start Depth]-[End Depth] AOI01-28-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] AOI02-04-SB-[Start Depth]-[End Depth] AOI03-01-SB-[Start Depth]-[End Depth] AOI03-02-SB-[Start Depth]-[End Depth] AOI03-03-SB-[Start Depth]-[End Depth] AOI03-04-SB-[Start Depth]-[End Depth] AOI03-08-SB-[Start Depth]-[End Depth] AOI03-09-SB-[Start Depth]-[End Depth] AOI03-13-SB-[Start Depth]-[End Depth] AOI03-14-SB-[Start Depth]-[End Depth] AOI03-15-SB-[Start Depth]-[End Depth]	Surface Soil, Single-Depth Interval	0-2 ft 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	AOI01-02 AOI01-03 AOI01-05	AOI01-02-SB-[Start Depth]-[End Depth] AOI01-02-SB-[Start Depth]-[End Depth] AOI01-02-SB-[Start Depth]-[End Depth] AOI01-03-SB-[Start Depth]-[End Depth] AOI01-03-SB-[Start Depth]-[End Depth] AOI01-03-SB-[Start Depth]-[End Depth] AOI01-05-SB-[Start Depth]-[End Depth] AOI01-05-SB-[Start Depth]-[End Depth] AOI01-05-SB-[Start Depth]-[End Depth]	Surface Soil, Multi-Depth Interval	0-6 in bgs 6-12 in bgs 12-24 in bgs	Hand Auger	(see above)	3-21

AOI	Location Identifier	Sample Identifier	Matrix	Depth	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
	AOI01-06	AOI01-06-SB-[Start Depth]-[End Depth]	(see above)	(see above)	(see above)	(see above)	(see above)
		AOI01-06-SB-[Start Depth]-[End Depth]					
		AOI01-06-SB-[Start Depth]-[End Depth]					
	AOI01-07	AOI01-07-SB-[Start Depth]-[End Depth]					
		AOI01-07-SB-[Start Depth]-[End Depth]					
		AOI01-07-SB-[Start Depth]-[End Depth]					
	AOI01-08	AOI01-08-SB-[Start Depth]-[End Depth]					
		AOI01-08-SB-[Start Depth]-[End Depth]					
		AOI01-08-SB-[Start Depth]-[End Depth]					
	AOI01-10	AOI01-10-SB-[Start Depth]-[End Depth]					
		AOI01-10-SB-[Start Depth]-[End Depth]					
		AOI01-10-SB-[Start Depth]-[End Depth]					
	AOI01-12	AOI01-12-SB-[Start Depth]-[End Depth]					
		AOI01-12-SB-[Start Depth]-[End Depth]					
		AOI01-12-SB-[Start Depth]-[End Depth]					
	AOI01-13	AOI01-13-SB-[Start Depth]-[End Depth]					
		AOI01-13-SB-[Start Depth]-[End Depth]					
		AOI01-13-SB-[Start Depth]-[End Depth]					
	AOI01-15	AOI01-15-SB-[Start Depth]-[End Depth]					
		AOI01-15-SB-[Start Depth]-[End Depth]					
		AOI01-15-SB-[Start Depth]-[End Depth]					
	AOI01-16	AOI01-16-SB-[Start Depth]-[End Depth]					
		AOI01-16-SB-[Start Depth]-[End Depth]					
		AOI01-16-SB-[Start Depth]-[End Depth]					
	AOI01-17	AOI01-17-SB-[Start Depth]-[End Depth]					
		AOI01-17-SB-[Start Depth]-[End Depth]					
		AOI01-17-SB-[Start Depth]-[End Depth]					
	AOI01-18	AOI01-18-SB-[Start Depth]-[End Depth]					
		AOI01-18-SB-[Start Depth]-[End Depth]					
		AOI01-18-SB-[Start Depth]-[End Depth]					
	AOI01-20	AOI01-20-SB-[Start Depth]-[End Depth]					
		AOI01-20-SB-[Start Depth]-[End Depth]					
		AOI01-20-SB-[Start Depth]-[End Depth]					
	AOI01-22	AOI01-22-SB-[Start Depth]-[End Depth]					
		AOI01-22-SB-[Start Depth]-[End Depth]					
		AOI01-22-SB-[Start Depth]-[End Depth]					
	AOI01-24	AOI01-24-SB-[Start Depth]-[End Depth]					
		AOI01-24-SB-[Start Depth]-[End Depth]					
		AOI01-24-SB-[Start Depth]-[End Depth]					

AOI	Location Identifier	Sample Identifier	Matrix	Depth	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
	AOI01-25	AOI01-25-SB-[Start Depth]-[End Depth]					
		AOI01-25-SB-[Start Depth]-[End Depth]					
		AOI01-25-SB-[Start Depth]-[End Depth]					
	AOI01-26	AOI01-26-SB-[Start Depth]-[End Depth]					
		AOI01-26-SB-[Start Depth]-[End Depth]					
		AOI01-26-SB-[Start Depth]-[End Depth]					
	AOI01-27	AOI01-27-SB-[Start Depth]-[End Depth]					
		AOI01-27-SB-[Start Depth]-[End Depth]					
		AOI01-27-SB-[Start Depth]-[End Depth]					
	AOI03-05	AOI03-05-SB-[Start Depth]-[End Depth]					
		AOI03-05-SB-[Start Depth]-[End Depth]					
		AOI03-05-SB-[Start Depth]-[End Depth]					
	AOI03-06	AOI03-06-SB-[Start Depth]-[End Depth]					
		AOI03-06-SB-[Start Depth]-[End Depth]	(see above)	(see above)	(see above)	(see above)	(see above)
		AOI03-06-SB-[Start Depth]-[End Depth]					
	AOI03-07	AOI03-07-SB-[Start Depth]-[End Depth]					
		AOI03-07-SB-[Start Depth]-[End Depth]					
		AOI03-07-SB-[Start Depth]-[End Depth]					
	AOI03-10	AOI03-10-SB-[Start Depth]-[End Depth]					
		AOI03-10-SB-[Start Depth]-[End Depth]					
		AOI03-10-SB-[Start Depth]-[End Depth]					
	AOI03-11	AOI03-11-SB-[Start Depth]-[End Depth]					
		AOI03-11-SB-[Start Depth]-[End Depth]					
		AOI03-11-SB-[Start Depth]-[End Depth]					
	AOI03-12	AOI03-12-SB-[Start Depth]-[End Depth]					
		AOI03-12-SB-[Start Depth]-[End Depth]					
		AOI03-12-SB-[Start Depth]-[End Depth]					
	AOI03-16	AOI03-16-SB-[Start Depth]-[End Depth]					
		AOI03-16-SB-[Start Depth]-[End Depth]					
		AOI03-16-SB-[Start Depth]-[End Depth]					
All	AOI01-01	AOI01-01-SB-[Start Depth]-[End Depth]	Subsurface Soil	Mid-point or 13-15 ft bgs	Sonic Drilling Sampling System	(see above)	3-21
	AOI01-11	AOI01-11-SB-[Start Depth]-[End Depth]					
	AOI01-28	AOI01-28-SB-[Start Depth]-[End Depth]					
	AOI02-01	AOI02-01-SB-[Start Depth]-[End Depth]					
	AOI02-02	AOI02-02-SB-[Start Depth]-[End Depth]					
	AOI02-03	AOI02-03-SB-[Start Depth]-[End Depth]					
	AOI03-01	AOI03-01-SB-[Start Depth]-[End Depth]					

AOI	Location Identifier	Sample Identifier	Matrix	Depth	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
	AOI03-02 AOI03-03 AOI03-04	AOI03-02-SB-[Start Depth]-[End Depth] AOI03-03-SB-[Start Depth]-[End Depth] AOI03-04-SB-[Start Depth]-[End Depth]					
All	AOI01-01 AOI01-11 AOI01-28 AOI02-01 AOI02-02 AOI02-03 AOI03-01 AOI03-02 AOI03-03 AOI03-04	AOI01-01-SB-[Start Depth]-[End Depth] AOI01-11-SB-[Start Depth]-[End Depth] AOI01-28-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] AOI03-01-SB-[Start Depth]-[End Depth] AOI03-02-SB-[Start Depth]-[End Depth] AOI03-03-SB-[Start Depth]-[End Depth] AOI03-04-SB-[Start Depth]-[End Depth]	Subsurface Soil	Above groundwater table or bottom of boring	(see above)	(see above)	3-21
Groundwater Samples							
All	AOI01-01 AOI01-28 AOI02-02 AOI02-03 AOI03-01 AOI03-02 AOI03-03 AOI03-04	AOI01-01-GW AOI01-28-GW AOI02-02-GW AOI02-03-GW AOI03-01-GW AOI03-02-GW AOI03-03-GW AOI03-04-GW	Groundwater	Mid-screen	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-Depth-D* AOI01-01-SB-Depth-MS* AOI01-01-SB-Depth-MSD*	Solid (Soil)	TBD	Hand Auger; Sonic Drilling Sampling System	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, 3-22

AOI	Location Identifier	Sample Identifier	Matrix	Depth	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
All	AOI01-1*	AOI01-01-GW-D* AOI01-01-GW-MS* AOI01-01-GW-MSD*	Aqueous (Groundwater)	Mid-screen	Bladder pump	PFAS (LC/MS/MS compliant with QSM 5.3 Table B-15)	3-14
NA	NA	CU-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	CU-ERB-01 CU-ERB-02 CU-ERB-03 CU-ERB-04	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	CU-DECON-01 CU-DECON-02	Decontamin-ation 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
ft = feet
GW = groundwater
in = inches
LC/MS/MS = liquid chromatography tandem mass spectrometry
MS = matrix spike
MSD = matrix spike duplicate
NA = not applicable
PFAS = per- and polyfluoroalkyl substances
PW = potable water
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 125 mL	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	28 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	8	1	1	1	1	1	12
Soil	PFAS	120	12	6	6	1	1**	146
	pH, TOC	3	1	1	0	0	0	5
	Grain Size	3	0	0	0	0	0	3
Decontamination Water	PFAS	2	0	0	0	0	0	2

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/ 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)				
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
3-12	*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
3-15	*Monitoring Well and Borehole Abandonment*	AECOM	N	See SOP for detailed procedures

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Modified for Project Work?	Comments
3-16	*Soil and Rock Classification*	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
3-41	*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	pH: ± 0.01 pH units Conductivity: ± 0.01 µS/cm Turbidity: ± 0.01 NTU DO: ± 0.01 mg/L Temp: ± 0.01 °C	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 2,000-10,000 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
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

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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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 $r_2 \geq 0.99$ 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	5 ppb and 50 ppb 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	5 ppb and 50 ppb 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-0044)

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 9045D
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

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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

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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 initialled 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 (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: Justin Vetter

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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