BW-2912B
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Quality Assurance Project Plan

Former Fort Ord, California
Volume I, Appendix E

Final Revision 0
Site Inspection for Per- and Polyfluoroalkyl Substances

Prepared for:
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922

On behalf of:
U.S. Department of the Army
Fort Ord BRAC
4463 Gigling Road, Room 101
Seaside, CA 93955

USACE Contract No. W91238-19-C-0027
Task No. 4.7.5

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Report Date: September 2022

Report Version: Final

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Acronyms and Abbreviations

%	percent
%R	percent recovery
°C	degrees Celsius
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
σrec	standard deviation of the recovered concentrations
ADR	Automated Data Review
AFFF	aqueous film-forming foam
Ahtna	Ahtna Global, LLC
amu	atomic mass unit
Army	U.S. Department of the Army
BEC	BRAC Environmental Coordinator
bgs	below ground surface
BLL	black legless lizard
BRAC	Base Realignment and Closure
CA	corrective action
CAS#	Chemical Abstract Service Number
CCRWQCB	California Regional Water Quality Control Board, Central Coast Region
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMX	Commercial-Mixed Use
COC	chemical of concern
CQCR	Contractor Quality Control Report
CQM	Construction Quality Management
CPR	cardiopulmonary resuscitation
CSEM	conceptual site exposure model
CSM	conceptual site model
CSUMB	California State University, Monterey Bay
CTS	California tiger salamander
DL	detection limit
DoD	Department of Defense
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
DTSC	California Department of Toxic Substances Control

DTW	depth to water
EDD	electronic data deliverable
ELAP	DoD Environmental Laboratory Accreditation Program
FAAF	Fritzsche Army Airfield
FDA	Fire Drill Area
FODIS	Fort Ord Data Integration System
FONR	Fort Ord Natural Reserve
FOSTA	Fort Ord Soil Treatment Area
FO-SVA	Fort Ord-Salinas Valley Aquitard
GIS	geographic information system
GWTP	groundwater treatment plant
H&S	health and safety
HACCP	Hazard Analysis & Critical Control Points
HAZWOPER	Hazardous Waste Operations and Emergency Response
HMP	Habitat Management Plan
HLA	Harding Lawson Associates
IA	interim action
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
ISC	instrument sensitivity check
LCS	laboratory control spike
LCSD	LCS duplicate
LOD	limit of detection
LOQ	limit of quantitation
MCL	maximum contaminant level
MCWD	Marina Coast Water District
MDL	method detection limit
MEC	munitions and explosives of concern
MQO	measurement quality objectives
mg/L	milligrams per liter
mL	milliliter
MPC	measurement performance criteria
MS	matrix spike
MSD	matrix spike duplicate
MSL	mean sea level
N/A	not applicable

NAPL	non-aqueous phase liquids
ND	non-detect
ng/L	nanograms per liter
NPL	National Priorities List
OU1	Operable Unit 1
OU2	Operable Unit 2
OUCTP	Operable Unit Carbon Tetrachloride Plume
PA	Preliminary Assessment
PARCCS	precision, accuracy, representativeness, comparability, completeness, sensitivity
PCE	tetrachloroethene
PE	registered Professional Engineer
PFAA	perfluoroalkyl acids
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POM	Presidio of Monterey
PSL	Project Screening Level
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
ROD	Record of Decision
RPD	relative percent difference
RSD	relative standard deviation
RSL	Regional Screening Level
SI	Site Investigation
SEA	site evaluation accomplished
SGS	SGS North America, Inc.
SIM	selected ion monitoring
Sites 2/12	Sites 2 and 12
SOP	standard operating procedure
SPE	solid phase extraction

SWRCB	California State Water Resources Control Board
STP	sewage treatment plant
TAL	target analyte list
TCE	trichloroethene
USACE	U.S. Army Corps of Engineers
VSR	Validation Summary Report
WWTP	wastewater treatment plant

1.0 Introduction

On behalf of the U.S. Army Corps of Engineers (USACE), Sacramento District, Ahtna Global, LLC (Ahtna) prepared this Quality Assurance Project Plan (QAPP)[1] under Contract Number W91238-19-C-0027 for a Site Inspection (SI) to be performed at the former Fort Ord (Figure 1) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund") to address historical releases of per- and polyfluoroalkyl substances (PFAS).

This QAPP is the governing guidance document for the PFAS SI at the former Fort Ord. This QAPP details quality assurance (QA) and quality control (QC) procedures for sampling and analytical activities performed on soil and groundwater. The QAPP ensures the data generated follow the data quality indicators (DQIs) of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS parameters), and are of sufficient quality to support project decisions.

The objective of the SI is to gather information from sites identified in the Preliminary Assessment (PA) Narrative Report (Ahtna, 2022c) as warranting further investigation to determine whether or not a release has occurred (Figure 2). If the SI indicates a release has occurred, a Remedial Investigation may be conducted to quantify the nature and extent of contamination, though in some cases, an expanded SI may be appropriate and will be a site-specific decision. The SI is not a study of the full extent of contamination at a site or a risk assessment. The specific objective of the SI is to determine whether PFAS are present in soil and groundwater by collecting data from sites where probable PFAS releases occurred, as identified in the PA Narrative Report (Ahtna, 2022c):

- Site 2: Main Garrison Sewage Treatment Plant (STP)
- Site 10: Former Burn Pit
- Site 40A: East Fritzsche Army Airfield (FAAF) Helicopter Defueling Area
- FAAF Fire & Rescue Station (Building 514)
- Main Garrison Fire Station (Buildings 4400, 4401, and S-4403)
- FAAF Fire Drill Area (FDA)[2]
- Operable Unit 2 (OU2): Fort Ord Landfills

This QAPP was prepared to ensure:

- The SI objectives and data quality objectives (DQOs) for the project are clearly identified.
- The field sampling protocols are documented and reviewed in a consistent manner.
- The data collected are scientifically valid and defensible.

Specifically, this QAPP describes and provides specifications for the following SI activities:

- Monitoring Well Installations

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[1] This document is Appendix E to the *Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I*. Volume I is also the governing document for sampling and analysis of soil (Appendix B), soil gas (Appendix C), landfill gas (Appendix D), PFAs (Appendix E). Volume II of the QAPP pertains to the former Fort Ord military munitions response program.

[2] The FAAF FDA was part of the former Operable Unit 1 (OU1), which was closed in 2017. Therefore, the site is hereinafter referred to as the FAAF FDA, except where historical information related to OU1 is discussed.

- Groundwater Sampling
- Soil Sampling

2.0 Worksheet #1 & 2: Title and Approval Page

Site Name/Project Name: Former Fort Ord/Superfund Response Actions

Site Location: Former Fort Ord, California

Document Title: Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix E Final Revision 0, Site Inspection for Per- and Polyfluoroalkyl Substances

Lead Organization: U.S. Army Corps of Engineers

Preparer's Name, Organization, and Contact Info: Eric Schmidt, Ahtna

9699 Blue Larkspur Lane, Suite 203, Monterey, CA 93940
(831) 287-5254
eschmidt@ahtna.net

Preparation Date: August 10, 2021

Project Role	Name Organization	Signature	Date
Investigative Organization's Project Manager	Derek Lieberman Ahtna	Derek J. Lieberman	9/17/2022
Investigative Organization's Project Chemist	Eric Schmidt Ahtna	Eric Schmidt	9/17/2022
Lead Organization's Technical Lead	Bridget Floyd USACE	B Floyd	9/16/2022
Lead Organization's Project Chemist	Kyle Bayliff USACE	Kyle Bayliff	9/16/2022

Plans and reports from previous investigations relevant to this project:

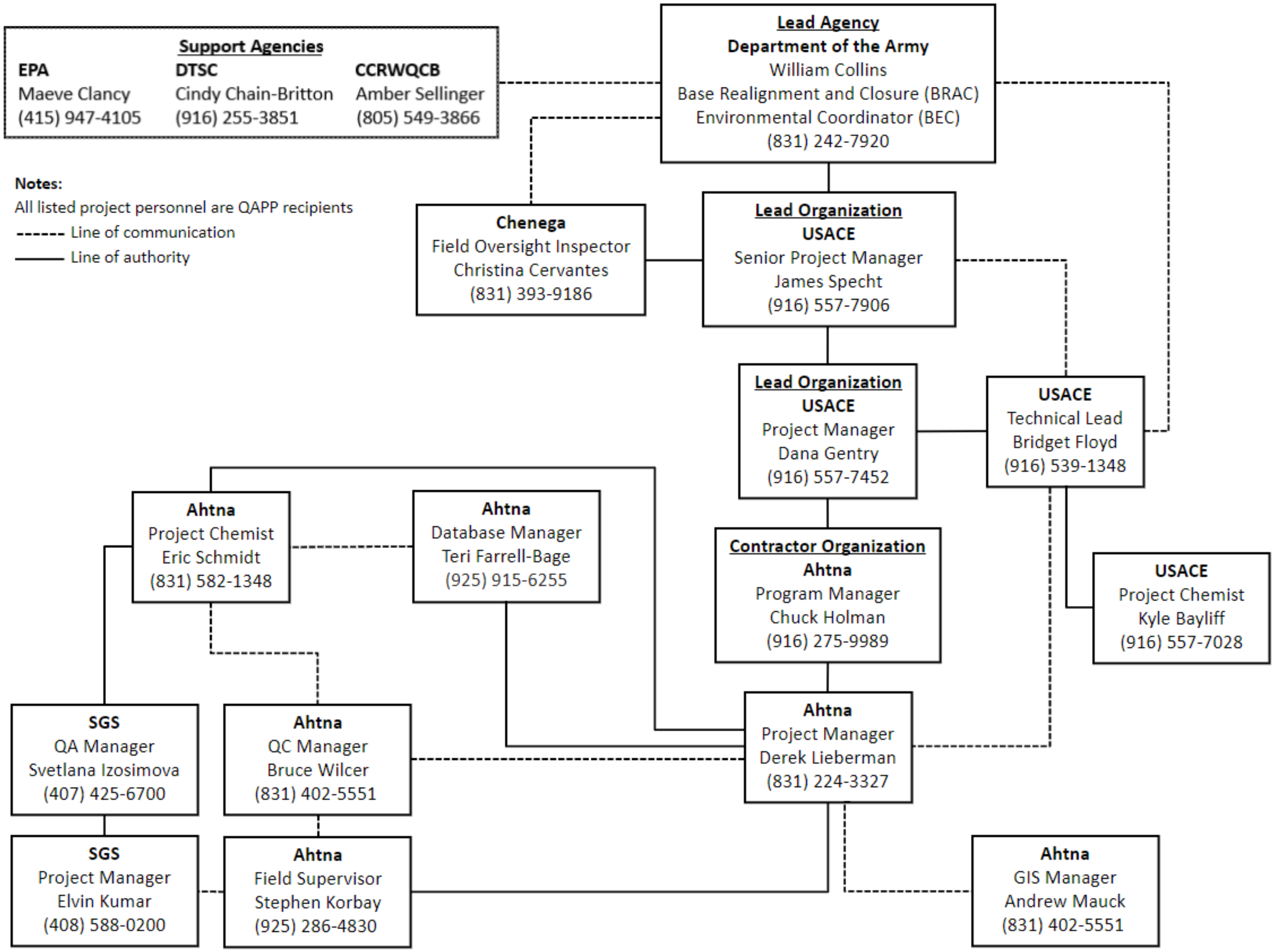
Site Name/Project Name:	Former Fort Ord/Superfund Response Actions
Site Location:	Monterey County, California
Site Number/Code:	Not Applicable (N/A)
Operable Units:	Basewide
Contractor Name:	Ahtna Global, LLC
Contract Number:	W91238-19-C-0027
Contract Title:	Former Fort Ord Basewide Groundwater and Soil Vapor Treatment and Monitoring, Former Fort Ord, California
Work Assignment Number:	N/A
Guidance used to prepare QAPP:	Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets, March 2012, Revision 1. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4, 2021 (DoD, 2021)
Regulatory Program:	CERCLA as amended by the Superfund Amendment and Reauthorization Act
Approval Entities:	U.S. Environmental Protection Agency (USEPA), California Department of Toxic Substance Control (DTSC), and Regional Water Quality Control Board, Central Coast Region (CCRWQCB) (collectively the "regulatory agencies")
Data Users:	U.S. Department of the Army (Army), USACE, USEPA (and its consultant TechLaw, Inc.), DTSC, CCRWQCB, Army/USACE contractors, citizen groups, and members of the public
Organizational partners (stakeholders) and connection with lead organization:	USACE, Army (lead agency/owner), USEPA (lead oversight agency), DTSC (support agency), and CCRWQCB (support agency)
The QAPP is (select one):	Generic:____ Project-Specific:_X_

Dates and titles of QAPP documents written for previous site work:

Title	Approval Date
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 10	March 2022
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 9	November 2021
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 8	February 2021
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 7	August 2019
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 6	March 2018
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 5	June 2017
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 4	March 2016
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 3	June 2015
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 2	February 2014
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 1	December 21, 2012
Draft Final Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Groundwater Extraction and Treatment Systems at Operable Unit 2 and Sites 2 and 12; Groundwater Monitoring Program at Sites 2 and 12, Operable Unit 1, Operable Unit 2, and Operable Unit Carbon Tetrachloride Plume	May 31, 2011
Draft Final, QAPP/CDQMP Groundwater Monitoring Program, Sites 2 and 12, OU2 and OUCTP	January 20, 2010
Final Sampling and Analysis Plan, Operable Unit 2 and Sites 2 and 12 Groundwater Treatment Systems, Former Fort Ord	August 20, 2009

3.0 Worksheet #3 & 5: Project Organization and QAPP Distribution

Reporting relationships between organizations involved in the project, including the lead organization, contractors, and subcontractor organizations are identified below.



4.0 Worksheet #4, 7 & 8: Personnel Qualifications and Sign-Off Sheet

Organization: Ahtna

Name	Project Title/Role	Education/ Experience	Specialized Training/ Certifications[1]	Signature[2]	Date
Chuck Holman	Program Manager	Resume on file	HAZWOPER		9/15/2022
Derek Lieberman	Project Manager	Resume on file	First aid, CPR, MEC, PE, H&S, HAZWOPER, CQM	Derek J. Lieberman	9/15/2022
Eric Schmidt	Project Chemist	Resume on file	HAZWOPER, CQM	Eric Schmidt	9/15/2022
Stephen Korbay	Field Supervisor	Resume on file	First aid, CPR, MEC, HAZWOPER, CQM	Steve Korbay	9/15/2022
Bruce Wilcer	QC Manager	Resume on file	HAZWOPER, CQM		9/15/2022
Teri Farrell-Bage	Database Manager	Resume on file	Not applicable	Teri Farrell-Bage	9/15/2022
Andrew Mauck	GIS Manager	Resume on file	Not applicable		9/15/2022

Notes:

[1] Specialized Training/Certifications Key:
CPR: cardiopulmonary resuscitation
CQM: Construction Quality Management
H&S: health and safety training including, but not limited to: hazard communication, fire extinguisher use, defensive driving, behavior-based safety, confined spaces
HAZWOPER: 40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response
MEC: munitions and explosives of concern recognition and safety training
PE: registered Professional Engineer

[2] Signatures indicate personnel have read and agree to implement this QAPP as written.

Worksheet #4, 7 & 8: Personnel Qualifications and Sign-Off Sheet (Continued)

Organization: SGS North America, Inc. (SGS)

Name	Project Title/Role, Location	Education/ Experience	Specialized Training/ Certifications	Signature[1]	Date
Elvin Kumar	Project Manager, Florida	Resume on file	Not applicable		09/16/22
Svetlana Izosimova	QA Officer, Florida	Resume on file	Not applicable	Svetlana Izosimova, QA Officer Digitally signed by Svetlana Izosimova, QA Officer DN: cn=Svetlana Izosimova, QA Officer, o=SGS North America, Inc., ou=SGS - Orlando, email=svetlana.izosimova@sgs.com, c=US Date: 2022.09.16 16:01:23 -04'00'	

Notes:

[1] Signatures indicate personnel have read and agree to implement this QAPP as written.

5.0 Worksheet #6: Communication Pathways

Communication Driver	Organization	Name and Position	Contact Information	Procedure (timing, pathways, documentation, etc.)
Regulatory agency interface	Army	William Collins, BEC	(831) 242-7920 William.K.Collins.civ@army.mil	Materials and information regarding the project will be forwarded by email to the regulatory agencies through the Army BEC for review at scheduled BRAC Cleanup Team meetings.
Army BRAC Office interface	USACE	Bridget Floyd, Technical Lead	(916) 539-1348 Bridget.M.Floyd@usace.army.mil	Materials and information regarding the project will be forwarded by email to the Army BRAC Office through USACE Technical Lead for review at scheduled Army Internal Progress Meetings.
Lead Organization Project Manager interface	Ahtna	Derek Lieberman, Project Manager	(831) 287-5258 dlieberman@ahtna.net	Materials and information regarding the project will be forwarded by email to USACE by the Ahtna Project Manager for review at weekly status meetings.
Field progress reports	Ahtna	Stephen Korbay, Field Supervisor	(925) 286-4830 skorbay@ahtna.net	Ahtna Field Supervisor will report fieldwork progress by email to Ahtna Project Manager daily.
Stop work due to safety issues	Ahtna	Holly Dillon, Site Safety and Health Officer	(831)-324-3299 hdillon@ahtna.net	All onsite Personnel have authority and responsibility to stop work on the site if an imminent hazard is observed. The Site Safety and Health Officer will be consulted by phone immediately for further recommendations.
QAPP changes prior to fieldwork	Ahtna	Derek Lieberman, Project Manager	(831) 287-5258 dlieberman@ahtna.net	Significant changes to the QAPP must approved by the Ahtna Project Manager, USACE Technical Lead, and USACE Project Chemist, and submitted to the regulatory agencies for review and comment via email

Communication Driver	Organization	Name and Position	Contact Information	Procedure (timing, pathways, documentation, etc.)
				(where the subject of the email is "QAPP Change") prior to implementation.
QAPP changes during project execution	Ahtna	Derek Lieberman, Project Manager	(831) 287-5258 dlieberman@ahtna.net	Field changes to the QAPP must be approved by the Ahtna Project Manager, USACE Technical Lead, and USACE Project Chemist by phone or email (where the subject of the email is "Field Change Request") prior to implementation.
Field corrective actions[1]	Ahtna	Stephen Korbay, Field Supervisor	(925) 286-4830 skorbay@ahtna.net	Ahtna Field Supervisor will determine the need for corrective action and will report field issues to Ahtna Project Manager daily. Ahtna Project Manager will notify the Ahtna QC Manager of issues within one business day and will respond to the request for corrective action within 24 hours.
Sample receipt variances	SGS	Svetlana Izosimova, QA Officer	(407) 425-6700 Svetlana.Izosimova@sgs.com	Discrepancies or non-compliance are documented immediately on the Sample Receipt Confirmation Form, which is automatically emailed to the SGS Project Manager, who will immediately contact the Ahtna Project Chemist for resolution.
Laboratory QC variances	Ahtna	Eric Schmidt, Project Chemist	(831) 582-1348 eschmidt@ahtna.net	Ahtna Project Chemist will report laboratory QC issues to USACE Technical Lead and USACE Project Manager by email within two business days of the occurrence.
Analytical corrective actions[1]	Ahtna	Eric Schmidt, Project Chemist	(831) 582-1348 eschmidt@ahtna.net	Ahtna Project Chemist will determine the need for corrective action and will report nonconformance and QC issues to the Ahtna Project Manager and USACE Project Chemist by email within two business days of the occurrence.

Communication Driver	Organization	Name and Position	Contact Information	Procedure (timing, pathways, documentation, etc.)
Data verification issues	Ahtna	Eric Schmidt, Project Chemist	(831) 582-1348 eschmidt@ahtna.net	Ahtna Project Chemist will report incomplete records issues to USACE Technical Lead and USACE Project Manager by email within five business days of completing data verification (Worksheet #35).
Data validation issues	Ahtna	Eric Schmidt, Project Chemist	(831) 582-1348 eschmidt@ahtna.net	Ahtna Project Chemist will report non-compliance with procedures to USACE Technical Lead and USACE Project Manager by email within five business days of receiving data validation reports.
Data usability issues	Ahtna	Eric Schmidt, Project Chemist	(831) 582-1348 eschmidt@ahtna.net	Ahtna Project Chemist will report data quality issues that could impact data usability to USACE Technical Lead/USACE Project Chemist within five business days of completing the usability assessment (Worksheet #37).
Data review corrective actions	Ahtna	Eric Schmidt, Project Chemist	(831) 582-1348 eschmidt@ahtna.net	Ahtna Project Chemist will determine the need for corrective action and will provide recommendations to the Ahtna Project Manager and USACE Technical Lead by email within five business days of completing the data review.
Release of analytical data	Ahtna	Eric Schmidt, Project Chemist	(831) 582-1348 eschmidt@ahtna.net	Analytical data will not be released until review or validation is completed, as appropriate. The Ahtna Project Chemist will approve the release of data to the Ahtna Project Manager.

Communication Driver	Organization	Name and Position	Contact Information	Procedure (timing, pathways, documentation, etc.)
Data import and export	Ahtna	Teri Farrell-Bage, Database Manager	(925) 915-6255 tbage@ahtna.net	The Ahtna Database Manager coordinates with the Ahtna Field Supervisor and SGS Project Manager to obtain data for electronic upload/manual entry into the data management system, QC review of the entered data, and preparation of the required tables and plots of the data. Coordinates with the Ahtna Project Chemist for QC purposes and forwards deliverables to the Project Manager.

Notes:

[1] In the event significant corrective action is required for field or laboratory activities, information concerning the corrective action will be provided to the regulatory agencies by the Army within 30 days of the event or the next scheduled meeting of the BRAC Cleanup Team, whichever is sooner.

6.0 Worksheet #9: Project Planning Session Summary

Date of Planning Session No. 1: 5/7/2021

Location: 9699 Blue Larkspur Lane, Suite 203, Monterey, California

Purpose: Discuss the scope of the QAPP, with a focus on QAPP Worksheets #10, #11, #15, and #17.

Participants:

Name	Title/Role	Affiliation	Phone Number/Email Address
Derek Lieberman	Project Manager	Ahtna	(831) 224-3327 dlieberman@ahtna.net
Margaret Lindh	Environmental Engineer	Ahtna	(831) 760-1050 mlindh@ahtna.net
Eric Schmidt	Project Chemist	Ahtna	(831) 582-1348 eschmidt@ahtna.net
Sylvester Kosowski	Senior Environmental Scientist	Ahtna	(831) 402-5850 skosowski@ahtna.net
Steve Bennett	Water Treatment Plant Manager	Ahtna	(831) 402-7886 sbennett@ahtna.net
Mark Fisler	Senior Plant Operator	Ahtna	(831) 224-3133 mfisler@ahtna.net

Notes/Comments:

Worksheet #10 – Conceptual Site Model

- Most Worksheet #10 topics, such as site operational history and suspected PFAS source areas, are described in the PA Narrative Report.
- Information about PFAS fate and transport can be found in the *Final PFAS Fate and Transport White Paper* (Arcadis, 2019a).[3]

Worksheet #11 – Project/Data Quality Objectives

- This worksheet will state the problem and goals of the study.
- DQOs defined in Worksheet #11 should be consistent with those developed for the project technical proposal.

Worksheet #15 – Project Required Reporting Limits and Laboratory Limits

- 18 PFAS compounds are listed in the Army PFAS guidance (Army, 2018).

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[3] The *Final PFAS Fate and Transport White Paper* was superseded by other references after Planning Session No. 1 and is no longer relevant to this QAPP.

Worksheet #17 – Sampling Design and Rationale

- Groundwater Sampling:
    - Groundwater sampling will occur at Site 10, Site 40A, the FAAF Fire Drill Area (FDA), the FAAF Fire & Rescue Station, the Main Garrison Fire Station, and OU2.
    - Two or three new wells will be installed downgradient of the FAAF FDA. These wells may also be sampled as a part of Operable Unit Carbon Tetrachloride Plume (OUCTP) monitoring.
    - Existing wells at OU2 will also be sampled for PFAS compounds.
    - Marina Coast Water District (MCWD) drinking water supply wells 29, 30, and 31 may also be sampled. The MCWD conducted PFAS sampling for these wells for four quarters in 2019 and 2020.
- Soil Sampling
    - Some deeper soil borings may be necessary. The USEPA SI Guidance focuses primarily on shallow soil impact on human health and the environment. However, because some PFAS compounds are known to migrate from deeper soils into groundwater, deeper soil borings may be necessary.
    - At the project planning meeting with the USACE, Ahtna may recommend soil borings to the water table at specific locations. However, because aqueous film-forming foam (AFFF) discharges during Fort Ord operations would have occurred at least 30 years ago, PFAS in deeper soils would have likely already migrated to groundwater. Therefore, deeper soil borings may not be necessary.
    - Shallow soil sampling at the Main Garrison Fire Station, the FAAF Fire & Rescue Station, and Site 40A is recommended. Soil sampling is recommended at depths of 5 feet and 10 feet below ground surface (bgs). The drainage channel north of Site 40A is recommended for soil sampling but may be difficult to access with heavy equipment.
    - During remediation efforts at the former Operable Unit 1 (OU1), impacted soils were removed from the former FDA. The site was then backfilled with clean soil, layered with 2- or 3-foot lifts of impacted soil, and was subsequently bioremediated. The efforts to remediate impacted soils may have resulted in some PFAS migrating into deeper soil. Therefore, a single soil boring to the water table (approximately 70 feet bgs) is recommended. The recommended soil boring location is near an area of elevated trichloroethene (TCE) concentrations in soil identified during former OU1 remediation.
    - Worksheet #17 must provide a rationale for the sampling design. Maps of proposed sampling locations should be included and should support DQOs in Worksheet #11. If a sample cannot be collected at the planned location, the decision process for changing its location and contingencies if field conditions are different from expected should be included in the QAPP; however, this is not expected to be an issue.

Consensus Decisions Made:[4]

- Shallow soil sampling is recommended at the grassy areas near the Main Garrison Fire Station and FAAF Fire & Rescue Station based on reported AFFF discharges.
- One soil boring to the water table at the FAAF FDA is recommended.

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[4] Consensus decisions listed here reference decisions made during the initial project planning meeting. Some of these decisions changed based on consensus decisions in subsequent project planning meetings.

Action Items:

Action	Responsible Party	Due Date
Research and draft Worksheets #10 and #11	Margaret Lindh	June 18, 2021
Confirm contract laboratory and target analyte list (TAL) for Worksheet #15	Eric Schmidt	June 18, 2021
Confirm TAL used by MCWD for drinking water supply wells to evaluate whether additional sampling is warranted for Worksheet #17	Eric Schmidt	June 18, 2021

Date of Planning Session No. 2: 6/22/2021

Location: Conference call

Purpose: Discuss the scope of the QAPP, DQOs, and recommended sampling.

Participants:

Name	Title/Role	Affiliation	Phone Number/Email Address
William Collins	BRAC Environmental Coordinator (BEC)	Army	(831) 242-7920 William.K.Collins.civ@mail.mil
Dana Gentry	Project Manager	USACE	(916) 557-7452 Dana.K.Gentry@usace.army.mil
Bridget Floyd	Technical Lead	USACE	(916) 557-7328 Bridget.M.Floyd@usace.army.mil
Jolie Higgins	Environmental Engineer	USACE	(910) 389-7434 Jolie.L.Higgins@usace.army.mil
Derek Lieberman	Project Manager	Ahtna	(831) 224-3327 dlieberman@ahtna.net
Margaret Lindh	Environmental Engineer	Ahtna	(831) 760-1050 mlindh@ahtna.net
Eric Schmidt	Project Chemist	Ahtna	(831) 582-1348 eschmidt@ahtna.net

Notes/Comments:

- 21 groundwater samples are proposed for the SI. QC samples will be collected in addition to these 21 groundwater samples. Five new A-Aquifer monitoring wells are also proposed.
- One new Upper 180-Foot Aquifer monitoring well downgradient of Site 10 is recommended based on PFAS migration trends noted near the FAAF FDA and OU2, which showed higher concentrations of PFAS further downgradient of the site than closer to the site.
- Per USEPA SI Guidance, SI sampling serves to determine if PFAS are present and are affecting human health and the environment, not to fully investigate the extent of contamination. Further

investigation will be conducted if SI sampling determines that PFAS are present and affecting human health and the environment.

- Collection of 26 soil samples is recommended.
- The recommended soil borings reflect the information about AFFF discharge practices at the FAAF Fire & Rescue Station and the Main Garrison Fire Station discovered during the PA. Since both sites have onsite worker populations and the extent of PFAS contamination is unknown, worker exposure is possible. The recommended soil boring locations will focus on areas most likely to be impacted by PFAS.
- One soil boring to the water table at the FAAF FDA is recommended. The need for additional soil borings to the water table will be evaluated based on SI data. Site 10 is west of the edge of the Fort Ord-Salinas Valley Aquitard (FO-SVA) and a soil boring to the water table would be approximately 240 feet deep, which is beyond the scope of the SI.
- DQOs (Worksheet #11) are consistent with USEPA SI Guidance to the extent practicable.
- Clarification on Worksheet #11, Step 2, Proposed Study Question 4: Has the lateral and vertical extent of PFAS-impacted media been defined? The goal of this question is not to determine the actual lateral and vertical extent of PFAS-impacted media. If the answer to this question is no, further sampling is recommended (as a part of a future investigation) to define the lateral and vertical extent of PFAS-impacted media.
- Previous PFAS sampling data for former OU1 and OU2 would not be sufficient for the SI because the TAL did not include all 24 PFAS compounds considered in the QAPP.
- The SI does not include a risk assessment per the USEPA SI Guidance and the focus is instead on analyzing exposure pathways.

Consensus Decisions Made:

- A total of 26 groundwater samples will be collected as a part of SI sampling.
- Five new A-Aquifer monitoring wells will be installed, and the three wells proposed for the FAAF FDA area will also be used for OUCTP analysis.[5]
- One new Upper 180-Foot Aquifer monitoring well, MW-10-07-180, will be included in the SI.
- Up to 38 soil samples may be collected as a part of SI sampling.
- There will be ten 10-foot soil borings.
- One soil boring to the water table will be advanced in the FAAF FDA as a part of SI sampling. A second soil boring to the water table may be recommended at the FAAF Fire & Rescue Station, depending on analytical results for the near-surface soil samples.

Action Items:

Action	Responsible Party	Due Date
Prepare the QAPP per the consensus decisions made	Ahtna	June 18, 2021

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[5] During field reconnaissance at the FAAF FDA and downgradient areas in the Fort Ord Natural Reserve (FONR) on February 28, 2022, it was determined two new monitoring wells would be sufficient for the purposes of the SI and minimize impacts to FONR habitat reserve areas.

Date of Planning Session No. 3: 3/16/2022

Location: Conference call

Purpose: QAPP status update

Participants:

Name	Title/Role	Affiliation	Phone Number/Email Address
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Notes/Comments:

- Per regulatory agency comments on the PA Narrative Report, Site 2 was added to the tertiary assessment in the PA Narrative Report. It was agreed by all parties that Site 2 should then be included in the QAPP.
- Per USEPA comments on the PA Narrative Report, soil sampling in the Site 10 Former Burn Pit excavation area was also added to the QAPP.

Consensus Decisions Made:

- The total number of shallow soil borings will increase to 12 because of the additional soil sampling at Site 2 and Site 10.
- Site 2: Main Garrison STP was added to the QAPP per changes to the PA Narrative Report.

Action Items:

Action	Responsible Party	Due Date
Revise the QAPP per the consensus decisions	Ahtna	June 2022

Date of Planning Session No. 4: 4/11/2022

Location: Conference call

Purpose: Review responses to comments and revisions to the PA Narrative Report to:

- Identify which are acceptable to the parties.
- Resolve remaining issues or concerns to the extent possible.
- Determine which issues or concerns may require further discussion and plan accordingly.

Participants:

Name	Title/Role	Affiliation	Phone Number/Email Address
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Notes/Comments:

This discussion focused primarily on the PA Narrative Report and related comments and concerns.[6] The following topics regarding the QAPP were discussed:

- The regulatory agencies all agreed with the general sampling strategy and locations presented in the PA Narrative Report and supported the start of SI fieldwork in the summer of 2022. CCRWQCB and DTSC had questions regarding the distance of sampling locations from the suspected source areas at some sites. Ahtna responded that the locations were chosen based on

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[6] Only notes and comments regarding the SI and this QAPP are included.

the extended time period since the last known AFFF use, the high mobility of PFAS in groundwater, knowledge of groundwater conditions, and results of groundwater modeling.

The regulatory agencies were concerned about historical PFAS releases from former wastewater treatment plants (WWTPs). The Army will evaluate limited soil sampling (i.e., shallow soil sampling) at Site 1 Ord Village STP and Site 36 FAAF STP; however, Site 32 East Garrison STP would be logistically much more difficult because the site was completely regraded and redeveloped into a residential area. These sites would also have to be added to the PA Narrative Report tertiary assessment and the QAPP. It is the CCRWQCB's understanding that State Water Resources Control Board (SWRCB) staff is preparing a report that will include PFAS results for groundwater samples collected at WWTPs throughout California, and preliminary results indicate an apparent increase in PFAS concentrations in groundwater associated with WWTPs with low-flow discharges to land. Once the SWRCB finalizes the data analysis and it is presented at a regularly scheduled SWRCB meeting, CCRWQCB staff will share the SWRCB staff report with the Army and other stakeholders.

- The USEPA would like the QAPP to be revised to show historical PFAS analytical results, if possible.
- The regulatory agencies supported a phased investigation approach where data are collected starting this year, with an evolving investigation strategy as new guidance and new information on PFAS are released.

Consensus Decisions Made:

- Sites recommended in the PA Narrative Report for inclusion in the SI are acceptable to the parties.
- The general sampling strategy for sites recommend for the SI is acceptable to the parties.
- Fieldwork for the SI should begin in the summer of 2022.

Action Items:

Action	Responsible Party	Due Date
Evaluate soil sampling at other former WWTP sites	Army/USACE	TBD based on results from Site 2 soil sampling
Begin SI fieldwork	Ahtna	Summer 2022
Evaluate the need for additional investigation based on future PFAS guidance	Army/USACE	TBD with promulgation of new PFAS guidance

Date of Planning Session No. 5: 5/13/2022

Location: Conference call

Purpose: Resolve any issues before written comments on the Draft QAPP are submitted to support start of SI fieldwork this summer.

Participants:

Name	Title/Role	Affiliation	Phone Number/Email Address
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Randall Bleichner	Engineering Geologist	DTSC	(916)255-3704 randall.bleichner@dtsc.ca.gov

Notes/Comments:

- The regulatory agencies indicated they had not looked at the Draft QAPP in sufficient detail yet to comment on it.
- USEPA said the drinking water Regional Screening Levels (RSLs) being discussed for PFAS are low.
- CCRWQCB noted Worksheet #9 in the QAPP did not have any information about how the Site 2 Main Garrison STP was added to the SI.
- CCRWQCB noted Site 10 and Main Garrison Fire Station sampling for groundwater onsite was not recommended because PFAS would have migrated offsite. The Army responded that groundwater modeling of PFAS transport from the site indicated this is appropriate because the last time AFFF was used at Site 10 was at least 30 years ago and there would have been more mobile, shorter-chain PFAS migrating into groundwater. Soil sampling will still be conducted at Site 10 for the longer-chain, less mobile PFAS in soil. There was a remedial action at Site 10 to remove soil due to total petroleum hydrocarbon contamination. It is possible PFAS in soil was removed at that time, but some could have migrated below the excavation limits as well. One new monitoring well is proposed between the OU2 Fort Ord Landfills and Site 10. If PFAS is present in groundwater at this location that indicates a release and a Remedial Investigation could be initiated.
- A conference call will be scheduled with the regulatory agencies before the end of the comment period for the Draft QAPP.

- The parties accept the sites included in the SI, which were primarily selected based on knowledge of where AFFF was used and is consistent with current Army guidance.
    - A USEPA comment on the Draft Final PA Narrative Report referenced a report from the DoD Inspector General (IG) that stated DoD focused too much on AFFF and not on other sources of PFAS. DoD has committed to addressing this issue but has not yet issued new policy or guidance. The Army noted the IG report itself only provides recommendations and is not considered guidance or policy.
    - Sources of PFAS other than AFFF may be addressed once DoD guidance or policy is updated. In the interim, the SI is limited to the current DoD guidance. Six of the seven sites included in the SI had evidence of historical use of AFFF. The other site is the Site 2 Main Garrison STP.
        - It is the Army's position that the Site 36 FAAF STP and Site 32 East Garrison STP were small, had low flows and limited operational periods, and did not receive significant PFAS-containing waste streams.
        - The Main Garrison STP did treat wastewater that could have contained PFAS because it received wastewater from most of the former Fort Ord for a longer time.
        - The SWRCB may compile its own data and have more information about low-flow WWTPs.
        - USEPA suggested the former Fort Ord would be a "safe" site to test the former WWTP sites for PFAS.

Consensus Decisions Made:

The QAPP should be revised to describe decisions made that led to differences in the scope of the SI between Planning Session No. 1 and the Draft QAPP.

Action Items:

Action	Responsible Party	Due Date
Revise the QAPP per the consensus decisions	Ahtna	June 2022

Date of Planning Session No. 6: 5/24/2022

Location: Conference call

Purpose: Discussion to go over any questions or concerns about the Draft QAPP before submittal of written comments.

Participants:

Name	Title/Role	Affiliation	Phone Number/Email Address
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Notes/Comments:

This meeting focused on addressing any comments, questions or concerns about the Draft QAPP before submittal of written comments. The regulatory agencies provided some questions and comments, which were expanded upon in the submitted written comments.

USEPA comments and questions included:

- Where was treated water from OU1 reinjected during OU1 operations? Was this considered? Ahtna responded that the treated water was discharged at a few different places, including infiltration trenches, and was used to irrigate the bioremediation area in the former FDA. Based on the results of previous PFAS sampling (see HGL, 2016), this treated water discharge was not an issue with respect to PFAS.
- There was some confusion regarding section numbers vs. worksheet numbers.
- The sampling described in the QAPP is not consistent with previous discussions, particularly with regard to Site 2.
- Worksheet #9 should be updated with information regarding the addition of Site 2.

CCRWQCB comments and questions included:

- Where can the Arcadis white papers (Arcadis, 2018; Arcadis, 2019a; and Arcadis, 2019b) be accessed?
- Sites should be consistently named (e.g., Sites 2 vs. Main Garrison STP and Site 10 vs. Former Burn Pit).
- Some sampling locations may be too far from the site of concern, notably at Site 10 and the Main Garrison Fire Station.
- Site 2 effluent discharge to Indian Head Beach during low tide may indicate the need to collect soil samples on the beach.

DTSC comments and questions included:

- Should groundwater grab samples be collected at Site 40A?
- In QAPP Section 8.4, the vertical boundaries were not described or established.

Consensus Decisions Made:

The Army will consider these questions and comments when preparing the next version of the QAPP.[7]

Action Items:

Action	Responsible Party	Due Date
Respond to regulatory agency comments and questions	Ahtna	June 2022
Determine if the Arcadis white papers can be distributed to the regulatory agencies[8]	Army	June 2022

Date of Planning Session No. 7: 6/16/2022

Location: Conference call

Purpose: Clarification of QAPP updates

Participants:

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Notes/Comments:

- USACE directed Ahtna to use Draft EPA Method 1633 for analysis of PFAS and to report all 40 PFAS compounds listed in Draft EPA Method 1633.
- CCRWQCB and DTSC had submitted comments on the Draft QAPP expressing concern about the distance between Ponding Area 1 at Site 2 and the monitoring wells proposed for sampling; however, an analysis of previous groundwater modeling efforts for evaluation of plume capture indicated contaminants in groundwater could travel from Ponding Area 1 to operating extraction wells as Site 12 within 15 years. Based on this, it was recommended that extraction well EW-12-05-180M and possibly EW-12-08-180U be included for sampling in the SI for Site 2.

Consensus Decisions Made:

- The QAPP will be updated to reference QSM 5.4 and Draft EPA Method 1633.
- All 40 compounds listed in Draft EPA Method 1633 will be reported as part of the SI.

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[7] Questions and comments made during this meeting were subsequently provided in writing by the regulatory agencies. The comments and the corresponding responses are in Appendices G, H, and I.

[8] The Arcadis white papers were superseded by other references after Planning Session No. 6 and are no longer relevant to this QAPP

- USACE will consider inclusion of Site 12 extraction wells in the SI.

Action Items:

Action	Responsible Party	Due Date
Revise the QAPP per the consensus decisions	Ahtna	June 2022
Evaluate recommendation to sample Site 12 extraction wells for the Site 2 SI	USACE	June 2022

Date of Planning Session No. 8: 6/22/2022

Location: Conference call

Purpose: Review of consensus decisions from 6/16/2022 and applicability of groundwater modeling

Participants:

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Notes/Comments:

- USACE confirmed Draft EPA Method 1633 should be used for analysis of PFAS and all 40 PFAS compounds listed in Draft EPA Method 1633 should be reported.
- USACE confirmed operating Site 12 extraction wells should be sampled during the SI for Site 2.

Consensus Decisions Made:

- The QAPP will be updated to reference QSM 5.4 and Draft EPA Method 1633.
- All 40 compounds listed in Draft EPA Method 1633 will be reported as part of the SI.

- Site 12 extraction wells will be sampled during the SI.

Action Items:

Action	Responsible Party	Due Date
Revise the QAPP per the consensus decisions	Ahtna	June 2022

7.0 Worksheet #10: Conceptual Site Model

The conceptual site model (CSM) presents an interpretation of specific conditions at the sites identified as part of the PA (Ahtna, 2022c). This CSM was also developed with data from other geologic and hydrogeologic investigations conducted at the former Fort Ord spanning over 35 years of environmental cleanup activities. The CSM represents the current understanding of existing conditions, including available data, environmental conditions, fate and transport, and potential exposure scenarios, which can be used to support the SI approach. The CSM is a working document that should be updated with new information or data as it becomes available to support future investigations, if warranted. This CSM may be revised as part of the SI Report, based upon the information and data collected during this work.

7.1 Fort Ord Background Information

The former Fort Ord is located along the Pacific Ocean in northwest Monterey County, approximately 80 miles south of San Francisco, California (Figure 1). The former military installation covers about 28,000 acres, is bounded by Monterey Bay to the west and the Santa Lucia Range to the south, and is surrounded by the cities of Del Rey Oaks, Marina, Sand City, and Seaside. State Highway 1 and the Union Pacific Railroad right-of-way traverse through the western portion of the former Fort Ord, separating the Monterey Bay beachfront from the rest of the installation. The former Fort Ord served as a training and staging facility for infantry troops from 1917 until its closure in 1994. In 1990, the former Fort Ord was placed on the USEPA's National Priorities List (NPL),[9] primarily due to volatile organic compounds found in groundwater beneath the Fort Ord Landfills. The former Fort Ord was closed in 1994 under the BRAC Act.[10] Environmental remediation at the former Fort Ord is being completed pursuant to the CERCLA §121, the National Oil and Hazardous Substances Contingency Plan, and the Federal Facility Agreement signed by representatives of the Army, USEPA, the California Department of Health Services (now DTSC), and the CCRWQCB. The Federal Facility Agreement became effective on November 19, 1990.

7.2 Known or Suspected Contaminants or Classes of Contaminants

PFAS refers to the entire class of approximately 600 per- and polyfluoroalkyl substances in commerce, of which perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) were historically the most widely used throughout the United States (DoD, 2019). PFAS are human-made compounds originally developed in the late 1930s and do not occur naturally in the environment. By the 1950s, PFAS had become included in many consumer and industrial products, notably in stain and water-repellant material, food packaging, and retail products (ITRC, 2020). PFAS have been used in a variety of industrial applications, including aerospace, automotive, building and construction, and electronics, because they help reduce friction. After 1972, the DoD began using AFFF that contained PFOS and, in some formulations, PFOA.

AFFFs are proprietary mixtures that are designed and used to extinguish fuel-based fires. The composition of AFFFs prior to 1989 is unknown because older AFFFs are no longer available. AFFF in the

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[9] The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the USEPA in determining which sites warrant further investigation.

[10] BRAC is the process the DoD has used to reorganize its installation infrastructure to more efficiently and effectively support its forces and increase operational readiness.

military has been primarily used for firefighting operations during emergencies, in automated fire suppression systems, and personnel training activities. PFAS in AFFF are used as wetting agents to form a thin layer of water over a fuel source.

PFOS and PFOA are two of the most prominent PFAS and are the most widely studied. Perfluorobutanesulfonic acid (PFBS) is a member of the PFAS class of chemical compounds, with a four-carbon fluorocarbon chain (PFOS and PFOA have eight carbons) and a sulfonic acid functional group. PFBS can be in the form of a colorless liquid or a corrosive solid. As an anion it functions as a stable fluorosurfactant because of the strength of carbon–fluorine bonds.

In 2022, the USEPA established Regional Screening Levels (RSLs) in soil and tap water for six compounds: hexafluoropropylene oxide dimer acid (HFPO-DA), PFBS, perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), PFOS, and PFOA (USEPA, 2022). These RSLs are listed in Worksheet #15.

The DoD screening levels for soil and tap water for these six compounds are the same as those established by USEPA (DoD, 2022). In addition, if multiple PFAS are encountered at a site, a 0.1 factor is applied to the screening level (e.g., the screening levels for PFOA, PFOS, and PFBS individually are 0.006 micrograms per liter (µg/L), 0.004 µg/L, and 0.6 µg/L, respectively) (DoD, 2021b). No federal or State of California Maximum Contaminant Levels (MCLs) for PFAS in drinking water have been established.

7.3 Site-Specific Background Information, Sources of Known or Suspected PFAS, and Primary Release Mechanisms

7.3.1 Site 2: Main Garrison Sewage Treatment Plant

Site 2 is located on the western side of former Fort Ord between State Route 1 and the Monterey Bay (Figure 3). The Main Garrison STP was owned and operated by the Army from the late 1930s through 1990, which encompassed a period of expanded and widespread use of PFAS-containing products. From its construction in the mid-1930s through its closure in 1990, the site served as the primary WWTP for the former Fort Ord, serving a majority of the residential areas and main industrial areas during its years of operation, and therefore could have inadvertently accepted PFAS-containing wastewater. The Main Garrison STP had a design capacity of 4.25 million gallons per day but typically treated only 2.8 million gallons per day (EA, 1991). Effluent from the Main Garrison STP was discharged into a storm drain that emptied onto Indian Head Beach during low tide and directly into Monterey Bay during high tide (HLA, 1995). The sewage sludge was digested anaerobically and dried in asphalt-lined sludge drying beds. The configuration of the site and analytical results from soil sampling conducted in 1996 indicate effluent from the sludge drying beds discharged to the evaporation pond immediately to the south (Ponding Area 1) with overflow going to Ponding Area 2 and Ponding Area 3 (HLA, 1997).

Before 1980, difficulties arose in complying with ammonia and chlorine residual National Pollutant Discharge Elimination System Permit discharge limits. From 1983 through 1985, the WWTP underwent extensive maintenance and repair. Nonetheless, the Main Garrison STP was still unable to consistently comply with effluent limits, so operation of the Main Garrison STP was phased out by 1990 (Weston, 1990). No remedial action was proposed for soil at Site 2 (Army, 1997); however, in 1997, as part of the maintenance and cleanup activities associated with the closure of Site 2, sludge was removed from the drying beds and evaporation ponds. The asphalt-lined drying beds were demolished and about 3 feet of soil was excavated, though PFAS could remain in the soil beneath the excavated area which could be a source of PFAS to groundwater. Approximately 15,000 cubic yards of sludge, soil, and asphalt and wood debris were disposed of in the OU2 Fort Ord Landfills under the engineered cover system. In addition, conveyance piping under the drying beds and evaporation ponds was removed and disposed of in the OU2 Fort Ord Landfills. The area was then revegetated with native plants (IT, 2000). In 2006, the site was transferred to California Department of Parks and Recreation and is currently operated as part of the Fort Ord Dunes State Park, although public access to the WWTP is restricted by a chain-link fence.

7.3.2 Site 10: Former Burn Pit

Site 10 is located in the Main Garrison area of the former Fort Ord near the main gate and about 160 feet south of the Main Garrison Fire Station. The site is near the intersection of Gigling Road and General Jim Moore Boulevard (Figure 4). This site was owned by the Army and operated by the Fort Ord Fire Department from the mid-1950s through 1990. During its years of operation, the site was used three to four times per year, with an estimated annual fuel consumption of 300 gallons (EA, 1990). During fire suppression training, the burn pit was filled with 3 to 4 inches of water and fuel, ignited, and extinguished using a foaming product. Fuels used for this purpose reportedly included off-specification aviation fuel (JP-4), gasoline, diesel, and waste oil. After the training sessions, water and residual unburned fuel percolated into the soil at the bottom of the unlined burn pit (HLA, 1996). By 1990, fire suppression training onsite involved partially filling seven half-drums with water, pouring fuel on top of the water, then igniting the fuel. After the fire was extinguished, the water and residual unspent fuel were allowed to percolate into the soil and evaporate (EA, 1990). This activity may have occurred four to five times for training and demonstrations during Fire Prevention Week, likely starting in the 1960s (Ahtna, 2022c); however, AFFF would not have been used until after 1972. By 1991, the pit was no longer used and was grass-covered (EA, 1991).

An interim action (IA) was performed at Site 10 in July 1995. The excavation area was approximately 80 feet wide by 100 feet long to a maximum depth of 10 feet. 1,451 cubic yards of soil were removed and treated at the Fort Ord Soil Treatment Area (FOSTA), and the excavation was backfilled with clean soil. Further soil gas and soil matrix sampling in 1996 indicated that elevated concentrations of compounds detected at Site 10 were generally confined to the immediate burn pit area and limited in vertical extent (HLA, 1996). However, Site 10 is a suspected source area of PFAS because PFAS-containing AFFF was likely used at this site for at least two decades and PFAS could remain in the soil beneath the excavated area which could be a source of PFAS to groundwater.

7.3.3 Site 40A: East FAAF Helicopter Defueling Area

Site 40A is located in the northwestern portion of the FAAF, east of the FAAF Fire & Rescue Station (Figure 5). This site was owned and operated by the Army until base closure in 1994. During Army operation, defueling stationary aircraft at a single point was performed to prevent leakage while the aircraft was on the ground or to facilitate maintenance operations. Defueling trucks were used to vacuum the bulk of the fuel out of the aircraft. During defueling operations at FAAF, the fire department was on standby in case of a spill or other incident.

Sometime in the late 1970s or early 1980s, a defueling tank ruptured, and 5,000 to 10,000 gallons of fuel were spilled. The fire department applied AFFF to the spill area to reduce the likelihood of fire. After the spill was contained, soil was placed in the spill area to absorb the fuel (and AFFF), after which the soil was loaded into dump trucks and disposed of at an unknown location. It was also stated that some AFFF entered the topographic low area to the north of the site and the waste soil was likely disposed of somewhere at FAAF or possibly the Fort Ord Landfills (Ahtna, 2022c). Site 40A is a suspected source area of PFAS because PFAS-containing AFFF was possibly released at this site in response to a fuel spill incident and PFAS could remain in the soil which could be a source of PFAS to groundwater.

7.3.4 FAAF Fire & Rescue Station (Building 514)

The former FAAF Fire & Rescue Station is located in Building 514 at the FAAF (now the Marina Municipal Airport), south of the airport control tower (Figure 5). This site was owned and operated by the Army as a fire station from 1961 through base closure in 1994. AFFF was stored at the Main Garrison Fire Station in 5- or 10-gallon plastic containers and delivered to the FAAF Fire & Rescue Station to refill the tanks on firefighting vehicles on an as-needed basis. Old or expired AFFF would periodically be rotated out of the tanks on the firefighting vehicles, with the old AFFF being discharged to the grassy area south of the FAAF Fire & Rescue Station. This activity occurred approximately annually unless the AFFF tank on a vehicle had to be emptied for maintenance purposes, which occurred every several years (Ahtna, 2022c). The former FAAF Fire & Rescue Station is a suspected source area of PFAS because PFAS-containing AFFF was likely discharged at this site annually for at least two decades and PFAS could remain in the soil which could be a source of PFAS to groundwater.

7.3.5 Main Garrison Fire Station (Buildings 4400, 4401, and S-4403)

The Main Garrison Fire Station is located on General Jim Moore Boulevard between Lightfighter Drive and Gigling Road and includes a complex of three buildings (Figure 4). From 1953 through base closure in 1994, the Main Garrison Fire Station operated as the primary fire station servicing Fort Ord. AFFF was delivered to the Main Garrison Fire Station in 5- or 10-gallon plastic containers. Some of the AFFF was stored in Building 4400 or a CONEX shipping container next to the station until needed at either the Main Garrison Fire Station or the FAAF Fire & Rescue Station (Building 514). Old or expired AFFF would periodically be rotated out of the tanks on the firefighting vehicles, with the old AFFF being discharged to the grassy area next to Building 4401. This activity occurred approximately annually. AFFF tanks on fire department vehicles were also drained when repairs on the tanks were needed. Some AFFF could have leaked or spilled in the grassy areas adjacent to the fire station, though this occurred only five times over 40 years (Ahtna, 2022c). The Main Garrison Fire Station is a suspected source area of PFAS because PFAS-containing AFFF was likely discharged at this site annually for at least two decades and PFAS could remain in the soil which could be a source of PFAS to groundwater.

7.3.6 Fritzsche Army Airfield Fire Drill Area

The FAAF FDA is located in the western part of the Marina Municipal Airport (Figure 6). The FAAF FDA was established in 1962 as a training area for the Fort Ord Fire Department west of FAAF. As part of training activities, waste fuel (primarily composed of outdated or water-contaminated JP-4) was discharged from an onsite storage tank into a pit, ignited, and then extinguished. Other fuels included hydraulic and lubrication oils, gasoline, diesel, and solvents. After 1972, AFFF was used during training activities to extinguish fires in the FDA, with training occurring at least once per quarter (i.e., four times per year) and 100 to 200 gallons of AFFF being used during each training event (Ahtna, 2022c). Training activities at the FDA were discontinued in 1985, and the associated structures (pipeline and aboveground storage tank) were removed.

These training activities are believed to have resulted in the release of contaminants to soil and groundwater (Army, 2017), though groundwater contamination was limited to the A-Aquifer, which is not used for drinking water purposes (HGL, 2017).

In 1987, approximately 4,000 cubic yards of contaminated soil were removed from the former FDA to a depth of 31 feet, and the area was then backfilled with clean soil. Excavated soils were spread over the area of the former FDA to a depth of 2.5 to 3 feet above the original ground surface and remediated using treated groundwater supplemented with an aqueous nutrient formulation to stimulate microbial degradation of hydrocarbons in the soil (HLA, 1988b). As the soil was remediated, it was removed and transported to a soil borrow area for use as fill in construction projects at the former Fort Ord (HGL, 2017).

Groundwater remediation using pump and treat systems with granular activated carbon (GAC) was conducted from 1988 through 2014 at the former OU1, which included the FAAF FDA. Treated water from OU1 was discharged at different locations within OU1 depending on the specific treatment system that was in operation at the time. Treated water discharge facilities included two infiltration trench areas in the Fort Ord Natural Reserve (FONR), one infiltration basin in the OU1 Off-Post Area (Armstrong Ranch to the northwest of the FONR), two injection wells in the FONR, and a spray irrigation system in the former FAAF FDA. Treatment facilities at OU1 utilized GAC to remove several chemicals of concern (COCs), though PFAS were not COCs and were not monitored during OU1 operations. However, sampling and analysis for PFOA and PFOS at the OU2 groundwater treatment plant (GWTP) in 2019 demonstrated that GAC was effective at removing PFAS (Ahtna, 2022c). In 2015, samples were collected at OU1 for PFOA and PFOS analysis and the results did not indicate the discharge facilities were a source of PFAS in groundwater (HGL, 2017).

Groundwater monitoring results showed the aquifer cleanup levels (ACLs) for COCs specified in the OU1 Record of Decision (OU1 ROD) were achieved at all wells by September 2014. Attainment monitoring performed during 2015 confirmed the OU1 ROD requirements had been met and would be maintained in the future (HGL, 2017). However, the FAAF FDA is a suspected source area of PFAS because PFAS-containing AFFF was likely used at this site for at least 13 years and PFAS could remain in the soil in the excavated area which could be a source of PFAS to groundwater.

7.3.7 OU2: Fort Ord Landfills

The OU2 Fort Ord Landfills are located east of the Main Garrison area in the northcentral part of the former Fort Ord (Figure 7). The Fort Ord Landfills were active from 1955 to 1987 and were used for residential and on-base waste disposal typical of municipal landfills during that time. Waste was placed in parallel trenches from 10 to 30 feet deep and then covered over with the native dune sand excavated during trenching operations. Detailed disposal records are not available; however, information gathered during field activities and from other sources indicates household and on-base commercial refuse, dried sewage sludge, construction debris, and small amounts of chemical waste (paint, oil, pesticides, electrical equipment, ink, and epoxy adhesive) were placed in the Fort Ord Landfills (Shaw, 2005). Additionally, in the 1970s or 1980s, there were at least two fire incidents at the Fort Ord Landfills, likely in Area E or Area F, where consolidated waste, including tires, burned and AFFF was used to suppress the fire (Ahtna, 2022c). These activities led to the release of contaminants to the underlying unconfined A-Aquifer.

The selected remedial action for soil at OU2 included placement of an engineered cover system over buried refuse at the OU2 Fort Ord Landfills. The engineered cover was constructed from 1997 to 2002 (Ahtna, 2022b). However, the release of PFAS from OU2 to the A-Aquifer is suspected because the Fort Ord Landfills received a variety of residential and commercial waste from various sources from 1960 through May 31, 1987. The Fort Ord Landfills also received impacted soils from a variety of Fort Ord remediation sites. Additionally, in the 1970s or 1980s, there were at least two fire incidents at the Fort Ord Landfills where consolidated waste including tires burned and AFFF was used to suppress the fire.

7.4 Secondary Contaminant Migration

Commonly encountered PFAS compounds typically have a carbon-fluorine "tail" (positively charged) and a non-fluorinated "head" (negatively charged), where the tail end is hydrophobic, and the head is hydrophilic. By design, many PFAS compounds form films at the air-water interface and result in accumulation on water surfaces and potential retention at the water table and/or capillary fringe (ITRC, 2020). Due to high solubility, PFAS do not occur as a separate phase. Where present in unsaturated soil, PFAS are subject to downward leaching due to water infiltration that mobilizes soil-bound PFAS compounds. The leaching potential of PFAS is dependent on soil properties (pH, redox conditions, carbon content, etc.), interaction with hydrophilic and hydrophobic properties of PFAS chain lengths, and specific site conditions (e.g., depth to groundwater, extent of flooding, and infiltration rates). Studies have shown that PFAS compounds may exhibit both rapid leaching through the vadose zone and long-term retention in soils (ITRC, 2020).

PFAS compounds resist typical environmental degradation processes and are not easily broken down by acids, bases, heat, or oxidants due to the strength of the compounds' carbon-fluorine bonds. Although PFAS may remain in soils and sediments near source zones, these compounds can be highly mobile, and some PFAS can be found in soils, waterbodies, and other environmental compartments at remote locations, far from known sources, presumably due to atmospheric deposition. Long-chain PFAS strongly adsorb to solids, such as soil, making them relatively immobile, while short-chain PFAS have high mobility in water and leachate, allowing them to migrate to underlying groundwater and through regional aquifers. In addition to soil, sediment, and groundwater, surface water bodies may also be impacted by PFAS-containing stormwater from AFFF-impacted sites.

Because of the intended use of AFFF, co-location of PFAS with non-aqueous phase liquids (NAPL) within the subsurface has been reported, which can impact PFAS migration and may result in PFAS accumulation within the NAPL/water interface (ITRC, 2020). PFAS in groundwater may also diffuse into lower-permeability soils. Due to the lack of degradation, back-diffusion of PFAS from these low permeability soils often results in persisting PFAS concentration in groundwater. PFAS diffusion may also occur in man-made materials, such as concrete, potentially resulting in ongoing contributing sources (ITRC, 2020).

7.5 Fate and Transport Considerations

7.5.1 Contaminant Transport Model

Many of the PFAS found in AFFF are surfactants and contain a charged functional group at environmental pH. As a result, most of the major PFAS releases of concern at Army installations are likely to contain a variety of PFAS that do not volatilize; therefore, soil vapor and air are not primary media of concern for either transport or receptor exposure (ITRC, 2022). The primary media of concern for PFAS releases at Army installations are soil, groundwater, surface water, and sediment. However, stormwater runoff from the former Fort Ord to the Monterey Bay or other surface water bodies is unlikely due to the topography and high-infiltration soil types present. Therefore, surface water and sediment are not considered potential exposure pathways for any of the sites. Sediment is also not considered a potential exposure pathway because potential PFAS-containing sediments would have been removed from the sites during previous remedial actions or were not present at the sites.

PFAS compounds are dissolved in AFFF and will migrate with the foam. Generally, at unlined fire training areas and AFFF discharge areas, PFAS will seep into subsurface soil and groundwater, or run off to neighboring surface water and sediments. PFAS can also seep into concrete. Because the PFAS compounds found in AFFF are non-volatile, air emissions of PFAS from AFFF are not suspected to be significant but have not been quantified. Some AFFF foam may blow away from the application area, particularly as it dries; however, the majority of the PFAS released are likely to move immediately into the subsurface from the release area. Both anionic perfluoroalkyl acids (PFAAs) and PFAA precursors will migrate downward through the vadose zone and then laterally once in the groundwater. A majority of PFAS mass is expected to be retained in the vadose zone (ITRC, 2022).

The principal factors that affect PFAS partitioning within soil, groundwater, surface water, and sediment are the charge(s) on the PFAS molecule, the length of the perfluoroalkyl chain, and, for PFAA precursors, the structure of the non-fluorinated part of the molecule. In general, shorter perfluoroalkyl chain length PFAS will migrate farther than their corresponding longer perfluoroalkyl chain length analogs, although perfluorobutanoic acid has been observed to be more adsorptive and less mobile than perfluoropentanoic acid. Hydrocarbon plumes, mainly consisting of light non-aqueous phase liquids, will be shorter than PFAS plumes and may contribute to retention of PFAS. As conditions become more aerobic, PFAA precursor transformation rates will likely increase, and formation of additional PFAAs may occur over time. Fluorotelomer precursors tend to form perfluorinated carboxylic acids, while sulfonamide precursors tend to form perfluorinated sulfonic acids via aerobic microbially-mediated reactions. Soil properties will also affect PFAS transport. Positively-charged PFAA precursors are more likely to adsorb to the negatively charged soils frequently encountered in the subsurface. Anionic PFAS adsorb more strongly in the presence of greater soil organic carbon content and as soil and groundwater pH decrease. Hydrophobic adsorption is the main retardation mechanism for PFAS compounds with six or more perfluorinated carbons.[11] Electrostatic adsorption mechanisms are more important for PFAS compounds with shorter perfluoroalkyl groups.[12] In the vadose zone, air-water interface partitioning may contribute substantially to the retardation of PFAS compounds. Some PFAS adsorption is expected to be irreversible, so mass transport will reduce over time (Milinovic et al., 2015; Miao et al., 2017).

7.5.2 Site 2: Main Garrison Sewage Treatment Plant Potential Receptors and Exposure Pathways

The illustrative CSM for Site 2 is presented in Figure 8 and the conceptual site exposure model (CSEM) for the Site 2 is presented in Figure 9.

Hydrogeologic Setting

Site 2 overlies the unconfined Upper 180-Foot Aquifer west of the FO-SVA. Because the FO-SVA is absent at Site 2, the A-Aquifer is considered part of the Upper 180-Foot Aquifer. The lithology of both the Upper 180-Foot Aquifer and Lower 180-Foot Aquifer is primarily sand to silty sand with up to 15 percent gravel in some zones. The Intermediate 180-Foot Aquitard, present between the Upper 180-

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[11] PFAS compounds with six or more perfluorinated carbons include PFOA, PFOS, and PFHxS.

[12] PFAS compounds with shorter perfluoroalkyl groups include perfluorobutanoic acid and perfluoropentanoic acid.

Foot Aquifer and the Lower 180-Foot Aquifer at approximately 128 to 138 feet bgs, is mainly sandy silt to silty and clayey sand and ranges in thickness from about 8 to 20 feet. During initial site characterization in 1992, the depth to groundwater ranged from about 40 to 60 feet bgs. Groundwater flow in the Upper-180 Foot Aquifer is generally southwest toward Monterey Bay, with a maximum hydraulic gradient of 6.9 x 10^{-4} feet/feet. Upper 180-Foot Aquifer water levels close to Monterey Bay are influenced by tidal fluctuation but the effects decrease to less than 0.1 foot approximately 1,000 feet from the shore. Groundwater flow in the Lower 180-Foot Aquifer is generally from Site 2 inland towards Site 12. Local variation in flow direction In the Lower 180-Foot Aquifer does occur near the Monterey Bay where water levels are affected by tidal conditions; however, there are only minor seasonal variations in water levels. Influence on water levels in the Lower 180-Foot Aquifer related to tidal changes is present over 2,000 feet from Monterey Bay, with a change of over one foot in water level measured at Site 12 during tidal influence monitoring in 1994. The Upper 180-Foot Aquifer is unconfined at Site 2 while the Lower 180-Foot Aquifer is confined and aquifer stress testing (from pumping) applied to the Upper 180-Foot Aquifer did not influence the Lower 180-Foot Aquifer. Pump tests were not conducted in the Lower 180-Foot Aquifer in the Site 2 area, though the Lower 180-Foot Aquifer was monitored during pump testing in the Upper 180-Foot Aquifer (HLA, 1995).

Most rainfall at Fort Ord occurs from November through April with an average annual precipitation of 14 inches (Harding ESE, 2002). Site 2 is located in the Marina watershed. The site lies in an area of minimal flood hazard, with elevations above the 100-year flood level. Surface water infiltration is high at Site 2 due to the permeable dune sand and near shore beach deposits existing at the site. The nearest surface water body is the Monterey Bay, located approximately 0.2 of a mile from the site. Stormwater runoff from Site 2 to the Monterey Bay or other surface water bodies is unlikely due to the high topography dunes surrounding the site and high infiltration soil types present at the site.

Ponding Areas 1, 2, and 3 still exist as depressions in the dunes, with Ponding Area 2 acting as a primary stormwater infiltration basin for inland runoff. An overflow pipe extends to Ponding Area 1, now acting as an overflow infiltration basin. Stormwater runoff from Site 2 is primarily towards these ponding areas.

At Site 2, permeable dune sand and near shore beach deposits are present from the ground surface to approximately 70 feet bgs. A sandy silt present at approximately 128 to 138 feet bgs acts as an aquitard between the Upper 180-Foot Aquifer and Lower 180-Foot Aquifer (HLA, 1995).

The configuration of the site and analytical results from soil sampling conducted in 1996 indicate effluent from the sludge drying beds discharged to the evaporation pond immediately to the south (Ponding Area 1) with overflow going to Ponding Area 2 and Ponding Area 3 (HLA, 1997). No previous remedial action was proposed for soil at Site 2 (Army, 1997); however, in 1997, as part of the maintenance and cleanup activities associated with the closure of Site 2, sludge was removed from the drying beds and evaporation ponds. The asphalt-lined drying beds were demolished and about 3 feet of soil was excavated. Approximately 15,000 cubic yards of sludge, soil, and asphalt and wood debris were disposed of in the OU2 Fort Ord Landfills under the engineered cover system. In addition, conveyance piping under the drying beds and evaporation ponds was removed and disposed of in the OU2 Fort Ord Landfills. The area was then revegetated with native plants (IT, 2000).

Potential Groundwater Targets

Generally, the highest concentrations of groundwater COCs are detected from 0 to 20 feet below the top of the water table. Concentrations decrease to non-detection at the bottom of the Upper 180-Foot Aquifer. COCs are not detected below the Intermediate 180-Foot Aquitard showing that the unit is a barrier to their downward migration (i.e., the Lower 180-Foot Aquifer is not impacted) (HLA, 1995). The Upper 180-Foot Aquifer is not used for water supply and there is no downgradient groundwater use. Per the *Water Quality Control Plan for the Central Coastal Basin* (Basin Plan; CCRWQCB, 2019), groundwater throughout the Central Coast Basin is suitable, or potentially suitable, for beneficial uses (agricultural water supply, municipal and domestic water supply, and industrial use); however, it is unlikely groundwater from the Upper 180-Foot Aquifer in the Site 2 area will be used for beneficial uses in the future due to seawater intrusion, as indicated by chloride concentrations in groundwater at Site 2 that are greater than threshold values (Ahtna, 2022a).[13] Additionally, Site 2 is within the Consultation Zone of the Fort Ord Special Groundwater Protection Zone where well construction is restricted.[14]

For deeper aquifers, downgradient of Site 2 are the MCWD drinking water supply wells 29, 30, 31, and 34, located approximately 3.4 miles, 3.6 miles, 3.9 miles, and 4.2 miles away from Site 2, respectively (Figure 2). Wells 29, 30, and 31 draw water from the Lower 180-Foot Aquifer and the 400-Foot Aquifer; however, these aquifers are hydraulically separated from the Upper 180-Foot Aquifer, which flows toward the Monterey Bay at Site 2. Well 34 draws water from the 900-Foot Aquifer (MCWD, 2020a); however, the 900-Foot Aquifer is separated from the above aquifers by a confining layer that is approximately 150 feet thick. These wells supply potable water to the City of Marina, the CSUMB campus, and parts of the City of Seaside. The MCWD water supply system operates as a blended system.

Potential Surface Water Targets

There are no drinking water intakes, fisheries, or aqueous sensitive environments downstream of Site 2. Due to the groundwater flow directions in the Upper 180-Foot Aquifer, it is also unlikely that there is a groundwater impact to surface water resulting from historical activities at Site 2.

Potential Soil Targets

There are no onsite resident, school, daycare, or worker populations at this site because it is owned by the California Department of Parks and Recreation and operated as part of the Fort Ord Dunes State Park. Access to the Site 2 area by the general public is restricted by signage and fencing due to habitat restoration efforts. Given that this site is within the Fort Ord Dunes State Park, ecological receptors are a potential concern; however, per the Army PFAS Guidance (Army, 2018), there is no guidance or obligation to assess for ecological risk. There is a potential future exposure pathway to site workers should the California Department of Parks and Recreation undertake any currently unplanned soil-disturbing activities at Site 2. It is expected that this area will remain a habitat reserve and general public access will remain restricted in the future.

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[13] The seawater intrusion front is defined as the inland extent at which the concentration of chloride in groundwater is at least 500 mg/L, which represents a level that is twice the National Secondary Drinking Water Regulation (250 mg/L) and which exceeds the concentration for water considered to be of "Class III - injurious or unsatisfactory" quality for agricultural irrigation (350 mg/L) (MCWRA, 2017).

[14] See Monterey County Code of Ordinances, Title 15 – Public Services, Chapter 15.08 – Water Wells, Section 15.08.140 – Special groundwater protection.

7.5.3 Site 10: Former Burn Pit Potential Receptors and Exposure Pathways

The illustrative CSM for Site 10 is presented in Figure 8 and the CSEM for Site 10 is presented in Figure 10.

Hydrogeologic Setting

Site 10 overlies the unconfined or semi-confined Upper 180-Foot Aquifer west of the FO-SVA (HLA, 1995). During initial site characterization in 1992, depth to groundwater in the Site 10 wells ranged from approximately 236 to 244 feet bgs. The Upper-180 Foot Aquifer is approximately 50 feet thick in the Site 10 vicinity and is predominantly composed of sand with minor amounts of silt and gravel. Groundwater flow in the Upper 180-Foot Aquifer in this area is to the northeast toward the OU2 Fort Ord Landfills. Hydraulic conductivities in this aquifer can reach up to 366 feet per day (HLA, 1995, Volume II). During initial site characterization in 1992, the horizontal hydraulic gradient was measured to be 0.004 feet/feet in the area surrounding the burn pit and 0.002 feet/feet closer to the burn pit (HLA, 1993b).

Most rainfall at Fort Ord occurs from November through April with an average annual precipitation of 14 inches (Harding ESE, 2002). Site 10 is located in the Marina watershed. The site lies in an area of minimal flood hazard, with elevations above the 500-year flood level. Surface water infiltration is high at Site 10 due to dark brown silty sand, which extends from ground surface to 200 feet bgs, and layers of well-graded and poorly graded sand below 200 feet bgs (HLA, 1996). The nearest surface water body is the Monterey Bay, located approximately 1.3 miles away from the site. Stormwater runoff from Site 10 to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site.

Stormwater runoff from the Site 10 area is primarily toward a vegetated depression a few hundred feet southwest of the site. The site's original design as a burn pit also indicates that stormwater may have collected in the pit and infiltrated into the soil and groundwater.

Dark brown silty sand extends from ground surface to 6 to 12 feet bgs. The predominant material underlying the silty sand is a yellow-brown, fine-to-medium-grained sand, which generally extends to at least 200 feet bgs. Only a few thin layers (less than 10 feet thick) of fine-grained material (i.e., silty sand or sandy clay) are interbedded with this thick sand deposit. Below 200 feet, layers of well-graded sand are interbedded with poorly graded sands and silty layers (HLA, 1993b).

Potential Groundwater Targets

Downgradient of Site 10 are the MCWD drinking water supply wells 29, 30, 31, and 34, located approximately 3.0 miles, 3.3 miles, 3.5 miles, and 3.7 miles away from Site 10, respectively (Figure 2). Wells 29, 30, and 31 draw water from the Lower 180-Foot Aquifer and the 400-Foot Aquifer and therefore could be impacted by migration of PFAS in groundwater from Site 10. Well 34 draws water from the 900-Foot Aquifer (MCWD, 2020a); however, the 900-Foot Aquifer is separated from the above aquifers by a confining layer that is approximately 150 feet thick. These wells supply potable water to the City of Marina, the California State University Monterey Bay (CSUMB) campus, and parts of the City of Seaside.

Particle tracking analysis using the Fort Ord groundwater model indicates that PFAS entering the Upper 180-Foot Aquifer at Site 10 could have traveled as far as the OU2 Fort Ord Landfills within 30 years and potentially commingled with the OU2 TCE plume in the Upper 180-Foot Aquifer (AEI, 2020).

Potential Surface Water Targets

There are no drinking water intakes, fisheries, or aqueous sensitive environments downstream of Site 10. It is also unlikely that there is a groundwater impact to surface water due to Site 10 burn pit activities. Because no surface water is present onsite and there is no stormwater runoff to surface water from Site 10, it is unlikely that PFAS generated from Site 10 burn pit activities migrated to surface water bodies.

Potential Soil Targets

Approximately 1,451 cubic yards of soil was removed and treated at the FOSTA in July 1995 (HLA, 1996). PFAS was not a contaminant of concern at that time, and thus the removed soil was not sampled for PFAS compounds. However, the soil was sampled for a variety of organic compounds associated with the fuels used in training events and soil above the target cleanup concentrations for those compounds was removed. Because 1,451 cubic yards of contaminated soils have already been removed as part of a previous IA, it is unlikely that PFAS-impacted soil remains near the ground surface at Site 10.

There are no resident populations onsite at Site 10. Approximately 200 feet to the northeast of the site is the Main Garrison Fire Station, which currently operates as the Presidio of Monterey (POM) Fire Station. Approximately 15 people work onsite; however, Site 10 has not been used as a training area since at least 1990. This current worker population is not considered a potential receptor because over 1,000 cubic yards of contaminated soil has already been removed from the site and the site is no longer in use.

There are no residential, school, or daycare facilities onsite or within 200 feet of areas of potential contamination and there are no sensitive terrestrial environments onsite. The property is zoned as Commercial-Mixed Use (CMX) and future land use could include both commercial and residential where PFAS-impacted soil could be exposed during development of these uses. However, Site 10 is within a designated commercial center that is part of the larger Campus Town CMX development. Per the Campus Town specific plan, future residential use is permitted but would be limited to levels above commercial spaces (second floor or higher) and the Site 10 area will be hardscaped (i.e., there are no expected exposure points for future residents) (City of Seaside, 2020).

7.5.4 Site 40A: East FAAF Helicopter Defueling Area Potential Receptors and Exposure Pathways

The illustrative CSM for Site 40A is presented in Figure 11 and the CSEM for Site 40A is presented in Figure 12.

Hydrogeologic Setting

The Salinas Basin underlies the Site 40A area. At the former Fort Ord, the Salinas Basin is composed of relatively flat-lying to gently dipping, poorly consolidated sediments. Aquifers within the Salinas Basin at the former Fort Ord, from top to bottom, are the A-Aquifer, Upper 180-Foot Aquifer, Lower 180-Foot Aquifer, 400-Foot Aquifer, and 900-Foot Aquifer.

The A-Aquifer is unconfined and occurs within the permeable older dune sand, which is among the youngest deposits of the area. The older dune sand extends from the ground surface to a depth of approximately 125 feet bgs in the Site 40A area. A groundwater divide in the A-Aquifer exists east of the OU2 Fort Ord Landfills and trends northward toward the former FAAF. Site 40A is located east of the A-

Aquifer groundwater divide, and groundwater flow in the A-Aquifer in the area is toward the northeast. Localized areas of seepage are present in the bluffs bordering the Salinas Valley, which indicates surface discharge is occurring from the A-Aquifer. Beneath the A-Aquifer lies the FO-SVA, an extensive fine-grained sequence that is approximately 15 feet thick in the Site 40A area (HLA, 1995) and is an effective barrier that prevents downward migration of contaminants from the A-Aquifer into the underlying Upper 180-Foot Aquifer (HGL, 2017).

In the FAAF area, the Upper 180-Foot Aquifer is confined beneath the FO-SVA (HLA, 1995). The Upper 180-Foot Aquifer consists of about 60 feet of fine to coarse sand and some gravel and is laterally extensive throughout the area. Groundwater flows eastward and southeastward under largely confined conditions. The direction of flow appears controlled by the degree of hydraulic communication with the underlying Lower 180-Foot Aquifer, separated by the Intermediate 180-Foot Aquitard, where present. Where this aquitard is discontinuous, groundwater from the Upper 180-Foot Aquifer drains into the Lower 180-Foot Aquifer (MACTEC, 2006).

The Intermediate 180-Foot Aquitard consists of approximately 50 feet of interbedded clay and clayey sand layers, occasionally mixed with coarse gravel. This aquitard hydraulically isolates the Upper and Lower 180-Foot Aquifers from one another but is discontinuous in the area south of Reservation Road, allowing recharge to the Lower 180-Foot Aquifer to occur (MACTEC, 2006).

The Lower 180-Foot Aquifer consists of approximately 200 feet of coarse sand and gravel, and the 400-Foot Aquifer consists of up to 250 feet of a sequence of interbedded sand and clay. These aquifers have historically been and continue to be a significant source of potable water for the former Fort Ord and City of Marina areas (MACTEC, 2006).

Underlying the 400-Foot Aquifer is a confining layer reported to be approximately 150 feet thick that separates the 400-Foot Aquifer from the 900-Foot Aquifer, which consists of sands and gravels interbedded with discontinuous lenses of clay between depths of approximately 750 and 1,700 feet bgs. The 900-Foot Aquifer is penetrated by the deep MCWD drinking water supply wells (HLA, 1995).

Most rainfall at Fort Ord occurs from November through April, with an average annual precipitation of 14 inches (Harding ESE, 2002). The site lies in an area of minimal flood hazard, with elevations above the 500-year flood level. Surface water infiltration is high at Site 40A due to the high permeability of soils present onsite (HLA, 1994a). The nearest surface water body is the Salinas River, located approximately 0.4 miles away from the site. Stormwater runoff from Site 40A to the Salinas River or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site.

Stormwater runoff from Site 40A is primarily toward a topographic low area to the northeast of the site. Stormwater runoff is also possible across the pavement toward the southwest and into a 24-inch diameter storm drain line which runs through the helicopter parking apron east of the FAAF Fire & Rescue Station. This storm drain line discharges at an outfall approximately 450 feet east of the FAAF Fire & Rescue Station (HLA, 1995).

In general, surface soils in the area of Site 40A consist of brown fine to coarse sand with some silt. Below about 5 feet bgs, subsurface soils down to the FO-SVA typically consist of yellowish-brown to yellow fine to coarse sand.

Potential Groundwater Targets

The A-Aquifer is not used for drinking water supply, and there is no downgradient groundwater use. All MCWD drinking water supply wells are located upgradient or cross-gradient from the site (Figure 2) and draw water from the deeper aquifers that are separated from the A-Aquifer by multiple aquitards.

The release of PFAS from Site 40A to the A-Aquifer is suspected because of reported historical use of AFFF during a response to a fuel spill in the late 1970s or early 1980s to reduce the likelihood of fire. Because of the mobility of certain PFAS in the soil pathway, the groundwater may be impacted in the downgradient area between the helicopter parking apron and the former Fort Ord boundary to the east. Site 40A is within the Prohibition Zone of the Fort Ord Special Groundwater Protection Zone where well construction is restricted; however, per the Basin Plan (CCRWQCB, 2019), groundwater throughout the Central Coast Basin is suitable, or potentially suitable, for beneficial uses. Though the A-Aquifer is not currently used for beneficial use, it could be used in the future and there is a potential exposure pathway for future residential receptors.

Potential Surface Water Targets

There are no drinking water intakes, downstream fisheries, or aqueous sensitive environments downstream of Site 40A. It is also unlikely that there is a groundwater impact to surface water due to the reported use of AFFF at Site 40A because the A-Aquifer downgradient of Site 40A discharges at the bluff face bordering the Salinas Valley and not to a surface water body.

Because no surface water is present onsite and there is no stormwater runoff to surface water from Site 40A, it is unlikely that PFAS generated from the Site 40A fuel spill response migrated to surface water bodies, and there are no associated potential receptors. Surface runoff from the site enters the topographic low area previously discussed and then infiltrates the ground surface.

Potential Soil Targets

There are no onsite resident, school, daycare, or worker populations at this site. Thus, there are no current potential receptor populations; however, the Site 40A area is within an aviation development reserve and permitted future uses include transportation terminals for airlines, aviation services, retail sales, and vehicle parking. Additionally, certain non-aviation-related uses may be permissible provided they are temporary (five years or less) in nature and can be removed in a timely manner to allow for aviation-related development (i.e., agricultural activities) (Coffman, 2018).

Because of the high permeability of soil in the area, AFFF infiltration into the soil in the drainage area north of Site 40A is possible and PFAS-impacted soil could remain near the ground surface because retention of longer-chain PFAS in shallow soils after extended percolation is possible. Because the site is within the aviation development reserve, future site workers could be potential receptors.

7.5.5 FAAF Fire & Rescue Station (Building 514) Potential Receptors and Exposure Pathways

The illustrative CSM for the FAAF Fire & Rescue Station is presented in Figure 11 and the CSEM for the FAAF Fire & Rescue Station is presented in Figure 13.

Hydrogeologic Setting

No previous site investigations have occurred at the former FAAF Fire & Rescue Station (now Marina Fire Rescue Station #2); however, site-specific geology and hydrogeology can be inferred from adjacent sites and basewide information. The Salinas Basin underlies the former FAAF Fire & Rescue Station area. At the former Fort Ord, the Salinas Basin is composed of relatively flat-lying to gently dipping, poorly consolidated sediments. Aquifers within the Salinas Basin at the former Fort Ord, from top to bottom, are the A-Aquifer, Upper 180-Foot Aquifer, Lower 180-Foot Aquifer, 400-Foot Aquifer, and 900-Foot Aquifer.

The A-Aquifer is unconfined and occurs within the permeable older dune sand, which is among the youngest deposits of the area. The older dune sand extends from the ground surface to a depth of approximately 125 feet bgs in the former Fire & Rescue Station area. A groundwater divide in the A-Aquifer exists east of the OU2 Fort Ord Landfills and trends northward toward the former FAAF. The former Fire & Rescue Station is located east of the A-Aquifer groundwater divide, and groundwater flow in the A-Aquifer in the area is toward the northeast. Localized areas of seepage are present in the bluffs bordering the Salinas Valley, which indicates surface discharge is occurring from the A-Aquifer. Beneath the A-Aquifer lies the FO-SVA, an extensive fine-grained sequence that is approximately 15 feet thick in the former Fire & Rescue Station area (HLA, 1995) and is an effective barrier that prevents downward migration of contaminants from the A-Aquifer into the underlying Upper 180-Foot Aquifer (HGL, 2017).

In the FAAF area, the Upper 180-Foot Aquifer is confined beneath the FO-SVA (HLA, 1995). The Upper 180-Foot Aquifer consists of about 60 feet of fine to coarse sand and some gravel and is laterally extensive throughout the area. Groundwater flows eastward and southeastward under largely confined conditions. The direction of flow appears controlled by the degree of hydraulic communication with the underlying Lower 180-Foot Aquifer, separated by the Intermediate 180-Foot Aquitard, where present. Where this aquitard is discontinuous, groundwater from the Upper 180-Foot Aquifer drains into the Lower 180-Foot Aquifer (MACTEC, 2006).

The Intermediate 180-Foot Aquitard consists of approximately 50 feet of interbedded clay and clayey sand layers, occasionally mixed with coarse gravel. This aquitard hydraulically isolates the Upper and Lower 180-Foot Aquifers from one another but is discontinuous in the area south of Reservation Road, allowing recharge to the Lower 180-Foot Aquifer to occur (MACTEC, 2006).

The Lower 180-Foot Aquifer consists of approximately 200 feet of coarse sand and gravel and the 400-Foot Aquifer consists of up to 250 feet of a sequence of interbedded sand and clay. These aquifers have historically been and continue to be a significant source of potable water for the former Fort Ord and City of Marina areas (MACTEC, 2006).

Underlying the 400-Foot Aquifer is a confining layer reported to be approximately 150 feet thick that separates the 400-Foot Aquifer from the 900-Foot Aquifer, which consists of sands and gravels interbedded with discontinuous lenses of clay between depths of approximately 750 and 1,700 feet bgs. The 900-Foot Aquifer is penetrated by the deep MCWD drinking water supply wells (HLA, 1995).

Most rainfall at Fort Ord occurs from November through April, with an average annual precipitation of 14 inches (Harding ESE, 2002). The former FAAF Fire & Rescue Station is located in the Marina watershed. The site lies in an area of minimal flood hazard, with elevations above the 500-year flood level. Surface water infiltration is high at the former FAAF Fire & Rescue Station due to the high permeability of soils present onsite (HLA, 1994a). The nearest surface water body is the Salinas River, located approximately 0.4 miles away from the site. Stormwater runoff from the former FAAF Fire & Rescue Station to the Salinas River or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Stormwater runoff from the site likely discharges to a low point to the north of the FAAF Fire & Rescue Station.

In general, surface soils in the area of the former FAAF Fire & Rescue Station consist of brown fine to coarse sand with some silt. Below about 5 feet bgs, subsurface soils down to the FO-SVA typically consist of yellowish-brown to yellow fine to coarse sand.

Potential Groundwater Targets

The A-Aquifer is not used for water supply, and there is no downgradient groundwater use. All MCWD drinking water supply wells are located upgradient or cross-gradient from the site (Figure 2) and draw water from the deeper aquifers that are separated from the A-Aquifer by the multiple aquitards.

The release of PFAS from the former FAAF Fire & Rescue Station to the A-Aquifer is suspected because of reported historical discharge of AFFF to the grassy areas next to the FAAF Fire & Rescue Station. This activity occurred approximately annually. The FAAF Fire & Rescue Station is within the Prohibition Zone of the Fort Ord Special Groundwater Protection Zone where well construction is restricted; however, per the Basin Plan (CCRWQCB, 2019), groundwater throughout the Central Coast Basin is suitable, or potentially suitable, for beneficial uses. Though the A-Aquifer is not currently used for beneficial use, it could be used in the future and there is a potential exposure pathway for future residential receptors.

Potential Surface Water Targets

There are no drinking water intakes, downstream fisheries, or aqueous sensitive environments downstream of the former FAAF Fire & Rescue Station. It is also unlikely that there is a groundwater impact to surface water due to the reported discharges of AFFF at the former FAAF Fire & Rescue Station because the A-Aquifer downgradient of the former Fire & Rescue Station discharges at the bluff face bordering the Salinas Valley and not to a surface water body.

Because no surface water is present onsite and there is no stormwater runoff to surface water from the former FAAF Fire & Rescue Station, it is unlikely that PFAS generated from the discharges of AFFF at the site migrated to surface water bodies, and there are no associated potential receptors. Surface runoff from the site enters the topographic low area to the north of the former Fire & Rescue Station and then infiltrates the ground surface.

Potential Soil Targets

There are no resident populations or schools within 200 feet of the former FAAF Fire & Rescue Station; however, because the site is still in use as the Marina Fire Rescue Station #2, the site worker population is considered a current and future potential receptor.

Because of the high permeability of soil in the area, AFFF infiltration into the soil in the unpaved area south of the former Fire & Rescue Station is possible, and PFAS-impacted soil could remain near the ground surface because long-term retention of longer-chain PFAS in shallow soils after extended percolation is possible.

7.5.6 Main Garrison Fire Station Potential Receptors and Exposure Pathways

The illustrative CSM for the Main Garrison Fire Station is presented in Figure 8 and the CSEM for the Main Garrison Fire Station is presented in Figure 14.

Hydrogeologic Setting

The former Main Garrison Fire Station (now the POM Fire Station) overlies the unconfined or semi-confined Upper 180-Foot Aquifer west of the FO-SVA (HLA, 1995). During initial characterization of adjacent Site 10 in 1992, depth to groundwater in the area ranged from approximately 236 to 244 feet bgs, and the horizontal hydraulic gradient was measured to be 0.004 feet/feet in the area surrounding Site 10 (HLA, 1993b). The Upper-180 Foot Aquifer was approximately 50 feet thick in the area and is predominantly composed of sand with minor amounts of silt and gravel. Hydraulic conductivities in this aquifer can reach up to 366 feet per day (HLA, 1995, Volume II). Particle tracking analysis using the Fort Ord groundwater model indicates that PFAS entering the Upper 180-Foot Aquifer at the former Main Garrison Fire Station could have traveled as far as the OU2 Fort Ord Landfills within 30 years and potentially commingled with the OU2 TCE plume in the Upper 180-Foot Aquifer (AEI, 2020). East of the OU2 Fort Ord Landfills, groundwater flows from the Upper 180-Foot Aquifer down into the Lower 180-Foot Aquifer through a natural discontinuity in the Intermediate 180-Foot Aquitard (HLA, 1995 and MACTEC, 2006), which allows low concentrations of chemicals of concern (COCs) associated with OU2 to enter the Lower 180-Foot Aquifer.

Most rainfall at Fort Ord occurs from November through April, with an average annual precipitation of 14 inches (Harding ESE, 2002). The former Main Garrison Fire Station is located in the Marina watershed. The site lies in an area of minimal flood hazard, with elevations above the 500-year flood level. Surface water infiltration is high at the site due to silty sand, which extends from ground surface to 200 feet bgs, and layers of well-graded and poorly graded sand below 200 feet bgs (HLA, 1996). The nearest surface water body is the Monterey Bay, located approximately 1.3 miles away from the site. Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Stormwater runoff from the site is primarily toward a vegetated depression a few hundred feet southwest of the site.

Dark brown silty sand extends from the ground surface to 6 to 12 feet bgs. The predominant material underlying the silty sand is a yellow-brown, fine-to-medium-grained sand, which generally extends to at least 200 feet bgs. Only a few thin layers (less than 10 feet thick) of fine-grained material (i.e., silty sand or sandy clay) are interbedded with this thick sand deposit. Below 200 feet, layers of well-graded sand are interbedded with poorly graded sands and silty layers (HLA, 1993b).

Potential Groundwater Targets

Downgradient of the former Main Garrison Fire Station are the MCWD drinking water supply wells 29, 30, 31, and 34, located approximately 2.9 miles, 3.3 miles, 3.4 miles, and 3.7 miles away from the former Main Garrison Fire Station, respectively (Figure 2). Wells 29, 30, and 31 draw water from the Lower 180-Foot Aquifer and the 400-Foot Aquifer and, therefore, could be impacted by migration of PFAS in groundwater from the former Main Garrison Fire Station. Well 34 draws water from the 900-Foot Aquifer (MCWD, 2020a); however, the 900-Foot Aquifer is separated from the above aquifers by a confining layer that is approximately 150 feet thick. These wells supply potable water to the City of Marina, the CSUMB campus, and parts of the City of Seaside (Ahtna, 2022c).

The release of PFAS from the former Main Garrison Fire Station to the Upper 180-Foot Aquifer is suspected because of reported historical discharge of AFFF to the grassy area next to Building 4401. This activity occurred approximately annually.

Potential Surface Water Targets

There are no drinking water intakes, fisheries, or aqueous sensitive environments downstream of the former Main Garrison Fire Station. Due to the distance of surface water bodies and groundwater flow directions in the Upper 180-Foot Aquifer, it is also unlikely that there is a groundwater impact to surface water resulting from historical activities at Site 10.

Because no surface water is present onsite and there is no stormwater runoff to surface water from the site, it is unlikely that PFAS generated from the discharges of AFFF at the site migrated to surface water bodies and there are no associated potential receptors.

Potential Soil Targets

There are no resident populations or schools within 200 feet of the Main Garrison Fire Station; however, because the site is still in use by POM Fire Department, this site worker population is considered a potential receptor.

Because of the high permeability of soil in the area, AFFF infiltration into the soil in the unpaved area west of Building 4401 is possible, and PFAS-impacted soil could remain near the ground surface due to long-term retention of longer-chain PFAS in shallow soils after extended percolation.

The firefighters at the Main Garrison Fire Station are DoD employees and therefore have a regular tour of duty consisting of three 24-hour shifts per week, equivalent to 72 hours per week (DoD, 2018). However, firefighters are not considered to be residential receptors. Per the USEPA Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A), a maximum daily exposure period for a resident of 24 hours (168 hours per week) is possible and the exposure duration is assumed to be 30 years, or up to a lifetime exposure of 70 years in some cases, when calculating reasonable maximum residential exposures (USEPA, 1989). Conversely, the career of a firefighter in federal service is reasonably assumed to be 20 years or less due the physically demanding aspects of the profession and federal requirements for maximum entry age and mandatory separation based on age (DoD, 2015). Additionally, a worker is defined as a person working on a property with an area of observed contamination <u>and</u> whose workplace area is on or within 200 feet of an area of observed contamination, and a resident is defined as a person who lives or attends school or day care on a property with an area of observed contamination <u>and</u> whose residence, school, or day care center is on or within 200 feet of the area of observed contamination (USEPA, 1992). Based on the USEPA guidance and federal requirements, firefighters are reasonably classified as workers and not residential receptors.

The Main Garrison Fire Station is within a designated commercial center that is part of the larger Campus Town CMX development. Per the Campus Town specific plan, future residential use is permitted but would be limited to levels above commercial spaces (second floor or higher) and the Main Garrison Fire Station area will be hardscaped (i.e., there are no expected exposure points for future residents) (City of Seaside, 2020).

7.5.7 Fritzsche Army Airfield Fire Drill Area Potential Receptors and Exposure Pathways

The illustrative CSM for the FAAF FDA is presented in Figure 11 and the CSEM for the FAAF FDA is presented in Figure 15.

Hydrogeologic Setting

The Salinas Basin underlies the FAAF FDA. At the former Fort Ord, the Salinas Basin is composed of relatively flat-lying to gently dipping, poorly consolidated sediments. Aquifers within the Salinas Basin at the former Fort Ord, from top to bottom, are the A-Aquifer, Upper 180-Foot Aquifer, Lower 180-Foot Aquifer, 400-Foot Aquifer, and 900-Foot Aquifer. Contaminants at the former OU1 were detected only in the A-Aquifer (HGL, 2017).

The A-Aquifer is unconfined and occurs within the permeable older dune sand, which is among the youngest deposits of the area. Aquifer materials in the saturated zone of the A-Aquifer consist predominantly of permeable, slightly silty, fine- to medium-grained sands with some coarse-grained sands. Typically, this aquifer depth ranges from approximately 80 feet to 125 feet bgs in the FAAF FDA area. The depth to water (dtw) ranges from approximately 60 feet to 110 feet bgs. A groundwater divide in the A-Aquifer exists east of the OU2 Fort Ord Landfills and trends northward toward the former FAAF. The FAAF FDA is located west of the A-Aquifer groundwater divide and groundwater flow in the A-Aquifer in the area is toward the northwest.

The A-Aquifer is underlain by a sequence of impermeable silts and clays that compose the FO-SVA. In the FAAF FDA area, the FO-SVA is an effective barrier that prevents downward migration of contaminants from the A-Aquifer into the underlying Upper 180-Foot Aquifer (HGL, 2017).

In the FAAF area, the Upper 180-Foot Aquifer is confined beneath the FO-SVA (HLA, 1995). The Upper 180-Foot Aquifer consists of about 60 feet of fine to coarse sand and some gravel and is laterally extensive throughout the area. Groundwater flows eastward and southeastward under largely confined conditions. The direction of flow appears controlled by the degree of hydraulic communication with the underlying Lower 180-Foot Aquifer, separated by the Intermediate 180-Foot Aquitard, where present. Where this aquitard is discontinuous, groundwater from the Upper 180-Foot Aquifer drains into the Lower 180-Foot Aquifer (MACTEC, 2006).

The Intermediate 180-Foot Aquitard consists of approximately 50 feet of interbedded clay and clayey sand layers, occasionally mixed with coarse gravel. This aquitard hydraulically isolates the Upper and Lower 180-Foot Aquifers from one another but is discontinuous in the area south of Reservation Road, allowing recharge to the Lower 180-Foot Aquifer to occur (MACTEC, 2006).

The Lower 180-Foot Aquifer consists of approximately 200 feet of coarse sand and gravel, and the 400-Foot Aquifer consists of up to 250 feet of a sequence of interbedded sand and clay. These aquifers have historically been and continue to be a significant source of potable water for the former Fort Ord and City of Marina areas (MACTEC, 2006).

Underlying the 400-Foot Aquifer is a confining layer reported to be approximately 150 feet thick that separates the 400-Foot Aquifer from the 900-Foot Aquifer, which consists of sands and gravels interbedded with discontinuous lenses of clay between depths of approximately 750 and 1,700 feet bgs. The 900-Foot Aquifer is penetrated by the deep MCWD drinking water supply wells (HLA, 1995).

Most rainfall at Fort Ord occurs from November through April, with an average annual precipitation of 14 inches (Harding ESE, 2002). The site lies in an area of minimal flood hazard, with elevations above the 500-year flood level. The FAAF FDA is located on a Holocene dune sand deposit with very high permeability (HLA, 1986). The nearest surface water body is the Salinas River, located approximately 1 mile away from the site. Stormwater runoff from the FAAF FDA to the Salinas River or other surface water bodies is extremely unlikely due to the topography and high infiltration soil types present at the site.

In general, surface soils in the area of the FAAF FDA consist of black to yellowish-brown fine- to medium-grained sand with some silt. Below about 5 feet bgs, subsurface soils down to the FO-SVA consist of Holocene dune sand deposits, which is typically relatively clean, yellowish-brown, well-sorted sand, with depths ranging from 80 to 125 feet bgs in the FAAF FDA area. The dune sands are highly permeable, and the soil moisture content in the top 25 feet of soil varies seasonally (HLA, 1986).

Potential Groundwater Targets

The A-Aquifer is not used for drinking water supply, and there is no downgradient groundwater use in the A-Aquifer. The closest drinking water supply wells are MCWD wells 10, 11, and 12, located 0.8, 0.4, and 1.0 miles away from the FAAF FDA, respectively, which are part of a system that supplies potable water to the City of Marina, the CSUMB campus, and parts of the City of Seaside (Ahtna, 2022c). However, these wells draw water from the 900-Foot Aquifer, which is separated from the above aquifers by a confining layer that is approximately 150 feet thick (Figure 2). Because groundwater contamination in the vicinity of the site is confined to the A-Aquifer, there is no pathway from this site to existing drinking water supply wells, and it is unlikely that these drinking water supply wells have been impacted by AFFF use at the FAAF FDA.

The release of PFAS from the FAAF FDA to the A-Aquifer is suspected because of reported regular use of AFFF at the former FAAF FDA for at least 13 years and historical detections of PFOA and PFOS in three A-Aquifer groundwater monitoring wells at concentrations exceeding the USEPA HA or DoD screening levels. The FAAF FDA is within the Prohibition Zone of the Fort Ord Special Groundwater Protection Zone where well construction is restricted; however, per the Basin Plan (CCRWQCB, 2019), groundwater throughout the Central Coast Basin is suitable, or potentially suitable, for beneficial uses. Though the A-Aquifer is not currently used for beneficial use, it could be used in the future and there is a potential exposure pathway for future residential receptors.

Potential Surface Water Targets

The FAAF FDA is located in a depression and is unpaved, with the exception of a small concrete equipment staging area used during former OU1 remediation efforts. Because of the topography and the high permeability of the soils present onsite, stormwater runoff offsite is unlikely.

There are no drinking water intakes, downstream fisheries, or aqueous sensitive environments downstream of the FAAF FDA. Due to the distance of surface water bodies and groundwater flow directions in the A-Aquifer, it is also unlikely that there is a groundwater impact to surface water due to FAAF FDA AFFF discharge.

Potential Soil Targets

There are no onsite or nearby resident, school, or daycare populations at this site; however, there are intermittent site worker populations associated with habitat management and educational activities in the FONR and there is a potential pathway to site workers. Given that this site is within the FONR, ecological receptors are a potential concern; however, per the Army PFAS Guidance (Army, 2018), there is no guidance or obligation to assess for ecological risk.

In 1987, approximately 4,000 cubic yards of contaminated soil were removed from the former FDA to a depth of 31 feet, and the area was then backfilled with clean soil. Excavated soils were spread over the area of the former FDA to a depth of 2.5 to 3 feet above the original ground surface and remediated using treated groundwater supplemented with an aqueous nutrient formulation to stimulate microbial degradation of hydrocarbons in the soil (HLA, 1988b). As the soil was remediated, it was removed and transported to a soil borrow area for use as fill in construction projects at the former Fort Ord (HGL, 2017).

Because extensive soil remediation occurred at the surface of the FAAF FDA, it is possible that PFAS-impacted soil remains onsite below the ground surface.

7.5.8 OU2: Fort Ord Landfills Potential Receptors and Exposure Pathways

Hydrogeologic Setting

The Salinas Basin underlies the OU2 area. At the former Fort Ord, the Salinas Basin is composed of relatively flat-lying to gently dipping, poorly consolidated sediments. Aquifers within the Salinas Basin at the former Fort Ord, from top to bottom, are the A-Aquifer, Upper 180-Foot Aquifer, Lower 180-Foot Aquifer, 400-Foot Aquifer, and 900-Foot Aquifer. Contaminants at OU2 are detected in the A-Aquifer, Upper 180-Foot Aquifer, and potentially the Lower 180-Foot Aquifer (Ahtna, 2022c).

The A-Aquifer is unconfined and occurs within the permeable older dune sand, which is among the youngest deposits of the area. These dune sand deposits range in thickness from 85 feet at the northwest edge of OU2 to 202 feet at the southeast edge of OU2. Aquifer materials in the saturated zone of the A-Aquifer consist predominantly of permeable, slightly silty, fine- to medium-grained sands with some coarse-grained sands. Depth to groundwater in the unconfined A-Aquifer is between 65 and 180 feet bgs in the OU2 area. The A-Aquifer is underlain by a sequence of impermeable silts and clays that compose the FO-SVA. In the OU2 area, the FO-SVA ranges in thickness from 54 feet in the west edge of the site to 65 feet in the northwest edge of the site (HLA, 1988a), and is an effective barrier that prevents downward migration of contaminants from the A-Aquifer into the underlying confined Upper 180-Foot Aquifer. A groundwater divide in the A-Aquifer exists east of the OU2 Fort Ord Landfills and trends northward toward the former FAAF. The OU2 Fort Ord Landfills are located west of the A-Aquifer groundwater divide, and groundwater flow in the A-Aquifer in the area is to the north and northwest.

In the OU2 area, the Upper 180-Foot Aquifer is mostly confined beneath the FO-SVA (HLA, 1995), and depth to groundwater in the Upper 180-Foot Aquifer is between 60 and 265 feet bgs. To the west, where the FO-SVA pinches out, the unconfined A-Aquifer and confined Upper 180-Foot Aquifer combine to form a continuous, unconfined hydrostratigraphic unit (identified as the unconfined Upper 180-Foot Aquifer). A north-trending groundwater divide in the unconfined Upper 180-Foot Aquifer exists midway between the FO-SVA and Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer west of the divide flows west and discharges to the Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer east of the divide flows under the FO-SVA (becoming confined) toward the Salinas Valley. The Upper 180-Foot Aquifer consists of about 60 feet of fine to coarse sand and some gravel and is laterally extensive throughout the area. Groundwater flows generally eastward under largely confined conditions. The direction of flow appears controlled by the degree of hydraulic communication with the underlying Lower 180-Foot Aquifer, separated by the Intermediate 180-Foot Aquitard, where present. Where this aquitard is discontinuous, groundwater from the Upper 180-Foot Aquifer drains into the Lower 180-Foot Aquifer (MACTEC, 2006).

The Intermediate 180-Foot Aquitard consists of approximately 50 feet of interbedded clay and clayey sand layers, occasionally mixed with coarse gravel. This aquitard hydraulically isolates the Upper and Lower 180-Foot Aquifers from one another but is discontinuous in the area south of Reservation Road, allowing recharge to the Lower 180-Foot Aquifer to occur (MACTEC, 2006).

The Lower 180-Foot Aquifer consists of approximately 200 feet of coarse sand and gravel and the 400-Foot Aquifer consists of up to 250 feet of a sequence of interbedded sand and clay. These aquifers have historically been and continue to be a significant source of potable water for the former Fort Ord and City of Marina areas (MACTEC, 2006).

Underlying the 400-Foot Aquifer is a confining layer reported to be approximately 150 feet thick that separates the 400-Foot Aquifer from the 900-Foot Aquifer, which consists of sands and gravels interbedded with discontinuous lenses of clay between depths of approximately 750 and 1,700 feet bgs. The 900-Foot Aquifer is penetrated by the deep MCWD drinking water supply wells (HLA, 1995).

Most rainfall at Fort Ord occurs from November through April, with an average annual precipitation of 14 inches (Harding ESE, 2002). The site lies in an area of minimal flood hazard, with elevations above the 500-year flood level. Soil in the area is primarily permeable dune sand deposits (HLA, 1988a). The nearest surface water bodies are a few small vernal ponds located in the Fort Ord National Monument southeast of the intersection of Watkins Gate Road and Hennekens Ranch Road, located approximately 1.2 miles away from the site. However, these vernal ponds are located in the Salinas River watershed, and the Fort Ord Landfills are located in the Marina watershed, making stormwater runoff from the Fort Ord Landfills to the vernal ponds unlikely. Stormwater runoff from the OU2 Fort Ord Landfills to other surface water bodies is also unlikely due to the topography and high infiltration soils present around the Landfills.

Soil in the area around the OU2 Fort Ord Landfills is primarily permeable dune sand deposits (HLA, 1988a). The Fort Ord Landfills area is part of a larger complex of older dune sands present through the west and north of the former Fort Ord (HLA, 1993a). Soils onsite are largely covered by landfill material and thus are inaccessible due to the engineered cover system in place at the OU2 Fort Ord Landfills.

Potential Groundwater Targets

Downgradient of the OU2 Fort Ord Landfills are MCWD drinking water supply wells 29, 30, 31, and 34, located approximately 1.0 miles, 1.3 miles, 1.5 miles, and 1.8 miles away from the OU2 Fort Ord Landfills, respectively (Figure 2). Wells 29, 30, and 31 draw water from the Lower 180-Foot Aquifer and the 400-Foot Aquifer and therefore could be impacted by migration of PFAS in groundwater from OU2. Well 34 draws water from the 900-Foot Aquifer (MCWD, 2020a); however, the 900-Foot Aquifer is separated from the above aquifers by a confining layer that is approximately 150 feet thick. These wells supply potable water to the City of Marina, the CSUMB campus, and parts of the City of Seaside.

The release of PFAS from OU2 to the A-Aquifer is suspected because the Fort Ord Landfills received a variety of residential and commercial waste from various sources from 1956 through May 31, 1987. The Fort Ord Landfills also received impacted soils from a variety of Fort Ord remediation sites, and AFFF-impacted soil from Site 40A may have been disposed of in the Fort Ord Landfills. Additionally, in the 1970s or 1980s, there were at least two fire incidents at the Fort Ord Landfills where consolidated waste, including tires, burned, and AFFF was used to suppress the fire. Finally, PFOA and PFOS were detected at concentrations above the USEPA RSLs and DoD screening levels in monitoring well MW-

OU2-23-180 (Ahtna, 2022c), and PFBS and perfluorohexanoic acid (PFHxA) were detected at low concentrations in downgradient MCWD drinking water supply well 29 (Ahtna, 2022c), with PFBS detected at a concentration below the USEPA RSL and DoD screening level.

Potential Surface Water Targets

There are no downstream drinking water intakes, fisheries, or sensitive environments. Due to the distance of surface water bodies and groundwater flow directions in the A-Aquifer and Upper 180-Foot Aquifer, it is also unlikely that there is a groundwater impact to surface water due to PFAS in the OU2 Fort Ord Landfills. The engineered cover system currently in place at the OU2 Fort Ord Landfills includes a linear low-density polyethylene liner and is impermeable to precipitation, which prevents stormwater from infiltrating through waste containing PFAS that may be below the cover system.

No surface water is present onsite, and there is no stormwater runoff to surface water from the OU2 Fort Ord Landfills.

Potential Soil Targets

There are no onsite or nearby resident, school, daycare, or worker populations at this site. Thus, there are no potential receptors.

The suspected sources of PFAS at the OU2 Fort Ord Landfills are the AFFF discharged during fire suppression in the 1970s or 1980s and possible disposal of other PFAS-containing materials there. At this time, the cover system for the OU2 Fort Ord Landfills consisted only of the native sandy soil; therefore, AFFF discharged during fire suppression would have been absorbed with minimal runoff due to the high permeability of soils at the former Fort Ord and PFAS impacts to surface soil in the area surrounding the OU2 Fort Ord Landfills due to surface runoff is unlikely. Impacted soils would be beneath the waste and inaccessible due to the engineered cover system constructed from 1997 to 2002 at the OU2 Fort Ord Landfills. The engineered cover system also acts as an impermeable barrier to rainwater, thereby eliminating infiltration as a transport mechanism. Additionally, PFOA and PFOS were not detected in A-Aquifer wells near the OU2 Fort Ord Landfills, indicating the OU2 Fort Ord Landfills are not a continuing source of PFOA/PFOS in the groundwater.

7.6 Land Use Considerations

7.6.1 Site 2: Main Garrison Sewage Treatment Plant

The site was previously owned by the Army and operated from the late 1930s through 1990 as a WWTP. The site is currently owned by the California Department of Parks and Recreation and is part of the Fort Ord Dunes State Park (Figure 3). It is expected land use will remain as a state park indefinitely.

7.6.2 Site 10: Former Burn Pit

The site is currently owned and managed by the City of Seaside as undeveloped open space (Figure 4). The property is zoned as CMX; therefore, future land use could include both commercial and residential. Per Seaside Municipal Code, Chapter 17.14, the CMX zone is applied to areas of the City identified by the General Plan as appropriate for pedestrian- and transit-oriented activity centers. The CMX zone is intended to accommodate retail stores, offices, theaters, restaurants, and other similar and related uses together with residential units in the context of mixed-use, pedestrian-oriented development, although mixed-use development is not required. The maximum allowable residential density within the CMX zone for the residential component of a mixed-use project is 25 dwelling units per acre.

7.6.3 Site 40A: East FAAF Helicopter Defueling Area

The site is located on property owned and operated by the City of Marina as the Marina Municipal Airport (Figure 5). The property is in an Aviation-Related Zone (zone A-1) and future land use is expected to remain as an airport. Per Marina Municipal Code, Chapter 17.28, zone A-1 accommodates two types of aviation-related uses: (a) those uses requiring direct access to aircraft operating areas and apron sites, that is, sites immediately adjoining and accessible to aircraft operating areas; and (b) uses, which though not needing a site contiguous to the aircraft operating area, rely upon local air transportation or provide services and facilities required by other aviation-related uses. Commercial recreational activities and lodging are not permitted uses in zone A-1. The *Marina Municipal Airport Master Plan* further specifies that the Site 40A area is within an aviation development reserve and permitted future uses include transportation terminals for airlines, aviation services, retail sales, and vehicle parking. Additionally, certain non-aviation-related uses may be permissible provided they are temporary (five years or less) in nature and can be removed in a timely manner to allow for aviation-related development (i.e., agricultural activities) (Coffman, 2018).

7.6.4 FAAF Fire & Rescue Station (Building 514)

This site is located on property owned and operated by the City of Marina as the Marina Fire Rescue Station #2 at the Marina Municipal Airport (Figure 5). Similar to Site 40A, the property is in an Aviation-Related Zone (zone A-1) and an aviation development reserve, and future land use is expected to remain as an airport fire station. Commercial recreational activities and lodging are not permitted uses in zone A-1.

7.6.5 Main Garrison Fire Station (Buildings 4400, 4401, and S-4403)

Upon base closure, Buildings 4400, 4401, and S-4403 transitioned to use by the Army as a POM Fire Department facility (Figure 4). The site is currently owned by the City of Seaside and is zoned as CMX; therefore, future land use could include both commercial and residential. Per Seaside Municipal Code, Chapter 17.14, the CMX zone is applied to areas of the City identified by the General Plan as appropriate for pedestrian- and transit-oriented activity centers. The CMX zone is intended to accommodate retail stores, offices, theaters, restaurants, and other similar and related uses together with residential units in the context of mixed-use, pedestrian-oriented development, although mixed-use development is not required. The maximum allowable residential density within the CMX zone for the residential component of a mixed-use project is 25 dwelling units per acre.

7.6.6 Fritzsche Army Airfield Fire Drill Area

This site is currently owned by the Army but is wholly within the FONR and is managed as habitat reserve per the Installation-Wide Multispecies Habitat Management Plan (HMP; USACE, 1997) (Figure 6). The property will be transferred to the University of California as part of the University of California Natural Reserve System. The property is in a habitat reserve area, and future land use is expected to be as habitat reserve. As a condition of property transfer, the University of California will be required to conserve in perpetuity sensitive wildlife and plant species occupying or potentially occupying the property and their habitats consistent with the HMP (Army, 1997).

7.6.7 OU2: Fort Ord Landfills

The OU2 area consists of the Fort Ord Landfills, which encompass approximately 120 acres of land that is undeveloped other than use as a landfill, as well as mixed-use residential, commercial, and undeveloped areas downgradient of the Fort Ord Landfills (Figure 7). These are the expected land uses for the OU2 area in the foreseeable future. The Army currently uses Fort Ord Landfills Area E for disposal of contaminated soil from the Site 39 Inland Ranges, and the property is expected to be transferred after this work is complete. Per the HMP, the Fort Ord Landfills area is designated for development with reserve areas or development with restrictions (USACE, 1997), though as a condition of property transfer, no development will be allowed on the Landfills engineered cover system, which will remain unirrigated open space. The Fort Ord Landfills are the apparent historical source of the OU2 groundwater COC plume, which generally extends across an area bounded by 3rd Avenue, Abrams Drive, Bunker Hill Drive, and Inter-Garrison Road.

7.7 Key Physical Aspects of the Former Fort Ord

7.7.1 Physiography and Topography

The predominant topography of the area reflects a morphology typical of the dune sand deposits that underlie the western and northern portions of the former Fort Ord. In these areas, the ground surface slopes gently to the west and northwest, draining toward Monterey Bay. Runoff is minimal because of the high rate of surface water infiltration into the permeable dune sand. Consequently, well-developed natural drainages are absent throughout much of this area. Closed drainage depressions typical of dune topography are common. Elevations at the former Fort Ord range from approximately 50 feet above mean sea level (MSL) at Site 2 to 250 feet above MSL at the OU2 Fort Ord Landfills.

7.7.2 Geology and Hydrology

The predominant lithology is a loose, well-sorted (poorly graded) fine-to-medium sand. The sands represent active and recently active dunes and older Pleistocene-age dune sands. The active dune sands parallel the beach and extend several hundred feet inland. The older dune sands cover most of the northern and western portions of the former Fort Ord. Paleosols, representing former ground surfaces (silty sands), exist within these sands. These paleosols indicate that one or more cycles of dune deposition have occurred with intervening periods of soil development. The paleosols in the dunes bordering the beach indicate that older dune sand is locally present beneath the recent dune sand.

Three groundwater aquifers are in the remediation phase of cleanup activities at the former Fort Ord: the unconfined A-Aquifer, the unconfined and confined Upper 180-Foot Aquifer, and the confined Lower 180-Foot Aquifer. The aquifers consist predominantly of fine to coarse-grained sands which are separated by silty clay or clayey fine-grained sand aquitards. The A-Aquifer is located within the recent dune sands and is perched above the regional FO-SVA. To the west where the FO-SVA pinches out, the unconfined A-Aquifer and confined Upper 180-Foot Aquifer combine to form a continuous, unconfined hydrostratigraphic unit (identified as the unconfined Upper 180-Foot Aquifer). A north-trending groundwater divide in the unconfined Upper 180-Foot Aquifer exists midway between the FO-SVA and Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer west of the divide flows west and discharges to the Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer east of the divide flows under the FO-SVA (becoming confined) toward the Salinas Valley due predominantly to agricultural pumping. The Upper and Lower 180-Foot Aquifers, and portions of the 400-Foot Aquifer (locally) are contained within valley fill deposits. The Upper 180-Foot Aquifer is separated from the Lower 180-Foot Aquifer by the Intermediate 180-Foot Aquitard, which appears to be laterally discontinuous in the eastern portion of the former Fort Ord near the OU2 and OUCTP areas creating a natural conduit between the aquifers (Army, 2008).

8.0 Worksheet #11: Project/Data Quality Objectives

DQOs are qualitative and quantitative statements that outline the decision-making process and specify the data required to support corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from data. The DQO process used for developing data quality criteria and performance specifications for decision-making is consistent with the *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4 (USEPA, 2006b). The DQO process consists of the following seven steps:

- Step 1: State the problem
- Step 2: Identify the goals of the study
- Step 3: Identify information inputs
- Step 4: Define the boundaries of the study
- Step 5: Develop the analytical approach
- Step 6: Specify performance or acceptance criteria
- Step 7: Develop the plan for obtaining data

The DQOs steps presented below are applicable to all seven SI locations:

- Site 2: Main Garrison STP
- Site 10: Former Burn Pit
- Site 40A: East FAAF Helicopter Defueling Area
- FAAF Fire & Rescue Station (Building 514)
- Main Garrison Fire Station (Buildings 4400, 4401, and S-4403)
- FAAF FDA
- OU2: Fort Ord Landfills

8.1 Step 1: State the Problem

Contamination of soil and groundwater has occurred at the former Fort Ord because of historical Army activities. Previous investigations identified PFAS in groundwater potentially associated with the use of AFFF in fire training areas and landfill disposal practices (AEI, 2020), and additional assessment found evidence of AFFF use or disposal at former aviation assets and fire stations (Ahtna, 2022c). However, the impacts to soil and groundwater are not sufficiently quantified to determine the need for further action under CERCLA.

8.2 Step 2: Identify the Goals of the Study

The goal of the SI is to confirm whether PFAS are present in soil and groundwater at sites where PFAS may have been historically released to the environment, identify potential exposure pathways, and use these data to support site disposition recommendations (i.e., whether or not further investigation is warranted under CERCLA).

- Proposed Study Question 1: Did the historical use of AFFF at a site result in PFAS impacts to soil or groundwater?

- Proposed Study Question 2: Are source areas present that continue to contribute to an ongoing release of PFAS to groundwater?
- Proposed Study Question 3: Are PFAS migrating toward downgradient drinking water supply wells through groundwater transport?
- Proposed Study Question 4: Is there a need for further Superfund action?

Alternative outcomes for the proposed study questions are identified in Step 5.

8.3 Step 3: Identify Information Inputs

Groundwater samples will be collected from up to 23 wells and two soil borings and analyzed for PFAS. Sample locations will include five newly installed groundwater wells and two soil borings advanced to the groundwater table in addition to the existing monitoring well network.

Thirty-two subsurface soil samples will be collected from 15 soil borings. Twelve soil borings will be advanced to a depth of 10 feet bgs, one soil boring will be advanced to 20 feet bgs, and two soil borings will be advanced to the groundwater table. Soil samples collected from each of the borings will be analyzed for PFAS.

The analytical data from groundwater and soil sampling completed as part of the SI will be used to determine whether PFAS may have been historically released to the environment at a site. These data will also be used in combination with PFAS data collected by MCWD for drinking water supply wells 29, 30, and 31 and published information on Fort Ord hydrogeology and local populations to identify or confirm potential exposure pathways and receptors.

8.4 Step 4: Define the Boundaries of the Study

The target media for the study are soil and groundwater from existing monitoring wells and wells to be installed for the SI, and the vadose zone of the target suspected release areas. The target media will be analyzed for the presence of 40 PFAS compounds per Draft EPA Method 1633 (Worksheet #15). The approximate spatial boundaries of the study areas are shown on Figures 2 through 7. The upper vertical boundaries are vadose zone soils and the lower vertical boundary is the Lower 180-Foot Aquifer, as shown on Figure 8 and Figure 11. The temporal boundaries for the SI are defined by the project schedule presented in Worksheet #14 & 16.

8.5 Step 5: Develop the Analytic Approach

Proposed Study Question 1: Did the historical use of AFFF or other PFAS-containing materials at a site result in PFAS impacts to soil or groundwater?

- If PFAS are identified in soil samples or in both soil and groundwater samples collected at a suspected release area, then the release area will be included as a site where a potential PFAS release has occurred.
- If PFAS are identified only in groundwater at a suspected release area, and no PFAS are detected in soil samples, then the site will not be considered a likely release area, and areas upgradient of the site will be evaluated for potential historical releases.
- If PFAS are not detected in either soil samples or groundwater samples, then the site will not be considered a likely release area and will be recommended for site evaluation accomplished (SEA).

Proposed Study Question 2: Are source areas present that continue to contribute to an ongoing release of PFAS to groundwater?

- If PFAS are detected in soil collected from newly installed borings as part of the source area soil sampling, then that area will be included in as a site where a PFAS source may be contributing to an ongoing release of PFAS to groundwater.
- If PFAS are not detected in soil collected from newly installed borings as part of the source area soil sampling, then that area will be recommended for SEA for soil.

Proposed Study Question 3: Are PFAS migrating toward downgradient drinking water supply wells through groundwater transport?

- If PFAS are detected in groundwater samples collected from existing and newly installed groundwater monitoring wells over the course of this study, and the spatial distribution of the PFAS detections are consistent with PFAS detected in downgradient drinking water supply wells, then groundwater migration from those source areas will be considered a complete transport pathway.
- If PFAS are not detected in groundwater samples collected from existing and newly installed groundwater monitoring wells over the course of this study or are detected at concentrations less than DoD screening levels, then the associated areas will be recommended for SEA.

Proposed Study Question 4: Is there a need for further Superfund action?

- If the results of the SI indicate a PFAS release has occurred at a site and PFAS are detected at concentrations greater than screening levels (Worksheet #15), then further Superfund action will be recommended for that site.
- If the results of the SI indicate a PFAS release has occurred at a site but PFAS are detected at concentrations less than screening levels (Worksheet #15), then the associated areas will be recommended for SEA.
- If the results of the SI indicate a PFAS release has occurred at a site but the PFAS detected do not have screening levels (Worksheet #15), then the need for further Superfund action will be evaluated for that site pending promulgation of action levels for the detected PFAS.
- If the results of the SI Indicate no PFAS release has occurred, then the associated areas will be recommended for SEA and no further Superfund action will occur.

8.6 Step 6: Specify Performance or Acceptance Criteria

Decision-making problems generally are addressed by performing statistical hypothesis tests on the collected data. A decision is made on whether the data provide sufficient evidence to allow a baseline condition (“null hypothesis”) to be rejected in favor of a specified alternative condition (“alternative hypothesis”). The limited nature and underlying variability of the collected data can occasionally result in either a “false rejection” of the baseline condition (i.e., rejecting the null hypothesis when, in fact, it is true) or a “false acceptance” of the baseline condition (i.e., failing to reject the null hypothesis when, in fact, it is false). Estimation problems involve using the collected data to estimate some unknown population parameter together with some reported measure of uncertainty in the estimate, such as a standard error or confidence interval. Conclusions will be made on the magnitude of the variability of the estimate, either in absolute terms or relative to the value of the estimate. As some uncertainty in the estimate is inevitable, a maximum level of uncertainty is generally adopted as representing an acceptable level.

The measurement performance criteria (MPC) for data associated with the target media and specific analyses include considerations for PARCCS. To meet PARCCS requirements, QC criteria are provided in the standard field and laboratory methodologies. These criteria include:

- The use of field duplicates, laboratory duplicates, and matrix spike/matrix spike duplicate samples (MS/MSD) to assess precision;
- Matrix spikes, laboratory control samples (LCS), calibration results, and field and method blanks to assess accuracy and bias;
- Field sampling design and sample collection standard operating procedures (SOPs) to determine representativeness;
- Standard methods and the consistent use of field and laboratory SOPs to achieve comparability; and
- Method detection limit (MDL) studies, calibration, and method blanks to determine and assess sensitivity.

Consistent sampling protocols, applicable documentation, sample handling procedures, and measurement system procedures that will be used during field and laboratory activities associated with the investigation. Worksheet #12 provides the MPC associated with the field and laboratory QC. Data generated from the sample handling system described in Attachment A and whose associated QC results meet the criteria described in the applicable methodology will be considered usable for supporting the goals of the study.

8.7 Step 7: Develop the Plan for Obtaining Data

The investigative strategy is based upon the requirements contained in the CSM. Groundwater samples will be collected from 23 wells and two soil borings and analyzed for PFAS. Sample locations will include five newly installed groundwater wells and two soil borings advanced to the groundwater table in addition to the existing monitoring well network. Thirty-two subsurface soil samples will be collected from 15 soil borings. Twelve soil borings will be advanced to a depth of 10 feet bgs, one soil boring will be advanced to a depth of 20 feet bgs, and two soil borings will be advanced to the groundwater table. Soil samples collected from each of the borings will be analyzed for PFAS. Further details are provided in Worksheet #17.

9.0 Worksheet #12: Measurement Performance Criteria

9.1 Worksheet #12a

Matrix: Groundwater

Analytical Group or Method: Draft EPA Method 1633

Concentration Level: Low

Sampling Procedure SOP Reference	Analytical Method SOP Reference	DQIs[1]	Measurement Performance Criteria	QC Sample or Activity Used to Assess MPC	QC Sample Assesses Error For
SOP #008	Draft EPA Method 1633/ SOPs FN: OP 075.1 & FN: MS024.2[2]	Accuracy	In addition to the requirements of Draft EPA Method 1633, the following must be met: 1) Isotopically labeled analogs of analytes must be used when they are commercially available. 2) QC samples and field samples must recover within in-house limits if project limits are not provided; otherwise, project limits must be met. Preliminary inhouse acceptance criteria of 20-150% must be used until inhouse limits are generated in accordance with Sections 9.4.1 and 9.4.2 of Draft EPA Method 1633. 3) The lower limit of inhouse acceptance criteria cannot be < 20%.	Isotope Extracted Labeled Standards	A
		Accuracy/Bias/ Precision	Analyte recoveries must be within in-house LCS limits if project limits are not provided; otherwise, project limits must be met. RPD ≤ 30% (between MS and MSD)	LCS/LCSD/MS/MSD	S&A

Sampling Procedure SOP Reference	Analytical Method SOP Reference	DQIs[1]	Measurement Performance Criteria	QC Sample or Activity Used to Assess MPC	QC Sample Assesses Error For
		Accuracy/Bias	No analytes detected >½ LOQ or > ⅒ the amount measured in any sample or ⅒ the regulatory limit, whichever is greater	Method Blank	A
		Precision	RPD ≤ 30%	Field Duplicate	S&A
		Accuracy/Bias	Analyte detection ≤ LOD	Field Blank	S&A
		Representativeness	Water samples analyzed and collected per Worksheet #17	Data Completeness Check	S&A
		Completeness	≥ 90% analytical completeness	Evaluation of number of unqualified results out of the total results reported[3]	A
		Sensitivity	All analyte concentrations must be within ± 30% of their true values.	Instrument Sensitivity Check (ISC)	A
			Concentration of each analyte must be ≤ ½ the LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	Instrument Blank	A

Notes:

[1] Data Quality Indicators are defined in Worksheet #37

[2] SGS North America, Inc. (SGS) is accredited for Draft EPA Method 1633 by DoD QSM 5.4

[3] Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

<: less than
≤: less than or equal to
>: greater than
≥: greater than or equal to
%: percent

A: analytical
DL: detection limit
DQI: data quality indicator
LC/MS/MS: liquid chromatography with tandem mass spectrometry
LCS: laboratory control samples

LCSD: laboratory control sample duplicate
LOQ: limit of quantitation
MPC: measurement performance criteria
MS: matrix spike
MSD: matrix spike duplicate
S&A: sampling and analytical
SOP: standard operating procedure
PSL: Project Screening Level
QC: quality control
RPD: relative percent difference
S: sampling

9.2 Worksheet #12b

Matrix: Soil

Analytical Group or Method: Draft EPA Method 1633

Concentration Level: Low

Sampling Procedure SOP Reference	Analytical Method SOP Reference	DQIs[1]	Measurement Performance Criteria	QC Sample or Activity Used to Assess MPC	QC Sample Assesses Error for
SOP #103	Draft EPA Method 1633/ SOPs FN: OP 076.0 & FN: MS024.2[3]	Accuracy	Recovery limits per QSM 5.4[2]	Isotope Extracted Labeled Standards	A
		Accuracy/Bias/ Precision	Recovery limits per QSM 5.4[2]	LCS/LCSD MS/MSD	S&A
		Accuracy/Bias	No analytes detected >½ LOQ or > ⅒ the amount measured in any sample or ⅒ the regulatory limit, whichever is greater.	Method Blank	A
		Precision	RPD ≤ 40%	Field Duplicate	S&A
		Accuracy/Bias	Analyte detection ≤ LOD	Field Blank Equipment Blank	S&A
		Representativeness	Samples collected and analyzed as described in Worksheet #17; review of elements outlined in Section 3 of Module 3 of the DoD Data Validation Guidelines for PFAS (EDQW, 2020)	Data Completeness Check	S&A
		Completeness	Analytical completeness > 90%	Evaluation of number of unqualified results out of the total results reported[4]	A

Sampling Procedure SOP Reference	Analytical Method SOP Reference	DQIs[1]	Measurement Performance Criteria	QC Sample or Activity Used to Assess MPC	QC Sample Assesses Error for
		Sensitivity	All analyte concentrations must be within ± 30% of their true values. Detection limits ≤ PSLs.	ISC	A

Notes:

[1] Data Quality Indicators are defined in Worksheet #37

[2] DoD, 2021, Quality Systems Manual for Environmental Laboratories, Version 5.4.

[3] SGS North America, Inc. (SGS) is accredited for Draft EPA Method 1633 by DoD QSM 5.4.

[4] Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

<: less than
≤: less than or equal to
>: greater than
≥: greater than or equal to
%: percent
A: analytical
DL: detection limit
DQI: data quality indicator
LC/MS/MS: liquid chromatography with tandem mass spectrometry
LCS: laboratory control samples
LCSD: laboratory control sample duplicate
LOQ: limit of quantitation
MPC: measurement performance criteria
MS: matrix spike
MSD: matrix spike duplicate
QC: quality control
RPD: relative percent difference
PSL: Project Screening Level
S: sampling
S&A: sampling and analytical
SOP: standard operating procedure

10.0 Worksheet #13: Secondary Data Uses and Limitations

This worksheet identifies sources of secondary data not generated for the specific purpose of this project, or data generated under a separate QAPP, and summarizes their uses for this project. A full list of references reviewed to complete the PA at the former Fort Ord is provided in the PA Narrative Report (Ahtna, 2022c). How the secondary data will be used and the limitations on their uses are specified. Data from these documents will be used as appropriate.

Data Type	Data Source	How Data Will be Used	Limitations on Data Use
Aerial imagery	ESRI, ArcGIS Online Aerial Imagery	Georeferenced aerial photos for figure backdrops.	No known limitations.
PFAS analytical data from previous investigations	OU1 Closeout Report (HGL, 2017) PFOA/PFOS Technical Summary Report (AEI, 2020) California SWRCB	Referenced for development of Worksheets #10 and #17.	Available PFAS data are limited to that from potable and monitoring wells from previous investigations. It cannot be verified that all historical sample collection or laboratory analysis for PFAS constituents was conducted in accordance with best practices (SOPs) for PFAS sampling to obtain technically defensible/usable data (i.e., not affected by sampling methods and procedures).
Past site uses	PA Narrative Report (Ahtna, 2022c)	Regional site conditions, historical site usage, historical contaminant identification and concentrations, and recommendations for further investigations referenced for development of Worksheets #10 and #17.	Site usage histories may omit records of AFFF procurement and use.

Data Type	Data Source	How Data Will be Used	Limitations on Data Use
Past site uses	Installation personnel interviews	Anecdotal histories of site use, AFFF use, and remedial actions completed referenced for development of Worksheets #10 and #17.	Several installation personnel who would have worked onsite during the peak of AFFF use are retired or out of contact. Findings from basic psychological research and neuroscience studies indicate memory is a reconstructive process that is susceptible to distortion.[15]

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[15] Lacy, J. W., & Stark, C. (2013). The neuroscience of memory: implications for the courtroom. Nature reviews. Neuroscience, 14(9), 649–658. https://doi.org/10.1038/nrn3563

11.0 Worksheet #14 & 16: Project Tasks & Schedule

11.1 Project Tasks

Applicable SOP(s) for the project tasks outlined in this Worksheet are listed in Worksheet #21 and provided in detail in Attachment A. The sampling tasks are described in Worksheets #17 and #18.

11.2 Investigation-Derived Waste Management and Equipment Decontamination

Liquid, solid, personal protective equipment and miscellaneous waste will be managed per the applicable provisions in SOPs 006, 007, 010, 113, and 122 (Attachment A).

11.2.1 Investigation-Derived Waste – Liquid

Liquid investigation-derived waste (IDW), including groundwater purged during sampling or well development and rinsate water from equipment decontamination, will be containerized onsite to prevent potential release to the environment and then treated at the OU2 GWTP using GAC.

11.2.2 Investigation-Derived Waste – Soil

Soil IDW, including soil generated from drilling or hand augering soil borings and soil from the saturated zone generated from drilling for monitoring wells, will be containerized onsite to prevent potential release to the environment and then sampled for waste characterization. If PFAS are not detected or are detected at concentrations less than or equal to screening levels (Worksheet #15b), then the soil cuttings or cores may be disposed of near the borehole or transported to the OU2 Fort Ord Landfills for disposal in Area E. If PFAS are detected at concentrations exceeding screening levels, then the soil IDW will be disposed of at OU2 Fort Ord Landfills Area E after solidification or stabilization with a soil amendment (e.g., activated carbon, organo-modified clay, pyrolyzed cellulose, blends of activated carbon/clay/aluminum hydroxides) to fixate PFAS and prevent leaching into the surrounding environment until the final engineered cover system is complete at Area E. Soil from the vadose zone generated from drilling for monitoring wells is not suspected to contain PFAS because the monitoring well locations are not within the potential source areas. Additionally, soil at the location of SB-10-14 in the Site 10 Former Burn Pit is clean backfill to 10 feet bgs (see Section 7.3.2). Therefore, these soil cuttings or cores may be disposed of near the borehole and are not required to be sampled for waste characterization.

11.2.3 Investigation-Derived Waste – Solid Waste

Other solid IDW, including personal protective equipment and sampling waste, such as protective coveralls, booties, disposable gloves, disposable HydraSleeves™, and sample containers, will be containerized onsite to prevent potential release to the environment. If PFAS are not detected or are detected at concentrations less than or equal to screening levels (Worksheet #15) in the liquid IDW and soil IDW associated with the other solid IDW, then the solid IDW may be placed in at trash receptacle at the OU2 GWTP for disposal at a municipal landfill. If PFAS are detected at concentrations exceeding screening levels in the liquid IDW and soil IDW associated with the other solid IDW, then the solid IDW will be double-bagged and stored at the OU2 Fort Ord Landfills for future disposal under the final engineered cover system at Area E.

11.3 Quality Control Tasks

Field SOPs will be implemented and field QC samples will be collected at the frequency indicated in Worksheet #20. Samples will be analyzed by the laboratory in accordance with this QAPP, DoD QSM 5.4, and the stated method. For items related to QC, see Worksheets #11, #12, #15, #22, #24, #25, #26 & 27, and #28.

11.4 Data Management Tasks

The following are the team members and their responsibilities for the data management process:

Project Chemist. Responsible for reviewing chain of custody forms and establishing the sample tracking system. Oversees proper use of Ahtna's sample management system and accuracy of the information entered. Reviews laboratory data for accuracy and quality and compares electronic outputs for accuracy to laboratory electronic copies. Conducts tracking of samples, forwards tracking information and received data to the Database Manager, and identifies the data inputs (for example, sample numbers) to use in generating tables and figures.

Database Manager. Responsible for setting up the data management system in consultation with the Project Chemist/Project Manager at the beginning of the data evaluation task. Oversees the data management process, including data conversion/manual entry into the data management system, QC of the entered data, and preparation of the required tables and plots of the data. Coordinates with the person responsible for reviewing the entered data for QC purposes. Forwards deliverables to the Project Manager.

Geographic Information System (GIS) Manager. Responsible for coordinating with the Project Manager to set up the geodatabase prior to sampling. Maintains spatial layers and overall geodatabase integrity and accuracy. Provides GIS-related outputs for reports.

11.5 Sample Tracking

The Project Manager is responsible for tracking samples in the sample tracking database to ensure that the analytical results for all samples sent for analysis are received. Copies of chain of custody forms from the field team are used to enter in sample identifications (IDs), collect data, and for analyses. Upon receipt of a sample receipt notice from the laboratory, the date received by the laboratory, and a date the electronic copy is due will be entered. Likewise, upon receipt of the electronic copy and electronic data deliverable (EDD), the date they are received will also be entered. The EDDs will be uploaded when received from the laboratory and will be tracked in the sample tracking table. Validation qualifiers will be added to the database and results qualified accordingly.

11.6 Data Types

The data will be added to the project database as they become available. The data will include new data collected in the laboratory and validated by Ahtna. The data source will be noted in the database.

11.7 Data Tracking and Management

Data sets received from analytical laboratories will be assigned a unique identifier tracked individually. Analytical laboratory reports of chemical analysis results will be tracked in a consistent fashion. The date of receipt, status of data validation, and status of database entry for each data set will be tracked and recorded in the project database.

Hard/Electronic Copy. Measurements made during field data collection activities will be recorded in field logbooks and sample processing logs. Field data will be reduced and summarized, tabulated, and stored along with the field logbooks and sample processing logs. Raw analytical laboratory data will be stored electronically.

Data Input Procedures. Sampling information, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development. The analytical data will be loaded into the database using EDD files received from the analytical laboratory. Validation qualifiers will be entered manually. Other available field-related data collected will be manually entered onto standard EDD templates for loading into the database. Historical data, either in hard copy or electronic form, will be manually entered on or formatted to standard EDD templates for database loading.

11.8 Computer Database

The technical data, field observations, laboratory analytical results, and analytical data validation will be managed using Ahtna's database (EQuIS™) to store and analyze project data submissions. EQuIS is a front-end user interface for data management using a back-end SQL Server™ database. Servers that house the database are stored and managed by EarthSoft, Inc., and backups of the primary database are performed by EarthSoft, Inc. to ensure no data loss. Secure database access is performed through EQuIS or SQL Server Management Studio software. Data validation is performed by Laboratory Data Consultants, Inc., and validation information is ultimately stored in the EQuIS database.

Access and privileges are provided to database support staff on an as-needed basis by the Ahtna Data Manager. This protects the database from unauthorized access and data modification. Privileges may range from read-only to loading, modifying, or querying the database.

In addition to the internal computer database, EDDs will be uploaded to the BRAC Fort Ord Data Integration System (FODIS) database and the CCRWQCB GeoTracker database (as required).

11.9 Geographic Information System

A project geodatabase will be set up prior to sampling by the Project Manager and GIS Manager. Ahtna will adhere to applicable federal geospatial data standards for tasks and deliverables in this QAPP and will meet the minimum requirements for spatial data in accordance with the current version of Spatial Data Standards for Facilities, Infrastructure, and Environment, whenever possible. Ahtna will submit the native GIS files that will include map data (.mxd) and geodatabase (.dbf) format. Ahtna will provide validated geospatial data to USACE for submission by BRAC to the FODIS database.

Each geospatial data set will be accompanied by metadata conforming to the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata and the Army Installation Geospatial Information & Services Metadata Standard, v1. The horizontal accuracy of geospatial data created will be tested and reported in accordance with the National Standard for Spatial Data Accuracy and the results will be recorded in the metadata. Data will have a datum of GCS_North American_1983 and a projection of North American Datum 1983 State Plane California Zone 4. The sea level datum used will be the National Geodetic Vertical Datum 1929 to conform with historical former Fort Ord data.

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

11.10 Data Management Documentation

Documentation of data management activities is critical because it demonstrates that data is being managed in a consistent and organized fashion. EQuIS software developed by EarthSoft, Inc. is an industry standard for the management of environmental data. EQuIS software is the user interface that accesses data stored in a SQL Server database. This database is managed and housed by EarthSoft. SQL Server updates, database backups, and customer support are provided to Ahtna by EarthSoft. EarthSoft also has an extensive community group and documentation regarding its application.

11.11 Presentation of Data

Depending on data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures showing concentration isopleths or location-specific concentrations
- Tables providing statistical evaluation or calculation results
- Presentation tools, such as ArcMap or similar analysis/presentation aids

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

11.12 Assessment and Audit Tasks

See Worksheets #31, #32, and #33.

11.13 Data Review Tasks

The laboratory will ensure the data are complete for all samples received. Laboratory data will be validated by Laboratory Data Consultants, Inc. Validated data and field logs will be reviewed to assess total measurement error and determine the overall usability of the data for project purposes. Final data are placed in the database with qualifiers. See Worksheets #34 through #37 for the tasks.

11.14 Documentation and Records

Each day of fieldwork, Ahtna will prepare a Project Field Report to describe onsite personnel, visitors, equipment, hours of operation, a summary of activities, quality and safety issues, corrective actions, and photographs. These daily Project Field Reports will be submitted to USACE weekly during fieldwork activities. A logbook will be kept, and documentation will follow the procedures outlined in SOP #101 (Attachment A).

A copy of the final QAPP will be kept at the Ahtna OU2 GWTP field office. Field forms are shown in Attachment B.

11.15 Project Schedule

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Baseline Habitat Survey, FONR	Denise Duffy and Associates	4/13/22	5/12/22	Habitat Checklist	10/17/22
Geophysical Utility Clearance	Advanced Geological Services	9/19/22	9/19/22	Maps of detected utilities, GPS coordinates of detected features	9/20/22
Sample collection, shallow soils at FAAF Fire & Rescue Station, Site 40A	Ahtna	9/20/22	9/21/22	CQCR	1/19/23
Sample collection, shallow soils at Main Garrison Fire Station, Site 2	Ahtna	9/22/22	9/23/22	CQCR	1/19/23
Shallow soil sample analyses	SGS	9/26/22	10/17/22	Report of Analyses/ Data Package	10/17/22
A-Aquifer monitoring well installation, FAAF FDA	Ahtna	10/17/22	10/21/22	CQCR	1/19/23
Soil boring to water table, FAAF FDA	Ahtna	10/21/22	10/22/22	CQCR	1/19/23
A-Aquifer monitoring well installation, Site 40A	Ahtna	10/22/22	10/24/22	CQCR	1/19/23
Soil boring to water table, Site 40A	Ahtna	10/25/22	10/25/22	CQCR	1/19/23
Soil boring to 20 ft bgs, Site 10	Ahtna	10/26/22	10/26/22	CQCR	1/19/23
Soil boring sample analyses	SGS	10/27/22	11/17/22	Report of Analyses/ Data Package	11/17/22
Upper 180-Foot Aquifer monitoring well installation, Site 10	Ahtna	11/2/22	11/5/22	CQCR	1/19/23
Monitoring well development	Ahtna	11/7/22	11/10/22	CQCR	1/19/23

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Sample collection, groundwater	Ahtna	11/14/22	11/18/22	CQCR	1/19/23
Groundwater sample analyses	SGS	11/21/22	12/12/22	Report of Analyses/ Data Package	12/12/22
Data validation	Laboratory Data Consultants	10/18/22	1/3/23	VSR	1/3/23
Reporting	Ahtna	11/21/22	4/11/23	Draft SI Narrative Report	4/11/23

Notes:

Well installation and soil boring activities starting October 17, 2022 will be on a 10 days on/4 days off schedule. October 17-26 and November 2-5 will be work days.

CQCR: Contractor Quality Control Report

VSR: Validation Summary Report

12.0 Worksheet #15: Laboratory-Specific Detection/Quantitation Limits

12.1 Worksheet #15a

Matrix: Groundwater

Analytical Method: Draft EPA Method 1633

Target Analyte Name	CAS Number	Units	PSL[1]	RSL[2]	Laboratory Specific		
					LOQ	LOD	DL
Perfluoroalkyl carboxylic acids							
Perfluorobutanoic acid (PFBA)	375-22-4	µg/L	--	--	0.02	0.004	0.00191
Perfluoropentanoic acid (PFPeA)	2706-90-3	µg/L	--	--	0.01	0.002	0.00094
Perfluorohexanoic acid (PFHxA)	307-24-4	µg/L	--	--	0.005	0.001	0.00050
Perfluoroheptanoic acid (PFHpA)	375-85-9	µg/L	--	--	0.005	0.001	0.00050
Perfluorooctanoic acid (PFOA)	335-67-1	µg/L	0.06	0.06	0.005	0.001	0.00050
Perfluorononanoic acid (PFNA)	375-95-1	µg/L	0.059	0.059	0.005	0.001	0.00061
Perfluorodecanoic acid (PFDA)	335-76-2	µg/L	--	--	0.005	0.001	0.00050
Perfluoroundecanoic acid (PFUnA)	2058-94-8	µg/L	--	--	0.005	0.002	0.00060
Perfluorododecanoic acid (PFDoA)	307-55-1	µg/L	--	--	0.005	0.002	0.00060
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	µg/L	--	--	0.005	0.002	0.00084
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	µg/L	--	--	0.005	0.001	0.00050
Perfluoroalkyl sulfonic acids							
Acid Form							
Perfluorobutanesulfonic acid (PFBS)	375-73-5	µg/L	6	6	0.005	0.001	0.00050
Perfluoropentansulfonic acid (PFPeS)	2706-91-4	µg/L	--	--	0.005	0.004	0.00112
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	µg/L	0.39	0.39	0.005	0.002	0.00070
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	µg/L	--	--	0.005	0.001	0.00050
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	µg/L	0.04	0.04	0.005	0.002	0.00054
Perfluorononanesulfonic acid (PFNS)	68259-12-1	µg/L	--	--	0.005	0.002	0.00057
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	µg/L	--	--	0.005	0.004	0.00114
Perfluorodecanesulfonic acid (PFDS)	335-77-3	µg/L	--	--	0.005	0.002	0.00064

Target Analyte Name	CAS Number	Units	PSL[1]	RSL[2]	Laboratory Specific		
					LOQ	LOD	DL
Fluorotelomer sulfonic acids							
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2FTS)	757124-72-4	µg/L	--	--	0.02	0.008	0.00323
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2FTS)	27619-97-2	µg/L	--	--	0.02	0.008	0.00347
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2FTS)	39108-34-4	µg/L	--	--	0.02	0.008	0.00367
Perfluorooctane sulfonamides							
Perfluorooctanesulfonamide (PFOSA)	754-91-6	µg/L	--	--	0.005	0.002	0.00067
N-methyl perfluorooctanesulfonamide (NMeFOSA)	31506-32-8	µg/L	--	--	0.005	0.002	0.00100
N-ethyl perfluorooctanesulfonamide (NEtFOSA)	4151-50-2	µg/L	--	--	0.005	0.003	0.00100
Perfluorooctane sulfonamidoacetic acids							
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	µg/L	--	--	0.005	0.004	0.00100
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	µg/L	--	--	0.005	0.004	0.00133
Perfluorooctane sulfonamide ethanols							
N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)	24448-09-7	µg/L	--	--	0.05	0.01	0.00438
N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)	1691-99-2	µg/L	--	--	0.05	0.02	0.00741
Per- and Polyfluoroether carboxylic acids							
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	µg/L	0.06	0.06	0.02	0.002	0.00100
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	µg/L	--	--	0.02	0.004	0.00186
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	µg/L	--	--	0.02	0.002	0.00100
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	µg/L	--	--	0.01	0.004	0.00114
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	µg/L	--	--	0.02	0.004	0.00120
Ether sulfonic Acids							
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	µg/L	--	--	0.02	0.004	0.00138
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OudS)	763051-92-9	µg/L	--	--	0.02	0.004	0.00175
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	113507-82-7	µg/L	--	--	0.01	0.004	0.00200
3-Perfluoropropyl propanoic acid (3:3FTCA)	356-02-5	µg/L	--	--	0.025	0.01	0.00452
2H,2H,3H,3H-Perfluorooctanoic acid (5:3FTCA)	914637-49-3	µg/L	--	--	0.125	0.02	0.00874
3-Perfluoroheptyl propanoic acid (7:3FTCA)	812-70-4	µg/L	--	--	0.125	0.2	0.00785

Notes:

[1] PSLs are from *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD screening levels; DoD, 2022). When multiple PFAS are encountered at a site, a 0.1 factor is applied to the DoD screening level. For example, in cases where multiple PFAS are detected, the screening level for PFBS in tap water is 0.6 µg/L (0.1 x 6 µg/L = 0.6 µg/L).

[2] RSLs are from https://www.epa.gov/risk/regional-screening-levels-rsls (USEPA, 2022a). When multiple PFAS are encountered at a site, a 0.1 factor is applied to the RSL. For example, in cases where multiple PFAS are detected, the RSL for PFBS in tap water is 0.6 µg/L (0.1 x 6 µg/L = 0.6 µg/L).

CAS#: Chemical Abstract Service Number
PSL: Project Screening Level
RSL: Regional Screening Level
LOD: limit of detection
LOQ: limit of quantitation
DL: detection limit
--: none listed

12.2 Worksheet #15b

Matrix: Soil

Analytical Method: Draft EPA Method 1633

Target Analyte Name	**CAS Number**	**Units**	**PSLs**[1]		**RSLs**[2]		**Laboratory Specific**		
			Residential	**Industrial**	**Residential**	**Industrial**	**LOQ**	**LOD**	**DL**
Perfluoroalkyl carboxylic acids									
Perfluorobutanoic acid (PFBA)	375-22-4	µg/kg	--	--	--	--	2.0	0.80	0.31
Perfluoropentanoic acid (PFPeA)	2706-90-3	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluorohexanoic acid (PFHxA)	307-24-4	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluoroheptanoic acid (PFHpA)	375-85-9	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluorooctanoic acid (PFOA)	335-67-1	µg/kg	190	2,500	190	2,500	1.0	0.40	0.10
Perfluorononanoic acid (PFNA)	375-95-1	µg/kg	190	2,500	190	2,500	1.0	0.40	0.12
Perfluorodecanoic acid (PFDA)	335-76-2	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluoroundecanoic acid (PFUnA)	2058-94-8	µg/kg	--	--	--	--	1.0	0.40	0.13
Perfluorododecanoic acid (PFDoA)	307-55-1	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluoroalkyl sulfonic acids									
Acid Form									
Perfluorobutanesulfonic acid (PFBS)	375-73-5	µg/kg	19,000	250,000	19,000	250,000	1.0	0.40	0.10
Perfluoropentansulfonic acid (PFPeS)	2706-91-4	µg/kg	--	--	--	--	1.0	0.40	0.16
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	µg/kg	1,300	16,000	1,300	16,000	1.0	0.40	0.16
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	µg/kg	--	--	--	--	1.0	0.40	0.15
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	µg/kg	130	1,600	130	1,600	1.0	0.40	0.10
Perfluorononanesulfonic acid (PFNS)	68259-12-1	µg/kg	--	--	--	--	1.0	0.40	0.18
Perfluorodecanesulfonic acid (PFDS)	335-77-3	µg/kg	--	--	--	--	1.0	0.40	0.14
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	µg/kg	--	--	--	--	1.0	0.40	0.15

Target Analyte Name	**CAS Number**	**Units**	**PSLs[1]**		**RSLs[2]**		**Laboratory Specific**		
			Residential	**Industrial**	**Residential**	**Industrial**	**LOQ**	**LOD**	**DL**
Fluorotelomer sulfonic acids									
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2FTS)	757124-72-4	µg/kg	--	--	--	--	2.0	1.0	0.30
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2FTS)	27619-97-2	µg/kg	--	--	--	--	2.0	1.0	0.35
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2FTS)	39108-34-4	µg/kg	--	--	--	--	2.0	1.0	0.54
Perfluorooctane sulfonamides									
Perfluorooctanesulfonamide (PFOSA)	754-91-6	µg/kg	--	--	--	--	1.0	0.40	0.10
N-methyl perfluorooctanesulfonamide (NMeFOSA)	31506-32-8	µg/kg	--	--	--	--	1.0	0.40	0.14
N-ethyl perfluorooctanesulfonamide (NEtFOSA)	4151-50-2	µg/kg	--	--	--	--	1.0	0.40	0.10
Perfluorooctane sulfonamidoacetic acids									
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	µg/kg	--	--	--	--	1.0	0.40	0.16
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	µg/kg	--	--	--	--	1.0	0.40	0.20
Perfluorooctane sulfonamide ethanols									
N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)	24448-09-7	µg/kg	--	--	--	--	5.0	2.0	0.64
N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)	1691-99-2	µg/kg	--	--	--	--	5.0	2.0	0.83
Per- and Polyfluoroether carboxylic acids									
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	µg/kg	230	3,500	230	3,500	2.0	0.80	0.29
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	µg/kg	--	--	--	--	2.0	0.80	0.34
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	µg/kg	--	--	--	--	1.0	0.40	0.11
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	µg/kg	--	--	--	--	1.0	0.40	0.10
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	µg/kg	--	--	--	--	2.0	0.80	0.24
Ether sulfonic acids									
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	µg/kg	--	--	--	--	2.0	1.0	0.44

Target Analyte Name	**CAS Number**	**Units**	**PSLs[1]**		**RSLs[2]**		**Laboratory Specific**		
			Residential	**Industrial**	**Residential**	**Industrial**	**LOQ**	**LOD**	**DL**
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OudS)	763051-92-9	µg/kg	--	--	--	--	2.0	1.0	0.36
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	113507-82-7	µg/kg	--	--	--	--	1.0	0.40	0.10
Fluorotelomer carboxylic acids									
3-Perfluoropropyl propanoic acid (3:3FTCA)	356-02-5	µg/kg	--	--	--	--	2.5	1.0	0.51
2H,2H,3H,3H-Perfluorooctanoic acid (5:3FTCA)	914637-49-3	µg/kg	--	--	--	--	12.5	5.0	1.15
3-Perfluoroheptyl propanoic acid (7:3FTCA)	812-70-4	µg/kg	--	--	--	--	12.5	5.0	1.27

Notes:

[1] PSLs are from Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program (DoD screening levels; DoD, 2022). When multiple PFAS are encountered at a site, a 0.1 factor is applied to the DoD screening level. For example, in cases where multiple PFAS are detected, the residential screening level for PFBS in soil is 19,000 µg/Kg (0.1 x 19,000 µg/Kg = 1,900 µg/Kg).

[2] RSLs are from https://www.epa.gov/risk/regional-screening-levels-rsls (USEPA, 2022a). When multiple PFAS are encountered at a site, a 0.1 factor is applied to the RSL. For example, in cases where multiple PFAS are detected, the Residential RSL for PFBS in soil is 19 µg/kg (0.1 x 19 µg/Kg = 1.9 µg/Kg).

CAS#: Chemical Abstract Service Number
PSL: Project Screening Level
RSL: Regional Screening Level
LOD: limit of detection
LOQ: limit of quantitation
DL: detection limit
--: none listed

13.0 Worksheet #17: Sampling Design and Rationale

The field activities will be conducted in general accordance with the SOPs for Sampling and Analysis of PFAS. Specific SOPs mentioned in this section are included in Attachment A. Daily field conditions and tasks will be recorded in the Field Logbook, and Daily Field Report forms in Attachment B. Site reconnaissance was completed during the PA, and no impediments to the sampling design are expected; however, if samples cannot be collected where planned, alternative sampling locations will be determined via the communication pathways outlined in Worksheet #6.

13.1 Investigation Areas

13.1.1 Site 2: Main Garrison Sewage Treatment Plant

Investigation of groundwater in the unconfined Upper 180-Foot Aquifer and shallow soil near the Main Garrison STP will be performed because the Main Garrison STP, as the primary WWTP for the former Fort Ord, could have inadvertently accepted PFAS-containing wastewater and runoff from the sludge drying beds could have infiltrated the ground surface in adjacent Ponding Area 1. The unconfined Upper 180-Foot Aquifer west of the FO-SVA is not used for water supply, and there is no downgradient groundwater use. However, due to the mobility of PFAS and aquifer recharge at the Site 2 infiltration galleries inducing groundwater flow to the northeast, as demonstrated by groundwater modeling (AEI, 2018; Ahtna, 2020; Ahtna, 2021a; and Ahtna, 2021b), a groundwater investigation will be performed in the area north and east of the Main Garrison STP at monitoring wells MW-02-13-180U and MW-02-13-180M and extraction wells EW-12-05-180M and EW-12-08-180U (Worksheet #18a and Figure 3) for PFAS sampling and analysis. The last discharge of effluent from the sludge drying beds to Ponding Area 1 would have occurred over 30 years ago and the infiltration galleries have been operational for over 22 years, with groundwater modeling showing travel time from Ponding Area 1 to MW-02-13-180M and MW-02-13-180U to be less than this, with treated water discharged at the infiltration galleries potentially traveling to Site 12 extraction wells within 15 years.

Soil sampling for PFAS analysis in the two lowest elevation points in Ponding Area 1 where discharge from the sludge drying beds would have been retained for the longest will be performed at depths ranging from the ground surface to 10 feet bgs because long-term retention of longer-chain PFAS in shallow soils after extended percolation is possible (Worksheet #18b and Figure 3). Although effluent from the Main Garrison STP was discharged into a storm drain that emptied onto Indian Head Beach during low tide, soil sampling will not be performed at Indian Head Beach because it is unlikely residual PFAS remains in soil there. There has been no discharge of treated wastewater at this location since at least 1990 and there has been ongoing beach erosion during the Main Garrison STP operational period (1930s to 1990) and since the STP discontinued operations in 1990. The southern Monterey Bay has had the highest coastal erosion rates in the state of California for at least the last century, averaging about 4 feet per year (Monterey Herald, 2020). Ponding Area 1 is relatively protected from erosional forces and soil samples from this location are therefore expected to be representative for evaluating potential historical PFAS discharges from the Main Garrison STP.

13.1.2 Site 10: Former Burn Pit

Groundwater investigation in the Upper 180-Foot Aquifer will be performed because of reported regular use of AFFF at this site for at least two decades (Ahtna, 2022c). Due to relatively high hydraulic conductivity, the potential for migration of PFAS in groundwater is high, and there are downgradient water supply wells. No new groundwater monitoring wells are proposed within or immediately downgradient of Site 10 because it is unlikely groundwater sampling at this location would show evidence of a PFAS release. Particle tracking analysis using the Fort Ord groundwater model indicates that PFAS entering the Upper 180-Foot Aquifer at Site 10 could have traveled as far as the OU2 Fort Ord Landfills within 30 years and potentially commingled with the OU2 TCE plume in the Upper 180-Foot Aquifer (AEI, 2020). Additionally, groundwater sampling for PFAS at OU2 in 2019 demonstrated PFAS compounds had migrated at least 13,500 feet downgradient from the OU2 Fort Ord Landfills within 60 years or less, but were not detected near the OU2 Fort Ord Landfills, the suspected source area (Ahtna, 2022c). Therefore, downgradient monitoring wells MW-OU2-29-180, MW-OU2-54-180, MW-OU2-55-180, MW-OU2-62-180 will be sampled for PFAS analysis and one new Upper 180-Foot Aquifer well will also be installed in the area between Site 10 and the OU2 Fort Ord Landfills and sampled for PFAS analysis (Worksheet #18a and Figure 4). The former Main Garrison Fire Station is adjacent to Site 10; therefore, these are the same wells proposed for the groundwater investigation for the Main Garrison Fire Station.

Additionally, because of long-term retention of longer-chain PFAS in shallow soils after extended percolation is possible, soil sampling for PFAS analysis in the former burn pit area in the center of the deepest IA excavation area will be performed at depths ranging from 15 to 20 feet bgs because this area was previously excavated and backfilled with clean soil to 10 feet bgs (Worksheet #18b and Figure 4).

13.1.3 Site 40A: East FAAF Helicopter Defueling Area

Investigation will be performed at Site 40A because of the reported use of AFFF during a fuel spill response (Ahtna, 2022c). The A-Aquifer is not used for water supply, and there is no downgradient groundwater use. However, due to the mobility of PFAS, a groundwater investigation will be performed in the downgradient area between the helicopter parking apron and the former Fort Ord boundary to the east, and two new A-Aquifer groundwater monitoring wells will be constructed in this area (Worksheet #18a and Figure 5) for PFAS sampling and analysis. The former FAAF Fire & Rescue Station is adjacent to Site 40A; therefore, these are the same two wells that will be used for the groundwater investigation for the FAAF Fire & Rescue Station. Additionally, because of long-term retention of longer-chain PFAS in shallow soils after extended percolation is possible, soil sampling for PFAS analysis in the drainage area to the north and east of the suspected helicopter defueling area will be performed at depths ranging from the ground surface to 10 feet bgs (Worksheet #18b and Figure 5).

13.1.4 FAAF Fire & Rescue Station (Building 514)

Investigation of groundwater in the A-Aquifer and shallow soil near Building 514 will be performed because of reported historical discharge of AFFF in the areas next to the FAAF Fire & Rescue Station (Ahtna, 2022c). The A-Aquifer is not used for water supply, and there is no downgradient groundwater use. However, due to the mobility of PFAS, a groundwater investigation will be performed in the downgradient area between the former FAAF Fire & Rescue Station and the former Fort Ord boundary to the east, and two new A-Aquifer groundwater monitoring wells will be constructed in this area (Worksheet #18a and Figure 5) for PFAS sampling and analysis. The former FAAF Fire & Rescue Station is adjacent to Site 40A; therefore, these are the same two wells that are being constructed for Site 40A. Additionally, because long-term retention of longer-chain PFAS in shallow soils after extended percolation is possible, workers at the fire station could be a target population; therefore, soil sampling for PFAS analysis in the grassy area to the south of Building 514 will be performed at depths ranging from the ground surface to 10 feet bgs (Worksheet #18b and Figure 5).

13.1.5 Main Garrison Fire Station (Buildings 4400, 4401, and S-4403)

Investigation of groundwater in the Upper 180-Foot Aquifer and shallow soil near Building 4401 will be performed because of reported historical discharge of AFFF at this site (Ahtna, 2022c). Due to relatively high hydraulic conductivity, the potential for migration of PFAS in groundwater is high, and there are downgradient water supply wells. No new groundwater monitoring wells are proposed within or immediately downgradient of the Main Garrison Fire Station because it is unlikely groundwater sampling at this location would show evidence of a PFAS release. Particle tracking analysis using the Fort Ord groundwater model indicates that PFAS entering the Upper 180-Foot Aquifer at the Main Garrison Fire Station could have traveled as far as the OU2 Fort Ord Landfills within 30 years and potentially commingled with the OU2 TCE plume in the Upper 180-Foot Aquifer (AEI, 2020). Additionally, groundwater sampling for PFAS at OU2 in 2019 demonstrated PFAS compounds had migrated at least 13,500 feet downgradient from the OU2 Fort Ord Landfills within 60 years or less, but were not detected near the OU2 Fort Ord Landfills, the suspected source area (Ahtna, 2022c). Therefore, downgradient monitoring wells MW-OU2-29-180, MW-OU2-54-180, MW-OU2-55-180, MW-OU2-62-180 will be sampled for PFAS analysis and one new Upper 180-Foot Aquifer well will also be constructed in the area between the Main Garrison Fire Station and the OU2 Fort Ord Landfills and sampled for PFAS analysis (Worksheet #18a and Figure 4). The former Main Garrison Fire Station is adjacent to Site 10; therefore, these are the same wells included in the groundwater investigation for Site 10.

Additionally, because long-term retention of longer-chain PFAS in shallow soils after extended percolation is possible, workers at the fire station could be a target population; therefore, soil sampling for PFAS analysis in the grassy area to the west of Building 4401 will be performed at depths ranging from the ground surface to 10 feet bgs (Worksheet #18b and Figure 4).

13.1.6 FAAF Fire Drill Area

Investigation of groundwater in the A-Aquifer and soil near the FAAF FDA will be performed because of reported historical discharge of AFFF at this site (Ahtna, 2022c). The A-Aquifer is not used for water supply, and there is no downgradient groundwater use in the A-Aquifer. However, existing groundwater monitoring well MW-BW-95-A will be sampled for PFAS analysis to confirm the FAAF FDA is no longer a source of PFAS to groundwater. Two new A-Aquifer groundwater monitoring wells will be installed at downgradient locations based on the results of the attainment monitoring completed in 2015 (HGL, 2016): one in the area of former monitoring well MW-OU1-85-A, one in the area former monitoring well MW-OU1-88-A, and one in the area of former injection well IW-OU1-10-A (Worksheet #18a and Figure 6). These proposed locations are within the FO-SVA Channel Low, a preferential pathway for groundwater contaminants in the A-Aquifer (HGL, 2016). Because these wells would be located downgradient of MW-BW-95-A, where carbon tetrachloride has been detected at concentrations exceeding the ACLs, these proposed wells would also serve to define the OUCTP in the A-Aquifer in this area.

Soil sampling for PFAS analysis from ground surface down to the groundwater interface will be performed to determine if PFAS-impacted soil remains at the FAAF FDA; therefore, one soil boring will be completed in an area of elevated petroleum hydrocarbon concentrations detected during soil confirmation sampling after soil remediation was completed in 1991 (HLA, 1994b) (Worksheet #18b and Figure 6).

13.1.7 Operable Unit 2

Groundwater investigation at OU2 in the Upper 180-Foot Aquifer will be performed because of the historical disposal practices used, the reported discharge of AFFF at the Fort Ord Landfills, and the detections of PFOA and PFOS at concentrations above the USEPA RSLs and DoD screening levels in monitoring well MW-OU2-23-180 (Ahtna, 2022c).

MW-OU2-23-180 will be resampled to confirm the results of the sampling event conducted in March 2019 (Ahtna, 2022c). Upgradient monitoring wells MW-OU2-50-180 and MW-OU2-54-180, and downgradient extraction well EW-OU2-03-180 will be sampled to evaluate the extent of PFAS in the southern lobe of the OU2 TCE plume in the Upper 180-Foot Aquifer (Worksheet #18a and Figure 7). Due to recent detected TCE concentrations above the ACL (5 µg/L) in the Upper 180-Foot Aquifer and the MCL (5 µg/L) in the Lower 180-Foot Aquifer east of the OU2 Ford Ord Landfills and upgradient of MCWD drinking water supply well 29, monitoring wells MW-OU2-62-180, MW-OU2-28-180, MW-BW-59-180 and MW-OU2-82-180 will be sampled to evaluate potential migration of PFAS at OU2 from the Upper 180-Foot Aquifer to the Lower 180-Foot Aquifer (Worksheet #18a and Figure 7). MCWD drinking water supply wells were monitored for PFAS in 2019 and 2020 per California SWRCB and Division of Drinking Water orders (MCWD, 2020b and MCWD, 2021); however, these supply wells will be resampled concurrently with the above-listed monitoring wells to ensure comparability of data (Figure 7).

13.2 PFAS Sampling Equipment and Materials

Because PFAS are potentially present in a variety of materials that may come into contact with water samples, and because laboratory analytical method detection limits are low (low to sub nanogram per liter concentrations), conservative precautions are recommended to avoid sample cross-contamination and false-positive results. The procedures in the SOPs provided in Attachment A and referenced in the descriptions of fieldwork tasks below are consistent best practices at the time of authoring. As part of the procedures, these SOPs provide lists of field equipment that are safe to use for PFAS sampling and those that are to be avoided (i.e., not recommended) for PFAS sampling. To ensure adherence to the PFAS sampling best practices outlined in the SOPs, each SOP includes a daily PFAS sampling checklist.

The following sections present the scope of work and sampling approach for sampling activities proposed for the SI.

13.2.1 Sampling

The field team will mobilize to wells associated with each Investigation Area. The team will unlock and uncap wells, allowing a minimum of 20–30 minutes for water levels to equilibrate to atmospheric pressure.

Groundwater samples will be collected by a HydraSleeve™ made of high density polyethylene or polypropylene. Use of the HydraSleeve is described in SOP #008 (Attachment A). Soil samples will be collected by manual retrieval using a hand auger. Use of a hand auger is described in SOP #103 (Attachment A).

13.2.2 Analytical

Samples will be analyzed for PFAS compliant with DoD QSM 5.4 Table B-24. The wells and soil borings selected for sample collection are listed in Worksheet #18, and their locations are depicted on Figures 2 through 7.

13.2.3 Reporting

Data will be reported in the SI Narrative Report.

13.3 Environmental Protection Plan

Environmental protection is defined as maintaining the environment in its natural state, to the extent possible, during and after fieldwork activities and returning the disturbed site to conditions similar to those present prior to these activities. Environmental protection will consist of protecting air, water, land, and biological resources.

13.4 Air Resources Protection

Fieldwork activities will be conducted to minimize the release of airborne particulates within and outside of the boundaries of the site. Dust and particulates will be controlled in accordance with the Accident Prevention Plan (Ahtna, 2021c) to minimize contaminate dispersion and to protect human health and the environment. It is anticipated, based on the proposed activities, that significant dust will not be generated. The use of water to control dust will be minimized to avoid impact to natural resources. Visual air monitoring will be conducted to verify the effectiveness of the program.

13.5 Land Resources Protection

Fieldwork within the FONR will be coordinated with the USACE Technical Lead, Onsite Biologist, Fort Ord BRAC Office Biologist, and the University of California, which manages the area, to minimize impact to natural resources and ongoing research projects. Coordination will include:

- Scheduling fieldwork to start after June 1, or after the beginning of the dry season (i.e., outside the primary growing season for rare plants) as determined by the Onsite Biologist and approved by University of California and the BRAC Office Biologist, to avoid the flowering periods of special-status species.
- Maintaining site security.
- Defining acceptable and unacceptable work areas, access routes, and turnaround and staging locations in the Habitat Checklist (Attachment C).
- Ensuring implementation of the conservation measures identified in the HMP (USACE, 1997) and Programmatic Biological Opinion (USFWS, 2017).

Prior to intrusive activities within the FONR, the Onsite Biologist will review existing habitat surveys to determine the quantity and specific location of threatened or endangered plants and animals within the planned well construction areas. This habitat survey data and information provided by the University of California will be used to minimize impact to the habitat and special-status species within FONR. Where practicable, adjustments will be made to construction plans (e.g., adjustments to monitoring well locations) and coordinated with the University of California to minimize the impact on natural resources.

The field activities will include soil borings, well drilling and development, and groundwater monitoring. The specific locations where these activities will occur are shown in Figure 6 and will be identified in the Habitat Checklist (Attachment C) prior to commencing fieldwork. Field personnel will receive training to familiarize them with the site restrictions necessary to minimize impacts to the habitat and special-status species on FONR lands. During each of these activities, staging areas and specific access routes will be established to minimize excess impact to the ground surface, such as rutting and erosion. Mats will be used where necessary to protect vegetation and prevent damage to the ground surface, including activities such as the operation of vehicles off of existing roads and creation of new access routes.

The Onsite Biologist will monitor work as necessary to ensure conservation measures are implemented. Baseline and 3-year follow-up monitoring will be conducted to determine if special-status species have been adversely impacted and if corrective measures are recommended. Because the corrective actions will take place in the FONR, which is one of several sites administered by the University of California, the Onsite Biologist will coordinate with the University of California, the USACE Technical Lead, and the BRAC Office Biologist prior to implementation.

Following the well installation activities, disturbed land around the wells will be restored as closely as possible to its original condition by limited grading after coordination with the USACE Technical Lead and the BRAC Office Biologist.

13.6 Water Resources Protection

The potential for impact to surface water resources is assumed to be minimal because there is no surface water drainage or storm drains that lead to surface water within the project sites. Equipment maintenance and fueling will be conducted offsite and away from open storm drain inlets.

13.7 Material Handling

Both hazardous and non-hazardous wastes may be generated during fieldwork activities. These wastes will be managed as described in Worksheet #14 & 16, Section 11.2.

Chemicals brought onsite will be managed per the Hazard Communication Program in the Accident Prevention Plan (Ahtna, 2021c).

13.8 HMP Species

Project activities undertaken must protect and maintain the special-status species found within FONR. Efforts are taken to avoid or minimize impacts to HMP species, with emphasis on three federally listed plant species: Monterey spineflower, Monterey gilia, and Yadon’s piperia. Special-status species listed in the HMP and Programmatic Biological Opinion (USFWS, 2017) that occur or may occur on FONR include:

- Monterey gilia (*Gilia tenuiflora* ssp. *Arenaria*) – federally endangered, state threatened
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*) – federally threatened
- Seaside bird’s beak (*Cordylanthus rigidus* ssp. *Littoralis*) – state endangered
- Sandmat manzanita (Arctostaphylos pumila)
- Monterey manzanita (*A. montereyensis*)
- Monterey ceanothus (*Ceanothus rigidus*)

- Eastwood’s goldenbush (*Ericameria fasciculata*)
- Yadon’s piperia (*Piperia yadonii*) – federally endangered
- Coast wallflower (*Erysimum ammophilum*)
- California black legless lizard (*Anniella pulchra nigra*; BLL) – state species of concern
- California tiger salamander (*Ambystoma californiense*; CTS) – federally threatened, state threatened
- Monterey ornate shrew (*Sorex ornatus salarius*) – state species of concern

Monterey gilia, Monterey spineflower, Seaside bird’s beak, and coast wallflower are annual herb species that may occur within maritime chaparral, coastal scrub, grasslands, dune scrub, or disturbed areas. Sandmat manzanita, Monterey manzanita, Monterey ceanothus, and Eastwood’s goldenbush are perennial shrub species that typically occur in maritime chaparral, but individuals can also be found mixed with oak woodland or coastal scrub habitats. Yadon’s piperia is a perennial herb that is typically found in maritime chaparral and Monterey pine habitats.

The BLL is a rare variety of the California legless lizard (*A. Pulchra*) that inhabits areas with sandy soils on the former Fort Ord. The Monterey ornate shrew is a rare variety of the ornate shrew (*S. ornatus*) found in riparian forest and oak woodland habitats. The CTS is typically found in vernal or seasonal ponds on the former Fort Ord. The CTS may also be found aestivating in small mammal burrows or under logs in upland areas within 2.2 kilometers of vernal ponds.

As identified in the Programmatic Biological Opinion (USFWS, 2017), success criteria for contaminated groundwater remediation are as follows:

After the final monitoring period for each of the federally listed species or designated Monterey spineflower critical habitat, species reestablishment will be considered successful when:

1. *densities and acreage of HMP annual species are within a normal range compared with information from reference sites, and;*
2. *the number of wells where HMP annual species are detected in follow-up surveys will be the same or greater than the number of wells where these species were found in baseline surveys.*

If the success criteria are not met, based on the evaluation of the monitoring data, corrective measures will be developed in coordination with the U.S. Fish and Wildlife Service, as specified in the Programmatic Biological Opinion (USFWS, 2017).

13.9 HMP Species Protection

The Onsite Biologist will identify areas containing populations of Monterey gilia and Monterey spineflower during baseline surveys. Access routes will be delineated with rope or flagging tape to ensure personnel and equipment stay within designated work areas and prohibit access to protected areas. The Onsite Biologist will ensure conservation measures are implemented during well installation activities in the FONR and will be available to resolve unanticipated resource issues as they arise.

The field activities will include drilling and well installation, well development and surveying, and groundwater monitoring. Ahtna will communicate to personnel working at the site the resources of concern and habitat protection requirements prior to the start of remediation activities. Staging areas, access routes, and turnaround areas will be clearly delineated and shown to field personnel. Field personnel will be instructed to lock the access gate behind them after each entry to and exit from the FONR. If a BLL or CTS is discovered during the proposed activities, the Onsite Biologist will be immediately notified. The Onsite Biologist will coordinate with the BRAC Office Biologist to confirm appropriate conservation steps, including relocation, if necessary. The Onsite Biologist will fill out the field observation form with the necessary information and then relocate the individual, if necessary, to suitable nearby habitat. If the Onsite and/or BRAC Office Biologist are not available onsite during observation of CTS or BLL, onsite personnel may carefully relocate BLL away from fieldwork if harm is imminent and fill out the biological observation form (Attachment C). Work must stop if CTS is observed until an approved Biologist has removed the CTS from the project site.

When driving vehicles and heavy equipment through the inner roads of the northern FONR area, personnel must walk in front of vehicles to ensure there are no Coast Horned Lizards in the road before the vehicle passes. If Coast Horned Lizards are observed, they must be relocated away from the vehicle's path. Observations of Coast Horned Lizards may be reported to the University of California and the BRAC Office Biologist for tracking purposes. This will apply to fieldwork activities associated with new monitoring wells MW-BW-96-A and MW-BW-97-A (Figure 6).

Some limited vegetation clearance may be necessary to access well locations. If necessary, vegetation clearance will be coordinated with the University of California, the BRAC Office Biologist, and USACE Technical Lead, and conducted following standard best management practices to protect the existing oak trees and special-status species. Tree branches may be trimmed as necessary to provide access, but no trees will be removed. Vegetation removed from work areas will be consolidated with other construction debris and taken to an appropriate disposal facility.

13.10 Pre-Construction Activities

13.10.1 Notification and Access

Property owners will be notified of fieldwork activities at least three days before the start of work. Site users will be coordinated with for site access, limited access to the project site during construction, and scheduling changes. The contact information of property owners for each soil boring and well location are provided in the table below.

Contact Information

Soil Boring or Well Name	Property Owner/User	Contact Name	Email	Phone
MW-10-07-180	CSUMB	Katie LaPlace	klaplace@csumb.edu	831-582-5189
MW-40A-01-A and MW-40A-02-A	City of Marina	Matt Mogensen	mmogensen@cityofmarina.org	831-884-1240
SB-40A-01 through SB-40A-07	City of Marina	Matt Mogensen	mmogensen@cityofmarina.org	831-884-1240
MW-BW-96-A and MW-BW-97-A	University of California	Joe Miller	jotmille@ucsc.edu	831-332-2435
SB-FDA-01	University of California	Joe Miller	jotmille@ucsc.edu	831-332-2435

Soil Boring or Well Name	Property Owner/User	Contact Name	Email	Phone
SB-02-17 and SB-02-18	California Department of Parks and Recreation	Amy Palkovic	Amy.Palkovic@parks.ca.gov	831-384-7420
SB-10-10 through SB-10-13	City of Seaside	Nisha Patel	npatel@ci.seaside.ca.us	831-899-6884
	POM Fire Department	Dave Wilcox	David.E.Wilcox18.civ@mail.mil	831-242-7701

13.10.2 Permitting

Permits for soil borings and monitoring well installation will be obtained from the Monterey County Department of Health; however, no permit fees are required to be paid because the former Fort Ord is a CERCLA site.

13.10.3 Utility Clearance

A utility clearance will be performed at each proposed well location before drilling activities commence to avoid encountering underground utilities and other potential obstructions. Clearance activities include notification of utility agencies and/or utility protection organizations, as appropriate, in addition to performing onsite surveys using the appropriate geophysical equipment. Locations of utilities will be marked on the ground surface with indications of the assumed type of utility. Prior to initiating intrusive activities, utility location information will be reviewed, including field markings and available drawings, to ensure the boring is a minimum of 3 feet away from a marked utility. The boring will be hand augured (or similar method) to a depth of 5 feet bgs.

13.10.4 Habitat Clearance

The Onsite Biologist will survey proposed soil boring and new monitoring well locations, access routes, and staging areas in the FONR prior to fieldwork activities for Monterey gilia, Monterey spineflower, and piperia. Identified plants will be GPS-located and mapped. The baseline survey will be conducted during the peak blooming period for Monterey gilia and Monterey spineflower. The maps will be used to field-identify and mark areas that personnel may not enter, areas that are permitted to access, stage equipment, and turn vehicles around.

13.10.5 Traffic Control Plan

Soil boring and new monitoring well locations are expected to be in areas with no or low public and/or property user traffic. If there is a need for traffic control, the proper safety delineators and protocol will be adhered to as described in the Accident Prevention Plan (Ahtna, 2021c).

13.11 Support Facilities

Support facilities include lockable containers, chemical toilets, portable containment tanks, and bins with lids. Lockable support facilities will be secured when project personnel are not on site. Decontamination facilities will consist of portable secondary containment for personnel and an equipment decontamination pad. Decontamination water will be collected in portable tanks for disposal. It is anticipated most of the support facilities will be located in the vicinity of the Ahtna field offices adjacent to the OU2 GWTP.

13.12 Construction Activities

The specific methods and material requirements for borehole drilling, soil logging, and well installation are presented in this section.

13.12.1 Borehole Drilling, Logging, and Soil Sampling

Five monitoring wells and three soil borings will be drilled using a truck- and/or track-mounted rotosonic (rotary-vibratory) or hollow stem auger drill rig. Drilling equipment brought to the site will be in operable condition and free of leaks in the hydraulic, lubrication, fuel, and other fluid systems. The work area footprint for these drill rigs, including support vehicles and drilling equipment, is expected to be approximately 20 feet by 70 feet or 1,400 square feet.

The borehole diameter will be sized to assure proper borehole sidewall clearance for soil sample collection and well construction. Figures 3, 4, 5, and 6 show the proposed locations of these monitoring wells and soil borings. The borings will be completed under the supervision of the Project Geologist, who will be responsible for oversight of borehole logging, soil sampling, well installation, and development activities. The procedures for rotosonic and hollow stem auger drilling are provided in SOP #006 and SOP #007, respectively. Additionally:

- The soil boring or well location will be verified and determined to be safe for construction operations from underground utilities and aboveground hazards.
- Drilling equipment will be staged at each location to avoid disturbing the normal flow of traffic using safety delineators as needed.
- Drilling equipment will be staged around locations in the FONR to avoid HMP species to the greatest extent possible.
- A hand auger will be used to dig the borehole from 0 to 5 feet below the ground surface to ensure there are no underground utilities at the borehole location.
- Drilling will commence, and removed soil will be classified in accordance with the Unified Soil Classification System (SOP #103).
- Field borehole logs will be used to determine proper borehole depth and well screen placement.
- Depending on site conditions, soil cuttings or cores may be disposed of near the borehole or containerized for transport and disposal per Worksheet #14 & 16, Section 11.2. Other liquid and solid IDW will be handled per Worksheet #14 & 16, Section 11.2.
- Soil samples will be collected from soil borings using a California-modified split-spoon sampler and transferred to the sample container using a stainless steel spoon or trowel.

Twelve shallow soil borings (up to 10 feet bgs) will be advanced using a hand auger.

- The soil boring location will be verified and determined to be safe for underground utilities.
- Removed soil will be classified in accordance with the Unified Soil Classification System (SOP #103).

- Depending on site conditions, soil cuttings may be disposed of near the borehole or containerized for transport and disposal per Worksheet #14 & 16, Section 11.2. Other liquid and solid IDW will be handled per Worksheet #14 & 16, Section 11.2.
- Soil samples will be transferred from the hand auger to the sample container using a stainless steel spoon or trowel.

Downhole equipment and tools will be cleaned and decontaminated before remobilizing the rig to the next well location and maintained in a clean condition throughout well installation activities. Equipment decontamination procedures will be in accordance with SOP #113 (Attachment A).

13.12.2 Well Construction

The specific methods and material requirements for well installation are presented in this section. Well construction details will be recorded in the field using a logbook (SOP #101) and the forms in Attachment B.

Well depths and location of the screen interval are estimated based on known site conditions; however, final depths and screen intervals will be determined in the field by the Project Geologist using geologic logs. The Project Geologist will evaluate the geologic logs based on selected soil samples and compare them to logs from nearby monitoring well locations. Each monitoring well screen interval will be placed within permeable geologic materials that correlate with existing nearby monitoring wells.

13.12.3 Construction Materials

Well construction materials will be in accordance with *Water Well Standards: State of California Bulletin 74-81 and Supplement 74-90* (CDWR, 1981 and 1991). Well construction materials will be new, clean, and in good condition. Casing for the proposed wells will consist of flush joint, threaded, 3-inch diameter Schedule 80 polyvinyl chloride (PVC) manufactured per ASTM F480. Joints between casing pipe and screen will be compatible.

The well screen will consist of new 3-inch diameter slotted Schedule 80 PVC. The monitoring well screen lengths will be comprised of 10-foot sections. The screen slot size will be 0.020-inch. A 3-inch diameter PVC bottom cap will be installed at the bottom of each monitoring well. A lockable expansion cap will be placed at the top of the PVC well casing for secure access to the well.

Wells will be constructed with centering guides of stainless steel and placed such that the well screen is positioned within the center of the borehole.

The filter pack sand will consist of clean, washed, rounded to subrounded siliceous material that is free from calcareous grains or material (#3 or #2/12 sand). A transition sand (#60) will be placed directly above the filter pack sand. Filter pack material will be protected from contamination prior to placement by either storing it in plastic-lined bags or in a location protected from the weather and contamination on plastic sheeting. Filter pack materials will be transported to the site in a manner that prevents contamination by other soils, oil and grease, and other chemicals.

The bentonite seal will be placed directly above the transition sand. A bentonite-cement grout seal will be used in the construction of monitoring wells and placed directly above the bentonite seal. Wells will be grouted to within 36 inches of land surface. The bentonite grout used in the construction of the well will contain standard bentonite-cement grout mixed in the ratio of 5 pounds bentonite gel, one 94-pound bag of Type 1 Portland cement, and 7 gallons of clean, potable water. The grout will have a weight of approximately 15.3 pounds per gallon. Cement will meet requirements of ASTM C150-00. Neither additives nor borehole cuttings will be mixed with the grout.

13.12.4 Assembly of Well

Each well will be installed within the completed boring and equipped with 30-foot long screens for A-Aquifer wells and a 20-foot long screen for the Upper 180-Foot Aquifer well assembled from 10-foot long sections. The estimated screen interval depths for the monitoring wells will be approximately 80 to 130 feet bgs for A-Aquifer wells, and 275 to 300 feet bgs for the Upper 180-Foot Aquifer wells. The final position of the well screen will be determined in the field by the Project Geologist.

If the protective plastic shipping sleeve is damaged, the affected screen and casing material will be decontaminated immediately prior to installation in the borehole. Care will be taken to ensure the casing does not contact the ground. Joints and other accessory parts will be securely fastened prior to installation in the borehole. The screen and 3-inch diameter casing will be placed in the hole in such a manner as to avoid jarring impacts and to ensure the assembly is not damaged. The well will be plumb, true, and centered in the hole by the use of centralizers.

Filter pack sand will be placed around the monitoring well screen and will extend two to three feet above the top of the well screen. Once the filter pack is placed, the well screen will be gently surged for approximately 30 minutes to mitigate bridging that may have occurred during filter pack placement. Once surging is complete, sand will be added as needed and a one- to two-foot thick layer of transition sand will be placed above the filter pack. The filter pack will be placed from the bottom of the borehole up, in such a manner as to ensure uniform placement around the screen. During placement of the sand pack, frequent measurement of the top of the sand pack will be made to confirm uniform placement of the material and that no bridging has occurred.

A three to five-foot thick bentonite pellet or chip seal will be installed at the top of the filter pack to isolate it from the surface and given a sufficient hydration time before the bentonite-cement grout seal is placed on top. A bentonite-cement grout seal will be used in the construction of monitoring wells and placed directly above the bentonite seal to within 36 inches of ground surface. The bentonite grout will contain materials of the type and proportions described in the Construction Materials section above. Monitoring wells will be constructed with a concrete surface seal that will extend to a minimum of 36 inches below the land surface and will be set directly above the bentonite-cement grout seal.

13.12.5 Surface Completion

Surface completion of each monitoring well will consist of either a flush vault or stovepipe. The 8-inch diameter traffic-rated flush-mounted steel vault will be a minimum of 12 inches deep set in the concrete surface seal and be equipped with a bolt-down watertight cover. The top of the vault will be raised slightly above existing grade, and the surface of the cement seal will slope away from the vault to the existing grade to promote surface drainage away from the well. The vault will be installed such that there are no more than 6 inches and no less than 5 inches between the top of the monitoring well casing and the top of the vault cover. The cover of the vault will have the wording “monitoring well” on its outer surface.

A stovepipe, or stickup, completion would include the 3-inch diameter well casing extending approximately 3 feet above the ground. The PVC well casing will be surrounded by a steel casing with lockable lid and filled to just below the well casing with sand pack material. If the well is in a vehicle traffic area, the steel casing will be flanked on at least three sides with traffic-rated bollards. The bollards and stovepipe will be set in a concrete pad as described above. The bollards and stovepipe will be painted yellow to alert vehicles of their presence.

13.13 Post-Construction Activities

The specific methods for well development, surveying, follow-up habitat monitoring, sampling, and reporting are presented in this section.

13.13.1 Well Development

Development of the groundwater monitoring wells will be conducted no less than two days following the placement of the grout seal atop the bentonite seal. The monitoring wells will be developed in accordance with ASTM D5521 to assure inflow is physically and chemically representative of that portion of the aquifer adjacent to the screened interval. The total depth of the monitoring well and the dtw data will be used to calculate the volume of water in the monitoring well casing. For each casing volume of water removed, measured water quality parameters (temperature, specific conductance, pH, and turbidity) will be recorded in the well development log (Attachment B). Water quality parameters will be measured in the following units:

Temperature	degrees Celsius (°C)
Specific conductance	micromhos per centimeter (µmhos/cm)
pH	standard pH units = -log [H+]
Turbidity	Nephelometric Turbidity Units (NTU)

A minimum of ten (10) casing volumes of water will be removed from each well, and water quality parameters will be monitored, with successful development indicated by three successive measurements of the parameters showing:

- pH has changed less than 0.1 pH units
- Temperature has changed 1°C or less and is approximately equal to ambient groundwater temperature
- Conductivity has changed less than 10 percent
- Consistent turbidity readings measured five minutes apart, with no more than 10 percent change

If well parameters have not stabilized after ten (10) well volumes have been purged, additional well purging will be performed until parameters stabilize, or a maximum of fifteen (15) well volumes have been purged, whichever occurs first.

In addition to the collection of water quality parameters, water levels will be recorded during development to gauge drawdown of water within the monitoring well. In the event recharge of water in the casing fails to keep up with the drawdown of the water table by the purging tool, well development will continue. If insufficient water recovery continues, the monitoring well will be considered to be developed even though water quality parameters have not stabilized.

13.13.2 Surveying

Following well installation, each well will be surveyed by a professional California-licensed land surveyor for northing and easting coordinates and elevation with respect to MSL in compliance with established protocol. Surveying will be conducted using North American 1983 Datum, California State Plane Zone 4 horizontal and National Geodetic Vertical Datum 1929. The top of each well casing will be surveyed within 0.1-foot horizontal and 0.01-foot vertical accuracy. Soil boring locations will be GPS-located.

13.13.3 Follow-Up Habitat Monitoring

The Onsite Biologist will conduct three years of annual follow-up habitat monitoring in the areas of the FONR disturbed during well installation field activities. Habitat monitoring will be conducted in accordance with the HMP (USACE, 1997) and the Programmatic Biological Opinion (USFWS, 2017). Follow-up surveys will be conducted during the peak blooming period for the species being monitored (Monterey gilia and Monterey spineflower). Each year for the three-year follow-up habitat monitoring period an evaluation report will be prepared and provided to BRAC detailing updated special-status plant species populations and document impacts during the well installation.

13.13.4 Deliverables and Reporting

An SI Narrative Report will be prepared following completion of field activities. The SI Narrative Report will describe well installation activities and present geologic logs, well completion diagrams, well development records, and sample analytical results. Recommendations for additional investigation, if necessary, will also be presented.

Results of the follow-up habitat monitoring of the special-status plant species in impacted areas will be reported annually for three years after well installations are completed.

14.0 Worksheet #18: Sampling Locations and Methods

This Worksheet facilitates completeness checks to ensure all planned samples have been collected and appropriate methods have been used.

14.1 Worksheet #18a

Matrix: Groundwater

Analyte/Analytical Group: PFAS

Site	Well ID	Sample Depth (ft bgs)[1]	Type[2]	Sampling SOP	Comments
Site 2	MW-02-13-180U	64	monitoring well	SOP #008	
	MW-02-13-180M	124	monitoring well	SOP #008	
	EW-12-05-180M	N/A	extraction well	SOP #105	
	EW-12-08-180U	N/A	extraction well	SOP #105	
Site 10 and Main Garrison Fire Station	MW-OU2-54-180	212.5	monitoring well	SOP #008	Sample results also used for OU2; collect only one sample from this well.
	MW-OU2-55-180	273	monitoring well	SOP #008	
	MW-OU2-29-180	275	monitoring well	SOP #008	
	MW-OU2-62-180	223	monitoring well	SOP #008	Sample results also used for OU2; collect only one sample from this well.
	MW-10-07-180	TBD	monitoring well	SOP #008	New well.
Site 40A and FAAF Fire & Rescue Station	MW-40A-01-A	TBD	monitoring well	SOP #008	New well.
	MW-40A-02-A	TBD	monitoring well	SOP #008	New well.
	SB-40A-07	100	soil boring	SOP #008	Collect groundwater sample at water table.
FAAF FDA	MW-BW-95-A	105	monitoring well	SOP #008	
	MW-BW-96-A	TBD	monitoring well	SOP #008	New well.
	MW-BW-97-A	TBD	monitoring well	SOP #008	New well.
	SB-FDA-01	70	soil boring	SOP #008	Collect groundwater sample at water table.

Site	Well ID	Sample Depth (ft bgs)[1]	Type[2]	Sampling SOP	Comments
OU2	MW-OU2-23-180	225	monitoring well	SOP #008	
	MW-OU2-50-180	213.5	monitoring well	SOP #008	
	MW-OU2-54-180	212.5	monitoring well	SOP #008	Sample results also used for Site 10 and Main Garrison Fire Station; collect only one sample from this well.
	EW-OU2-03-180	N/A	extraction well	SOP #105	
	MW-OU2-62-180	223	monitoring well	SOP #008	Sample results also used for Site 10 and Main Garrison Fire Station; collect only one sample from this well.
	MW-OU2-28-180	240	monitoring well	SOP #008	
	MW-BW-59-180	355	monitoring well	SOP #008	
	MW-OU2-82-180	355	monitoring well	SOP #008	
	MCWD Well 29	N/A	supply well	SOP #105	
	MCWD Well 30	N/A	supply well	SOP #105	
	MCWD Well 31	N/A	supply well	SOP #105	

Notes:

[1] Sample depth is approximate midpoint of saturated screen interval for monitoring wells and port depth for multiport wells. Sample depths are N/A for extraction wells and supply wells because the sample cannot be collected from a discrete depth.

[2] Field QC samples will be collected per the schedule in Worksheet #20.

Ft bgs: feet below ground surface

N/A: not applicable

TBD: to be determined

14.2 Worksheet #18b

Matrix: Soil

Analyte/Analytical Group: PFAS

Site	Soil Boring ID	Sample Depth (ft bgs)	Type[1]	Sampling SOP	Comments
Site 10	SB-10-14	15 and 20	drill rig	SOP #103	Within area of deepest IA excavation at the site.
Main Garrison Fire Station	SB-10-10	1, 5, and 10	hand auger[2]	SOP #103	Expired AFFF potentially discharged to unpaved area next to Building 4401 hose tower.
	SB-10-11	1, 5, and 10	hand auger		
	SB-10-12	1, 5, and 10	hand auger		
	SB-10-13	1, 5, and 10	hand auger		
Site 2	SB-02-17	1, 5, and 10	hand auger	SOP #103	Within lowest elevation areas of Ponding Area 1.
	SB-02-18	1, 5, and 10	hand auger		
Site 40A	SB-40A-01	1, 5, and 10	hand auger	SOP #103	Within drainage channel downgradient of helicopter defueling area.
	SB-40A-02	1, 5, and 10	hand auger		
	SB-40A-03	1, 5, and 10	hand auger		
FAAF Fire & Rescue Station	SB-40A-04	1, 5, and 10	hand auger	SOP #103	Expired AFFF potentially discharged to unpaved area next to FAAF Fire & Rescue Station.
	SB-40A-05	1, 5, and 10	hand auger		
	SB-40A-06	1, 5, and 10	hand auger		
	SB-40A-07	30, 65, and 100	drill rig		Location to be determined based on shallow soil sampling results; final sample depth depends on depth to water table.
FAAF FDA	SB-FDA-01	20, 45, and 70	drill rig	SOP #103	Within former burn pit excavation footprint at location of boring CB-4; final sample depth depends on depth to water table.

Notes:

[1] Field QC samples will be collected per the schedule in Worksheet #20.

[2] In the event of borehole collapse or obstructions, an alternative nearby location will be selected for soil sampling or alternative methods will be used per SOP #103.

ft bgs: feet below ground surface

15.0 Worksheet #19 & 30: Sample Container, Preservation, and Hold Times

Laboratory: SGS

Florida:
4405 Vineland Rd, Suite C-15
Orlando, FL 32811

Telephone: (407) 425-6700
Point of Contact: Svetlana Izosimova
Email: Svetlana.Izosimova@sgs.com

Sample Delivery Method: Courier to San Jose, CA distribution center or FedEx overnight shipment to Florida

Analyte/ Analyte Group	Matrix	Method/SOP	Container(s) (number, size & type per sample)[1]	Preservation	Preparation Holding Time	Analytical Holding Time[2]
PFAS	Water	Draft EPA Method 1633/SOP #FN: OP 075.1	2 x 500 mL high-density polyethylene bottles 1 x 60 mL high-density polyethylene bottles	<6°C (not frozen)	14 days	28 days
PFAS	Soil	Draft EPA Method 1633/SOP #FN: OP 076.0	1 x 4-ounce high-density polyethylene jar	<6°C (not frozen)	28 days	28 days

Notes:

[1] Sample container caps will not be lined with Teflon™ per SGS Orlando SOPs FN: OP 075.1 and FN: OP 076.0 (Attachment A).

[2] Data package turnaround time is 15 business days

°C: degrees Celsius

PFAS: per- and polyfluoroalkyl substances

16.0 Worksheet #20: Field Quality Control Summary

This Worksheet describes the types of field QC samples available to assess MPC. Each sampling and analysis activity conducted for the SI has its own need for field QC samples.

Matrix	Analyte/ Analytical Group	Field Samples	Field Duplicates	Matrix Spike/ Matrix Spike Duplicate	Field Blanks[1]	Equipment Blanks	Total # analyses
Groundwater	PFAS	25	Two per batch of field samples as feasible or a minimum of 10% of project samples	One MS/MSD pair per batch of field samples, or a minimum of 5% of project samples	1 per 20 samples or 1 per day	1 per 20 samples or 1 per day	~35
Soil	PFAS	32	Two per batch of field samples as feasible or a minimum of 10% of project samples	One MS/MSD pair per batch of field samples, or a minimum of 5% of project samples	1 per 20 samples or 1 per day	1 per 20 samples or 1 per day	~44

Notes:

[1] Whichever is more frequent

PFAS: per- and polyfluoroalkyl substances

17.0 Worksheet #21: Field SOPs

SOP#[1]	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option / Equipment Type	Modified for Project Work	Comments
001	Field Sample Management	Ahtna	N/A	N/A	N/A
002	Field Activity Records	Ahtna	N/A	N/A	N/A
006	Hollow Stem Auger Drilling[2]	Ahtna	N/A	N/A	N/A
007	Sonic Drilling[2]	Ahtna	N/A	N/A	N/A
008	Standard Operating Procedure: Sampling Groundwater with a HydraSleeve™, 2019	HydraSleeve	Passive Sampler	N/A	N/A
010	Standard Operating Procedure Downhole Meter Groundwater Quality Parameter Collection	Ahtna	N/A	N/A	N/A
101	Standard Operating Procedure for Logbook Documentation and Field Notes (PFAS-Specific)	Ahtna	N/A	N/A	N/A
103	Standard Operating Procedure for Soil Sampling (PFAS-Specific)	Ahtna	N/A	N/A	N/A
105	Standard Operating Procedure for Groundwater Sampling (PFAS-Specific)	Ahtna	N/A	N/A	N/A
111	Standard Operating Procedure for Sample Chain of Custody	Ahtna	N/A	N/A	N/A
112	Standard Operating Procedure For Labeling, Packaging, and Shipping Samples (PFAS-Specific)	Ahtna	N/A	N/A	N/A
113	Standard Operating Procedure for Equipment Decontamination (PFAS-Specific)	Ahtna	N/A	N/A	N/A
120	Standard Operating Procedure for Water Quality Measurements and Calibration (PFAS-Specific)	Ahtna	N/A	N/A	N/A
121	Standard Operating Procedure for Monitoring Well Installation (PFAS-Specific)[2]	Ahtna	N/A	N/A	N/A

SOP#[1]	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option / Equipment Type	Modified for Project Work	Comments
122	Standard Operating Procedure for Monitoring Well Development (PFAS-Specific)	Ahtna	N/A	N/A	N/A

Notes:

[1] Copies of the field SOPs are included in Attachment A.

[2] Monitoring wells shall be constructed in accordance with *ASTM D5092 – Standard Practice for Design and Installation of Groundwater Monitoring Wells* (ASTM International, 2016) and Federal, State, and local regulations.

N/A: not applicable

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Electric Water Level Sounder	Calibrated against steel tape	Maintain in proper working order, store in a secure location, decon after each use	Check battery and sensitivity daily prior to use	Inspect tape for damage prior to use	Prior to use	Calibrates with steel tape to within 0.05 ft/100 feet dtw	Send into factory for repair	Field Supervisor	SOP #010
YSI Sonde Downhole Meter	Calibrated with solutions	Decon after each use, store according to manufacturer directions	Check battery prior to use	Inspect for damage prior to use	Prior to use	According to manufacturer instructions	Check manual or send to factory for repair	Field Supervisor	SOP #010
Digital Thermometer	Factory calibrated, ice-point method per HACCP-based SOP	Store in a secure location, avoid excessive heat	Check battery prior to use	Inspect for damage prior to use	Annually	Factory calibration, temperature reading = $0^{o}C \pm 1^{o}C$	Replace with new unit	Field Supervisor	SOP #010

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GPS unit	Calibrate using field app	Maintain in proper working order and store in a secure location	Ensure USB battery pack is activated and LED status is flashing blue	Inspect for damage prior to use	Prior to use	According to manufacturer instructions	Check user guide or replace with new unit	Field Supervisor	Trimble, 2021

Notes:

°C: degrees Celsius

HACCP: Hazard Analysis & Critical Control Points (Title 9 Code of Federal Regulations Part 417)

N/A: not applicable

SOP: standard operating procedure

19.0 Worksheet #23: Analytical SOPs

The SOPs referenced below are the laboratory-specific procedures for the tests for which the laboratory is certified under the DoD Environmental Laboratory Accreditation Program (ELAP) and are included in Attachment A. Laboratories with the DoD ELAP certificate undergo annual audits by the independent accrediting bodies responsible for the DoD ELAP certification. Copies of certifications, including the specifically referenced methods, are included in Attachment D.

Data will be evaluated based on the guidance provided in the DoD QSM 5.4, the published methods, and the laboratory QA Manual.

SOP Reference Number	Title	Organization	Definitive or Screening Data	Matrix/ Analytical Group	Revision Date	Equipment Type	Modified for Project Work?
SGS SOP# ORLD-SAM-101-21-SOPT	Sample Receipt and Storage	SGS	NA	Soil/Water PFAS	Mar 12, 2020	None	No
SGS SOP# SAM108.11	Sample and Laboratory Waste Disposal	SGS	NA	Soil/Water PFAS	Aug 24, 2020	None	No
SGS SOP# FN: OP 075.1	Standard Operating Procedure for the Extraction of Per- and Polyfluorinated Alkyl Substances From Water Samples For LC/MS/MS Analysis	SGS	Screening	Water PFAS	April 2022	LC/MS/MS	No
SGS SOP# FN: OP 076.0	Standard Operating Procedure for the Extraction of Per- and Polyfluorinated Alkyl Substances From Soil Samples For LC/MS/MS Analysis	SGS	Screening	Soil PFAS	April 2022	LC/MS/MS	No
SGS SOP# FN: QA 020.10	Procedures For Development and Use of Method Performance Criteria and	SGS	Screening	NA	December 2019	NA	No

SOP Reference Number	Title	Organization	Definitive or Screening Data	Matrix/ Analytical Group	Revision Date	Equipment Type	Modified for Project Work?
	Experimental Method Detection Limits						
SGS SOP# FN: MS024.2	Analysis of Per- and Polyfluorinated Alkyl Substances (PFAS) In Aqueous and Solid Samples by LC/MS /MS	SGS	Screening	Soil/Water PFAS	April 2022	LC/MS/MS	No

20.0 Worksheet #24: Analytical Instrument Calibration

Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference
LC/MS/MS[1]	Ion Transitions (Precursor-> Product)	Every field sample, standard, blank, and QC sample.	In addition to requirements of Draft EPA Method 1633, the following must be met: 1) If a qualitative or quantitative standard containing an isomeric mixture (branched and linear isomers) of an analyte is commercially available for an analyte, the quantification ion used must be the quantification ion identified in Table 2 of Draft EPA Method 1633 unless interferences render the product ion unusable as the quantification ion. 2) In cases where interferences render the product ion	NA	Corrective Action Not Required	FN: MS024.2

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference
			unusable as the quantification ion, project approval is required before using the alternative product ion.			
LC/MS/MS[1]	Ion Ratio	All analytes detected in a sample	Must meet all of the requirements of Draft EPA Method 1633	Document and discuss the failure in the Case Narrative. Apply I-flag to the result associated with the failure.		FN: MS024.2
LC/MS/MS[1]	Instrument Sensitivity Check (ISC)	Daily. At the beginning of each analytical sequence, prior to sample analysis.	In addition to the requirements of Draft EPA Method 1633, the following must be met: All analyte concentrations must be within ± 30% of their true values.	Correct problem and rerun ISC. If problem persists, repeat ICAL.	Lab Manager/ Analyst[2]	FN: MS024.2
LC/MS/MS[1]	Mass Calibration	Initially, annually, and after performing major maintenance. Verified weekly through the	Per the criteria of SOP FN: MS024.2 and manufacturers specifications	N/A	Lab Manager/ Analyst[2]	FN: MS024.2

Instrument	**Calibration Procedure**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Person Responsible for CA**	**SOP Reference**
		analysis of a Check Tune.				
LC/MS/MS[1]	Mass Calibration Verification	After mass calibration, prior to standards, and samples analysis	Peak apex shift less than approximately 0.1 atomic mass unit (amu)	Instrument will need to be recalibrated following the manufacturer's instructions.	Lab Manager/ Analyst[2]	FN: MS024.2
LC/MS/MS[1]	Tuning of LC/MS/MS	When masses fall outside ± 0.5 amu of true masses	Within 0.5 ± 0.1 amu of true value	Retune and verify. If tuning fails acceptance criteria, perform a mass calibration and repeat the tune check.	Lab Manager/ Analyst[2]	FN: MS024.2
LC/MS/MS[1]	A minimum 7-point calibration curve is created for the native PFAS compounds using an Isotope Dilution or Extracted Internal Standard technique.	Prior to initial use and after ICV or CCV failure, prior to sample analysis	The lowest level calibration standard must meet a signal-to-noise ratio of 3:1 and be at a concentration less than or equal to the LOQ. Percent error between the calculated and expected amounts of an analyte should be ≤ ±30% (70-130% of True Value) for all standard	Evaluate standards, chromatography, and mass spectrometer response. If problem found with above, correct as appropriate, then repeat initial calibration.	Lab Manager/ Analyst[2]	FN: MS024.2

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference
			levels, except the lowest point which should be ≤ ±50% (50-150% of True Value).			
LC/MS/MS[1]	Initial Calibration Verification (ICV)	Once after each ICAL, prior to sample analysis.	Must be made from a second source standard. All reported analytes and labeled compounds within ± 30% of their true value	Correct problem, rerun ICV. If problem persists, repeat ICAL.	Lab Manager/ Analyst[2]	FN: MS024.2
LC/MS/MS[1]	CCV Standard	Analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, the mid-point CCV must be analyzed after every 10 samples.	The percent difference (%D) for each analyte of interest will be monitored. The |%D| must be ±30% for the target analytes and EIS in each CCV.	Reanalyze CCV in duplicate immediately. If both pass, samples can be reported. If either fails or if immediate re-analysis of CCV in duplicate cannot be performed all samples since acceptable CCV must be reanalyzed. If the CCV fails high, any associated	Lab Manager/ Analyst[2]	FN: MS024.2

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference
				samples that are ND can be reported.		
LC/MS/MS[1]	LOD standard	Quarterly	All compounds must be detected	Reprep and reanalyze LOD.	Lab Manager/ Analyst[2]	FN: QA 020.10
LC/MS/MS[1]	LOQ Verification	Quarterly	Within 50% of true value	Reprep and reanalyze LOQ.	Lab Manager/ Analyst[2]	FN: QA 020.10
LC/MS/MS[1]	Bile Salts Standards	Daily, prior to analysis of all matrix types (aqueous, solid, tissue, and AFFF).	All Draft EPA Method 1633 requirements for evaluation of the relationship of the retention time of the bile salt peak(s) to the retention time window of PFOS must be met for all matrix types. The retention time window of PFOS applies to the retention time of all isomers of PFOS. The retention time of the bile salt(s) peak must fall out of the retention time window of PFOS by at least one minute.	NA	Lab Manager/ Analyst[2]	FN: MS024.2

Notes:

[1] SGS Orlando, Florida

[2] The analyst initiates the corrective action and the lab manager, QA Manager and/or analyst are responsible for the corrective action.

amu – Atomic Mass Unit
CA – Corrective Action
CCV – Continuous Calibration Verification
ICAL – Initial Calibration
ICB – Initial Calibration Blank
ICV – Initial Calibration Verification
ISC – Instrument Sensitivity Check
LC/MS/MS – liquid chromatography with tandem mass spectrometry
LOQ – limit of quantitation
ND – non-detect

21.0 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[1]	Backflush of column, injection port and pre-columns, cleaning of ion spray cone, adjustment of collision energies, others as needed	Calibration Check	Visual	As Needed	Initial calibration or calibration verification passes method specifications	Perform additional maintenance prior to instrument calibration or calibration verification	Analysts	FN: MS024.2
LC/MS/MS[1]	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	FN: MS024.2

Notes:

[1] SGS Orlando

LC/MS/MS: liquid chromatography with tandem mass spectrometry

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

Sampling Organization: Ahtna

Laboratory: SGS

Method of sample delivery (shipper/carrier): SGS courier or FedEx overnight shipping

Number of days from reporting until sample disposal: 7 days for water samples and 14 days for soil samples

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Chain of custody	Ahtna Field Technicians	SOP #111
Packaging and Shipping Environmental Samples	Ahtna Field Technicians	SOP #112
Sample receipt, and Storage	SGS Sample Management Supervisor	SGS SOP# ORLD-SAM-101-21-SOPT
Sample and Laboratory Waste Disposal	SGS Sample Management Supervisor	SGS SOP# SAM108.11

Notes:
SOP: standard operating procedure

23.0 Worksheet #28: Analytical Quality Control and Corrective Action

Matrix: Aqueous and Soil

Analyte/Analytical Group: PFAS

Analytical Method/SOP Reference: Analysis of Per- and Polyfluorinated Alkyl Substances by LC/MS/MS and Isotope Dilution; MS024.1, Rev. 04/2022

Analytical Organization: SGS

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Instrument Blank	Immediately following the highest standard analyzed in the calibration, daily prior to analyzing standards, after each CCV, and immediately following samples with PFAS concentrations exceeding the quantification range.	In addition to the requirements of EPA Draft Method 1633, the following must be met: Concentration of each analyte must be ≤ ½ the LOQ.	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 calibration standard and the sample(s) following exceed this acceptance criteria (> ½ LOQ), they must be reanalyzed	Lab Manager/ Analyst	Accuracy Laboratory Contamination	Concentration of each analyte must be ≤ ½ the LOQ.

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
			using a fresh aliquot of the sample extract.			
Method Blank	1 per batch of field samples of up to 20 samples	In addition to the requirements of EPA Draft Method 1633, the following must be met: No analytes detected > ½ LOQ or > 1/10th the amount measured in any associated sample or 1/10th the regulatory limit, whichever is greater	Correct the problem. If required, re-extract and reanalyze MB and all QC samples and field samples processed with the contaminated blank. Samples may be re-extracted and analyzed outside of holding times, as necessary for corrective action associated with QC failure. Examine the project-specific requirements. Contact the client as to additional measures to be taken.	Lab Manager/ Analyst	Accuracy Laboratory Contamination	No analytes detected > ½ LOQ or > 1/10th the amount measured in any associated sample or 1/10th the regulatory limit, whichever is greater

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Laboratory Control Sample (LCS) and Low-Level Laboratory Control Sample (LLLCS)	1 per batch of field samples of up to 20 samples	In addition to the requirements of EPA Draft Method 1633 the following must be met: 1) Analyte recoveries must be within in-house limits if project limits are not provided; otherwise, project limits must be met. Preliminary inhouse acceptance criteria of 40-150% must be used until inhouse limits are generated in accordance with Section 14.5.4 of EPA Draft Method 1633. 2) The lower limit of inhouse acceptance criteria cannot be < 40%.	In addition to the requirements of EPA Draft Method 1633, the following must be met: Samples may be re-extracted and analyzed outside of holding times, as necessary for corrective action associated with QC failure. Examine the project-specific requirements. Contact the client as to additional measures to be taken.	Lab Manager/ Analyst	Accuracy Bias Precision	Results within acceptance limits

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	1 per batch of field samples of up to 20 samples	In addition to the requirements of EPA Draft Method 1633, the following must be met: Analyte recoveries must be within in-house LCS limits if project limits are not provided; otherwise, project limits must be met. RPD ≤ 30% (between MS and MSD)	Examine the project-specific requirements. Contact the client as to additional measures to be taken. If the analyte(s) are not listed, use in- house LCS limits if project limits are not specified. Flag outliers	Lab Manager/ Analyst	Accuracy Bias Precision	Results within acceptance limits
Extracted Internal Standard (EIS) Compounds	Every field sample, standard, blank, and QC sample.	In addition to the requirements of EPA Draft Method 1633, the following must be met: 1) Isotopically labeled analogs of analytes must be used when they are commercially available. 2) QC samples and field	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If the failure confirms, follow the requirements listed in EPA Draft Method 1633, Section 15.3.2. If EIS recoveries still fall outside of the	Lab Manager/ Analyst[2]	Accuracy	Results within acceptance limits

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
		samples must recover within in-house limits if project limits are not provided; otherwise, project limits must be met. Preliminary inhouse acceptance criteria of 20-150% must be used until inhouse limits are generated in accordance with Sections 9.4.1 and 9.4.2 of EPA Draft Method 1633. 3) The lower limit of inhouse acceptance criteria cannot be < 20%.	acceptance range, the client must be contacted for additional measures to be taken.			
Non-extracted Internal Standard (NIS) Compounds	Every field sample, standard, blank, and QC sample.	In addition to the requirements of EPA Draft Method 1633, the following must be met: 1) NIS areas must be greater	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If the failure confirms, examine the	Lab Manager/ Analyst[2]	Accuracy Bias Precision	Results within acceptance limits

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
		than 30% of the average area of the calibration standards in undiluted sample extracts and sample extracts that required additional NIS to be added. NIS areas corrected for the dilution factor must be greater than 30% of the average area of the calibration standards in diluted samples when additional NIS was not added post dilution of the extract.	project-specific requirements. Contact the client as to additional measures to be taken.			

Notes:

EIS – Extracted Internal Standards
ND – non-detect
NIS – Not extracted Internal Standards
LC/MS/MS – liquid chromatography with tandem mass spectrometry
LCS – Laboratory Control Sample
LLLCS - Low-Level Laboratory Control Sample
LOQ – limit of quantitation
MS – matrix spike
MSD – matrix spike duplicate

24.0 Worksheet #29: Project Documents and Records

Sample Collection and Field Records

Record	Generation	Verification	Storage location/archival
Field logbook, field forms, and photographic log	Field Team	Field Supervisor	Project Folder on Ahtna Server
Chain of Custody Forms	Field Team/Laboratory	Field Supervisor	Project Folder on Ahtna Server
Air Bills	Laboratory Staff	Laboratory Project Manager	Project Folder on Ahtna Server
Equipment Inspection and Calibration Forms	Field Team	Field Supervisor	Project Folder on Ahtna Server
Deviations	Project Chemist	Project Manager	Project Folder on Ahtna Server
Corrective Action Reports	Project Chemist	Project Manager	Project Folder on Ahtna Server
Correspondence	Project Chemist	Project Manager	Project Folder on Ahtna Server
Three-Phase QC Process Forms	Field Team	Field Supervisor	Project Folder on Ahtna Server
Tailgate Safety Meeting Log	Field Team	Field Supervisor	Project Folder on Ahtna Server

Project Assessments

Record	Generation	Verification	Storage location/archival
Field audit checklist	QC Manager	Project Manager	Project Folder on Ahtna Server
Data verification checklists	Project Chemist	Project Manager	Project Folder on Ahtna Server
Data validation reports	Validation Team	QC Manager	Project Folder on Ahtna Server

Laboratory Records and Data Deliverables

Record	Generation	Verification	Storage location/archival
Sample Receipt Forms	Laboratory Staff	Laboratory Project Manager	Project Folder on Ahtna Server
Stage 4 Laboratory Reports	Laboratory Staff	Laboratory Project Manager	Project Folder on Ahtna Server
Electronic Data Deliverables	Laboratory Staff	Laboratory Project Manager	Project Folder on Ahtna Server and FODIS
Narrative	Laboratory Staff	Laboratory Project Manager	Project Folder on Ahtna Server
Summary Results	Laboratory Staff	Laboratory Project Manager	Project Folder on Ahtna Server
QC Results	Laboratory Staff	Laboratory Project Manager	Project Folder on Ahtna Server

Project Reports

Record	Generation	Verification	Storage location/archival
Weekly Field Report	Project Manager	Program Manager	Submit to USACE Technical Lead
CQCR	Field Supervisor	Project Manager	Submit to USACE Technical Lead
SI Narrative Report	Project Manager	Program Manager	Submit for Government Review

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

Assessment Type	Responsible Party & Organization	Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Sample Collection and Documentation	Ahtna Qualified Sampler	Daily during field activities	August 2022 – November 2022	Sample collection and field activity forms will be assessed daily; deviations will be noted in the Daily Reports	24 hours following assessment
Health and Safety	Ahtna Site Safety and Health Officer	At the beginning of each sampling event and Daily Safety Meetings	During Sampling Events	Daily Safety Meeting Minutes	24 hours following assessment
Data Quality Assessment	QC Manager/Ahtna	Per Analytical Data Package	August 2022 – December 2022	Data Validation Report	Within four weeks of receipt of data
Laboratory Audit	QC Manager/Ahtna	As needed	As needed	Audit Report	Within two weeks of issuance of audit report

This Worksheet addresses assessment of the effectiveness of the project implementation and the associated QA/QC activities.

25.1 Field Assessment and Response Actions

Planned project assessments will be completed for the SI through the Three-Phase QC Process, as follows:

- Preparatory Phase: Activities and assessments conducted during the preparatory phase are conducted prior to the start of a feature of work to ensure technical requirements and work prerequisites have been completed. Discrepancies will be resolved and corrective actions implemented and verified prior to the start of work.
- Initial Phase: Activities and assessments conducted during the initial phase are performed during the first day of the feature of work to verify compliance with the specifications and requirements described in this QAPP and approved project plans and procedures. Discrepancies will be resolved and corrective actions implemented and verified prior to work proceeding.

- Follow-Up and Reporting Phase: Activities and assessments performed during the follow-up and reporting phase are conducted to verify continued compliance with project requirements and to verify project reports meet client and regulatory requirements.

An overview of the Three-Phase QC Process and related forms used to document the process are provided in Attachment E.

25.1.1 Equipment Inspections

Inspections will be performed daily on equipment prior to and during its use to ensure the equipment is in safe operating condition. The Project Manager, or their representative, will perform these inspections along with the operator.

All preventive maintenance procedures recommended by the manufacturer will be followed. Equipment found to be unsafe will be flagged, and its use prohibited until unsafe conditions have been corrected.

25.2 Verification and Testing Procedures

25.2.1 Nonconformance/Corrective Action (CA)

Non-conforming items and activities are those that do not meet the project requirements. When such a condition is identified, Ahtna will implement a CA program to:

- Document the non-conforming item or procedure and determine the cause of the nonconformance and its effect on project performance and the integrity of completed work;
- Correct or replace the non-conforming item in the most efficient and effective manner; and
- Verify and document that the corrective action taken is successful.

25.2.2 Documentation of Non-Conforming Items

The Project Manager, or their representative, will document nonconformance items in the field logbook. This list will clearly state what is not complying, the date the noncompliance was originally discovered, and the date the work was corrected.

25.2.3 Implementation of CA

The Project Manager, or their representative, will stop work on an item or feature pending satisfactory correction of the deficiency. The Project Manager, or their representative, will have the authority to stop work until CAs are implemented. In some cases, the CA may be obvious and may be implemented immediately upon identification of the nonconformance. Others may require additional input from technical and/or operations staff, additional equipment and/or materials, or changes in existing structures or completed work.

25.2.4 Verification and Documentation of CA

The Project Manager, or their representative, will verify successful completion of CAs for non-conformances on a follow-up inspection. The Weekly Field Status Report will reflect CAs completed. The Project Manager, or their representative, will also update the re-work item list with the CA taken and the date the CA was completed. Recurring non-conformances of similar nature will be investigated to determine the root cause of the problem so as to eliminate or minimize future occurrences of the nonconformance.

25.2.5 Nonconformance/QC Reporting

A nonconformance is defined as an identified or suspected deficiency or discrepancy with regard to an approved document (e.g., improper sampling procedures, improper instrument calibration, calculation, or computer program); or an item where the quality of the end product itself or subsequent activities using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with the established plans or procedures.

Any team member engaged in project work that discovers or suspects a nonconformance is responsible for informing the Project Manager, or their representative. The Project Manager will evaluate each nonconformance and provide a disposition, which describes the actions to be taken.

The Project Manager, or their representative, will verify that no further project work that is dependent on the non-conforming item or activity is performed until the situation has been corrected back to the original condition intended by the project documentation. Documentation of the nonconformance and CA, along with the appropriate verification and approval signatures, will be included in the project file. Copies of the non-conformances will be maintained by the Project Manager.

25.3 Internal Laboratory Audits

As part of its QA program, the laboratory QA/QC manager will conduct periodic checks and audits of the analytical systems to verify that the systems are working properly and personnel are adhering to established procedures and documentation practices. These checks and audits will also assist in determining or detecting where problems are occurring. In addition to conducting internal reviews and audits, as part of its established QA program, the laboratory is required to take part in regularly scheduled Performance Evaluations, and laboratory audits from state and federal agencies for applicable tests. Each laboratory selected to support this project must maintain current DoD ELAP, National ELAP, or federal certifications and USACE approval, as appropriate.

25.3.1 Laboratory Corrective Action

If a particular laboratory analysis is deemed “out of control,” CA will be taken by the laboratory to maintain continued data quality.

Each laboratory must adhere to its in-house CA policy. The coordinator of the laboratory’s analytical section will be responsible for initiating laboratory CA when necessary.

25.4 Assessments and Corrective Action

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Phase I – Preparatory Phase						
Planning Document review	Internal Memo	Document Author	Prior to the start of field activities	Response to comments documentation and USACE approval of document as applicable	Derek Lieberman, Project Manager, Ahtna	One week
Planning document (QAPP) sign-off by field and laboratory	Memo	Stephen Korbay, Field Supervisor, Ahtna Elvin Kumar, Project Manager, SGS	Prior to the start of field activities	Obtain sign-off that document has been read and understood by field and lab personnel	Eric Schmidt, Project Chemist, Ahtna	One week
Review of lab and field personnel readiness	Memo	Stephen Korbay, Field Supervisor, Ahtna Elvin Kumar, Project Manager, SGS	Prior to the start of field activities	Provide kickoff meeting notes from field and lab meetings	Eric Schmidt, Project Chemist, Ahtna	One week
Review of field equipment	Memo	Stephen Korbay, Field Supervisor, Ahtna	Prior to the start of field activities	Provide checklist documenting field equipment is available and in good working order	Eric Schmidt, Project Chemist, Ahtna	Prior to the start of field activities

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Phase II – Initial Phase						
Field and laboratory audit	Field and lab audit report	Stephen Korbay, Field Supervisor, Ahtna Elvin Kumar, Project Manager, SGS Derek Lieberman, Project Manager, Ahtna	Within 48 hours of audits	Field and laboratory to issue a formal response to audit findings requiring corrective action	Eric Schmidt, Project Chemist, Ahtna	One week
Review of Contractor QC Reports	Memo	Stephen Korbay, Field Supervisor, Ahtna Bruce Wilcer, QC Manager, Ahtna	Within 48 hours of review	Revision of Contractor Quality Control Reports (CQCRs) as needed	Derek Lieberman, Project Manager, Ahtna	One week
Review of project plans to reflect current site or lab activities	Memo	Stephen Korbay, Field Supervisor, Ahtna Elvin Kumar, Project Manager SGS	Within 10 days of observations	Update project plans to reflect current conditions (may be an addendum to existing document) or documentation of changes to field or lab protocol to be in accordance with project plans	Derek Lieberman, Project Manager, Ahtna	Prior to next scheduled sampling event

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Phase III – Follow-Up and Reporting Phase						
Review of Data Reports	Internal comments from staff and external comments from client and regulatory agencies	Document Author Derek Lieberman, Project Manager, Ahtna	Internal = prior to issuance of report External = within 30 days of receipt of report	Provide response to comments and revise report as needed	Commenting client and/or agencies Bridget Floyd, Technical Lead, USACE	30 days

25.4.1 QA Management

Type of Report	Frequency (Daily, Weekly Monthly, Quarterly, Annually, Etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Non-Routine Occurrences Report	As needed	Within 48 hours of a Non-Routine Occurrence in the field or laboratory. A copy of this report will also be included in the CQCR	Eric Schmidt, Project Chemist, Ahtna	USACE: Dana Gentry, Project Manager; Kyle Bayliff, Project Chemist; Bridget Floyd, Technical Lead Ahtna: Eric Schmidt, Project Chemist Chenega: Christina Cervantes, Field Oversight Inspector
Field Work Variance Report	As needed	Prior to implementation of proposed change or immediately following a variance implemented in the field. A copy of the Field Work Variance will also be included in the CQCR	Stephen Korbay, Field Supervisor, Ahtna	USACE: Dana Gentry, Project Manager; Kyle Bayliff, Project Chemist; Bridget Floyd, Technical Lead Ahtna: Derek Lieberman, Project Manager; Eric Schmidt, Project Chemist Chenega: Christina Cervantes, Field Oversight Inspector
Validation Summary Report	Following each sampling event	Produced as part of the SI Narrative Report	Eric Schmidt, Project Chemist, Ahtna	USACE: Dana Gentry, Project Manager; Kyle Bayliff, Project Chemist; Bridget Floyd, Technical Lead Fort Ord BRAC: William Collins, BEC Fort Ord Administrative Record USEPA: Maeve Clancy, Project Manager TechLaw: Joe Carter, Cheryl Moeller CCRWQCB: Amber Sellinger, Project Manager DTSC: Cindy Chain-Britton, Project Manager

26.0 Worksheet #34: Data Verification and Validation Inputs

This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the contract, methods, SOPs, and the QAPP.

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	X
7	Equipment Calibration Records	X	X
8	Chain of Custody Forms	X	X
9	Sampling Diagrams/Surveys	X	X
10	Drilling Logs	X	X
11	Relevant Correspondence	X	X
12	Change Orders/Deviations	X	X
13	Field Audit Reports	X	X
14	Field Corrective Action Reports	X	X
Analytical Data Package			
15	Cover Sheet (laboratory identifying information)	X	X
16	Case Narrative	X	X
17	Sample Chronology (e.g., dates and times of receipt, preparation, and analysis)	X	X
18	LOD/LOQ Establishment and Verification	X	X
19	Standards Traceability	X	X
20	Instrument Calibration Records	X	X
21	Definition of Laboratory Qualifiers	X	X
22	Results Reporting Forms	X	X
23	QC Sample Results	X	X

Item	**Description**	**Verification (completeness)**	**Validation (conformance to specifications)**
24	CA Reports	X	X
25	Raw Data	X	X
26	Chromatograms	X	X
27	Electronic Data Deliverable	X	X

27.0 Worksheet #35: Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Methods	QAPP, SOP	Records support implementation of the SOP-sampling and analysis.	Project Chemist, Ahtna
Performance Requirements	QAPP, SOP	Verify laboratory method SOPs are sufficient to satisfy DQOs.	Project Chemist, Ahtna
Sampling Locations, Number of Samples	QAPP, SOP	Verify that sample locations and quantities will be sufficient to satisfy DQOs.	Project Chemist, Ahtna
Three phase inspection forms and Other Field Documentation	QAPP, SOP	Review daily sampling activity reports including pertinent field sampling data.	Project Chemist, Ahtna
Chain of Custody	QAPP, SOP	Examine traceability of data from sample collection to generation of project reported data.	Project Chemist, Ahtna
Deviations	QAPP, SOP	Determine impacts of any deviations from methods.	Project Chemist, Ahtna
Sensitivity	QAPP, SOP	Verify that LODs and LOQs are achieved as outlined in the QAPP and that the laboratory successfully analyzed a standard at the LOD.	Project Chemist, Ahtna
Precision	QAPP, SOP	Review data against performance criteria and determine impact of any result out of criteria.	Project Chemist, Ahtna
Accuracy	QAPP, SOP	Review data against performance criteria and determine impact of any result out of criteria.	Project Chemist, Ahtna
QC samples	QAPP, SOP	Ensure that a sufficient number of QC samples are analyzed, as outlined in the QAPP, to meet DQOs.	Project Chemist, Ahtna
Electronic Data Deliverables (EDDs)	QAPP	Verify that acceptable EDDs have been qualified. The Laboratory Data Consultants Automated Data Review (LDC ADR) EDD format files will be uploaded into the FODIS chemistry database, EDD files will be submitted to USACE. EDD File Specifications are provided in Attachment E.	Project Chemist, Ahtna

28.0 Worksheet #36: Data Validation Procedures

Analytical Group/Method:	**Draft EPA Method 1633**
Data deliverable requirements:	LDC ADR
Analytical specifications:	Worksheet #28
Measurement performance criteria:	Worksheet #12
Percent of data packages to be validated:	100% Stage 2B
Percent of raw data reviewed:	10% Stage 4
Percent of results to be recalculated:	10% Stage 4
Validation procedure:	DoD Data Validation Guidelines
Validation qualifiers:	See table below
Electronic validation program:	LDC ADR

Notes:

Data Validation Guidelines:
Quality Systems Manual for Environmental Laboratories, Version 5.4 (DoD, 2021),
General Data Validation Guidelines, Revision 1 (EDQW, 2019)
Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (EDQW, 2020)
LDC ADR = Laboratory Data Consultants Automated Data Review format

SUMMARY OF DATA QUALIFIERS

Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result was an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively identified” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

29.0 Worksheet #37: Data Usability Assessment

To the extent possible, the USEPA data quality assessment (DQA) process will be followed to verify the type, quality, and quantity of data collected are appropriate for their intended use. DQA methods and procedures are outlined in the DoD General Data Validation Guidelines (EDQW, 2019), and Data Quality Assessment: A Reviewer's Guide (USEPA, 2006a). The DQA process included five steps:

1. Review the DQOs and sampling design
2. Conduct a preliminary data review
3. Select a statistical test
4. Verify the assumptions of the statistical test
5. Draw conclusions from the data

After the data are received from the field team or from the laboratory, validation of the data will occur as described in Worksheet #36. During validation, where necessary, validation qualifiers will be applied to the data indicating that it has limited use, should perhaps be examined more closely, or has dramatically failed one or more DQI criteria and has been rejected. This information will be supplied to the project team via a validation report and to the data management team through updates to the database. A DQA report will be prepared on a periodic basis summarizing the overall quality of the data, including field data, field QC data, laboratory QC data, laboratory QC data trends, and laboratory data. This will further illustrate the limitations of any qualified data that may have resulted during data validation. It is incumbent on the project team to then utilize the data in an appropriate manner based on any limitations that have been identified.

29.1 Usability Assessment Process

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

Data usability is the process of evaluating the data validation results and determining the confidence with which any data point(s) may be used. Usability is determined by evaluating the data validation qualifier applied, and the laboratory QC results. Concentration values may be considered to have a high degree of confidence because the associated method performance criteria were achieved. Estimated concentration results are evaluated with respect to the bias contributed to the value by the associated QC result. Bias direction can be estimated for data quality impacts due to surrogate recoveries, matrix spike recoveries, and laboratory control sample recoveries. Sample concentration results that are rejected during data validation are not used in the decision-making process and should not be reported.

29.2 Evaluative Procedures

Describe the evaluative procedures used to assess overall measurement error associated with the project:

Data usability is evaluated with respect to the DQOs developed in Worksheet #11 of this QAPP to check that the opportunity for incorporating unacceptable and manageable error into the decision-making process is minimized to the extent possible. The acceptable error associated with the analytical data results and their use is contained in Worksheet #11, which describes the DQOs for the project. The analytical data, data validation qualifiers, and QC results will be evaluated to determine the confidence with which the soil and groundwater data can be used in the project decision-making process. The criteria used in the data usability summary are presented as follows using the DQI criteria required for this project and measured as PARCCS.

29.3 Personnel

Identify the personnel responsible for performing the usability assessment:

In-depth assessment occurs during the data verification process. The verification will assess conformance with the requirements of the methods, SOPs, and objectives of the QAPP. The findings of the data verification process will generate qualifiers applied to the data considered in context to assess the overall usability of the data. Data usability is first evaluated by the data validation team, the QA/QC Manager, and the laboratory performing the fixed based analysis. Usability of data collected in the field is first determined by the field team, field supervisor, and site QA/QC Manager. Once the data are validated, the usability of the data are determined by the project team:

- Project Chemist, Ahtna
- Database Manager, Ahtna
- Project Manager, Ahtna
- Field Supervisor, Ahtna

29.4 PARCCS Overview

29.4.1 Introduction

This QA program addresses both field and laboratory activities. QA objectives are formally measured through the computation of performance measures known as DQIs, which are in turn compared to pre-defined measurement quality objectives (MQOs) specific to the project objectives. The DQIs for measurement data are expressed in terms of PARCCS parameters. Evaluation of DQIs provides the mechanism for ongoing control and evaluation of data quality throughout the project and ultimately will be used to define the data quality achieved for the various measurement parameters. The field QA/QC program will be accomplished through the collection of field duplicates, equipment blanks, and field blanks. The analytical QA/QC program will be assessed through the internal laboratory QC performed, including but not limited to method blanks, LCS recoveries, surrogate recoveries, and MS/MSD recoveries. The following sections describe the DQIs in greater detail, with a discussion of the associated MQOs.

29.4.2 Precision

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. Total precision is the measurement of the variability associated with the entire sampling and analytical process. It is determined by analysis of duplicate field and laboratory samples and measures variability introduced by both the laboratory and field operations. Field duplicate and MS/MSD samples will be analyzed to assess field and laboratory precision. For duplicate sample results, the precision is evaluated using the relative percent difference (RPD). For replicate results, the precision is measured using the relative standard deviation (RSD). The formula for the calculation of RPD is provided below.

If calculated from duplicate measurements: (Eq. 1)

$$RPD = \frac{C1 - C2}{\overline{x}(C1, C2)} \times 100$$

Where:

RPD = relative percent difference

C1 = larger of the two observed values

C2 = smaller of the two observed values

$\overline{x}$ = mean of the observed values

If calculated from three or more replicates, use RSD rather than RPD: (Eq 2)

$$\frac{S}{\overline{x}} \times 100$$

Where:

RSD = relative standard deviation

S = standard deviation

$\overline{x}$ = mean of replicate analyses Standard deviation,

S is defined as follows: (Eq 3)

$$S = \sqrt{\frac{(x_1 - \overline{x})^2 + (x_2 - \overline{x})^2 + (x_3 - \overline{x})^2 + ..}{n - 1}}$$

Where:

S = standard deviation

n = number of replicate measurements

x = measured value of the replicate

$\overline{x}$ = mean of the replicate analyses

For field duplicates, the precision goals for this project are RPD = 30% for liquid samples and RPD = 40% for soil samples. For laboratory duplicates, the RPD goals are dictated by the specific analytical and laboratory QC acceptance criteria.

29.4.3 Accuracy and Bias

Accuracy refers to the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement. The converse of accuracy is bias, in which a systematic mechanism tends to consistently introduce errors in one direction or the other. Bias in environmental sampling can occur in one of three ways; these mechanisms and their associated diagnostic and management methods are as follows:

- High bias can stem from cross-contamination of sampling, packaging, or analytical equipment and materials. Cross-contamination is monitored through blank samples, such as equipment blanks, field blanks, and method blanks. These samples assess the potential for cross-contamination from, respectively, sampling equipment, ambient conditions, packaging and shipping procedures, field filters, and laboratory equipment. Data validation protocols described in Worksheet #36 present a structured approach for data qualification based on blank samples.
- Low bias can stem from the dispersion and degradation of target analytes. The effects of these mechanisms are difficult to quantify. Sampling accuracy can be maximized, however, by the adoption and adherence to a strict field QA/QC program. Specifically, sampling procedures will be performed following standard protocols described in Worksheet #17. Through regular review of field procedures, deficiencies will be documented and corrected in a timely manner.
- High or low bias can be due to poor recoveries, poor calibration, or other system control problems. The effects of these mechanisms on analytical accuracy may be expressed as the percent recovery of an analyte that has been added to the environmental sample at a known concentration before analysis. Analytical accuracy in the laboratory will be determined through the analysis of LCSs and MS/MSDs. As with blank samples, data validation protocols provide a structured formula for data qualification based on erroneously high or low analyte recoveries.

Accuracy, when potentially affected by high or low recoveries as described in the third bullet above, is presented as percent recovery (%R), the mass spectrometry recovery is defined as:

$$\%R = \frac{S - U}{C_{sa}} \times 100$$

Where:

%R = percent recovery

S = measured concentration in spiked aliquot

U = measured concentration in unspiked aliquot

C_{sa} = actual concentration of spike added

For situations where a standard reference material is used instead of or in addition to MSs: (Eq 5)

$$\%R = \frac{C_m}{C_{sm}} \times 100$$

Where:

%R = percent recovery

C_m = measured concentration of standard reference material

C_{sm} = actual concentration of standard reference material

Accuracy goals are presented as upper and lower control limits for percent recovery and are generated through the compilation of control charts and referenced in each laboratory method SOP attached to this QAPP.

29.4.4 Representativeness

Representativeness is defined by the degree to which the data accurately and precisely describe a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. If the results are reproducible, the data obtained can be said to represent the environmental condition. Representativeness is evaluated by collecting sufficient numbers of samples of an environmental medium, properly chosen with respect to place and time. The precision of a representative set of samples reflects the degree of variability of the sampled medium, as well as the effectiveness of the sampling techniques and laboratory analysis. Representativeness will be determined through consensus with USACE and AFCEC concerning appropriate sampling scope.

29.4.5 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same for all data uses in that sufficient amounts of valid data are to be generated. The percent completeness for each set of samples will be calculated as follows:

$$\%\ Completeness\ =\ \frac{Valid\ Data}{Total\ Data\ Planned} \times\ 100$$

The QA objective for completeness for all parameters will be 95 percent.

29.4.6 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is evaluated using established and approved analytical methods, consistency in the basis of analysis (e.g., wet weight, volume), consistency in reporting units (µg/L, milligrams per liter [mg/L]), and analysis of standard reference materials. By using standard sampling and analytical procedures, data sets will be comparable.

29.4.7 Sensitivity

Sensitivity refers to the minimum magnitude at which analytical methods can resolve quantitative differences among sample concentrations. If the minimum magnitude for a particular analytical method is sufficiently below an action level or risk screening criterion, then the method sensitivity is deemed sufficient to fully evaluate the dataset with respect to the desired reference values. Frequently, risk-based screening levels fall below the sensitivity of even the most sensitive analytical methods. In such cases, it is necessary to review the qualifications of several laboratories, both from the standpoint of sensitivity as well as other DQIs, to select the best laboratory for the project. The MDL is a theoretical limit determined through an MDL study, in which the concentration of a spiked solution is tested at least seven times. The standard deviation of the recovered concentrations (σrec) is computed and multiplied by the t-distribution value to arrive at the MDL. Additionally, the incorporation of the analysis of a series of method blanks is all used to establish MDLs that allow for the elimination of general laboratory "background" contamination. The data is evaluated using the following: DL, LOD and LOQ. The DL is defined as the concentration with a 1% false-positive rate, meaning a concentration at the DL has a 99% rate of being greater than 0. The LOD is defined as the concentration with a 1% negative rate, meaning a concentration at the LOD has a 99% rate of being detected above the DL. The LOQ is defined as the smallest concentration that produces a quantitative result. Any concentration detected above the DL and less than the LOQ will be reported as estimated. Any analyte not detected above the DL will be reported as not detected at the LOD. Analytical sensitivity is readily evaluated by comparing method LODs to risk-based screening values. The results of this analysis demonstrate the suitability of the selected methods to the project requirements and are presented in Worksheet #15.

29.5 Documentation

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

Data usability will be documented through validation reports as well as through the issuance of data quality assessment reports (DQARs), which will summarize how the data reflect the specific criteria for the DQIs assigned to the project, identify the limitations of the data, and describe the effect any qualified results have on the decision made pursuant to the project’s DQOs. A DQAR containing this information will be included in interim and final Phase I RI reports where applicable and will provide discussions of the data usability assessment.

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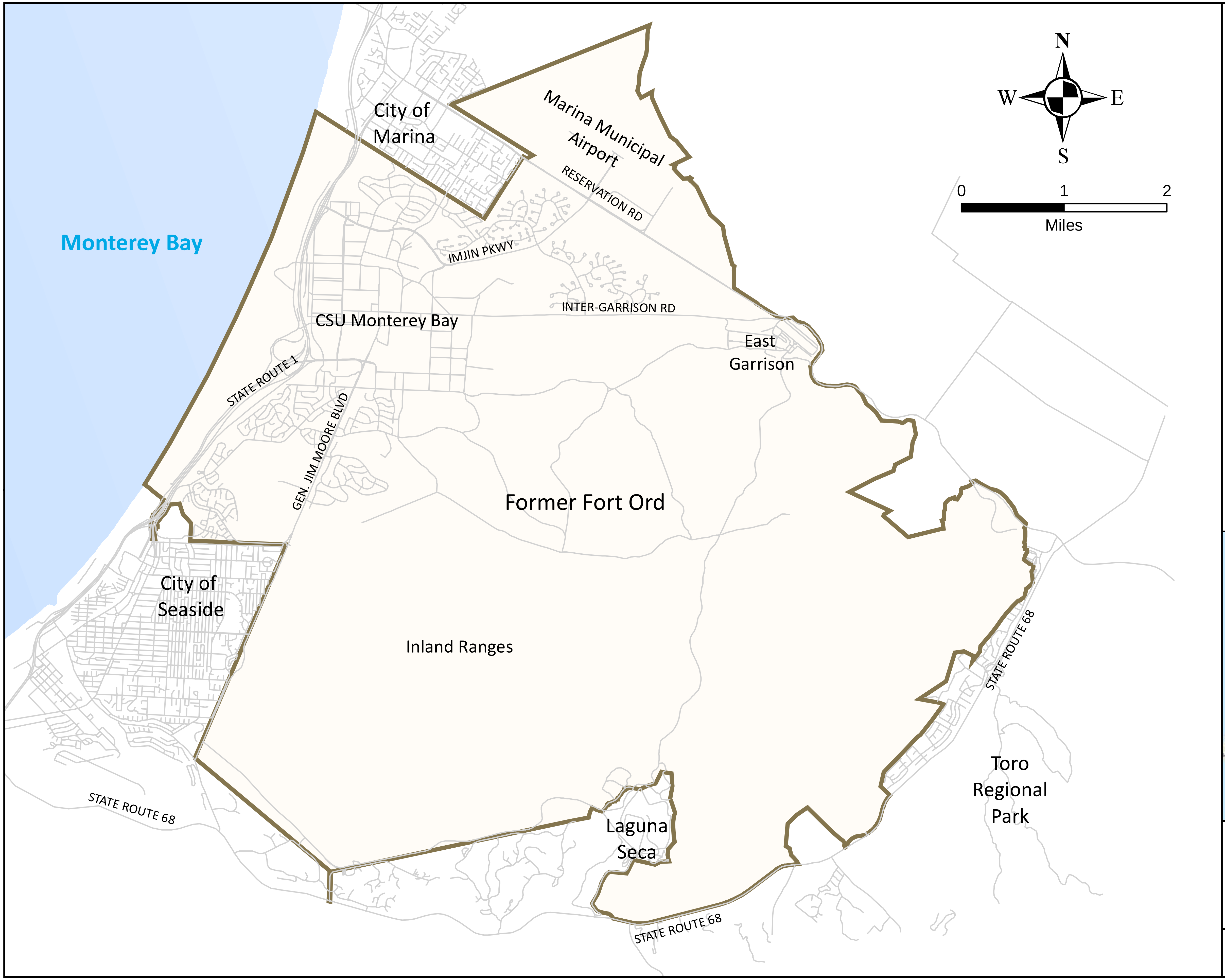
FIGURES

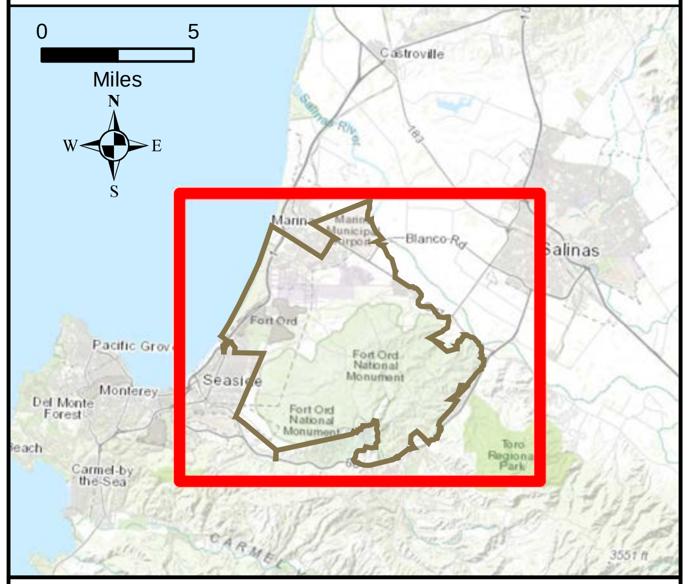


EXPLANATION

▭ Former Fort Ord Boundary

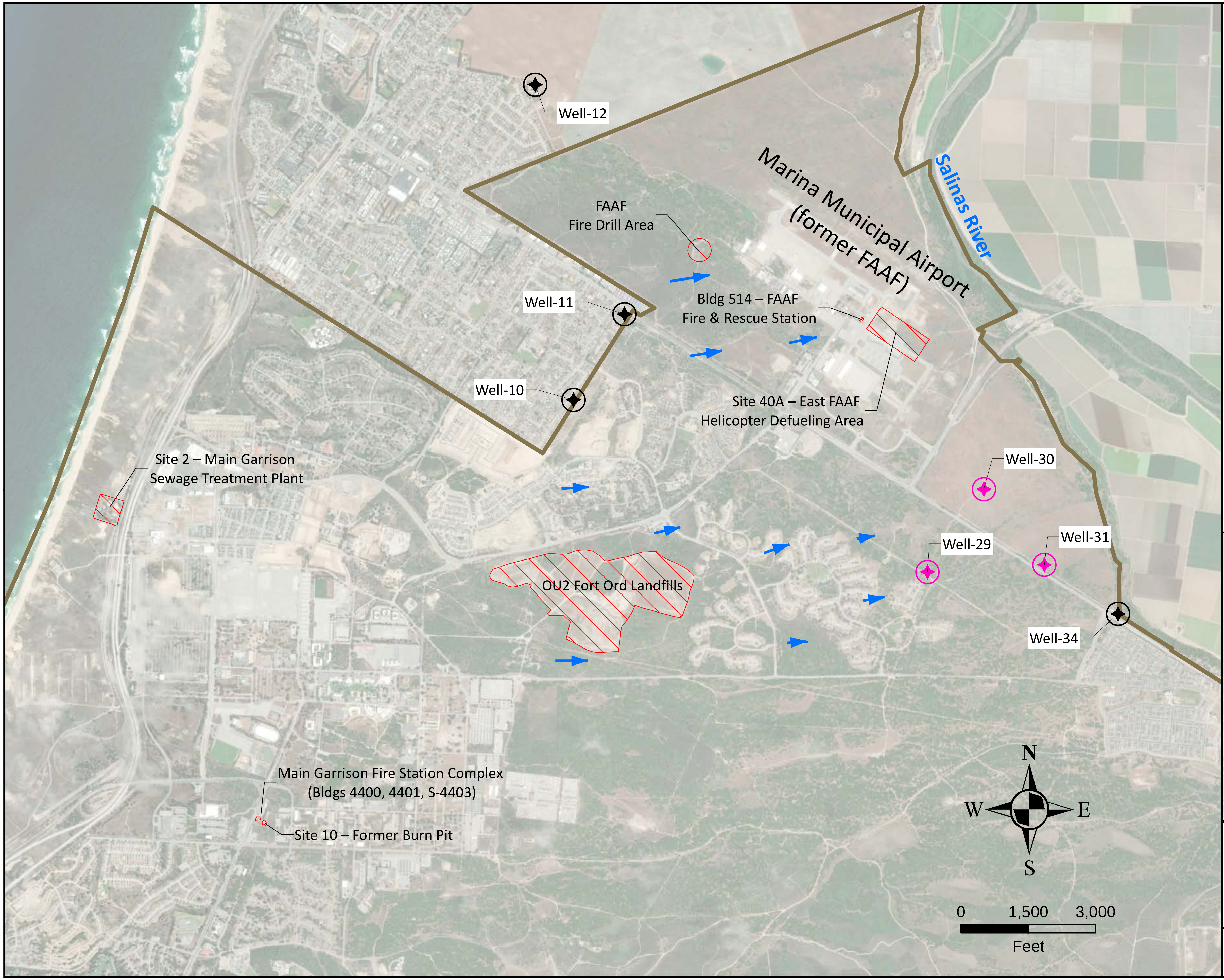
— Roads

NOTES:
1. Marina Municipal Airport is the former Fritzsche Army Airfield (FAAF)
2. CSU Monterey Bay is located within the former Main Garrison area.



FORMER FORT ORD LOCATION MAP
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 6/14/2022 | Figure: 1



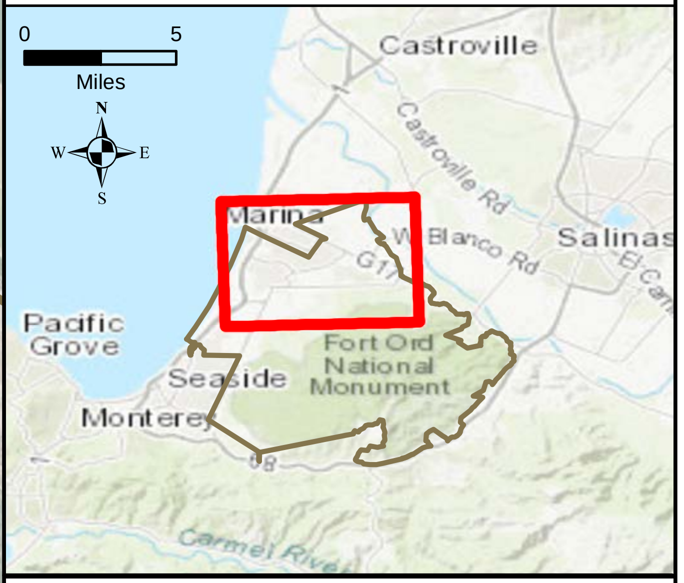
EXPLANATION

- ▨ Suspected PFAS Release Sites
- → General Lower 180-Foot/400-Foot Aquifer Groundwater Flow Direction*
- ▭ Former Fort Ord Boundary
- ✦ Well screened in the Lower 180-Foot/400-Foot Aquifer
- ✦ Well screened in the 900-Foot Aquifer

NOTES:

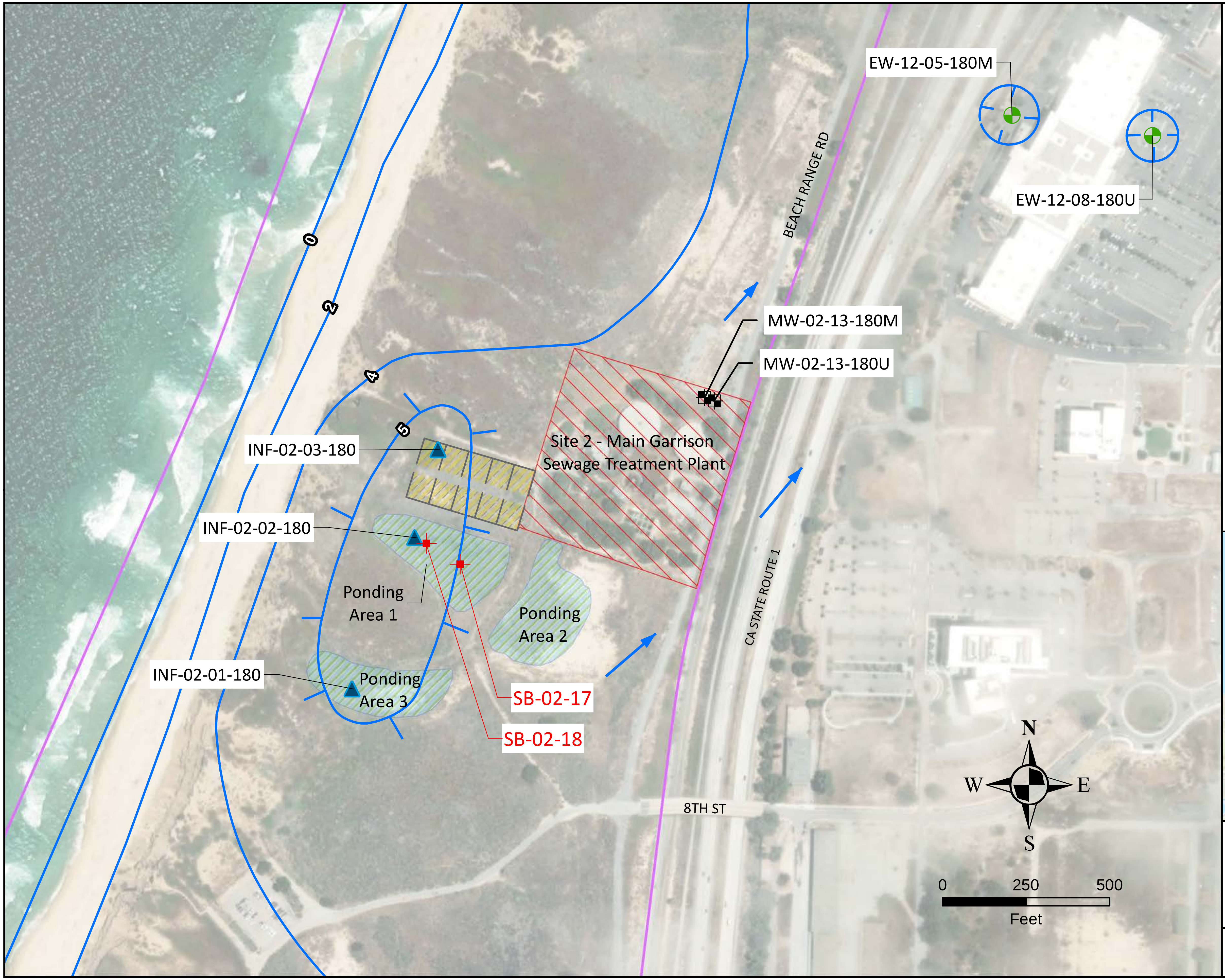
**Operable Unit Carbon Tetrachloride Plume Fourth Quarter 2019 - Third Quarter 2020 Groundwater Monitoring Report* (Ahtna, 2021)

FAAF = Fritzsche Army Airfield
OU2 = Operable Unit 2 (Fort Ord Landfills)



SUSPECTED PFAS RELEASE SITES AND
NEARBY DRINKING WATER SUPPLY WELLS
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 6/16/2022 | Figure: 2



EXPLANATION

- 🟥 Suspected PFAS Release Sites
- ▨ Former Sludge Drying Beds
- ▨ Ponding Area
- ☐ Fort Ord Dunes State Park
- ▲ Existing Infiltration Wells

Recommended Sampling Locations

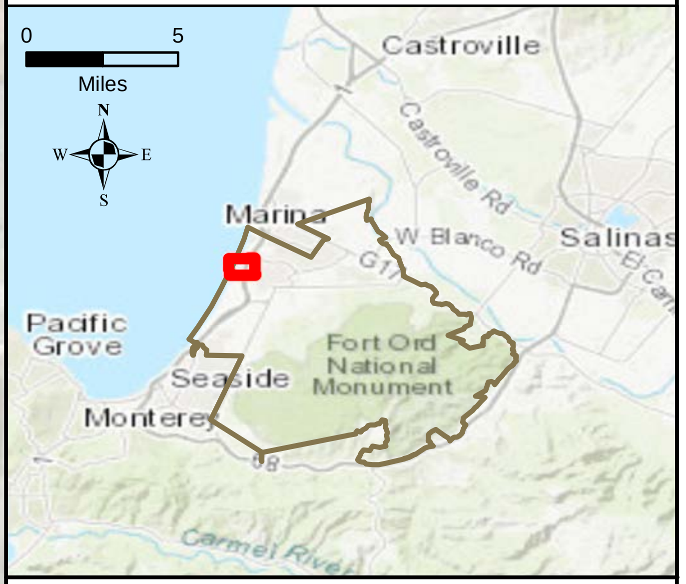
- ■ Existing Groundwater Monitoring Wells
- ● Existing Operating Extraction Wells
- ✚ Proposed Soil Boring Location

Groundwater

- — Groundwater Elevation Contour
- → General Groundwater Flow Direction
- ⊕ Location of Groundwater Depression
- ✛ Location of Groundwater Mound

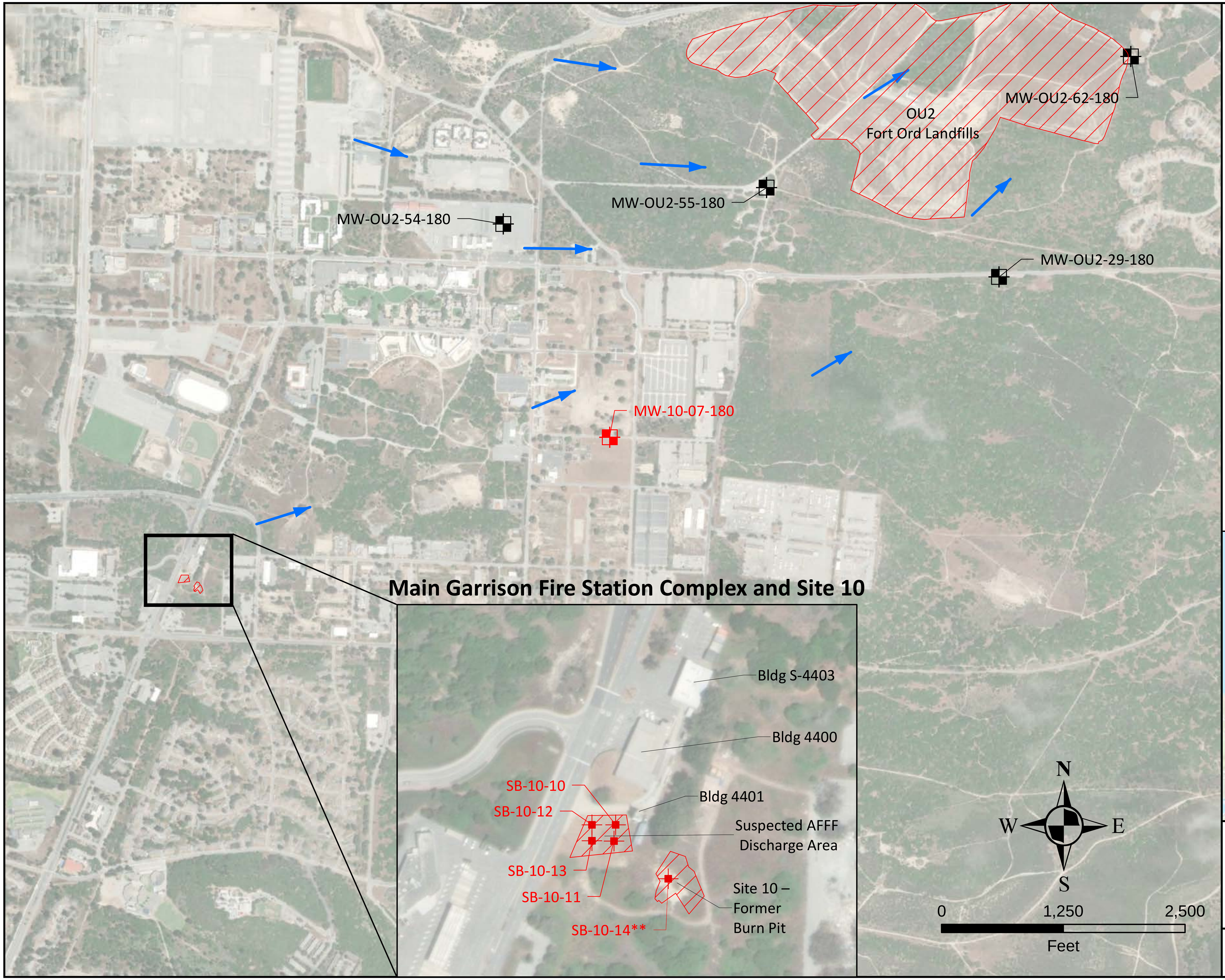
NOTES:
Groundwater elevation contours and general groundwater flow direction are based on one interpretation of historical data because most Site 2 groundwater monitoring wells were decommissioned in 2014; other interpretations may be possible.

Groundwater elevation contours are with respect to mean sea level.



SAMPLING LOCATIONS
SITE 2 - MAIN GARRISON
SEWAGE TREATMENT PLANT
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 6/23/2022 | Figure: 3



EXPLANATION

▨ Tertiary Sites

→ General Upper 180-Foot Aquifer Groundwater Flow Direction*

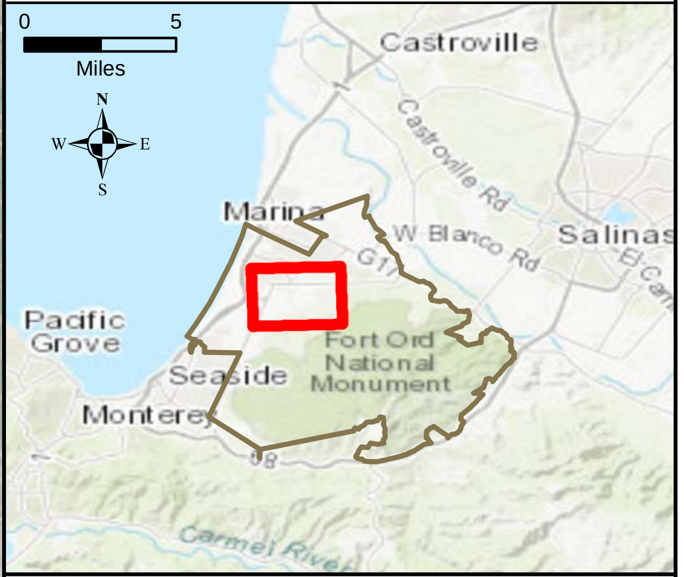
Recommended Sampling Location

■ Existing Groundwater Monitoring Well

🟥 New Groundwater Monitoring Well

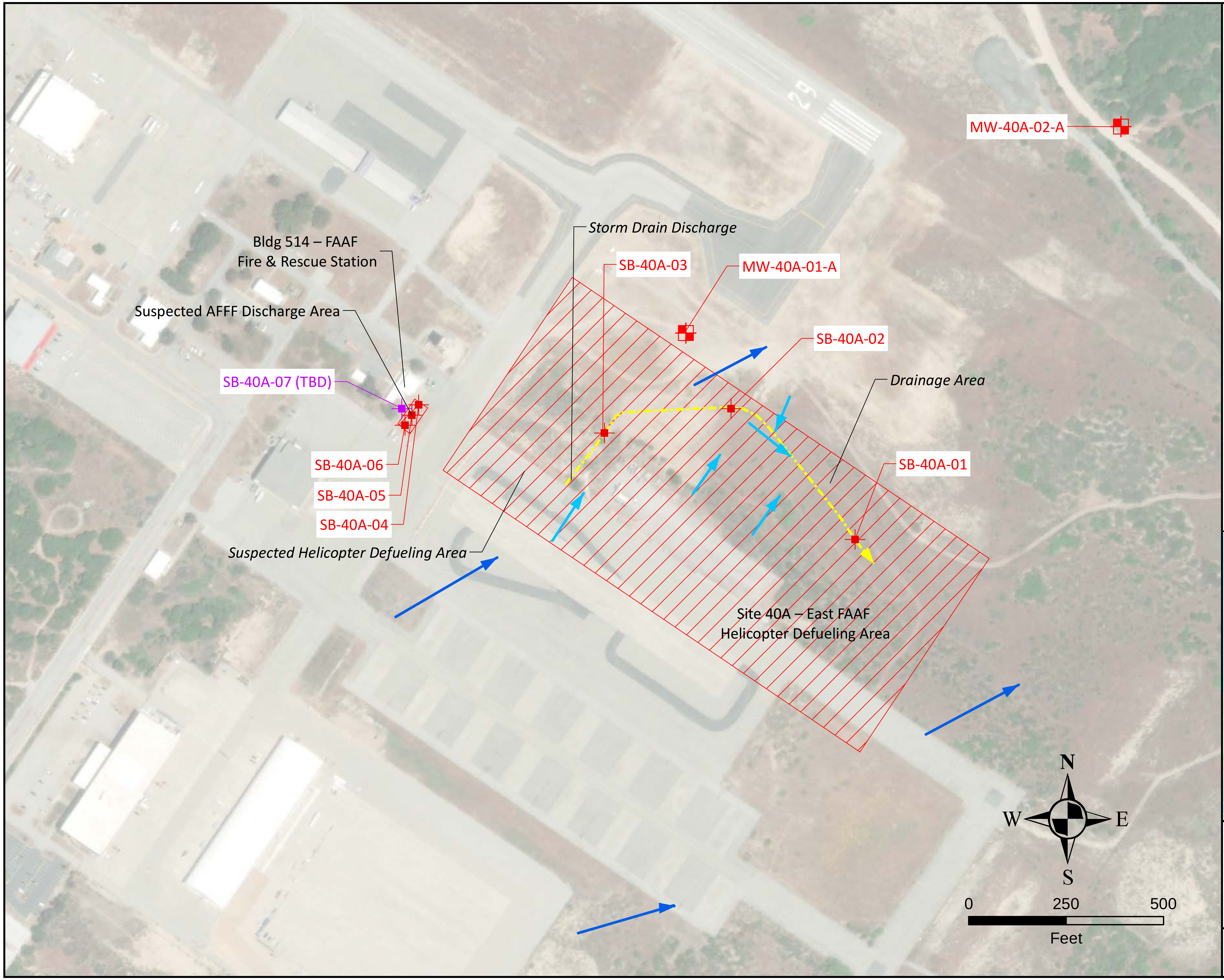
✚ Proposed Soil Boring Location

NOTES:
OU2 = Operable Unit 2 (Fort Ord Landfills)
AFFF = Aqueous Film Forming Foam
Buildings 4400, 4401, and S-4403 = Main Garrison Fire Station
Site 10 = Former Burn Pit
*Groundwater Flow Direction Source
A. North of Inter-Garrison Road: *Fourth Quarter 2019 - Third Quarter 2020 OU2 Remedy Monitoring and Operations and Maintenance(Ahtna, 2021)*
B. South of Inter-Garrison Road: *Sites 2/12, OU2, and OUCTP First Quarter 2014 Groundwater Monitoring Program(AES, 2014)*
** SB-10-14 sample location was determined using an overlay of the excavation limits as provided in the Interim Action Confirmation Report, Site 10 - Burn Pit (HLA, 1996; Admin Record: BW-1382). Location was selected in the center of the area that was excavated at the greatest depth.



SAMPLING LOCATIONS
MAIN GARRISON FIRE STATION AND
SITE 10 - FORMER BURN PIT
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 6/16/2022 | Figure: 4



EXPLANATION

▨ Suspected PFAS Release Sites

Recommended Sampling Locations

- Proposed Groundwater Monitoring
- Proposed Soil Boring Location
- Proposed Deep Soil Boring Location

Water Flow

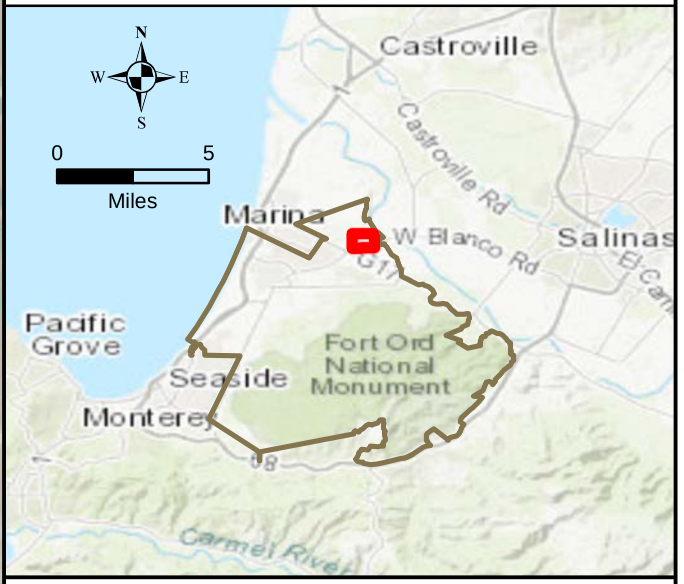
- General A-Aquifer Groundwater Flow Direction*
- General Surface Water Flow Direction
- Drainage Channel

NOTES:

**Fourth Quarter 2019 - Third Quarter 2020 OU2 Remedy Monitoring and Operations and Maintenance* (Ahtna, 2021)

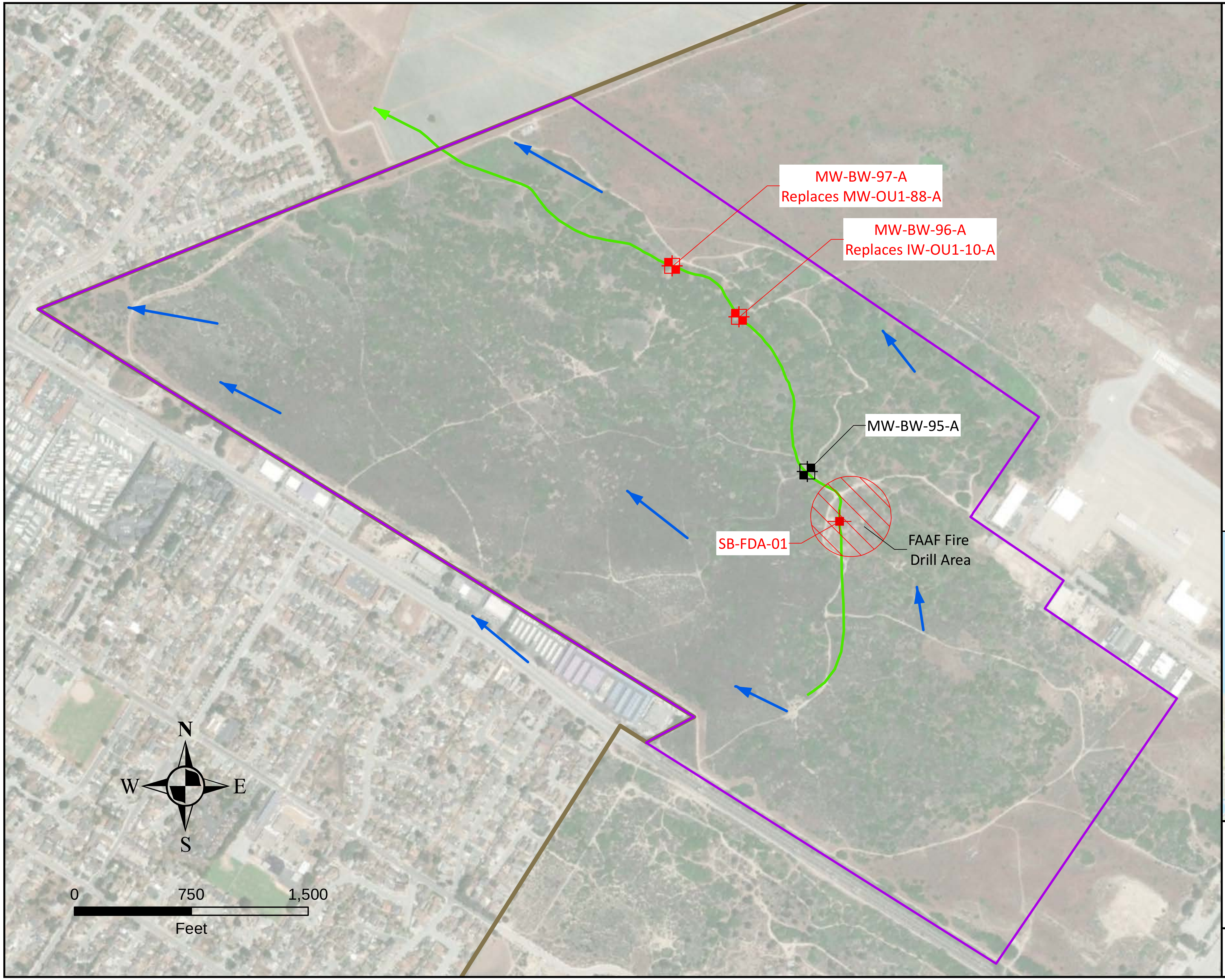
The final location of SB-40A-07 will be determined based on analytical results for samples collected at SB-40A-04, -05, and -06.

AFFF = Aqueous Film Forming Foam
FAAF = Fritzsche Army Airfield



SAMPLING LOCATIONS
FAAF FIRE & RESCUE STATION AND
SITE 40A - EAST FAAF HELICOPTER DEFUELING AREA
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna	Date: 8/29/2022	Figure: 5



EXPLANATION

▨ Suspected PFAS Release Sites

▭ Fort Ord Natural Reserve Boundary

▭ Former Fort Ord Boundary

→ General A-Aquifer Groundwater Flow Direction*

→ Fort Ord-Salinas Valley Aquitard Channel Low**

Recommended Sampling

✚ Existing groundwater monitoring well

✚ Proposed new groundwater monitoring well

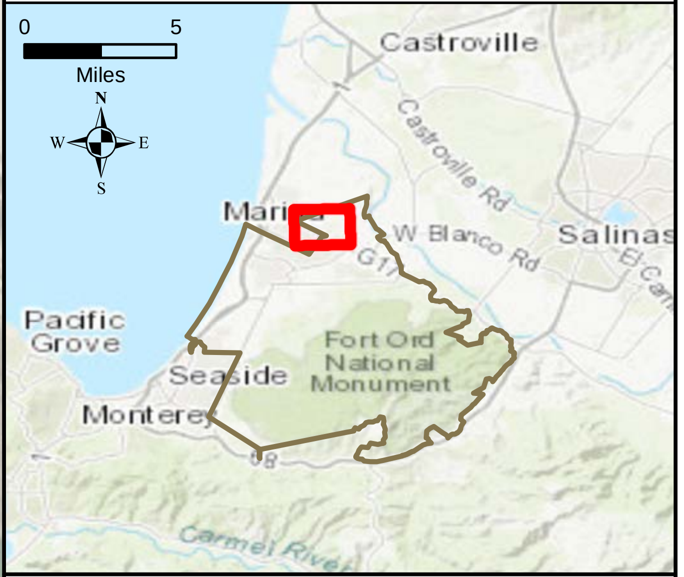
✚ Proposed new soil

NOTES

**Fourth Quarter 2019 - Third Quarter 2020 OU2 Remedy Monitoring and Operations and Maintenance* (Ahtna, 2021)

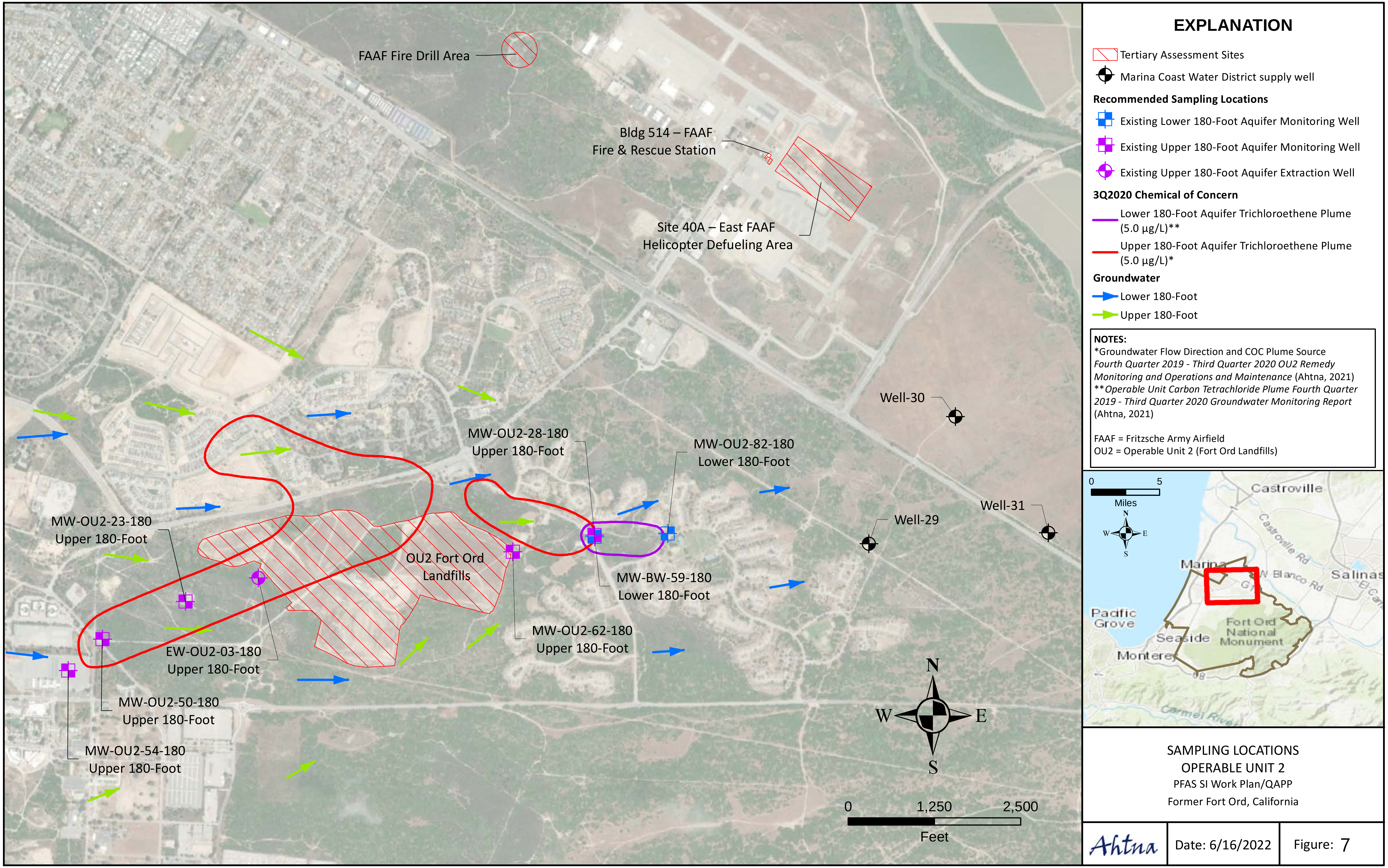
***Remedial Action Completion Report/Technical Memorandum, Operable Unit 1 Attainment Monitoring Results, Sampling Events #1 through #4* (HGL, 2016)

FAAF = Fritsche Army Airfield



SAMPLING LOCATIONS
FAAF FIRE DRILL AREA
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 6/16/2022 | Figure: 6



EXPLANATION

▨ Tertiary Assessment Sites

⊕ Marina Coast Water District supply well

Recommended Sampling Locations

⊕ Existing Lower 180-Foot Aquifer Monitoring Well

⊕ Existing Upper 180-Foot Aquifer Monitoring Well

⊕ Existing Upper 180-Foot Aquifer Extraction Well

3Q2020 Chemical of Concern

— Lower 180-Foot Aquifer Trichloroethene Plume (5.0 µg/L)**

— Upper 180-Foot Aquifer Trichloroethene Plume (5.0 µg/L)*

Groundwater

→ Lower 180-Foot

→ Upper 180-Foot

NOTES:

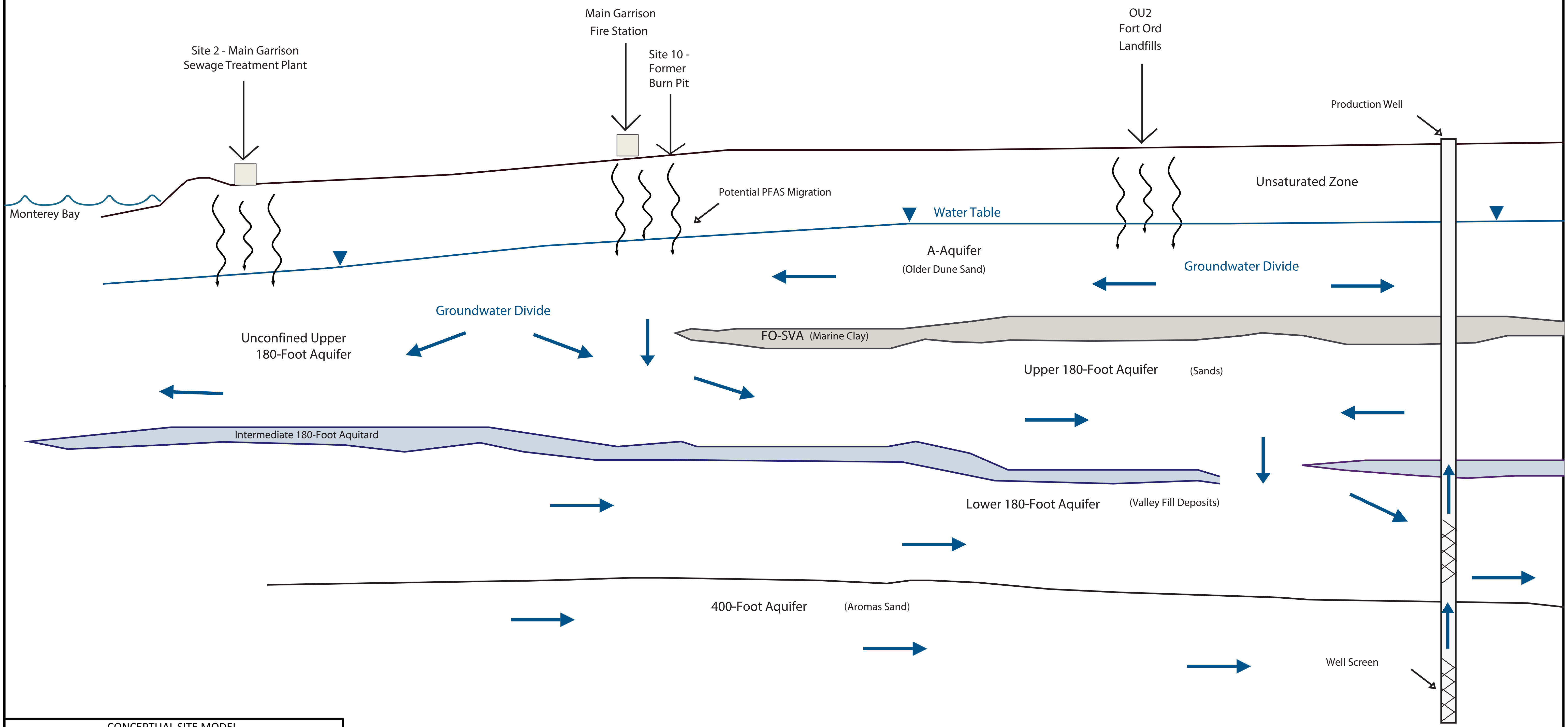
*Groundwater Flow Direction and COC Plume Source *Fourth Quarter 2019 - Third Quarter 2020 OU2 Remedy Monitoring and Operations and Maintenance* (Ahtna, 2021)

***Operable Unit Carbon Tetrachloride Plume Fourth Quarter 2019 - Third Quarter 2020 Groundwater Monitoring Report* (Ahtna, 2021)

FAAF = Fritzsche Army Airfield
OU2 = Operable Unit 2 (Fort Ord Landfills)

SAMPLING LOCATIONS
OPERABLE UNIT 2
PFAS SI Work Plan/QAPP
Former Fort Ord, California

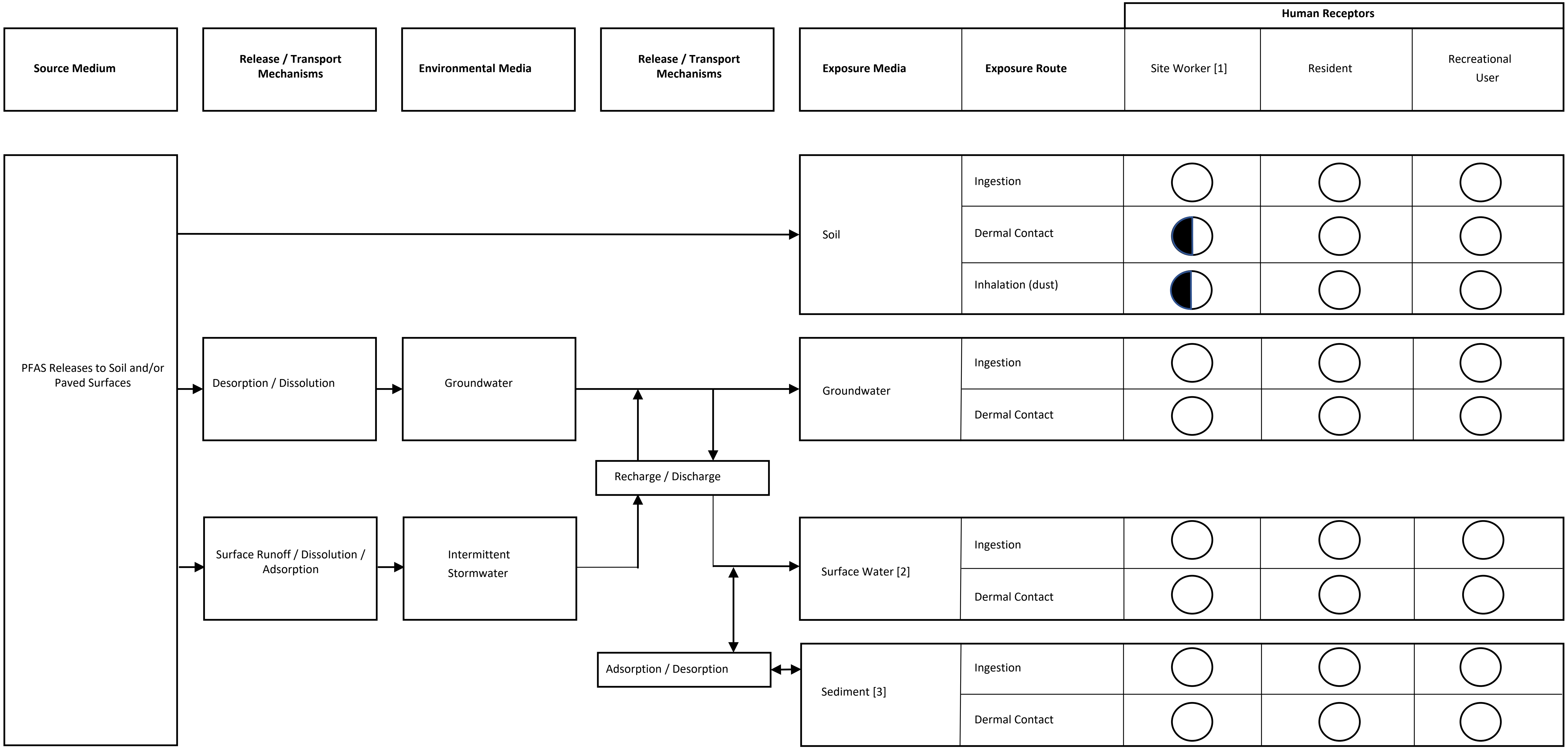
Ahtna | Date: 6/16/2022 | Figure: 7



CONCEPTUAL SITE MODEL
MAIN GARRISON FIRE STATION,
SITE 2 - MAIN GARRISON SEWAGE TREATMENT PLANT,
SITE 10 - FORMER BURN PIT, and
OU2 FORT ORD LANDFILLS
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna	Date: 04/01/2022	Figure: 8

Notes:
Not to scale
→ = Groundwater flow path
FO-SVA = Fort Ord Salinas Valley Aquitard
OU2 = Operable Unit 2 (Fort Ord Landfills)
PFAS = Per- and polyfluoroalkyl substances
Intermediate 180-Foot Aquitard consists of interbedded clay and clayey sand layers, occasionally mixed with coarse gravel
Potential PFAS contamination may enter into the water table and follow the groundwater flow path.



		Human Receptors		
Exposure Media	**Exposure Route**	Site Worker [1]	Resident	Recreational User
Soil	Ingestion	○	○	○
	Dermal Contact	◐	○	○
	Inhalation (dust)	◐	○	○
Groundwater	Ingestion	○	○	○
	Dermal Contact	○	○	○
Surface Water [2]	Ingestion	○	○	○
	Dermal Contact	○	○	○
Sediment [3]	Ingestion	○	○	○
	Dermal Contact	○	○	○

Legend

○ Incomplete Exposure Pathway

◐ Potentially Complete Exposure Pathway

Notes

[1] Potential exposure pathway is for future site workers.

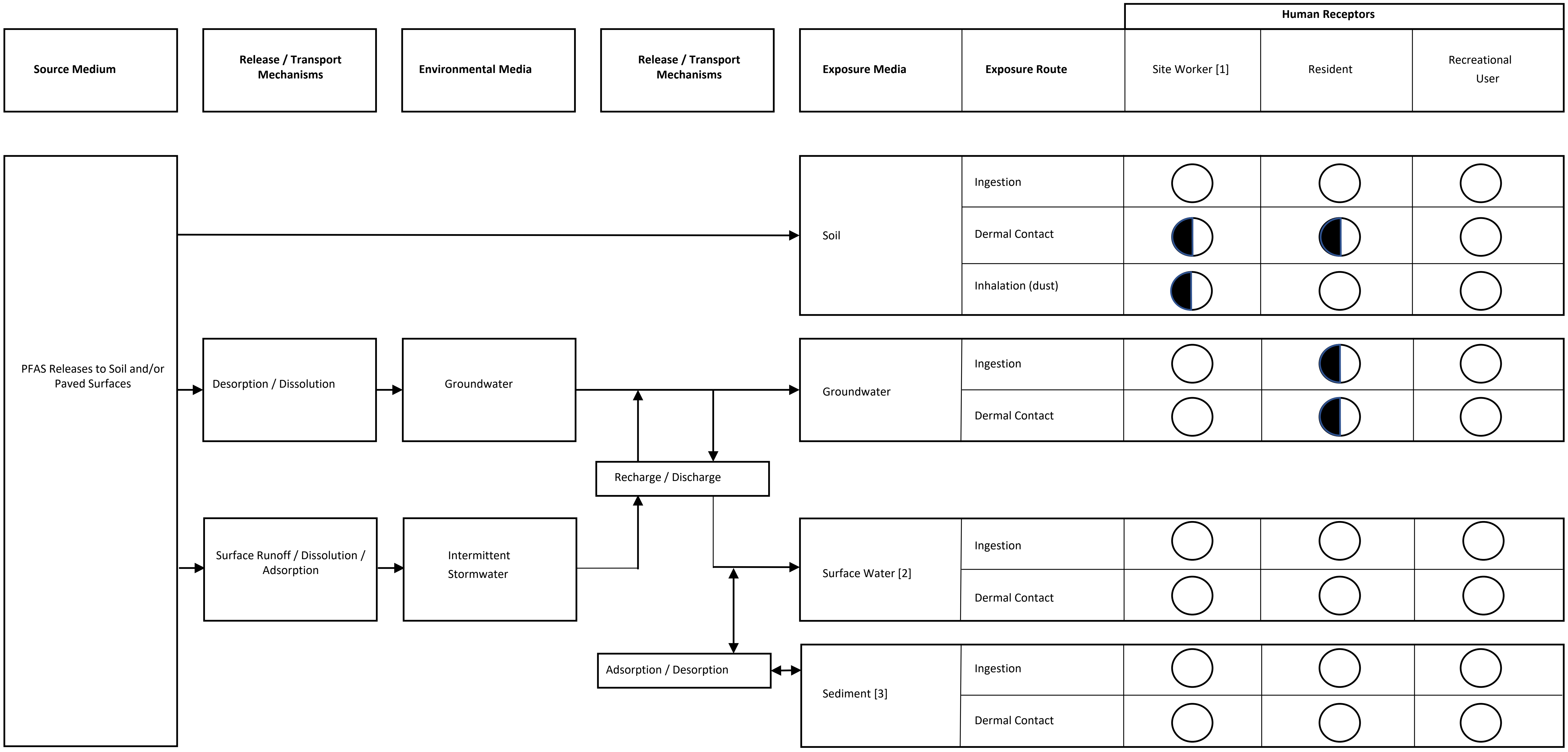
[2] Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Therefore, surface water is not considered a potential exposure pathway.

[3] Sediment is not considered an exposure pathway for the site because potential PFAS-containing sediments were not present or would have been removed during previous remedial actions.

CONCEPTUAL SITE EXPOSURE MODEL
SITE 2 - MAIN GARRISON SEWAGE TREATMENT PLANT

PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna	Date: 4/18/2022	Figure: 9



		Human Receptors		
Exposure Media	**Exposure Route**	Site Worker [1]	Resident	Recreational User
Soil	Ingestion	○	○	○
	Dermal Contact	◐	◐	○
	Inhalation (dust)	◐	○	○
Groundwater	Ingestion	○	◐	○
	Dermal Contact	○	◐	○
Surface Water [2]	Ingestion	○	○	○
	Dermal Contact	○	○	○
Sediment [3]	Ingestion	○	○	○
	Dermal Contact	○	○	○

Legend

○ Incomplete Exposure Pathway

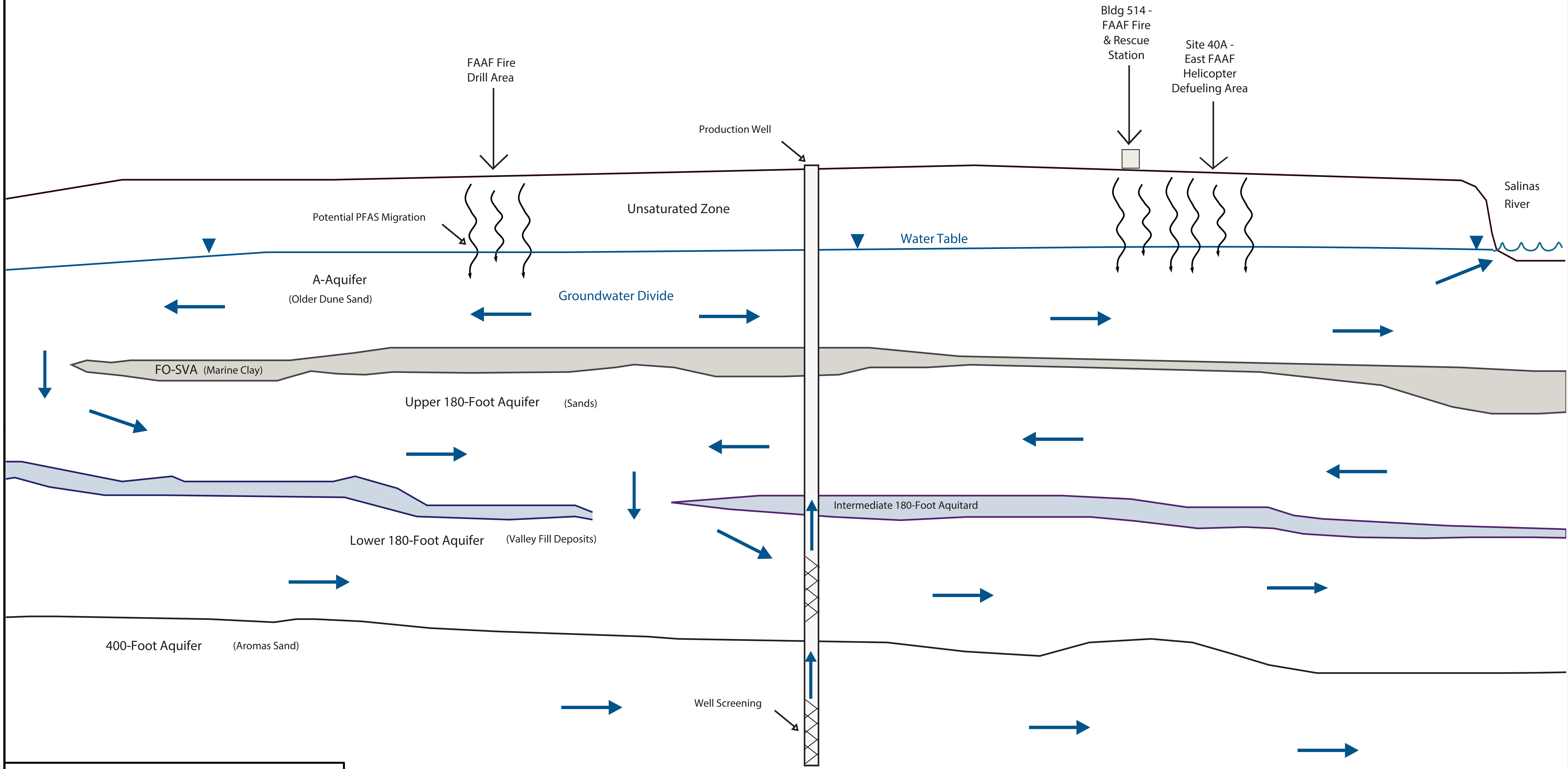
◐ Potentially Complete Exposure Pathway

Notes
[1] Potential exposure pathway is for future site workers.
[2] Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Therefore, surface water is not considered a potential exposure pathway.
[3] Sediment is not considered an exposure pathway for the site because potential PFAS-containing sediments were not present or would have been removed during previous remedial actions.

CONCEPTUAL SITE EXPOSURE
MODEL SITE 10 - FORMER BURN PIT

PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 4/18/2022 | Figure: 10

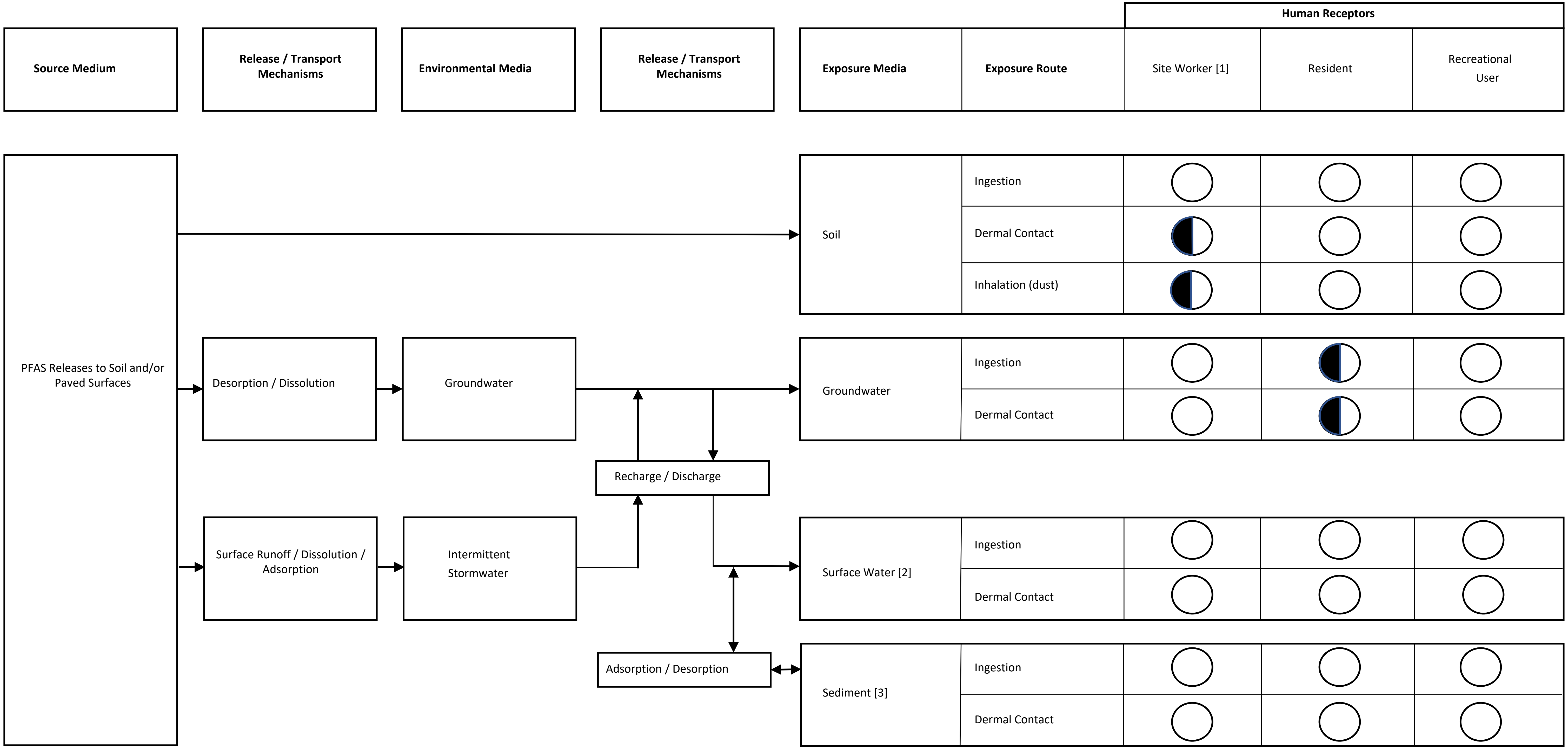


CONCEPTUAL SITE MODEL
FAAF FIRE & RESCUE STATION,
SITE 40A - EAST FAAF HELICOPTER DEFUELING AREA,
and FAAF FIRE DRILL AREA
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Date: 12/19/2021

Figure: 11

Notes:
Not to scale
→ = Groundwater flow path
FAAF = Fritzsche Army Airfield
FO-SVA = Fort Ord Salinas Valley Aquitard
PFAS = Per- and polyfluoroalkyl substances
Intermediate 180-Foot Aquitard consists of interbedded clay and clayey sand layers, occasionally mixed with coarse gravel
Potential PFAS contamination may enter into the water table and follow the groundwater flow path.



		Human Receptors		
Exposure Media	Exposure Route	Site Worker [1]	Resident	Recreational User
Soil	Ingestion	○	○	○
	Dermal Contact	◐	○	○
	Inhalation (dust)	◐	○	○
Groundwater	Ingestion	○	◐	○
	Dermal Contact	○	◐	○
Surface Water [2]	Ingestion	○	○	○
	Dermal Contact	○	○	○
Sediment [3]	Ingestion	○	○	○
	Dermal Contact	○	○	○

Legend

○ Incomplete Exposure Pathway

◐ Potentially Complete Exposure Pathway

Notes

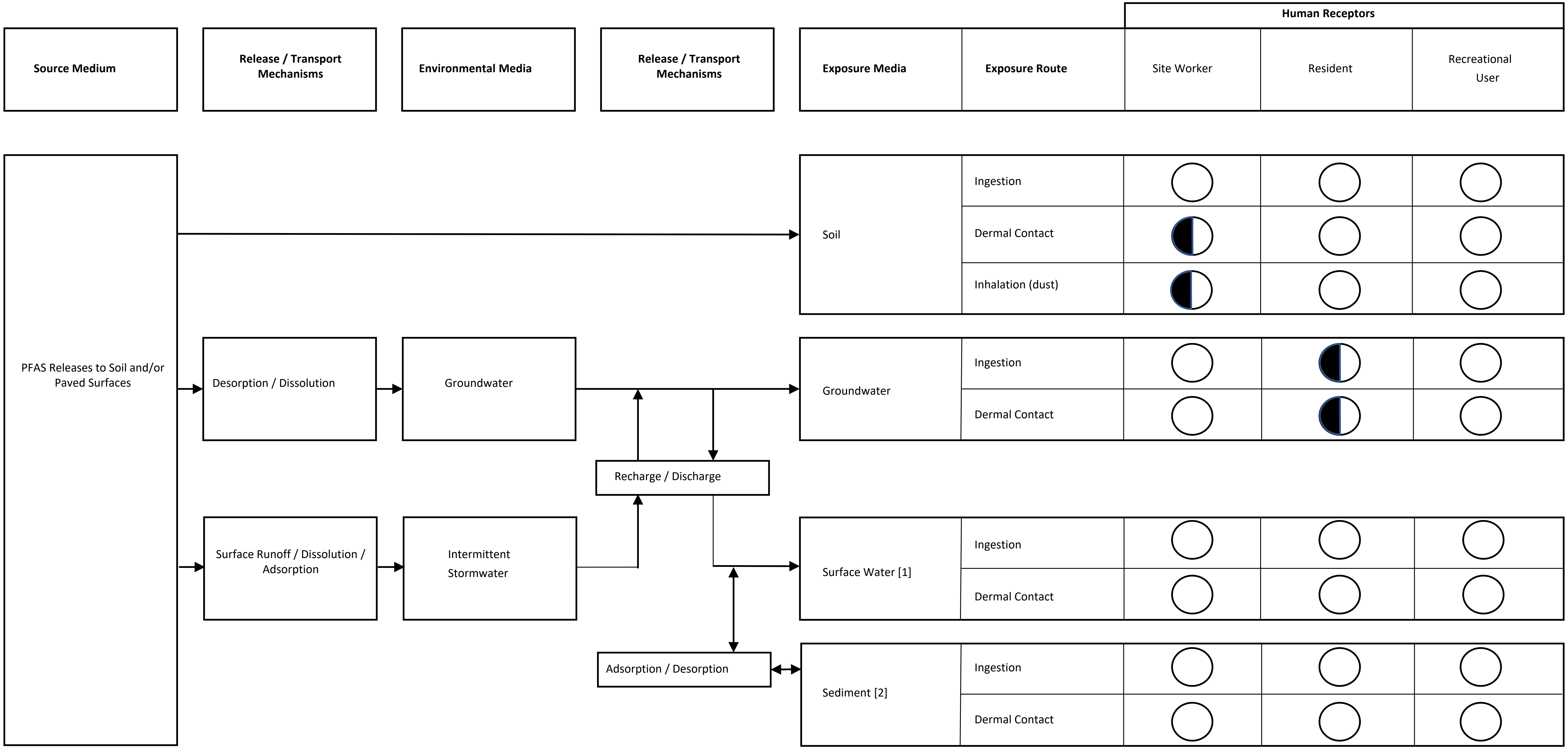
[1] Potential exposure pathway is for future site workers.

[2] Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Therefore, surface water is not considered a potential exposure pathway.

[3] Sediment is not considered an exposure pathway for the site because potential PFAS-containing sediments were not present or would have been removed during previous remedial actions.

CONCEPTUAL SITE EXPOSURE MODEL
SITE 40A - EAST FAAF HELICOPTER DEFUELING AREA
PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 4/18/2022 | Figure: 12



Exposure Media	Exposure Route	Human Receptors		
		Site Worker	Resident	Recreational User
Soil	Ingestion	○	○	○
	Dermal Contact	◐	○	○
	Inhalation (dust)	◐	○	○
Groundwater	Ingestion	○	◐	○
	Dermal Contact	○	◐	○
Surface Water [1]	Ingestion	○	○	○
	Dermal Contact	○	○	○
Sediment [2]	Ingestion	○	○	○
	Dermal Contact	○	○	○

Legend

○ Incomplete Exposure Pathway

◐ Potentially Complete Exposure Pathway

Notes

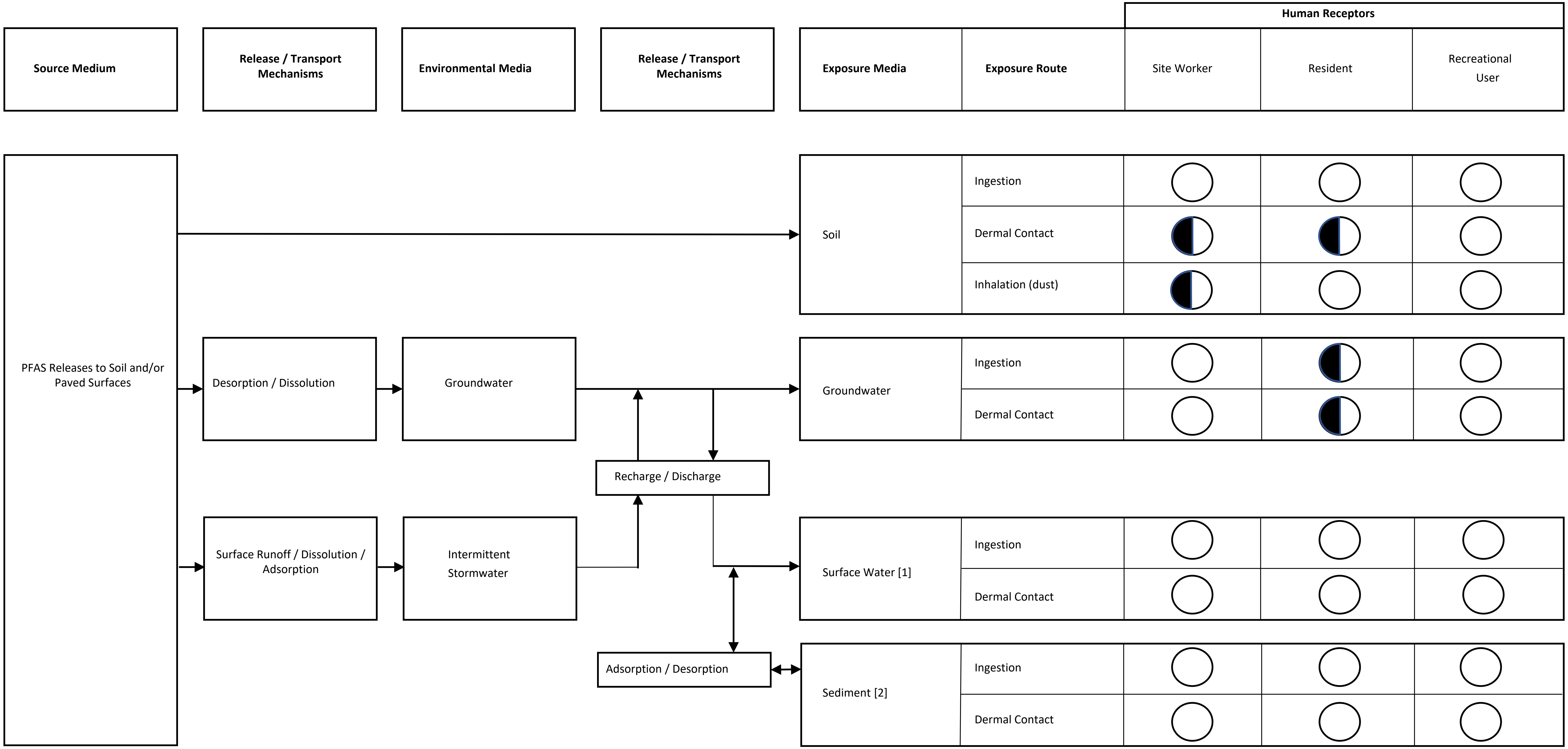
[1] Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Therefore, surface water is not considered a potential exposure pathway.

[2] Sediment is not considered an exposure pathway for the site because potential PFAS-containing sediments were not present or would have been removed during previous remedial actions.

CONCEPTUAL SITE EXPOSURE MODEL
FAAF FIRE & RESCUE STATION

PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 4/18/2022 | Figure: 13



Exposure Media	Exposure Route	Human Receptors: Site Worker	Human Receptors: Resident	Human Receptors: Recreational User
Soil	Ingestion	○	○	○
	Dermal Contact	◐	◐	○
	Inhalation (dust)	◐	○	○
Groundwater	Ingestion	○	◐	○
	Dermal Contact	○	◐	○
Surface Water [1]	Ingestion	○	○	○
	Dermal Contact	○	○	○
Sediment [2]	Ingestion	○	○	○
	Dermal Contact	○	○	○

Legend

○ Incomplete Exposure Pathway

◐ Potentially Complete Exposure Pathway

Notes

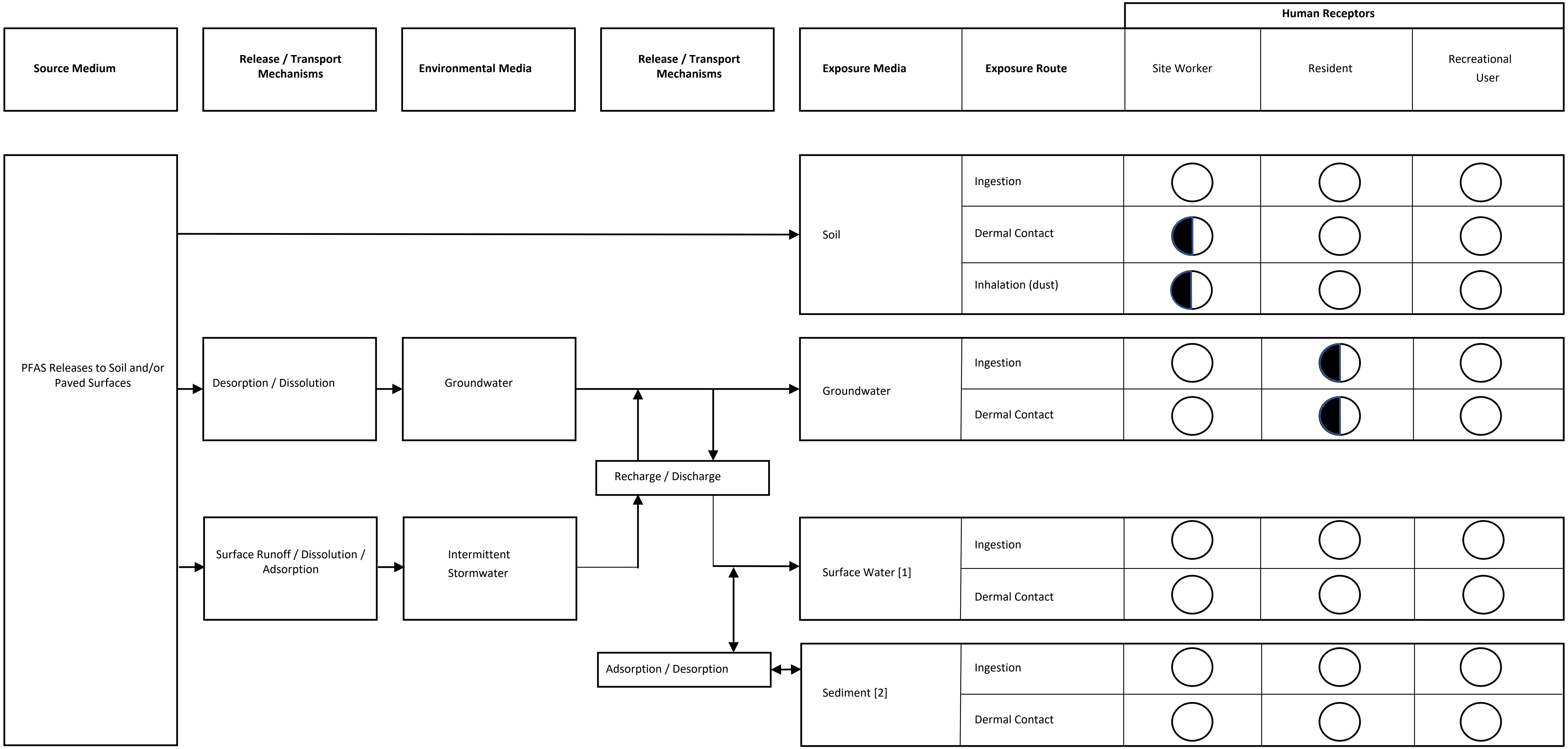
[1] Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Therefore, surface water is not considered a potential exposure pathway.

[2] Sediment is not considered an exposure pathway for the site because potential PFAS-containing sediments were not present or would have been removed during previous remedial actions.

CONCEPTUAL SITE EXPOSURE MODEL
MAIN GARRISON FIRE STATION

PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 4/18/2022 | Figure: 14



Exposure Media	Exposure Route	Site Worker	Resident	Recreational User
Soil	Ingestion	○	○	○
	Dermal Contact	◐	○	○
	Inhalation (dust)	◐	○	○
Groundwater	Ingestion	○	◐	○
	Dermal Contact	○	◐	○
Surface Water [1]	Ingestion	○	○	○
	Dermal Contact	○	○	○
Sediment [2]	Ingestion	○	○	○
	Dermal Contact	○	○	○

Legend

○ Incomplete Exposure Pathway

◐ Potentially Complete Exposure Pathway

Notes

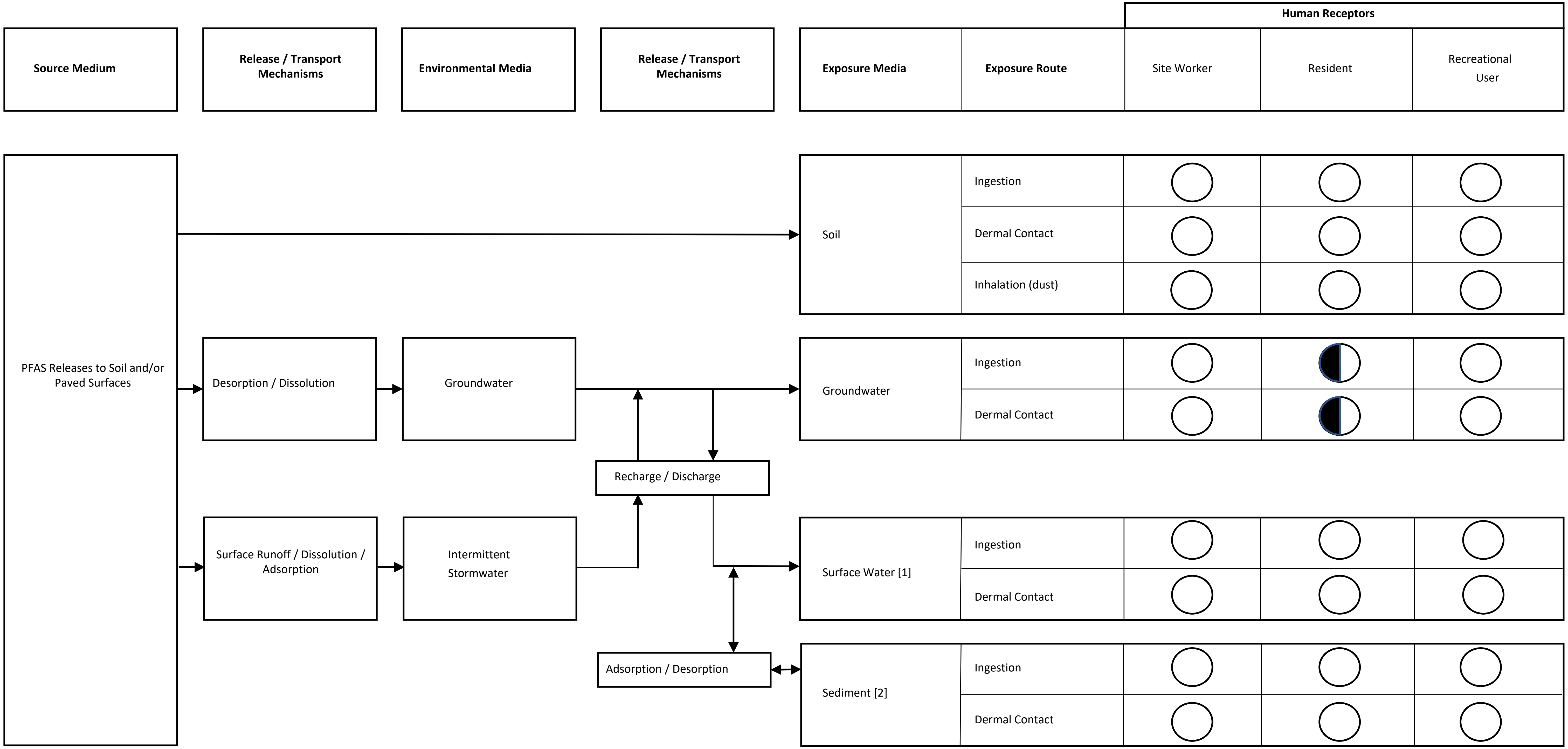
[1] Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Therefore, surface water is not considered a potential exposure pathway.

[2] Sediment is not considered an exposure pathway for the site because potential PFAS-containing sediments were not present or would have been removed during previous remedial actions.

CONCEPTUAL SITE EXPOSURE MODEL
FAAF FIRE DRILL AREA

PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 4/18/2022 | Figure: 15



Exposure Media	Exposure Route	Site Worker	Resident	Recreational User
Soil	Ingestion	○	○	○
	Dermal Contact	○	○	○
	Inhalation (dust)	○	○	○
Groundwater	Ingestion	○	◐	○
	Dermal Contact	○	◐	○
Surface Water [1]	Ingestion	○	○	○
	Dermal Contact	○	○	○
Sediment [2]	Ingestion	○	○	○
	Dermal Contact	○	○	○

Legend

○ Incomplete Exposure Pathway

◐ Potentially Complete Exposure Pathway

Notes

[1] Stormwater runoff from the site to the Monterey Bay or other surface water bodies is unlikely due to the topography and high infiltration soil types present at the site. Therefore, surface water is not considered a potential exposure pathway.

[2] Sediment is not considered an exposure pathway for the site because potential PFAS-containing sediments were not present or would have been removed during previous remedial actions.

CONCEPTUAL SITE EXPOSURE MODEL
OPERABLE UNIT 2

PFAS SI Work Plan/QAPP
Former Fort Ord, California

Ahtna | Date: 4/18/2022 | Figure: 16

ATTACHMENTS

ATTACHMENT A

Standard Operating Procedures (SOPs)

Sampling SOPs

SOP #	Title
001	Field Sample Management
002	Field Activity Records
006	Hollow Stem Auger Drilling
007	Sonic Drilling
008	Standard Operating Procedure: Sampling Groundwater with a HydraSleeve™, 2019
010	Standard Operating Procedure Downhole Meter Groundwater Quality Parameter Collection
101	Standard Operating Procedure for Logbook Documentation and Field Notes (PFAS-Specific)
103	Standard Operating Procedure for Soil Sampling (PFAS-Specific)
105	Standard Operation Procedure for Groundwater Sampling (PFAS-Specific)
111	Standard Operating Procedure for Sample Chain of Custody
112	Standard Operating Procedure for Labeling, Packaging, and Shipping Samples (PFAS-Specific)
113	Standard Operating Procedure for Equipment Decontamination (PFAS-Specific)
120	Standard Operating Procedure for Water Quality Measurements and Calibration (PFAS-Specific)
121	Standard Operating Procedure for Monitoring Well Installation (PFAS-Specific)
122	Standard Operating Procedure for Monitoring Well Development (PFAS-Specific)

1.0 Purpose

The purpose of this standard operating procedure (SOP) is to demonstrate representative environmental sample data by documenting the management of samples from time of collection through analysis and final disposition.

2.0 Scope

This SOP applies to all personnel who collect and/or handle environmental samples.

3.0 Method

3.1 General

An essential part of the sampling/analytical portion of any environmental project is demonstrating the integrity of the sample from collection to data reporting. Projects where analytical data are critical to project conclusions demand that accountability of the history of a sample be available to demonstrate that the data are a true representation of the environment. The chain of custody (COC) form is used as evidence in legal proceedings to demonstrate that a sample was not tampered with or altered in any way that may skew the analytical accuracy of the laboratory results. Therefore, it is extremely important that COC forms be complete, accurate, and consistent.

- Demonstrating sample integrity and accountability requires strict adherence to the proper use of the following six essential sampling components:
- Field Sampling Plans (FSPs);
- Sample labels;
- Sample logs (i.e., boring, well construction, development, and sampling log sheets);
- Sample custody seals;
- Field logbooks; and
- COC forms.

Successful implementation of these components requires a thorough understanding of sample custody requirements. A sample is under an organization's custody if:

- It is in an employee's physical possession;
- It is in view of an employee, after being in their physical possession;
- It was in an employee's physical possession and then locked up so no one could tamper with it; and
- It is in a designated and identified secure area, controlled and restricted to authorized personnel (or individuals accompanied by authorized personnel) only.

A sample remains in an organization's custody until relinquished in writing to another person or organization that is authorized to take custody of the sample.

3.2 Procedures

3.2.1 Sample Identification

Samples will be identified using the naming convention presented in Worksheets 26 and 27 of the project QAPP.

3.2.2 Sample Labels

Sample labels are required to prevent misidentification of samples. Sample labels will generally be pre-printed by a database technician and taken to the field by the sampling crew.

The sample label will be affixed to the proper sample container at the time of the sampling event by the field sampler. The labels will contain the following information:

- Sample identification number (ID);
- Site ID;
- Analyses requested;
- Preservatives used;
- Matrix spike/matrix spike duplicate (MS/MSD) if required.
- Field sampler’s initials;
- Date (mm/dd/yy or m/d/yy, i.e., 04/03/18 or 4/3/18 is April 3, 2018); and
- Time of sample collection (military format).

Custody seals are narrow strips of adhesive paper used to document that no sample tampering has occurred during transport from the time of collection to laboratory receipt. Custody seals will be signed, dated, and attached to all coolers so they tear if the cooler is opened.

3.2.3 Field Logbooks

All samples collected will be documented in field logbooks. All field documentation will follow SOP-002, Field Activity Records.

3.2.4 Chain-of-Custody Form

Every person involved with sample collection and handling will know and understand the COC form, discussed in detail in SOP-111, Chain-of-Custody. These procedures will be made available to all field personnel.

The sample shipper will complete the COC form while preparing the samples for shipment. This individual or other authorized person will sign the “Relinquished By” box prior to sealing a sample shipping container for courier pickup after checking that samples and COC forms match (in other words, only samples identified on the enclosed COC(s) are in the container and all samples enclosed are listed on the COC(s) enclosed). The “Received By” box will be signed by the laboratory sample receipt staff. As long as COC forms are sealed inside the sample shipping container, commercial carriers are not required to sign the COC form.

Distribution of the COC form will be:

- Original and one copy - sealed in plastic bag and taped inside the top of the shipping container;
- One copy - file in appropriate Field Office project file; and
- One copy - submit to Data Management staff.

All changes to a COC form will be made by striking the incorrect information with a single line, initialing and dating the strike, and inserting the correct information. If changes are made to a COC form after the original distribution, the following steps will be taken:

- Make the change by striking the incorrect information with a single line, initialing and dating the strike, and inserting the correct information (in black or blue indelible ink). Add a comment as to why the change was made, as appropriate.
- Distribute copies of the corrected COC form as specified above.

Whenever a sample is split with a second party (e.g., client, agency) a separate COC form must be prepared for those samples.

4.0 Records

Procedures for maintaining COC forms are described in SOP-111, Chain-of-Custody.

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to set site-wide criteria for content entry and form of field logbooks, and to document procedures employed in recording site activities photographically or using a video camera.

2.0 SCOPE

This SOP applies to all personnel who record information in field logbooks, or employ photographic or video techniques to document site activities.

3.0 METHOD

3.1 General

An essential part of the sampling/analytical portion of any environmental project is assuring that proper documentation of all activities is accomplished. The primary document used to record site data is the field logbook. Tasks where analytical data or conclusions based upon analytical data may be used in litigation demand that accountability of the history of a sample be available to demonstrate that the data are a true representation of the environment. The field logbook may be used as evidence in legal proceedings to defend procedures and techniques employed during site investigations. Therefore, it is extremely important that field logbook documentation be factual, complete, accurate and consistent.

Likewise, when photographic or videographic techniques are used to document site activities, the goal of the records is a true representation of field activities that accurately portrays site conditions or procedures.

3.2 Procedures

3.2.1 Preparation

New field logbooks will be obtained as needed from the Field Manager/Task Leader. The individual using the field logbook will be responsible for its care and maintenance throughout the field task.

Field logbooks will be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the logbook. The following information will be recorded on the cover, binding, or inside the front cover of the logbook:

- Field document control number;
- Activity;
- Contractor’s name;
- Phone number; and
- Site contact (Field Manager/Task Leader).

3.2.2 Operation

The following requirements must be followed when using a logbook:

- The date must be recorded at the top of each page.
- If data collection forms are specified by an activity-specific plan or procedure, the information need not be duplicated in the logbook.
- All changes must be made with a single line through the deletion. Changes must be initialed and dated.
- A diagonal line must be drawn through any space left at the bottom of each page.
- The bottom of each page will be signed by the author.
- Do not remove any pages from the logbook.

Entries into the field logbook will be preceded with the time of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged.

At each station where a sample is collected or an observation made, a detailed description of the location is required. If a map is not already available that shows the sample location, a sketch of the location is required. The sketch or diagram should be detailed enough for other individuals to locate the points at future times. A direction indicator or compass direction should be located on the sketch. It is preferred that maps and sketches be oriented so that north is towards the top of each page.

Events and observations that should be recorded include, but are not limited to:

- Changes in weather that may impact field activities;
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation;
- Problems, downtime, or delays;
- Upgrade or downgrade of personal protective equipment;
- All task members and visitors;
- Actual and background readings of health and safety monitoring equipment;
- Identification of equipment used, including model numbers and/or serial identification numbers;
- Start and end times of sample locations; and
- Decontamination times and methods.

When samples are collected, the following should be recorded:

- Sample location;
- Sample number;
- Sample methodology;
- Sample description;
- Sample collector;
- Sample depth;
- Sample type;
- Sample analyses requested;
- Sample preservation and confirmation; and
- Quality control (QC) sample numbers and types.

3.2.3 Visual Recordings

When visual recordings (photographs or video recordings) are made, they will be documented in the associated field logbook. At the start of the day, the weather conditions should be recorded; the weather should also be noted if site conditions change (e.g., weather goes from clear to overcast) throughout the day. For each photograph, the following information must be recorded:

- Location;
- Date and time;
- Photographer;
- Detailed description of subject of photograph;
- Direction of photograph (e.g., “taken facing northwest”);
- Identification of individuals in the photograph and their affiliation;
- Photograph number;
- Mechanical difficulties (if encountered) and corrective actions taken (and results).

A figure, map, or sketch of the site indicating the locations where photographs were taken is useful, especially if before and after photographs are to be taken at different times (potentially by different photographers, although using the same photographer is highly recommended).

For video recordings, the same information should be noted, along with the start and stop times on the recording. If the camera is capable of captioning with date, time, and text information to the recorded image, this is recommended. Such a captioning capability aids in later labeling and identifying the photographs or video recordings.

Photographs and/or video recordings should be taken with a camera-lens system having a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots are to be avoided unless previously approved by the client.

Most video cameras offer the cameraperson, or an accompanying field technician, audio recording capability that can be used to provide a running commentary on the activities recorded. This information is not a substitute for hard-copy documentation in a logbook (wind blowing across the microphone or technical difficulties may render the sound inaudible). Commentary should be pertinent and succinct.

3.2.4 Post-Operation

At the conclusion of a task or when a logbook has been completed, it will be submitted to the Field Manager/Task Leader for filing in the Project File.

Cameras will be returned to the location designated by the field task leader in the field office (the camera and film must be kept in a temperature and humidity controlled environment when not in use; camera batteries may need to be recharged overnight). Film and developed photographs should be protected from unnecessary exposure to light (to avoid fading), and video recordings must be protected from magnetic fields. The video cartridge must be labeled.

After the first day of work and on a regular basis thereafter, the Field Manager/Task Leader will perform a QC content check for compliance with this SOP.

4.0 RECORDS

Documentation will follow all guidelines contained in this SOP.

1.0 Purpose

This Standard Operating Procedure (SOP) establishes guidelines and procedures for field personnel to use during the supervision of drilling operations involving hollow stem auger techniques. Additional specific hollow stem auger drilling procedures and requirements will be provided in the project work plans.

2.0 References

- SOP-001 - Field Sample Management
- SOP-005 - Well Installation, Development, and Decommissioning Guidelines

3.0 Definitions

3.1 Hollow Stem Auger Drilling

A drilling method using rotating auger flights (typically in 5 foot joints) with a bit on the bottom of the lead flight (sometimes called the "lead auger"). The flights consist of a hollow pipe and an outer spiral plate, which when rotated, forces soil cuttings upward along the borehole wall to the surface. The auger string is advanced by rotation, with pressure exerted by the rig, forcing the bit to cut the soil at the bottom and direct cuttings to the augers.

A retractable plug with a pilot bit is placed at the bottom of the auger string to prevent cuttings from entering the hollow stem. When the plug is retracted, a sampler may be sent through the hollow center to sample soil at the bottom of the borehole without requiring the augers to be removed. A wireline sampler may also be attached to the inside of the lead auger for coring as the borehole is advanced.

This method is commonly used for drilling and sampling of soil borings, collection of soil gas and screening-level water samples, and installation of some smaller diameter wells. The well casing string may be placed through the hollow stem.

The hollow stem auger drilling method has advantages over other drilling techniques in certain circumstances, and disadvantages in others. This method is highly suitable for unconsolidated and consolidated fine-grained soils. Hollow-stem auger drilling can achieve the most rapid rates of penetration in soft sticky clay-dominated soils. However, coarse and consolidated gravels and hard bedrock may be too dense for adequate drill penetration. Soil cuttings are typically disaggregated and remolded, making bedding, fabric, and soil property determination difficult.

The most reliable method for logging of soils during hollow stem auger drilling is by collecting relatively intact samples through the hollow stem. An advantage of the hollow stem auger method is that soil samples can be readily obtained from the bottom of the hole without requiring the removal of the auger string (unlike air or mud rotary methods).

This drilling method may be used to install monitoring wells (limited by diameter) as there is good depth control, and the auger can be progressively pulled as well construction materials are added to the borehole. The methodology may also be used to drill out monitoring wells for abandonment.

Another advantage of the hollow stem auger method is that air or mud are not required as circulating media. Therefore, there is limited to no potential for flushing of soil samples collected for chemical analyses, and a reduction in volumes of investigated derived wastes requiring costly handling and management procedures. Auger-type rigs can be significantly smaller than other types of rigs, making them the most suitable for some jobs with significant space constraints, including overhead clearance.

Additional disadvantages of the hollow stem auger method include a typical maximum depth of 100 to 200 feet (may be less depending on soil conditions). Hard soil horizons or very coarse gravel (cobbles and boulders) may be impenetrable with this method.

4.0 Procedure

This section contains responsibilities, procedures and requirements for hollow stem auger drilling. The selection and implementation of hollow stem auger drilling techniques must incorporate site specific conditions and requirements. Consequently, the project work plans will identify the following:

- The purpose of each borehole (e.g., to install monitoring well, soil sampling, well abandonment, etc.)
- Specific methodology for drilling, including equipment and cuttings/fluid containment
- Specific locations, depths, and diameters of boreholes
- Objectives and types of sampling and/or logging of borehole
- Details of mobilization/demobilization and decontamination of equipment

- Appropriate health and safety guidelines and personnel protective equipment

- Additional procedures or requirements beyond those covered in this SOP

4.1 Responsibilities

4.1.1 The Delivery Order Manager is responsible for ensuring that all hollow stem auger drilling activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Contractor Quality Control Manager (CQCM) is responsible for periodic review of field generated documentation associated with this SOP. The CQCM is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to hollow stem auger drilling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to hollow stem auger drilling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff responsible for reporting deviations from the procedures to the Site Superintendent, Delivery Order Manager, or the CQCM.

4.2 Drilling Site Mobilization

4.2.1 Rig Decontamination and Preparation

4.2.1.1 All drilling and sampling equipment should be decontaminated before drilling.

4.2.1.2 The driller and rig geologist/engineer should inspect the drilling equipment for proper maintenance and appropriate decontamination prior to each time the rig is mobilized to a site. All clutches, brakes and drive heads should be in proper working order. All cables and hydraulic hoses should be in good condition. All auger joints and bits should also be in good condition (e.g., no cracked or bent blades, bits are not excessively worn, etc.).

4.2.1.3 Any observed leakage of fluids from the rig should be immediately repaired and the rig decontaminated again before it is allowed to mobilize.

4.2.2 Site Preparation

4.2.2.1 The logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

4.2.2.2 Before mobilization, the Site Superintendent and/or the rig geologist/engineer should assess the drilling site with the driller. This assessment should identify potential hazards (slip/trip/fall, overhead power lines, etc.), and determine how drilling operations may impact the environment (dust, debris, noise). Potential hazards should be evaluated and corrected, or the borehole location changed or shifted, as per the project work plans.

4.2.2.3 The Site Supervisor or appropriate designee should ensure that all identifiable underground utilities around the drilling location have been marked, and the borehole location appropriately cleared per the project work plans. At a minimum, copies of the site clearance documents should be kept on-site.

4.2.3 Mobilization and Set-Up

4.2.3.1 Once the site is prepared, the rig is mobilized to the site and located over the borehole location. The rig is leveled with a set of hydraulic pads attached to the front and rear of the rig. The driller should always raise the mast slowly and carefully to prevent tipping or damaging the rig, and avoiding obstructions or hazards.

4.2.3.2 Appropriate barriers and markers should be in place prior to drilling, as per the site health and safety plan. Visqueen (plastic) may be required beneath the rig.

4.3.2.3 Appropriate cuttings and other investigation-derived waste containment should be set on site prior to commencement of drilling.

4.2.4 Health and Safety Requirements

4.2.4.1 Tailgate Safety Meetings should be held in the manner and frequency stated in the health and safety plan. All personnel at the site should have appropriate training and qualifications as per the health and safety plan.

4.2.4.2 During drilling all personnel within the exclusion zone should pay close attention to rig operations. The rotating auger blades can snag or catch loose clothing and literally screw someone into the ground.

4.2.4.3 Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the rig geologist/engineer of any unforeseen hazard, or when anyone is approaching the exclusion zone.

4.3 Drilling Procedures

4.3.1 Breaking Ground

4.3.1.1 Prior to the commencement of drilling, all safety sampling and monitoring equipment will be appropriately calibrated per the project work plans.

4.3.1.2 The rig geologist/engineer should inform the driller of the appropriate equipment (e.g., cookie cutter, etc.) to be used for penetration of the surface cover (e.g., asphalt, concrete, cement, etc.). In the event of breaking ground where a shallow subsurface hazard may exist (unidentifiable utility, trapped vapors, etc.), the driller should be informed of the potential hazard and drilling should commence slowly to allow continuous visual inspection and/or monitoring, and if necessary, stop for probing.

4.3.2 Borehole Drilling

During drilling operations, and as the borehole is advanced, the rig geologist/engineer will generally:

- Observe and monitor rig operations;
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance;
- Prepare a lithologic log from soil samples or cuttings; and
- Supervise the collection of, and prepare soil, soil vapor, and groundwater samples.

4.3.2.1 As drilling progresses the rig geologist/engineer should observe and be in frequent communication with the driller regarding drilling conditions. This includes relative rates of penetration (indicative of fast or slow drilling) and chattering or bucking of the rig. These conditions, including the relative drilling rate, should be recorded on the boring log. Drilling should not be allowed to progress faster than the rig geologist/engineer can adequately observe conditions, compile boring logs, and supervise safety and sampling activities.

The rig geologist/engineer should also observe the rig operations, including the make-up and tightening of connections as additional auger joints are added to the auger string. Any observed problems, including significant down time, and their causes are recorded on the field log.

4.3.2.2 Cuttings and fluids containment during drilling should be observed and supervised by the rig geologist/engineer, as per specifications in the project work plans.

4.3.2.3 The rig geologist/engineer will oversee or conduct appropriate health and safety sampling and monitoring. If any potentially unsafe conditions are evident from the above drilling observations and the health and safety sampling and monitoring, the rig geologist/engineer may suspend drilling operations at any time and take appropriate actions as per the health and safety plan. In the event suspension of drilling activities occur:

- The Site Superintendent must be informed of the situation;
- Appropriate corrective action must be implemented before drilling may be continued; and
- The observed problem, suspension, and corrective action are entered on the FADL.

4.3.2.4 During drilling the rig geologist/engineer will compile a boring log. The log will be compiled preferably from soil samples recovered while drilling. Logs should only be compiled from cuttings if this is the only option. Observations of drilling conditions are also entered on the log. If total depth was reached prematurely due to refusal, the cause of refusal should be noted on the boring log.

4.3.2.5 Subsurface soil samples may be collected with a split spoon sampler or Shelby tube during drilling. The sampling will be supervised by the rig geologist/engineer. Soil samples (drive samples) can be readily obtained at discrete intervals with these methods.

4.3.2.6 Soil organic vapor (SOV) sampling may be conducted at discrete intervals during hollow stem auger drilling. This is done by stopping at the desired depth and driving a sample probe through the hollow stem into the soil ahead of the bit and then collecting a vapor sample. The sampling should be supervised by the rig geologist/engineer.

4.3.2.7 Groundwater screening (grab) samples can be obtained at discrete intervals during drilling. One method is to auger to the bottom of the selected interval or zone and pull the auger back to the top of the interval, allowing groundwater through the open borehole. A water sample is then collected with a bailer run through the inside of the augers. Another method is to stop the augers at a selected interval or zone and advance a hydropunch sampler beyond the lead auger to retrieve a water sample.

4.3.3 Borehole Abandonment

If the borehole is to be abandoned once drilling is completed, the abandonment will follow procedures outlined in SOP_005. The abandonment will be supervised by the rig geologist/engineer.

4.3.4 Monitoring Well Completion

If a monitoring well is to be installed in the borehole, the well completion will follow procedures outlined in SOP_005. The well installation activities will be supervised by the rig geologist/ engineer.

4.4 Demobilization/Site Restoration

After drilling, sampling, well installation or borehole abandonment is completed the hollow stem rig is rigged down and removed from the borehole location. The demobilization/site restoration will be supervised by the rig geologist/engineer or appropriate designee.

4.4.1 All debris generated by the drilling operation will be removed and appropriately disposed.

4.4.2 The site should be cleaned (ground washed if necessary) and surface conditions restored as per the project work plans.

4.4.3 All abandoned borings should be topped off and completed as per the project work plans. All monitoring wells will also have their surface completions finished as per the project work plans.

4.4.4 Any remaining hazards as a result of drilling activities will be identified and appropriate barriers and markers put in place, as per the health and safety plan.

4.4.5 All soil cuttings and fluids will be properly contained, clearly labeled, and maintained as per the project work plans.

4.4.6 The Site Superintendent or appropriate designee should inspect the site to make sure that post-drilling site conditions are in compliance with the project work plans.

5.0 Records

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SOP_002

ROTOSONIC DRILLING

STANDARD OPERATING PROCEDURE

1.0 Purpose

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use during the drilling operations involving rotosonic (sonic) techniques. Additional specific drilling procedures and requirements will be provided in the project work plans.

2.0 References

2.1 SOP 3.2 - Subsurface Soil Sampling While Drilling

2.2 SOP 6.1 - Sampling Equipment and Well Material Decontamination

2.3 SOP 6.2 - Drilling and Heavy Equipment Decontamination

2.4 SOP 8.1 - Monitoring Well Installation

2.5 SOP 8.3 - Borehole and Well Abandonment

2.6 SOP 10.1 - Soil Organic Vapor Sampling

2.7 SOP 10.2 - Cone Penetration Testing and Hydropunch Groundwater Sampling

2.8 SOP 15.1 - Lithologic Logging

2.9 SQP 4.2 - Records Management

3.0 Definitions

3.1 Sonic Drilling

A method of drilling that employs two oscillators in the drill head that are essentially out of tune, and act as counterweights working against one another. By adjusting the tuning and generating resonance down the tool string to the bit, the bit is driven downwards.

Cuttings are recovered as core sample or displaced into outside of borehole. Cuttings are usually transferred into a polyethylene sample bag, or Lexan liner, for logging and/or storage.

Sonic drilling is most often used in scenarios when the drilling (whether through particular ground materials, or to a particular depth) is difficult and the integrity of the core sample is extremely important.

The drill bit is advanced first, then core barrel is run into the ground. Then the is advanced over the core barrel before retraction. Sometimes water is added when working at greater depths. However, it is preferred to do it dry, as it allows us to determine where the groundwater is.

Continuous core is inherent to the sonic drilling method. A continuous core provides a detailed look at the soil at the depths drilled. This results in a better understanding of the subsurface conditions.

Cuttings produced by this method are typically intact, making for accurate logs to be produced. Soil samples can be obtained from the bottom of the hole; however, it typically requires removing the entire drill string.

Additional considerations in using sonic drilling techniques include the potential of volatilizing contaminants due to the heat generated by the oscillating bit.

4.0 Procedure

This section contains responsibilities, requirements, and procedures for sonic drilling.

The selection and implementation of sonic drilling techniques must incorporate site specific conditions and requirements. Consequently, the project work plans will identify the following:

- The purpose of each borehole (e.g., to install monitoring well, soil sampling, soil vapor sampling, etc.)
- Specific methodology for drilling, including equipment to be utilized and cuttings/fluid containment requirements
- Specific locations, depths, and diameters of boreholes
- Type of sampling and/or logging of borehole
- Details of mobilization/demobilization and decontamination of equipment
- Appropriate health and safety guidelines and personnel protective equipment requirements
- Additional procedures or requirements beyond those covered in this SOP

4.1 Responsibilities

4.1.1 The Delivery Order Manager is responsible for ensuring that all sonic drilling activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Contractor Quality Control Manager (CQCM) is responsible for periodic review of field generated documentation associated with this SOP. The CQCM is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to sonic drilling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sonic drilling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Site Superintendent, Delivery Order Manager, or the CQCM.

4.2 Equipment Requirements and Considerations

4.2.1 Rigs used for sonic drilling shall have the casing and drill string handling system integrally built into the mast assembly. A rig which requires personnel to climb onto the mast to attach or detach the hammer is unacceptable for safetyreasons.

4.2.2 The drill rigs should preferably be self-propelled and capable of accessing anticipated site field conditions. Each rig should have a mechanical draw-works capable of holding roughly 30,000 lbs (minimum).

4.2.3 Casings should have a minimum tensile strength of 100,000 psi, and will have external and internal flush threads on each pin and box for connecting. The use of rope thread drive casing with dissimilar metal threaded end pieces attached to mild steel casing bodies will notbe allowed. The drive casing shall have uniform wall thickness, tensile strength, and threaded ends machined directly to the casing. A hardened drive shoe with the same internal and external dimensions of the drive casing will be threaded to the bottom of the first joint of the drive casing.

4.2.4 Teflon^{TM}-based thread compound will NOT be used to lubricate drill pipe and drive casing threads.

4.2.5 Drive casings of various lengths should be provided by the subcontractor to facilitate emplacement of sand pack, bentonite seal, and grout. One 3-foot, two 5-foot and two 10-foot lengths, besides a sufficient number of standard length drive casing joints, are recommended for each rig.

4.2.6 A hydraulic casing extractor should be used to remove the drive casing from the borehole. Extraction of the casing by "hammering-up" with the casing hammer will not be allowed. The hydraulic casing extractor should have a minimum pulling capacity of 250 tons and be constructed as a single unit with hydraulic cylinders, pulling arms, base plate, valves, hoses, slips and spiders, safety bypass valves, back-up wrench, and break-out tongs. The slips and spiders should be of sufficient size to grip the outside of the drive casing and withstand the lifting force of 250 tons.

4.3 Drilling Site Mobilization

4.3.1 Rig Decontamination and Preparation

4.3.1.1 All drilling and sampling equipment should be decontaminated before drilling as per SOP Nos. 6.2 and 6.1, and the project work plans.

4.3.1.2 The driller and rig geologist/engineer should inspect the drilling equipment for proper maintenance and appropriate decontamination prior to each time the rig is mobilized to a site. All clutches, brakes and drive heads should be in proper working order. All cables and hoses should be in good condition. All drill pipe, drive casing and bits should also be in good condition (e.g., no damaged threads on the drive casing or drill pipe, no damaged or excessively worn bits, etc.).

4.3.1.3 Any observed leakage of fluids from the rig should be immediately repaired and the rig decontaminated again before it is allowed to mobilize.

4.3.2 Site Preparation

4.3.2.1 The logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

4.3.2.2 Before mobilization, the Site Superintendent and/or the rig geologist/engineer should assess the drilling site with the driller. Drill site space requirements commonly include not only area for the rig, but also swing-out clearance for the cyclone and access for a pipe truck or fork lift carrying pipe. This assessment should identify potential hazards (slip/trip/fall, overhead power lines, etc.), and determine how drilling operations may impact the environment (dust, debris, noise). Potential hazards should be evaluated and corrected, or the borehole location changed or shifted, as per the project work plans.

4.3.2.3 The Site Supervisor or appropriate designee should ensure that all identifiable underground utilities around the drilling location have been marked, and the borehole location appropriately cleared per the project work plans. At a minimum, copies of the site clearance documents should be kept on-site.

4.3.3 Mobilization and Set-Up

4.3.3.1 Once the site is prepared, the rig is mobilized to the site and located over the borehole location. The rig is leveled with a set of hydraulic pads attached to the front and rear of the rig. The driller should always raise the mast slowly and carefully to prevent tipping or damaging the rig, and avoiding obstructions or hazards. The cyclone should be positioned so that cuttings can be easily collected as they drop out of the bottom opening.

4.3.3.2 Appropriate barriers and markers should be in place prior to drilling, as per the site health and safety plan. Visqueen (plastic) may be required beneath the rig per the project work plans.

4.3.2.3 Appropriate cuttings and other investigation-derived waste containment should be set on site prior to commencement of drilling. If drilling is to be conducted in the saturated zone, provisions should be made to ensure adequate containment of formation water produced during drilling operations.

4.3.4 Health and Safety Requirements

4.3.4.1 Tailgate Safety Meetings should be held in the manner and frequency stated in the health and safety plan. All IT and subcontractor personnel at the site should have appropriate training and qualifications as per the health and safety plan.

4.3.4.2 During drilling all personnel within the exclusion zone should pay close attention to rig operations. The drill pipe and drive casing are quite heavy, and dangerous if dropped. Other equipment on the rig can easily snag clothing and crush fingers or limbs. In addition, heavy equipment such as pipe trucks and fork lifts will be operated at the drill site.

4.3.4.3 The sonic rig is quite noisy when the casing is being advanced. In addition, the rig can generate considerable noise when drilling through gravel and cobbles. Therefore, establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the rig geologist/engineer of any unforeseen hazard, or when anyone is approaching the exclusion zone.

4.4 Drilling Procedures

4.4.1 Breaking Ground

4.3.1.1 Prior to the commencement of drilling, all safety sampling and monitoring equipment will be appropriately calibrated per the project work plans.

4.4.1.2 The rig geologist/engineer should inform the driller of the appropriate equipment (e.g., cookie cutter, etc.) to be used for penetration of the surface cover (e.g., asphalt, concrete, cement, etc.). In the event of breaking ground where a shallow subsurface hazard may exist (unidentifiable utility, trapped vapors, etc.), the driller should be informed of the potential hazard. Drilling should commence slowly to allow continuous visual inspection and/or monitoring, and if necessary, stop for probing or hand excavation and clearance.

4.4.2 Borehole Drilling

During drilling operations, and as the borehole is advanced, the rig geologist/engineer will generally:

- Observe and monitor rig operations;
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance;
- Prepare a lithologic log from soil samples or cuttings; and
- Supervise the collection of, and prepare soil, soil vapor, and groundwater samples.

4.4.2.1 As drilling progresses the rig geologist/engineer will be in frequent communication with the driller and be cognizant of drilling conditions which may provide lithologic or chemical information. This includes relative rates of penetration (indicative of fast or slow drilling) and chattering or bucking of the rig. These conditions should be recorded on the boring log per SOP No, 15.1.

The rig geologist/engineer should know the total depth of the borehole at all times during drilling. Drilling should not be allowed to progress faster than the rig geologist/engineer can adequately observe conditions, compile boring logs, and supervise sampling and safety activities.

The rig geologist/engineer should also observe the rig operations, including the make-up and tightening of connections as additional drill pipe and drive casing are added to the drill string. No leaks should be evident in the air system on the rig. Any observed problems, including significant down time, and their causes are recorded on the Field Activity Daily Log (FADL) (Attachment 6.1).

4.4.2.2 Cuttings and fluids containment during drilling should be observed and supervised by the rig geologist/engineer, as per specifications in the project work plans.

4.4.2.3 The rig geologist/engineer will oversee or conduct appropriate health and safety sampling and monitoring. If any potentially unsafe conditions are evident from the above drilling observations and the health and safety sampling and monitoring, the rig geologist/engineer may suspend drilling operations at any time and take appropriate actions as per the health and safety plan. In the event suspension of drilling activities occur:

- The Site Superintendent must be informed of the situation;
- Appropriate corrective action must be implemented before drilling may be continued; and
- The observed problem, suspension, and corrective action are entered on the FADL.

4.4.2.4 In some instances water may need to be added to facilitate advancement of the drill string. This should be done only if absolutely necessary, following specifications for the water source and/or any sampling and analysis requirements per the project work plans. Foam additives should not be used and are commonly prohibited by regulatory agencies for environmental applications. If water is injected into the borehole it should be noted on the boring log and the FADL.

4.4.2.5 During drilling the rig geologist/engineer will compile a boring log as per SOP No. 15.1. The log will be compiled preferably from soil samples recovered while drilling.

Observations of drilling conditions and responses are also entered on the log as discussed above and in SOP No. 15.1. If total depth was reached prematurely due to refusal, the cause of refusal should be noted on the boring log and the FADL.

4.4.2.6 Subsurface soil samples may be collected with a split spoon sampler or Shelby tube during drilling per SOP No. 3.2. This will require tripping out (removing) the inner rotary drill string. The sampling will be supervised by the rig geologist/engineer. Soil samples (drive samples) can be readily obtained at discrete intervals with these methods.

4.4.2.7 Soil organic vapor (SOV) sampling may be conducted at discrete intervals during sonic drilling. This is done by stopping at the desired depth, tripping out the inner string, and driving a sample probe through the drive casing into the soil ahead of the drive shoe. The vapor sample is then collected through the sample probe using a vacuum pump at the surface. The sampling should be supervised by the rig geologist/engineer following procedures in SOP No. 10.1.

4.4.2.8 Groundwater screening (grab) samples can be obtained at discrete intervals during drilling. One method is to drill to the bottom of the selected interval or zone and pull the drive casing back a selected distance, allowing groundwater through the open borehole. The inner drill string is tripped out of the hole and a water sample is then collected with a bailer run through the inside of the drive casing.

Another method is to stop the drill string at a selected interval or zone, trip out the inner drill string, and advance a hydropunch sampler beyond the drive casing to retrieve a water sample. The groundwater screening sampling procedures should essentially follow those described in SOP No. 10.2.

4.4.3 Borehole Abandonment

If the borehole is to be abandoned once drilling is completed, the abandonment will follow procedures outlined in SOP No. 8.3. The abandonment will be supervised by the rig geologist/engineer.

4.4.4 Monitoring Well Completion

If a monitoring well is to be installed in the borehole, the well completion will follow procedures outlined in SOP No. 8.1. The well installation activities will be supervised by the rig geologist/engineer.

4.5 Demobilization/Site Restoration

After drilling, sampling, well installation, or borehole abandonment is completed the sonic rig is rigged down and removed from the borehole location. The demobilization/site restoration will be supervised by the rig geologist/engineer or appropriate designee.

4.5.1 All debris generated by the drilling operation will be removed and appropriately disposed.

4.5.2 The site should be cleaned (ground washed if necessary) and surface conditions restored as per the project work plans.

4.5.3 All abandoned borings should be topped off and completed as per the project work plans. All monitoring wells will also have their surface completions finished as per the project work plans.

4.5.4 Any remaining hazards as a result of drilling activities will be identified and appropriate barriers and markers put in place, as per the health and safety plan.

4.5.5 All soil cuttings and fluids will be properly contained, clearly labeled, and maintained as per the project work plans.

4.5.6 The Site Superintendent or appropriate designee should inspect the site to make sure that post-drilling site conditions are in compliance with the project work plans.

5.0 Records

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SQP No. 4.2.

6.0 Attachments

6.1 Field Activity Daily Log

ATTACHMENT 6.1 FIELD

ACTIVITY DAILY LOG

F1

FIELD ACTIVITY DAILY LOG

Daily Log	Date:			
	No.			
	Sheet Of			

PROJECT NAME: FORT ORD, CA

Project Number: 783751

FIELD ACTIVITY SUBJECT:

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS

VISITORS ON SITE:

CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:

WEATHER CONDITIONS:

IMPORTANT TELEPHONE CALLS:

SHAW PERSONNEL ON SITE:

SIGNATURE:

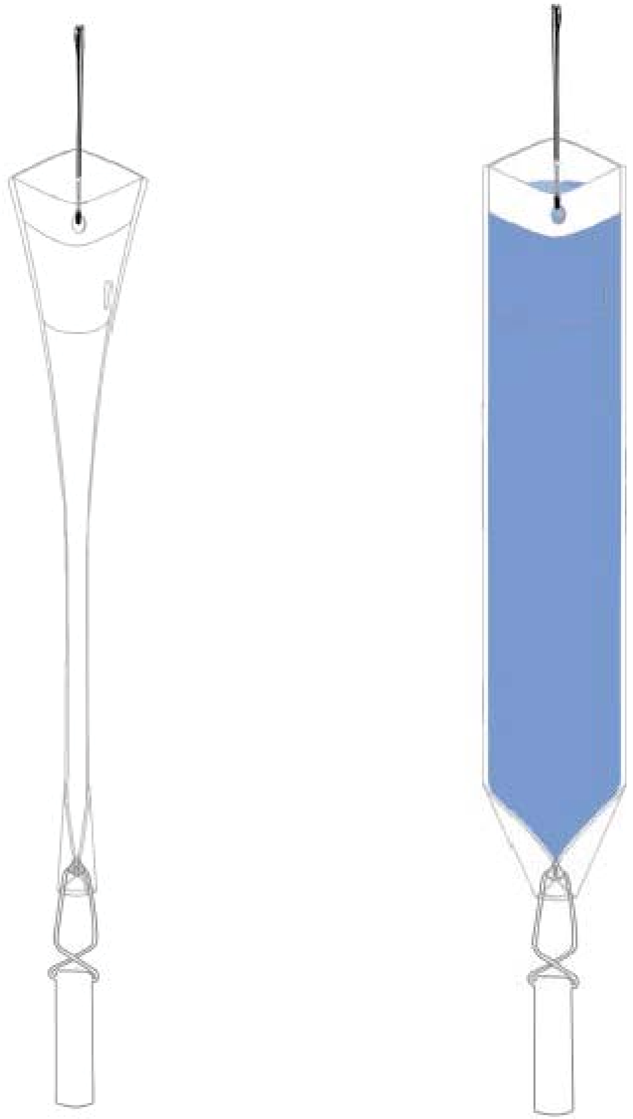
DATE:

HYDRASleeve™

Simple by Design

US Patent No. 6,481,300; No. 6,837,120; No. 9,726,013; others pending

Standard Operating Procedure: Sampling Groundwater with a HydraSleeve



This guide should be used in addition to field manuals and instructions appropriate to the chosen sampling device (i.e., HydraSleeve, SpeedBag or Super/Skinny Sleeve and W3 HybridSleeve).

Find the appropriate field manual and instructions on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact:
GeoInsight, P.O. Box 1266, Mesilla Park, NM 88047
800-996-2225, info@hydrasleeve.com.

Table of Contents

Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect groundwater samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only. It excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative groundwater samples depends on the natural movement of groundwater (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of groundwater for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

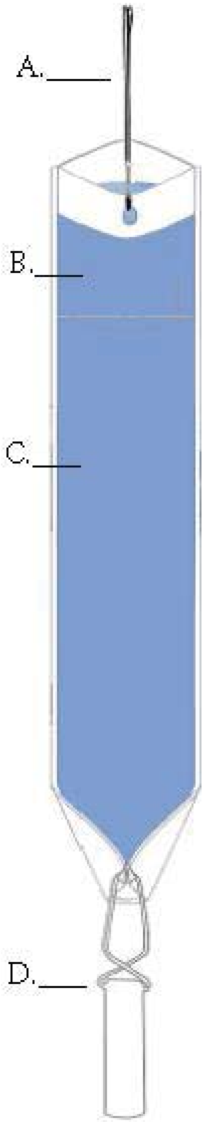
The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term groundwater monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

Description of the HydraSleeve

The basic HydraSleeve (Figure 1) consists of the following components*:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75" OD and are available in a variety of sizes. An optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.



*Other configurations such as top weighted assemblies, Super/SkinnySleeves, Speedbags, and W3 Hybrids are available.

Note: The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

Table 1. Dimensions and Volumes of HydraSleeve Models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 600 mls HydraSleeve	~600mls	30”	2.5”	1.4”
Standard 1-liter HydraSleeve	~1 Liter	38”	3”	1.9”
Super/SkinnySleeve 1-liter	~1 Liter	38”	2.5"	1.5”*
Super/SkinnySleeve 1.5-liter	~1.5 Liters	52”	2.5”	1.5”*
Super/SkinnySleeve 2-liter	*~2Liters*	*66"*	*2.5"*	*1.5"**
4-Inch HydraSleeves				
Standard 2.5 liter	~2 Liters	38”	4”	2.7”

* outside diameter on the Heavy Duty Universal Super/SkinnySleeves is 1.5" however when using with schedule 40 hardware the O.D. of the assembly will be 1.9"

It's also recommended that you size the diameter of the HydraSleeve according to the diameter of the well (i.e. use 2-inch HydraSleeves in 2-inch wells). Using smaller sleeves in larger diameter wells (i.e. 2-inch HydraSleeves in 4-inch wells) will result in a longer fill rate and will require special retrieval instructions (explained later).

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

HydraSleeves can be custom-fabricated by GeoInsight in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied using a HydraSleeve.

HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen. It fills by pulling it up through the screen a distance equivalent to the length of the sampler when correctly sized to the well diameter. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2" ID PVC well, 50' total depth, 10' screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2" well (2.5" flat width/1.5" filled OD x 30" long, 600 ml volume), deploy the sampler so the weight (a 5 oz., 2.5" long weight with a 2" long clip) rests at the bottom of the well. The top of the sleeve is thus set at ~34" above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30" before it is filled; therefore, it is full (and the top check valve closes) at approximately 64" (5.3 feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

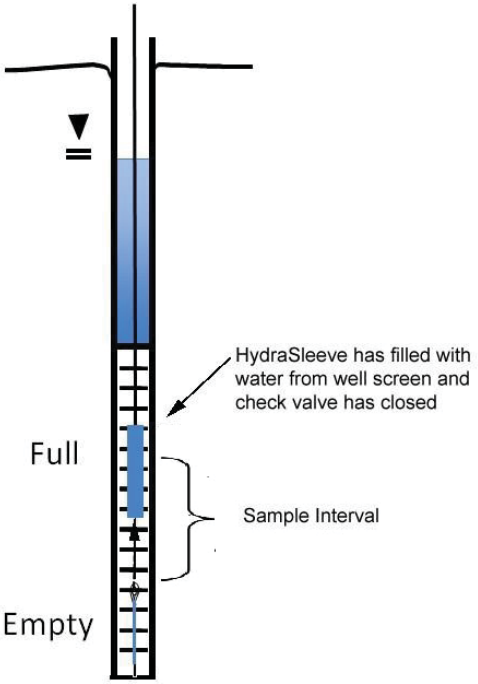


Figure 2. Correct Placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

<u>The solution?</u> Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 36" (3 feet) from the bottom of the well, or 2-feet before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

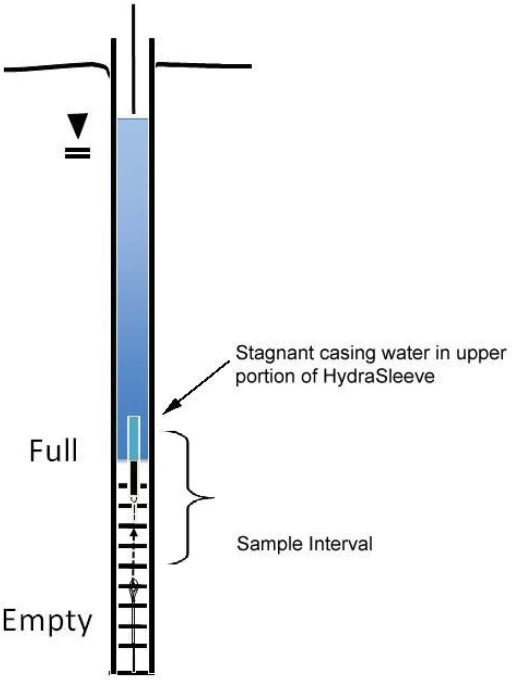


Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

NOTE: Using smaller diameter HydraSleeves (2-inch) in larger diameter wells (4-inch) causes a slower fill rate. Special retrieval methods are necessary if this is your set up (shown later in this document).

Procedures for Sampling with the HydraSleeve

Collecting a groundwater sample with a HydraSleeve is usually a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a groundwater contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve.

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the Basic HydraSleeve*

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.
2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.
3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.
4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, if spring clips are not being utilized, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together to align the holes and slide the weight clip through the holes.
6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

*See Super/SkinnySleeve assembly manual and HydraSleeve Field Manual for other assembly instructions.

II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Note: Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

Note: Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The basic HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In some cases, like when useing the SpeedBags, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

  NOTE: If using top weights additional equilibration time is needed to allow the top weight time to compress the HydraSleeve into the bottom of the well.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event.

  In periodic (i.e., quarterly, semi-annual, or annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.
2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)
3. Measure the water level in the well.
4. Use one of the following 3 retrieval methods. In all 3 scenarios, when the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

   a. In one smooth motion, pull the tether up 30”-60" (the length of the sampler) at a rate of about 1 foot per second (or faster). The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1:1 ratio or the length of the HydraSleeve if the sleeve is sized to fit the well). This is analogous to coring the water column in the well from the bottom up.

   b. There are times it is recommended that the HydraSleeve be oscillated in the screen zone to ensure it is full before leaving the screen area. Pull up 1-3 feet, let the sleeve assembly drop back down and repeat 3-5 times before pulling the sleeve to the surface. The collection zone will be the oscillation zone. ***When in doubt use this retrieval method.***

   c. SpeedBags require check valve activation and oscillation during recovery: When retrieving the SpeedBag, pull up hard 1-2 feet to open the check valve; let the assembly drop back down to the starting point; REPEAT THIS PROCESS 4 TIMES; and then quickly recover the SpeedBag through the well sceen to the surface.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.
6. Discard the small volume of water trapped in the Hydrasleeve above the check valve by pinching it off at the top under the stiffeners (above the check valve).

v. Sample Discharge

NOTE: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

Be sure you have discarded the water sitting above the check valve – see step #6 above.

1. Remove the discharge tube from its sleeve.
2. Hold the HydraSleeve at the check valve
3. Puncture the HydraSleeve at least 3-4 inches below the reinforcement strips with the pointed end of the discharge tube. NOTE: For some contaminants (VOC's/sinkers) the best location for discharge is the middle to bottom of the sampler. This would be representative of the deeper portion of the well screen.
4. Discharge water from the HydraSleeve into your sample containers. Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.
5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column needs to be sampled, the HydraSleeve can be deployed with an optional top weight in addition to a bottom weight. The top weight will collapse the HydraSleeve to a very short (approximately 6” to 24”) length, depending on the length and volume of the sampler. This allows the HydraSleeve to fill in a water column only 3’ to 10’ in height (again) depending on the sampler size. Note the SuperSleeves accomplish the same thing but provide greater sample volume at a lower per sample cost.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

1. It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
2. It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

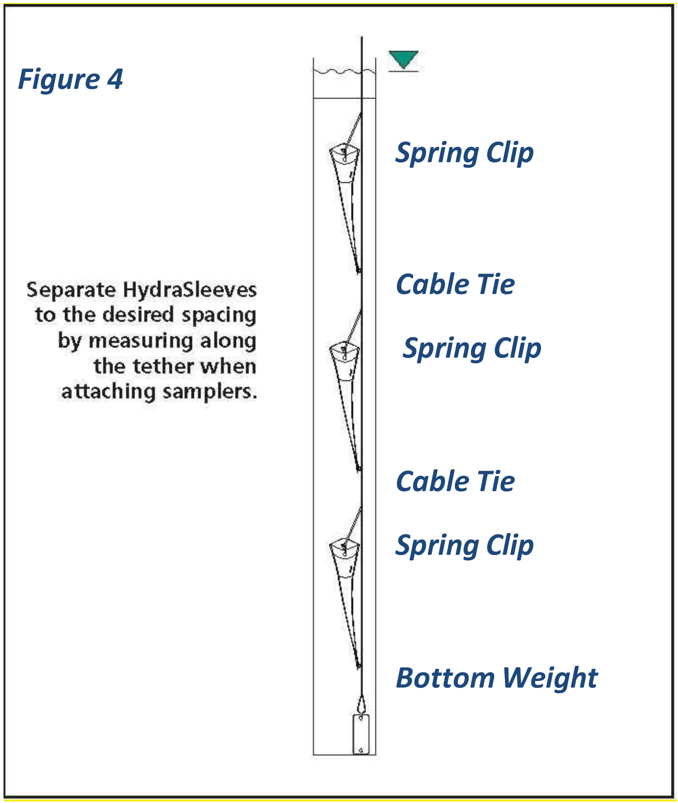


Figure 4

Separate HydraSleeves to the desired spacing by measuring along the tether when attaching samplers.

Figure 5. Multiple HydraSleeve deployment

If there is a need for only 2 samplers, they can be installed as follows. The first sampler can be attached to the tether as described above, a second attached to the bottom of the first using your desired length of tether between the two and the weight attached to the bottom of the second sampler (figure 6). This method can only be used with 2 samplers; 3 or more HydraSleeves in tandem need to be attached as described above.

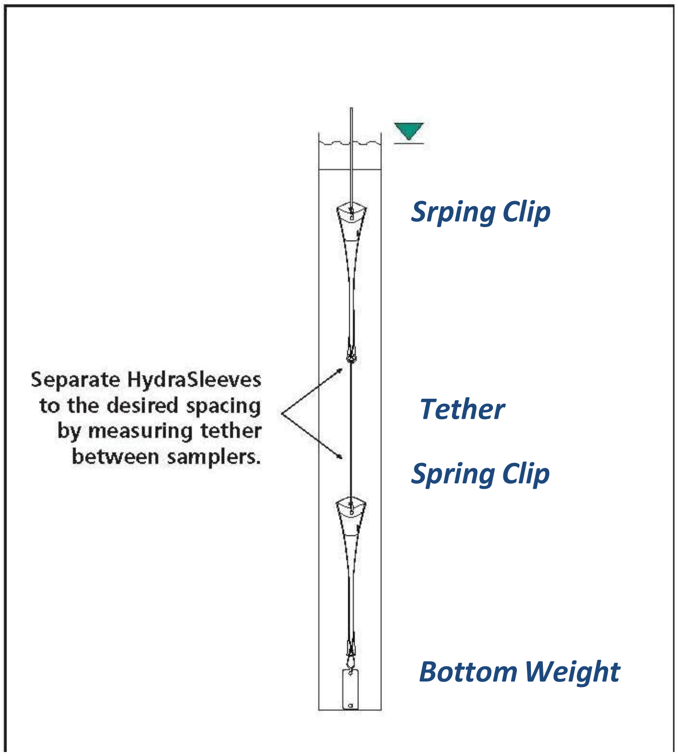


Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight will be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

References

McAlary, T. A. and J. F. Barker, 1987, Volatilization Losses of Organics During groundwater Sampling From Low-Permeability Materials, groundwater Monitoring Review, Vol. 7, No. 4, pp. 63-68

Parsons, 2005, Results Report for the Demonstration of No-Purge groundwater Sampling Devices at Former McClellan Air Force Base, California; Contract F44650-99-D-0005, Delivery Order DKO1, U.S. Army Corps of Engineers (Omaha District), U.S. Air Force Center for Environmental Excellence, and U.S. Air Force Real Property Agency

Robin, M. J. L. and R. W. Gillham, 1987, Field Evaluation of Well Purging Procedures, groundwater Monitoring Review, Vol. 7, No. 4, pp. 85-93

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Standard Operating Procedure
Downhole Meter Groundwater Quality Parameter Collection
No. 010

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures for calibrating and operating the field equipment necessary for collecting groundwater quality parameters by downhole meter.

2.0 Equipment List

- Decontamination equipment including soap, de-ionized and tap water
- Health and safety equipment including safety glasses and nitrile/latex exam gloves
- Field logbook, indelible ink pens and field forms
- Rinse water receptacle and disposal area
- Water level meter
- Tools to open wells
- YSI 6-Series (6920) Multi-parameter Water Quality Sonde or equivalent downhole multi-parameter probe
- Calibration cup
- Probe guard
- Battery if required
- Ruler
- Barometer recommended
- Calibration solutions:
    - Conductivity: 10 milliSiemen per centimeter (mS/cm) YSI 3163 or 1 mS/cm YSI 3165 or equivalent
    - pH: pH 7 and pH 10 buffer solutions or pH 4 and pH 7 buffer solutions
    - Oxygen-reduction potential (ORP): Zobell standard recommended
    - Turbidity: two standards 0 nephelometric turbidity unit (NTU) and 100 NTU of formazin prepared by YSI, Hach, or other approved vendor.
    - Water for dissolved oxygen (DO)
- Ring stand recommended
- YSI 200 foot Sonde cable (for deeper wells)
- YSI 100 foot Sonde cable (for shallower wells)

3.0 Procedures

3.1 Downhole Meter Calibration

If the Sonde did not come with the sensors installed, install and activate the appropriate sensors per manufacturer's instructions. Remove protective caps on the sensors before calibration or use of the meter. If the meter is rented, calibration has already been performed by the vendor and field calibration is not necessary during field events lasting less than 1 month. If the meter is rented, it is assumed that, unless warranted by erroneous field data, the meter will not require any maintenance.

To perform calibration of the Sonde, follow the general procedures below or specific manufacturer directions.

1. If installed, remove the Sonde probe guard.
2. Use the calibration cup supplied with the Sonde for all calibrations.
3. Rinse the Sonde probe and calibration cup with water and shake off excess.
4. Rinse the Sonde probe and calibration cup with a small amount of calibration solution if there is sufficient volume.
5. While calibrating the Sonde can be upright or inverted, but the sensors should be fully submerged.
6. Turn on the YSI meter and select Calibrate on the menu.

The following approximate volumes of calibration solution are to be used (check calibration solution and meter directions).

- Conductivity: 320 milliliters (mL) upright (150 mL inverted)
- Dissolved Oxygen: 1/8 inch (”) water vented to air
- pH/ORP: 200 mL upright (150 mL inverted)
- Optical sensors (turbidity): 225 mL upright (do not calibrate inverted)

7. Fill the calibration cup with the appropriate amount and type of calibration standard.
    a. For conductivity, be sure the probe is dry prior to immersing and no salt deposits. Make sure the sensor is completely immersed past the vent hole. Rotate the Sonde to remove air bubbles from sensor. Allow the temperature to equilibrate for approximately one minute after submersion.
    b. When calibrating dissolved oxygen, place 3 millimeters (mm) or 1/8” of water in the calibration cup. Engage only one or two threads of the calibration cup to vent to air. Loosen the bottom cap if the probe is inverted. Do not immerse DO or temperature sensors in the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for temperature equilibration.
    c. For pH, allow approximately one minute for temperature stabilization.
8. Screw the cup onto the probe. It is recommended to use a ring stand to prevent the probe from falling over.
9. In the Sonde Menu select “Calibrate”.
10. Input the calibration type you are performing (i.e., conductivity, Dissolved Oxygen, pH, ORP, Turbidity).
    a. Select Specific Conductivity for Conductivity calibration.
    b. Calibrating for percent (%) DO will also calibrate for milligrams per liter (mg/L) DO.
    c. For pH, enter 2-point calibration for two buffer solutions.
    d. For turbidity, enter 2-point calibration.

11. Once a parameter is selected, some will have a number that appears in parenthesis, which is the default value to be used for calibration.
12. Check the number is correct on the calibration standard being used, and press Enter or change the calibration value accordingly.
    a. For pH you must enter the calibration value, which is usually temperature dependent.
    b. For DO, you must enter the current barometric pressure. If you do not have a barometer, check the local weather station and calculate according to actual elevation. Barometric pressure must be entered in mm Hg. If given in in Hg, multiply by 25.4. To calculate for elevation take the barometric pressure at sea level in your area and subtract the following; divide your location's altitude in feet above sea level by 100 and multiply by 2.5.
    c. For turbidity, the 0 NTU standard must be calibrated first.
13. A real time value will display, with all enabled sensors reading values, not just the sensor currently being calibrated.
    a. For turbidity activate the wiper function to remove any bubbles if necessary.
14. Observe the stabilization of the sensor value being calibrated. When the reading stabilizes for approximately 30 seconds, press Enter to accept calibration.
15. Press Enter to return to the Calibration menu, and proceed to the next calibration. Repeat steps 3-13 for each calibration standard. For pH and turbidity 2-point calibrations, the Sonde will prompt you for the second calibration solution. Dry the Sonde between readings.
16. Once completed rinse and dry the Sonde.

The Sonde is now ready to be used for readings throughout the day. Recalibrate as necessary if field conditions present erroneous data or the Sonde experiences mechanical issues. Record the calibrations were performed in the daily field logbook and other paperwork as necessary. Remember to replace any protective caps on the sensors following calibration or use of the meter and decontamination.

3.2 Site Control

- Upon arrival at groundwater monitoring well or sample station, position field vehicle in location convenient to access well as necessary for use of pump and field equipment while collecting parameters. Consider using the field vehicle to provide safety from traffic or shade from the sun.
- Establish a work area as needed. Lay out equipment in an orderly manner so as to avoid creating trip hazards. This is an important consideration in regards to cords and tubing. If necessary, use traffic cones or caution tape to define a work area and do not allow the public or subcontractors to enter your work area. Control activities in the sample collection work area so as to preserve the quality and integrity of the parameters being collected.

3.3 Water Level Measurement

Water level indicators (sounders) need to be calibrated and checked for accuracy. If more than one instrument is to be used, they should be checked by measuring a single well using both instruments to assure that measurements are consistent. A single water level meter can be checked against another tape (i.e. 100 foot reel measuring tape). Turn on unit and test the audible detector by depressing button on the site of unit before use.

Prior to leaving field office or before beginning water level measurements, decontaminate the probe and cable. Inspect well casing and locking cap for tampering, damage, maintenance needs or rust and make note of the conditions on the appropriate *Well Maintenance Form* and in the field logbook.

Use care when removing the well cap or J-plug and observe if there is a pressure difference between the closed well and atmospheric pressure. If project groundwater wells tend to build pressure attach a lanyard to well cap to eliminate the potential for injury from rapid pressure release. Never place body, face or head directly over a well while opening the well cap. Each well shall be marked with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed. In the event a marking is not visible or well is not yet surveyed, take the water level reading from the north-side top of casing.

Don disposable silicone or nitrile exam gloves before lowering well sounder probe and measuring tape into the well. After decontaminating the sounder following water level measurement, properly dispose of exam gloves. A fresh pair of exam gloves should be used for each well or monitoring station.

Slowly lower probe into the monitoring well until contact with the water surface. An audible alarm on the water level meter will occur when the probe touches the water. Gently lift and lower the probe until an accurate measurement can be determined. Adjust well sounder sensitivity as necessary to get a good reading. Obtain the reading from the established mark on the well casing and measure to the nearest 0.01 foot. Record water level on the appropriate field forms.

After a water level measurement is collected at a groundwater monitoring well, decontaminate the measuring tape and reel. After decontamination is completed, properly secure the sounder in the sampling vehicle before moving on to the next location.

3.4 Equipment Setup

Remove any sample or hardware from the well and allow settling time before deployment of the downhole meter, approximately five minutes. Remove hardware and take water level readings in a manner to minimize disturbance of the water column in the monitoring well, lower and remove equipment slowly.

Be sure the Sonde and cables have been decontaminated prior to deployment in the monitoring well. Connect the Sonde to the power source if needed and connect communication cable from the Sonde to the probe.

Remove the probe guard and any protective sensor caps before using the Sonde. After calibration of the meter, confirm the sensors and parameters that are needed (turbidity, temperature, DO, ORP, and conductivity) are all reading on the instrument display. Replace the probe guard and keep in place during deployment. Check the pump intake depth for the current monitoring well and attach the correct length of Sonde cable to the meter (100 foot or 200 foot cable available).

Deploy the meter into the monitoring well and secure at the top of the well once the appropriate depth has been reached as to avoid kinking. Attempt to not disturb the water column too much while deploying by lowering the meter slowly. Allow settling time before collecting parameters, approximately two minutes.

3.5 Groundwater Quality Parameter Collection

On the YSI meter menu, Select Run. Choose Discrete Sampling on the meter's menu. Discrete sampling is used for spot sampling and short term sampling. In the Discrete Sampling Menu, set the appropriate sample interval sample time length. The default sample interval is four seconds and is appropriate for most discrete sampling. Optionally, identify the location by entering a filename and site name. Then select Start Sampling. Once the sample interval time has passed (4 seconds), the data will be displayed and it can be saved by selecting Log Last Sample.

When using the downhole meter, place the meter at the specified pump depth and record one measurement on the field paperwork once stabilized. If no other readings are required, remove the Sonde and cable from the monitoring well. Replace the hardware and deploy a passive diffusion bag (PDB) as necessary for the next sampling event. Replace the well cap and secure well.

3.6 Equipment Decontamination and Waste Disposal

Decontaminate the Sonde, meter cables, and all sensor probes with deionized water and a mild detergent. A small brush may be used on the sensors if necessary. The cable connector port must always be covered to prevent moisture from entering. If the cable is not connected cover the port with the pressure cap.

For short term storage place approximately 0.5 inches of water in the calibration or storage cup and place it on the Sonde. The use of a moist sponge is also acceptable instead of water. Do not immerse the sensors. The purpose is to keep the air in the cup at 100% humidity. Any type of water may be used such as tap water, distilled water, or deionized water. Make sure the cup is on tight to prevent evaporation. Check periodically to make sure there is still water/moisture present. For Sondes with level sensors, keep the tube sealed and dry.

Containerize any decontaminate water and dispose at the Sites 2 and 12 groundwater treatment plant (2/12 GWTP). Bag up any non-hazardous solid wastes, such as disposable gloves and paper towels, for disposal in a garbage receptacle.

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STANDARD OPERATING PROCEDURE
FOR LOGBOOK DOCUMENTATION AND FIELD NOTES (PFAS-Specific)
No. 101

1.0 INTRODUCTION

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field personnel in the techniques and requirements for recording information in logbooks and to ensure that field activities are properly documented. Adequate documentation is necessary to describe the work performed. Attention to detail is vital as field logbooks have been shown to be useful in administrative and judicial proceedings and for cost recovery measures.

This SOP relates specifically to per- and polyfluoroalkyl substances (PFAS) investigations.

1.2 Scope

The scope of this SOP is to describe the data entry requirements and suggested format for field logbooks.

2.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for reviewing the adequacy of the logbooks during and after fieldwork.

Field Team Lead (FTL) – The FTL is responsible for reviewing the adequacy of the logbooks during fieldwork.

Field Personnel – Each person in the field is responsible for maintaining a field logbook.

3.0 DEFINITIONS

Field logbook – The field logbook, used to record daily field activities and act as a historical factual record of events, will be maintained on loose paper (PFAS-free) secured on masonite or aluminum clipboards (i.e. plastic clipboards, binders, or spiral hard cover notebooks are not acceptable). Field logbooks are permanently assigned to a specific project.

Field datasheets – Any documentation that is supportive of the field logbook information that is important for preserving an accurate historic record of field activities but is recorded on unbound paper. These records should be referenced in the field logbook and include groundwater sampling datasheets, equipment calibration datasheets, photograph logs, lithologic logs, chain of custody forms, shipping manifests, daily tailgate meeting records, etc.

Electronic Datasheets – Any documentation that is supportive of the field logbook information that is important for preserving an accurate historic record of field activities but is recorded electronically through field instruments. These records should be referenced in the field logbook and include global position system (GPS) coordinates, pressure transducer data, photographs, etc.

4.0 EQUIPMENT

Sampling for PFAS requires (and prohibits) specific equipment:

- A field logbook, as described above, with pre-numbered consecutive pages.
- Ball-point pen.
- Waterproof and PFAS-contain (ie. Post-it-notes) materials for record keeping **may not** be used.

5.0 PROCEDURE

5.1 Field Logbooks

Each logbook shall contain the following information on the cover:

- Owner of the book
- Book number
- Job name and project number
- Project task, if applicable
- Start date
- End date

It is useful to include project contact information on the inside front cover or first page of the logbook. Contact information includes names and phone numbers of subcontractors, project assistants, field team members, and emergency numbers from the site-specific health and safety plans.

Each logbook page shall include the following:

- Job name or number and date at the top of each page
- Date and signature at the bottom of each page, over any remaining blank lines

Logbooks entries shall adhere to the following guidelines:

- Pages shall never be removed from the logbook
- All information must be printed legibly using ball-point pens
- Entries shall be written using objective and factual language and should be made in chronological order
- Entries shall be made on subsequent lines such that no blank lines exist on each page

- If any space remains on the bottom of the last page of field entries at the conclusion of the day's entries, a diagonal line shall be drawn to obscure any additional entries on that page
- Initial all diagonal lines.
- If corrections are necessary, a single line may be drawn through the original entry. The corrected information may then be added and should be initialized and dated.

At a minimum, the standard daily entries shall include the following:

- Project name and location
- Page number
- Date and time; time shall be based on the 24-hour clock (i.e., 2100 instead of 9 pm)
- Weather conditions and changing weather that may impact site conditions
- Site conditions and other salient observations
- Full names and titles/roles of personnel on-site, including visitors
- Daily objectives
- Time and location of activities
- Work start/stop times
- Level of PPE
- All relevant field observations, major task decisions, comments, or other valuable site investigation information
- References to relevant datasheets and documentation preserved outside the logbook such as groundwater sampling datasheets, soil boring logs, etc. Do not duplicate information from the referenced sheets in the logbook.
- Location of work areas (sketches or photographs when appropriate, with north arrow and approximate scale)
- Survey and/or location of any sampling points, including swing-tie measurements
- Type of field instrumentation (model number and serial number) and all calibrations performed
- Decontamination times and methods
- All field measurements
- Type, amount, and method of disposal for investigation-derived waste
- Changes/deviations from the work plan and reason for deviations
- Any general observations or notes
- Daily equipment calibration and maintenance
- Sample record (sample identification, date, time, media, number of samples, and location)
- Any communication with the PM or client pertaining to decisions being made in the field
- Persons contacted and topics discussed

Correct erroneous field record or logbook entries with a single line through the error. Do not erase incorrect information. Date and initial revised entries. Logbooks and field forms will be kept in the project file when complete or when not in use.

5.2 Field Datasheets

All unbound data documentation is part of the field records and should be maintained with safe document handling and archiving procedures. These records should be recorded with ball-point pens on plain paper. As soon as possible, the unbound records shall be scanned to create an electronic record to ensure document preservation.

5.3 Electronic Datasheets

All electronic data that are part of the field records shall be downloaded to a designated location and maintained for project use. Care must be taken when downloading the electronic data to ensure that the original record is preserved. Naming conventions should be used to indicate the project, date, and other relevant information to ensure accurate use.

5.4 Document Control

At the conclusion of a task or project, all field documentation, including the field logbook, field datasheets, and electronic data, should be submitted to the PM for records retention. All original documents should be kept in the project file. Copies of all field notes and field records will be included in reports.

6.0 REFERENCES

Amec Foster Wheeler Environment & Infrastructure, Inc., 2016. *Quality Program Plan: Site Investigation Of Potential Perfluorinated Compound (PFAS) Release Areas At Multiple United States Air Force (USAF) Base Realignment and Closure (BRAC) Installations*. Prepared for USAF. Revised September 2016.

Interstate Technology Regulatory Council (ITRC), 2020. *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)*. Fact Sheet, revised April 2020.

U.S. Environmental Protection Agency (USEPA), 2017. *Logbooks Operating Procedure, SESDPROC-1002-R0.* October 1.

7.0 REVISION LOG

Revision Date	Author	Revision Details
1/2/14	Brandie Hofmeister	Initial Issue
4/15/16	Andrew Weller	Reference Section: ADEC Field Sampling Guidance Updated, Project-Specific Statement of Work Removed
12/1/16	Ashley Olson	Logo
2/23/17	Katelyn Barnett Decker	Logo
9/1/17	Lexie Lucassen	Updated ADEC *Site Characterization Work Plan and Reporting Guidance* and

		Field Sampling Guidance references and incorporated into text
2/21/18	Casey Greenstein	Modified for PFCs
4/9/18	Alexa FitzGerald	Modified for PFAS
2/19/2021	Mike Records	Removed NY specific references, added AK references and AGL logo, updated ITRC reference to current
2/2/2022	Mike Records	Updated ADEC Field Sampling Guidance reference to current (2022)
2/4/2022	Margaret Lindh	Removed ADEC References and updated with USEPA guidance documents

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STANDARD OPERATING PROCEDURE FOR SOIL SAMPLING (PFAS-SPECIFIC)
Ahtna - No. 103

1.0 INTRODUCTION

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field personnel in the techniques and requirements for collecting soil samples from both the surface and subsurface soils in order to document the extent of contaminated soil and to determine the geotechnical, physical, and chemical properties of the soil while conducting per- and polyfluoroalkyl substances (PFAS) investigation sampling.

1.2 Scope

The scope of this SOP is to cover all aspects of soil sampling conducted by Ahtna personnel including, but not limited to, surface soils and subsurface soils, such as stockpiles, excavations, and drilling cores during PFAS investigations. The techniques described in this SOP are based on the Alaska Department of Environmental Conservation (ADEC) Field Sampling Guidance, dated October 2019. This SOP does not apply to sediment sampling.

This SOP should be used in conjunction with other applicable SOPs, including the following:

- SOP No. 34, *Incremental Sampling Methodology*
- SOP No. 101, *Logbook Documentation and Field Notes (PFAS-Specific)*
- SOP No. 110, *Quality Control Samples (PFAS-Specific)*
- SOP No. 111, *Sample Chain of Custody (PFAS-Specific)*
- SOP No. 112, *Labeling, Packaging, and Shipping Samples (PFAS-Specific)*
- SOP No. 113, *Equipment Decontamination Procedures (PFAS-Specific)*
- SOP No. 201, *Field Sampling Protocols (PFAS-Specific)*

2.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the field staff and ensuring that field staff has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP, but are considered the best sampling methods for the current project.

Site Safety and Health Officer (SSHO) – The SSHO oversees site-specific health and safety activities and ensures compliance with the project requirements. The SSHO conducts personal protective equipment (PPE) evaluations, selects the appropriate PPE, lists the requirements in the site-specific safety and health plan (SSHP), and coordinates with the field team to implement the SSHP.

Field Team Lead (FTL) – The FTL shall ensure that samples are collected using procedures that are in accordance with the UFP-QAPP, installation-specific work plans, and applicable SOPs. The FTL shall also be required to make rational and justifiable decisions when deviations from these procedures are necessary because of field conditions or unforeseen issues and report the deviations to the PM.

Field Personnel – Field personnel assigned to sampling activities are responsible for completing their tasks according to specifications outlined in the UFP-QAPP, installation-specific work plans, applicable SOPs, and other appropriate procedures. Field personnel are responsible for reporting deviations from procedures to the FTL.

3.0 DEFINITIONS

Auger flight – A steel section (typically 5-feet long) attached to an auger to extend the auger as coring depth increases.

Borehole – Any hole drilled or hydraulically driven into the subsurface for the purpose of identifying lithology, collecting soil samples, and/or installing monitoring wells.

Composite sample – Two or more grab sub-samples (aliquots) taken from a specific soil and site at a specific point in time. The aliquots are collected and homogenized, and then a single average sample is collected from the mixture.

Core sampler - A metal rod, generally 4- to 5-feet long by 2.25- to 3.25-inch in diameter, typically utilized along with drive rods and a polyvinyl chloride (PVC) or acetate or equivalent liner that is used to collect soil cores utilizing a direct-push rig. Inside the probe rods are smaller diameter, center rods affixed with a solid drive tip that seals the lower end of the probe rods during direct push drilling. Once the target depth is achieved, the center rods and drive tip are removed, which opens the bottom end of the probe rods. A PVC/acetate sample liner is then attached and lowered to the bottom of the push rods, and the assembly is then advanced to collect the soil sample within the liner. The center rod string with the liner is then removed from the direct push rods in order to access the recovered soil core. The process of direct push and soil core recovery is repeated within the same boring until reaching total boring depth.

Discrete sample – A sample taken from a distinct interval of a distinct size that is representative of one specific location at a specific point in time.

Grab sample – A discrete portion or single aliquot collected from a specific location at a given point in time. Grab samples are not composited.

Hand auger – A stainless steel cylinder (bucket or tube) approximately 3–4-inches in diameter and one foot long, open at both ends with the bottom edge designed to twist into the soil and cut out a soil core. The bucket or tube collects the soil sample. The auger has a T-shaped handle (for hand operation) attached to the top of the bucket by extendable stainless steel rod(s). A slide hammer can be attached, in place of the T- handle to drive a tube sampler.

Liner – A cylindrical sampling device generally made of plastic, brass, stainless steel that is placed inside a split-spoon, macro-core or hand auger bucket to collect soil samples. For purposes of PFAS sampling, liners will be made of PVC, acetate or equivalent non-PFAS material.

Macro-core – A piston rod sampling device, typically 4 or 5-feet long, generally made of carbon steel, which fits onto hollow push rods. A direct-push probe rig pushes the sampler to the desired sample depth, then extension rods are lowered through the hollow push rods to release a stop-pin which allows the sampler to be filled when advanced at the desired sampling interval.

Incremental Sampling Methodology (ISM) – structured sampling and processing protocol that reduces data variability and provides an estimate of mean contaminant concentrations in a volume of soil. ISM provides representative contaminant concentrations in samples of specific soil volumes, defined as decision units (DUs), by collecting numerous increments of soil that are combined, processed, and subsampled for laboratory analysis according to specific field and laboratory protocols.

Sampling spoon – A small, stainless steel device (typically disposable) that is operated with one hand to scoop soils into a sampling container or other vessel if homogenization is required. A small shovel may also be used to collect soil samples.

Shelby tube sampler – A cylindrical sampling device generally made of steel, which is driven into the subsurface soil through the hollow-stem auger or hand auger device with a slide hammer. The tube, once retrieved, may be capped and the undisturbed soil sample extruded in the laboratory prior to analysis.

Split-spoon sampler – A cylindrical sampling device made of carbon or stainless steel, which fits into a hollow stem auger on a drill rig. The split spoon is hinged lengthwise, which allows the sample to be retrieved by opening ("splitting") the spoon.

Surface soils – Under Alaska regulation 18 AAC 75.990(127), surface soil is defined as soil that extends from the surface to 2 feet below ground surface (bgs). However, the surface soils may be considered a different depth depending on the project goals. Note that surface soils may reside under a paved surface.

Subsurface soils – Under Alaska regulation 18 AAC 75.990(123), subsurface soil is defined as soil that is deeper than 2 feet bgs. However, subsurface soils may be considered a different depth depending on the project goals. Typically, subsurface soils are located above bedrock or any other consolidated material.

TerraCore® (Or EnCore®) sampler – A coring device that allows a specific quantity of soil to be collected (e.g., 5 grams and 25 grams). This device has a tight-fitting cap that seals with an O-ring. Samples collected in this manner may be frozen prior to shipment to the lab.

4.0 FIELD PROCEDURES

Soil conditions can vary widely at hazardous waste sites, which can affect the rate of contaminant migration through the soil. Therefore, it is important that detailed records be maintained during sampling, particularly with respect to the sample location, depth, color, odor, lithology, hydrogeology, and readings derived from field monitoring equipment. Surface and shallow subsurface soil samples shall be described using the Unified Soil Classification System (attached to the end of this SOP) and/or ASTM guidance D2487 Standard Practices for Classification of Soils for Engineering Purposes (Unified Soil Classification System), unless otherwise directed by the installation-specific work plan. The details within this SOP should be used in conjunction with installation-specific work plans. The following are procedures/considerations for field activities at potential PFAS release areas.

4.1 Field Equipment

The following equipment and supplies may be used for PFAS soil sampling:

- Field logbook made of standard/loose plain paper, held together by an aluminum or Masonite field clipboard. The pages must be marked with consecutive page numbers.
- Ball-point pens: do not use markers, felt pens, or pens with water resistant ink.
- Nitrile gloves
- Laboratory-supplied sample containers, preservatives, labels, chain of custody forms, custody seals, and temperature blanks (no glass, LDPE, or Teflon-lined caps).
- Non-PFAS containing packaging paper (to protect sample bottles during shipment to lab)
- Non-PFAS containing tape
- Ice (wet ice only; gel ice is not allowed) and coolers
- Zip-top plastic bags and/or stainless steel bowls, pans, or trays
- Stainless steel spoons, trowels
- Survey stakes, flags, or whiskers
- Personal Protective Equipment, as specified in the project-specific Health and Safety Plan
- Decontamination equipment
- Paper towels
- Chain of custody forms
- Munsell soil color charts
- Grain size charts (included at the end of this SOP)
- Hand lens

4.1.1 Manual (Hand) Sampling

- Shovel, pick ax, pick mattock, or other excavating tools
- Stainless steel hand auger with extension rods, as necessary
- Toolkit

4.1.2 Split-Spoon or Shelby Tube Sampling

- Drill rig equipped with hollow-stem augers and a drop hammer

- Stainless steel split-spoon or Shelby tube samplers (at least two)
- Acetate split-spoon liners
- Stainless steel basket or spring retainers for loose soils
- Brass sleeves and caps
- Boring log sampling forms (non-water-resistant to avoid PFAS cross-contamination)
- Toolkit

4.1.3 Continuous Sampling

- Drill rig equipped with direct-push capabilities and push rods
- Sufficient number of non-PFAS drill rod liners for the planned number of sampling intervals
- Hook-blade utility knife to cut the liners
- Basket retainers and caps for the liner ends for loose soils
- Boring log sampling forms (non-water-resistant to avoid PFAS cross-contamination)
- Toolkit

4.2 Decontamination

Before collecting any soil samples, decontaminate all sampling devices. Dedicated or disposable equipment should be rinsed with laboratory certified PFAS-free water. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of reusable sampling equipment that comes into contact with sampled media shall be decontaminated before initiation of sampling operations and between each sample location and interval. Decontamination solutions shall be replenished between sampling locations as needed. Spent decontamination fluids will be containerized, properly labeled and appropriately disposed of according to the investigation derived waste (IDW) plans addressed in the installation-specific work plan.

4.3 Sampling Preparation

Prior to sample collection, follow these general steps:

1. Ensure that all dedicated sampling equipment is new, and all reusable, non-dedicated sampling equipment is decontaminated per the SOP.
2. Don the appropriate PPE, as specified in the SSHP.
3. Determine the sample collection locations based on the project goals and work plan specifications.

4.4 Soil Retrieval

4.4.1 Manual Retrieval

Soil samples may be collected from surface soils using hand tools, from subsurface soils using hand tools such as shovels or a hand-auger, or from subsurface soils exposed at the surface by heavy equipment in an excavation. For manual sampling, follow these general steps:

1. Ensure that the sampling area is safe for entry. If the sample is to be collected from within an excavation, ensure that the excavation meets all criteria for safe entry.
2. Use hand tools to access the depth required for sampling. If using a shovel or hand auger, place the soil cuttings on a flat surface as specified in the work plan. If possible, lay the cuttings in stratigraphic order.
3. When collecting the sample, collect soil from freshly uncovered soil.

4.4.2 Split-Spoon Soil Retrieval

Subsurface soil samples may be collected from soil recovered from a split-spoon sampler when drilling with a hollow-stem auger drill rig. For sampling from this device, follow these general steps:

1. Remove any pavement or sub-base material that is obstructing access to subsurface soils from an area twice the diameter of the drill bit, as necessary.
2. Ensure that the drill rig and all tooling are decontaminated prior to drilling.
3. Set up the drill rig with the hollow-stem auger, the drill bit, and the center rod, and drill to the first sample depth.
4. As soil is brought to the surface with the auger flights, periodically remove these cuttings from the area as specified in the work plan.
5. When the sample depth is reached, remove the center rod and deploy the split-spoon sampler. Insert an acetate liner prior to sampler deployment, as necessary.
6. With the sampler shoe at the ground surface in the sample location, mark the center rod with four 6-inch increments to allow for blows to be counted.
7. Drive the sampler using the hammer. Use a full 30-inch drop as specified by the American Society of Testing and Materials (ASTM) Method D-1586. Record the number of blows required to drive the spoon through each 6-inch increment, as well as the length of the tube that penetrated the material being sampled, the weight of the hammer, and distance dropped.
8. Cease driving upon reaching the sampler length or refusal. Refusal is when little to no progress is made for 50 hammer blows.
9. Pull up the center rod and sampler and remove the sampler from the drill rods.
10. Open the sampler to access the soil, being careful not to disturb the soil. If using a sampler liner, slide the liner from the sampler without disturbing the soil. Wipe the outside of the sealed liner with a paper towel and mark the depth on the outside of the liner with a marker. Open the liner using a hook-blade utility knife. Typically, a ground cover should be placed in the working area so that soil unsettled from the sampler does not fall to the ground.

4.4.3 Direct-Push Soil Retrieval

Subsurface soil samples may be collected from a dual-tube sampler or a single rod sampler when using a direct-push drill rig or sonic drill rig, or a Shelby-tube sampler when using a hollow-stem auger drill rig with a hydraulic direct-push capability. All samplers use a plastic liner to allow for soil removal from the sampler. For sampling from these devices, follow these general steps:

1. Ensure that the drill rig and all tooling are decontaminated prior to drilling.
2. Drill to the first sample depth.

3. When the sample depth is reached, remove the drive tooling and deploy the sample barrel with an acetate liner and a drive tip.
4. Advance the sample barrel through the desired sample interval and then retrieve the sample by retrieving the rods.
5. Retrieve the soil by sliding the liner from the sample barrel. The liner may need to be removed using a hydraulic extruder.
6. Wipe the outside of the sealed liner with a paper towel and mark the depth on the outside of the liner with a marker.
7. Open the sampler to access the soil by cutting twice along the liner length using a hook-blade utility knife. Typically, a ground cover should be placed in the working area so that soil unsettled from the liner does not fall to the ground.

4.5 Sample Collection

For all soil samples, follow these general steps:

1. Remove bits of vegetation and large gravel from the sample as these items are not analyzed and reduce the available sample volume for analysis.
2. Take care to prevent cross-contamination and misidentification of samples.
3. Properly label the sample according to the SOP.
4. Record the sample location (both horizontal and vertical), the sample date and time, and any other applicable information in the field notebook and on any applicable sampling forms prior to moving on to another sampling location. Note that samples collected from a soil recovery device during drilling should be collected from a discrete (short interval at least 6 inches but not to exceed 2 feet in length) depth interval.
5. Decontaminate any non-dedicated, reusable sampling equipment according to the SOP, prior to moving on to another sampling location.
6. All samples will be collected in order of volatility. Samples that are degraded by aeration (volatiles) shall be collected first and with the least disturbance as possible and immediately preserved. Collect a volatile grab sample using a sampling spoon or gloved hand, or as necessary, use a TerraCore® or EnCore® sampler to collect a pre-determined volume (generally 50 grams). A field scale should be used to ensure the correct amount of sample material is collected. Place volatile samples directly into a laboratory-supplied jar and preserve with applicable materials.
7. Samples that are not degraded by aeration will be collected after soil is homogenized. Collect a non-volatile grab sample using a stainless-steel sample spoon or gloved hand, and place the soil into a re-sealable plastic bag or bowl/pan/tray to homogenize the soil. Place the homogenized soil directly into a laboratory-supplied jar and preserve with applicable materials.
8. Make notes on the boring log regarding the soil characterization and geologic features, including any staining or olfactory observations (see SOP on soil logging). Note that samples should generally be collected prior to characterization of soil to preserve the integrity of the volatile samples.
9. Wipe down the jar threads to remove any bits of soil and close the jar with the lid, and wipe the outside of the jar, using a paper towel or other clean, dry wipes.
10. Place the sample container in the shipping container, typically a chilled cooler, and proceed with further sampling.

11. When sampling is complete, remove the drill rig to the decontamination area.
12. Properly package and ship all samples according to the SOP 112.

For specific types of sampling, follow the steps outlined below.

4.5.1 Discrete Sampling

Typically, discrete sampling is the preferred method of sampling unless otherwise dictated for the specific project. The locations where discrete samples are to be collected should be explained in a site-specific work plan.

4.5.2 Composite Sampling

Composite sampling may only be conducted if previously approved in a site-specific work plan. Composite samples should have equal aliquots of soil (as measured by mass) collected as discrete samples from all sub-locations. Aliquots of volatile samples will be collected directly into laboratory-supplied jars and preserved immediately. Aliquots of non-volatile samples should be homogenized before placing into laboratory-supplied jars.

4.5.3 Incremental Sampling Methodology

ISM sampling may only be conducted if previously approved in a site-specific work plan. The ISM sampling approach shall be conducted in accordance SOP No. 34. ISM sampling is similar to a composite sample in that equal aliquots of soil (as measured by mass) are collected within is predetermined decision unit. Replicate samples should be collected using the same sampling techniques, in order to verify that the ISM sample is truly representative of the DU. Care should be taken to ensure the replicate samples are not collected from co-located or adjacent locations.

4.5.4 Geotechnical Sampling

Note that for geotechnical sample collection, the soil should be left in the sampler liner, the ends capped to preserve the soil matrix integrity, and the sample transported to the laboratory for analysis. The soil should not be removed from the sampler liner prior to laboratory analysis.

5.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2020. 18 Alaska Administrative Code 75, *Oil and Other Hazardous Substances Pollution Control.* November 7.

ADEC, 2019. *Field Sampling Guidance*, October.

American Society of Testing Materials (ASTM), 2016. *Standard Practice for Soil Exploration and Sampling by Auger Borings*, Method D 1452-16, November 1.

ASTM, 2017 *Standard Practice for Clarification of Soils for Engineering Purposes (Unified Soil Classification System)*, Method D2487-17, December 15.

ASTM, 2018. *Standard Practice for Standard Penetration Test and Split Barrel Sampling of Soils, Standard,* Method D-1586-18, December 1.

Hewitt, Alan D., et al. 2007. Protocols for Collection of Surface Soil Samples at Military Training and Testing Ranges for the Characterization of Energetic Munitions Constituents. U.S. Army Corps of Engineers. ERDC/CRREL TR-07-10.

Interstate Technology Regulatory Council (ITRC), 2018. *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)*. Fact Sheet, released March 2018.

U.S. Air Force (USAF), HQ USAF/A7C, 2012. *Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations.* August.

6.0 REVISION LOG

Revision Date	Author	Revision Details
1/4/13	Olga Stewart	Initial Issue
12/1/2016	Ashley Olson	Updated based on final ADEC sampling guidance, updated logo
2/23/17	Katelyn Barnett Decker	Logo
9/1//2017	Lexie Lucassen	Updated references (IRTC I*ncremental Sampling Methodology, 2012;* ADEC *UST Procedures Manual*, 2017; and ADEC *Field Sampling Guidance,* 2017.) Updated text based on new references.
2/21/2018	Casey Greenstein	Modified for PFCs. Typos corrected.
3/5/2018	Alexa FitzGerald	Modified for PFAS Sampling.
4/24/2020	Ashley Olson	Updated ISM discussion
4/27/2020	Lexie Lucassen	Updated sampling procedures Section 4.5: Step 4: updated to be consistent with Ahtna SOP-03. Step 6: added that volatile samples should be weighed with field scale. Deleted duplicated, redundant step to label sample jar
11/12/2020	Mike Records	Update 1.2 Scope to reference SOPs 100, 101, 112, and 113
12/10/2020	Mike Records	Update ASTM, ITRC references to current
2/22/2021	Mike Records	Updated missed references to 100 level PFAS SOPs, removed project-specific NY references, added AK-specific references and AGL logo

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)		
	▨	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
	▨	GM	Silty gravels, gravel-sand-silt mixtures
	▨	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)		
	▨	SW	Well-graded sands, gravelly sands, little or no fines
	▨	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
	▨	SM	Silty sands, sand-silt mixtures
	▨	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%	▨	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	▨	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	▨	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	▨	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	▨	CH	Inorganic clays of high plasticity, fat clays
	▨	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	▨	PT	Peat and other highly organic soils

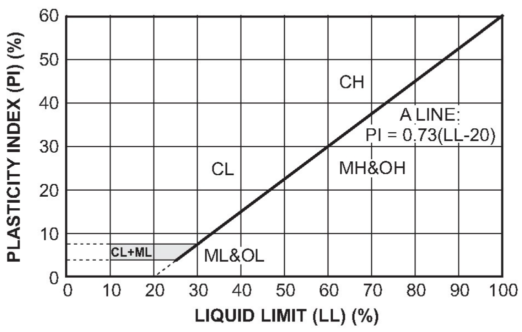
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent	GW, GP, SW, SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

PLASTICITY CHART



Ahtna
Global, LLC

STANDARD OPERATING PROCEDURE
FOR GROUNDWATER SAMPLING (PFAS-SPECIFIC)
No. 105

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to direct field personnel in the proper methods for collecting and documentation of groundwater samples for chemical analysis. This SOP should be used in conjunction with the project-specific work plan, which will include additional procedures and requirements for the individual project.

2.0 SCOPE

The scope of this SOP applies to all Ahtna personnel and subcontractors engaged in collecting water quality parameters while purging and groundwater sampling during per- and polyfluoroalkyl substances (PFAS) investigations. The SOP was developed per the U.S. Environmental Protection Agency (USEPA) *General Field Sampling Guidelines* (USEPA, 1994). This SOP should be used in conjunction with other applicable SOPs, including the following:

- SOP No. 101, *Logbook Documentation and Field Notes (PFAS-Specific)*
- SOP No. 112, *Labeling, Packaging, and Shipping Samples (PFAS-Specific)*
- SOP No. 113, *Equipment Decontamination Procedures (PFAS-Specific)*
- SOP No. 119, *Groundwater and LNAPL Measurements (PFAS-Specific)*

Qualified persons, as defined by California Code of Regulations Title 8 §5192, will be engaged in or directly supervise the collection and handling of environmental samples.

3.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the field staff and ensuring that field staff has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP, but are considered the best sampling methods for the current project.

Site Safety and Health Officer (SSHO) – The SSHO oversees site-specific health and safety activities and ensures compliance with the project requirements. The SSHO conducts personal protective equipment (PPE) evaluations, selects the appropriate PPE, lists the requirements in the site-specific safety and health plan (SSHP), and coordinates with the field team to implement the SSHP.

Field Team Lead (FTL) – The FTL shall ensure that samples are collected using procedures that are in accordance with the UFP-QAPP, project-specific work plans, and applicable SOPs. The FTL shall also be required to make rational and justifiable decisions when deviations from these procedures are necessary because of field conditions or unforeseen issues and report the deviations to the PM.

Field Personnel – Field personnel assigned to sampling activities are responsible for completing their tasks according to specifications outlined in the UFP-QAPP, project-specific work plans, applicable SOPs, and other appropriate procedures. Field personnel are responsible for reporting deviations from procedures to the FTL.

4.0 DEFINITIONS

Multiple types of equipment can be used to purge and sample groundwater. The correct equipment to use should be determined by the project manager based on site conditions and should be outlined in the project-specific work plan.

Bailer – A bottom-filling cylindrical tube with a check valve at the bottom.

Bladder Pump – A positive displacement pump that is acceptable for collection of all analytes and depths. Can be small enough to sample from wells as small as 3/4-inch in diameter.

Dedicated Groundwater Monitoring Equipment – Equipment that is installed in one well to purge and sample only one well, and that remains in that well for the duration of the monitoring program. Dedicated equipment does not need to be decontaminated between sampling events.

Gear Pump – Positive-displacement pump that is acceptable for low-flow purging and sampling of all analytes.

HydraSleeve™ – Sampler consisting of a sampling sleeve, a stainless steel weight, and a self-sealing valve. Typically used for no-purge sampling. Effective for discrete interval sampling and low-yield wells.

Inertia Pump – A riser tube fitted with a one-way foot valve. Best used on small diameter wells (2 inches or less). Can be used if the depth to water is less than approximately 25 feet.

Peristaltic Pump – A negative air pressure pump that can be used if the depth to water is less than approximately 25 feet.

Snap Sampler™ – Collects representative samples in-situ without purging. Effective for discrete interval sampling. For use on wells 2 inches in diameter or greater.

Submersible Pump – A positive-pressure pump that is acceptable for collection of all analytes. Achievable depths are limited by the power of the pump and length of wiring. Well must be at least 2 inches in diameter.

5.0 PROCEDURE

The Field Team Lead should work with the Project Manager to obtain historical information on which wells have historically had contaminants present, so that wells with the greatest concentrations may be sampled last to minimize potential cross contamination.

Groundwater sampling may be performed using several sampling devices including submersible pumps, bladder pumps, peristaltic pumps, inertia pumps, and bailers. The choice of sampling device will be based on site-specific considerations including the well diameter, depth of groundwater, analytes of interest, and well sampling method (when applicable), which will be detailed in the project-specific work plan. Groundwater sampling devices should compliment the intended data use and site decisions, and selected groundwater purging and sampling equipment should minimize increases in sample temperature, water column agitation, and sample agitation. Various types of purging and sampling equipment available for groundwater sampling are described in *ASTM Standard Guide for Sampling Ground-Water Monitoring Wells, D 4448-01* (ASTM, 2007).

Materials used during groundwater sampling must not absorb, desorb, or leach contaminants of concern from or into a potential groundwater sample. The materials used must be resistant to chemical and biological degradation. If bailers are used, the bailer must be made of stainless steel, or HDPE with a check valve at the bottom. Bailers must not be made of Teflon® or any other PFAS-containing material.

5.1 Field Equipment

- Field logbook made of standard/loose plain paper (non-weatherproof), held together by an aluminum or Masonite field clipboard. Alternatively, a spiral-bound notebook with non-weatherproof paper and/or cover can be used. The pages must be marked with consecutive page numbers.
- Ball-point pens: do not use markers, felt pens, or pens with water resistant ink.
- Nitrile gloves
- Laboratory-supplied sample containers, preservatives, labels, chain of custody forms, custody seals, and temperature blanks (no glass, LDPE, or Teflon-lined caps).
- Non-PFAS containing packaging paper (to protect sample bottles during shipment to lab)
- Non-PFAS containing tape
- Ice in polyethylene bags and coolers
- Personal Protective Equipment, as specified in the project-specific Health and Safety Plan
- Decontamination equipment
- Paper towels
- Chain of custody forms

5.2 Pre-Sampling Tasks

Tasks to be completed prior to sampling each day include the following:

1. Inspect the equipment to ensure that it is in good working order.

2. Calibrate all field analytical test equipment (e.g., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature) according to the instrument manufacturers' specifications or scope-specific work plan. Calibration results will be recorded on the appropriate form(s) as specified by the project work plans. Instruments that cannot be calibrated according to the manufacturers' specifications will be removed from service and tagged.

3. Water level meters will be calibrated at the beginning of the project and then every six months using a steel surveyors tape.

5.3 Decontamination

Before collecting any water samples, all sampling devices shall be decontaminated in accordance with SOP 113, *Equipment Decontamination*. Reusable non-dedicated equipment will be rinsed with laboratory certified PFAS-free water prior to and following the collection of each sample. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of sampling equipment shall be decontaminated before initiation of sampling operations and between each sample location and interval. Decontamination solutions shall be replenished between sampling locations as needed. Spent decontamination fluids will be containerized, properly labeled and appropriately disposed of according to the investigation derived waste (IDW) plans addressed in the project-specific work plan.

5.4 Purging and Sampling with a Bailer

1. Measure and record static groundwater level.
2. Tie bailer wire, chain, or other approved line material to the top of the bailer and the other end to an unmovable object.
3. Slowly lower the bailer into the water column to avoid disturbing sediment until the bailer is full.
4. Raise the bailer to the surface.
5. Empty water into a bucket.
6. Repeat steps until water is clear.
7. Using the bailer tip, empty contents into sample containers.

5.5 Purging and Sampling Using Low Stress (Low Flow) Procedure

1. Measure and record static groundwater level.
2. If suspected to be present in the well, check for the presence of NAPL using an electronic NAPL-detecting device. If detected, record the presence and thickness of NAPL in the field notebook.
3. Place pump or bottom of tubing in the well within the screened interval.
4. Secure the tube from the pump to the influent connector at the bottom of the flow-through cell of the water quality meter.
5. Start pump.
6. Adjust purge rate to minimize and stabilize drawdown.
7. Once drawdown is stable, start collecting water quality parameters according to SOP 120, *Water Quality Measurements*.

8. Routinely measure and record the DO, ORP, conductivity, pH, turbidity, temperature, and current groundwater level throughout the purge at approximately 3- to 5-minute intervals. Record the purge groundwater parameters on a Groundwater Sampling Form.
9. Continue to measure and record the groundwater parameters and current groundwater level until the parameters stabilize according to the following stabilization criteria. Groundwater parameters are considered stable after purging if three successive readings of at least three parameters are within:
   - ± 0.1 pH
   - ± 3% conductivity
   - ± 10 mV ORP
   - ± 10% DO
   - ± 10% turbidity

   Note: If three well volumes have been purged and the required number of parameters have still not stabilized, a sample may be collected. For low-yield wells, the well may be purged dry and sampled after 80% recharge.
10. Disconnect the tubing from the water quality meter.
11. Collect and label samples in the following order:
    - VOCs (reduce flow rate to 100-150 mL/min during sample collection)
    - SVOCs including DRO/RRO, PCBs, pesticides, herbicides (reduce flow rate to 100-150 mL/min during sample collection)
    - Total Organic Carbon
    - Total and dissolved (filtered) metals.
12. If the well purges dry, collect sample after the well recharges to approximately 80% of its pre-purge volume.
13. As soon as possible after sample collection, place each labeled sample into a cooler with wet ice. If wet ice is not available, gel ice may be used if it is physically separated from the sample containers by containing either the ice or the samples in polyethylene zipper bags.

6.0 REFERENCES

American Society of Testing and Materials (ASTM), 2019. Standard Guide for Sampling Ground-Water Monitoring Wells, D4448-19.

Interstate Technology Regulatory Council (ITRC), 2020. *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS).* Fact Sheet, revised April 2020.

U.S. Air Force (USAF), HQ USAF/A7C, 2012. *Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations.* August.

U.S. Environmental Protection Agency (USEPA), 1994. *General Field Sampling Guidelines.* August 11.

USEPA, 1996. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells,* July 30. Last revised 19 September, 2017.

7.0 REVISION LOG

Revision Date	Author	Revision Details
7/28/15	Joel Brann	Initial Issue
2/23/17	Katelyn Barnett Decker	Logo
9/1/17	Lexie Lucassen	Updated ADEC *Field Sampling Guidance* to August 2017. 3.0 Equipment – added additional pump/sampler types.
12/12/2017	Lexie Lucassen	Added header
12/27/2017	Lexie Lucassen	Updated EPA low stress sampling procedure reference to include 2017 revision.
2/21/2018	Casey Greenstein	Modified for PFCs
3/5/2018	Alexa FitzGerald	Modified for PFAS Sampling.
10/24/2019	Lexie Lucassen	Wording edits for PFAS-specific sampling, added references to other SOPs
10/27/2019	Morgan Bruno	Edited so that gel ice is allowed, if separated from the sample containers by polyethylene zipper bags
12/10/2020	Mike Records	Update ASTM, ITRC references to current
1/20/21	Andrew Weller	Included reference to 2019 ADEC *Field Sampling Guidance*
2/22/2021	Mike Records	Updated to reference 100 level PFAS-specific SOPs, deleted NY-specific references, added AK-specific references and AGL logo
2/4/2022	Mike Records	Updated ADEC Field Sampling Guidance reference to current (2022). Removed project-specific SOP 201 reference.
4/26/2022	Mike Records	Updated 18 AAC 75 reference to Nov 2021
7/6/2022	Margaret Lindh	Updated to USEPA and California specific

Ahtna
Global, LLC

STANDARD OPERATING PROCEDURE FOR SAMPLE CHAIN OF CUSTODY (COC)
No. 111

1.0 INTRODUCTION

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field personnel in the techniques and requirements for maintaining the sample chain of custody (COC).

Proper handling, chain of custody, and documentation are necessary to provide an accurate written record to track the possession, handling, and location of samples from the moment of collection through reporting.

1.2 Scope

The scope of this SOP is to cover aspects of sample handling, with respect to custody, and the proper techniques for documenting the custody on the COC form.

2.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the field staff and ensuring that field staff has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP but are considered the best sampling methods for the current project.

Sampler – The sampler is responsible for the handling and documentation of sample custody as specified in this SOP.

3.0 DEFINITIONS

Chain of custody (COC) – The chronological documentation of sample custody, showing the control, transfer, and analysis of samples.

Custody seal – An adhesive label placed across a shipping container opening that is used to detect tampering with samples after they have been packed for shipping.

Sample – A material that is housed in containers and identified with a unique sample identification number that is to be analyzed by a laboratory.

Sample custody – A sample is considered under custody if it is in your possession, if it is in your view after having been in your possession, if it was in your possession and is then locked up to prevent tampering, or if it is in a designated and identified secure area.

Sample label – An adhesive paper or tag that is placed on sample containers to designate a sample identification number and other identifying information.

4.0 EQUIPMENT

While conducting per- and polyfluoroalkyl substances (PFAS) investigations, all materials and equipment used will be PFAS-free. Equipment needed for chain of custody documentation includes the following:

- Sample jars that have been filled and labeled in accordance with the work plan
- Quality control (QC) sample containers
- Coolers with return address written on inside lid
- COC forms
- Custody seals
- Gallon-sized re-sealable plastic bags
- PFAS-free tape

Note that this SOP is intended to be used in conjunction with the following SOPs, and as such, the equipment and materials needed for those activities are not included in this SOP:

- Logbook Documentation and Field Notes (No. 101)
- Labeling, Packaging, and Shipping Samples (No. 112)

5.0 PROCEDURE

Sample identification documents will be carefully prepared so that sample identification and chain of custody are maintained. Sample identification documents include the field logbook, sample labels, custody seals, and COC records.

A sample is in custody if it meets one of the following conditions:

- In an authorized person’s physical possession
- In an authorized person’s view after being in possession
- Was in an authorized person’s possession then locked up
- Kept in a secured area that is restricted to authorized personnel

5.1 Field Custody Procedures

The following procedures shall be used by field personnel:

- As few persons as possible will handle samples.
- The sample collector will be personally responsible for the care and custody of samples collected until they are transferred to the laboratory.

- The sample collector will record sample data (time of collection, sample number, analytical requirements, and matrix) in the field logbook.
- Sample labels shall be completed for each sample, using a ballpoint pen.

5.2 Chain of Custody Record

All samples will be accompanied by a COC record. The COC form is typically provided by the laboratory unless otherwise specified in the work plan. The chain of custody record will be fully completed in duplicate. Information to be included on a chain of custody form includes the following:

- Project name and number
- Contractor name and address
- Laboratory name and address
- Name of person that collected the sample(s)
- Sample identification number
- Sample date and time (time in 24-hour format)
- Laboratory analysis methods required for each sample jar
- Preservatives added to each sample jar
- Sample matrix (soil, water, or other)
- Number of containers per sample
- Airway bill tracking number (if applicable)

Additional remarks can be added to the COC record to alert the laboratory including the following:

- Matrix spike/matrix spike duplicate (MS/MSD) sample volume. The note “MS/MSD” should be added within the same line as the primary sample.
- A request for rapid turnaround time.
- A note regarding the potential concentrations in a highly-contaminated sample to guide laboratory dilution prior to analysis.

Indication of a duplicate sample should never be included on a COC record.

5.3 Sample Packaging

Samples will be labeled and packaged according to the labeling, packaging, and shipping SOP (SOP 112). The COC record will accompany all sample shipments. One COC record shall be prepared for each shipment. One COC record will be prepared for each cooler, even if multiple coolers are included in one shipment. The cooler name and NPDLWO# are required on the COC. The samples in the cooler must be listed on the COC record.

The COC record will be placed in a re-sealable plastic zip-lock bag, the bag sealed shut to prevent water intrusion from the bagged wet ice in the cooler, and the bag taped (using PFAS-free tape) to the inside lid of the cooler. If one sample is contained in two coolers (i.e. one sample has too many containers to fit in one cooler), then a copy of the COC record will suffice to accompany the second cooler as long as the original is in the first cooler and the copy is denoted as a copy.

The duplicate copy of the COC record will be retained by the sampler and distributed as necessary to the sample coordinators. Airway bills will also be retained with the COC record as documentation of transport.

Custody seals will be pre-printed on PFAS-free paper. Seals will be signed and dated with a ball point pen at the time of use. Sample shipping containers will be sealed in as many places as necessary to ensure that the container cannot be opened without tearing the custody seals. Typically, one custody seal will be placed along the front opening, and one along the side opening of a cooler. PFAS-free tape will be placed over the seals to ensure that seals are not accidentally broken during shipment.

If a sampler hand transports the samples to the laboratory without sample shipment, custody seals are not required.

5.4 Transfer of Custody

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler will sign, date, and note the time as “relinquished by” on the COC record. The receiver will also sign, date, and note the time as “received by” on the COC record. The date and time of the receiver and relinquisher shall be the same.

When samples are transported by a common commercial carrier such as American Airlines or Federal Express, the carrier will not sign the COC record. However, the airway bill tracking number should be recorded on the COC record. For this reason, the date and time of the receiver and relinquisher will not match when shipping through a common commercial carrier.

5.5 Laboratory Custody Procedures

A designated sample custodian will accept custody of the shipped samples and verify that the sample identification number matches the COC record. Pertinent information about shipment, pickup, and courier will be entered in the “Remarks” section. Temperature of the coolers at the time of receiving will be noted on the COC record.

6.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2019. *Field Sampling Guidance*, October.

AFCEE (U.S. Air Force Center for Environmental Excellence). 2000 (September). *Quality Program Plan.* AFC-J23-35Q85101-M3-0002. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis Air National Guard Base, MA.

American Society for Testing and Materials (ASTM), 2018. *Standard Guidance for Chain of Custody Procedures*, ASTM D4840-99(2018)e1.

U.S. Environmental Protection Agency (EPA), Office of Emergency and Remedial Response, EPA/540/R-941/013, Feb 94 - *User's Guide to the Contract Laboratory Program*.

EPA, Office of Emergency and Remedial Response, EPA/540/R-96/0, Dec 96 -*Sampler's Guide to the Contract Laboratory Program*.

7.0 REVISION LOG

Revision Date	Author	Revision Details
1/2/14	Brandie Hofmeister	Initial Issue
6/2/16	Andrew Weller	Referenced 2016 ADEC Field Sampling Guidance and Minor Grammar Edits
12/1/2016	Ashley Olson	Updated logo
9/1/2017	Lexie Lucassen	Updated to August 2017 ADEC *Field Sampling Guidance*
4/10/18	Alexa FitzGerald	Modified for PFAS
2/9/2021	Mike Records	Referenced 2019 ADEC *Field Sampling Guidance*, added AGL logo

Ahtna
Global, LLC

STANDARD OPERATING PROCEDURE
FOR LABELING, PACKAGING, AND SHIPPING SAMPLES
(PFAS-Specific)
No. 112

1.0 INTRODUCTION

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field personnel in the techniques and requirements for labeling, packaging, and shipping samples.

1.2 Scope

The scope of this SOP is to cover all aspects of labeling samples for identification, packaging samples for safe transport, and shipping samples from the field to the laboratory for analysis, as conducted by Ahtna personnel or their subcontractors.

2.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the field staff and ensuring that field staff has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP, and are considered the best methods for the current project.

Field Team Lead (FTL) – The FTL is responsible for overseeing the collection and labeling of samples specified in accordance with the UFP-QAPP, installation-specific work plans, and applicable SOPs. The FTL shall also be required to make rational and justifiable decisions when deviations from these procedures are necessary because of field conditions or unforeseen issues and report the deviations to the PM.

Sampler/Technician – The sampler/technician is responsible for the collection and labeling of samples as specified in this SOP. The sampler/technician is also responsible for ensuring adequate packaging and proper shipping as specified in this SOP and the project specific work plan.

3.0 DEFINITIONS

Air waybill – The shipping document that identifies the sender and addressee, transport carrier, size, and priority of a shipment transported by aircraft.

Bill of Lading – a detailed list of a shipment of goods in the form of a receipt given by the carrier to the person consigning the goods to acknowledge receipt of goods.

Dangerous goods or hazardous materials – A substance or material, including a hazardous substance, that the United States Department of Transportation (DOT) has determined can pose an unreasonable risk to health, safety, and property when transported in commerce and that DOT has designated as a hazardous material.

Environmental sample – Any sample that has less than reportable quantities of any hazardous constituents according to DOT 49 CFR Section 172.

Excepted Quantity (DOT & IATA Definition) - A hazardous substance whose class is permitted on passenger aircraft but in such a small defined amount as to pose a low risk during transport by aircraft. Hazardous substances that meet the definition of Excepted Quantity may be exempted from documentation, packaging, marking, and labeling requirements typically required when presenting hazardous materials for passenger air transportation. Items shipped as excepted quantities are limited to volumes as specified in IATA Dangerous Goods Regulations (DGR) Table 2.6.A and DOT 49 CFR 173.4a.

Limited Quantity of Dangerous Goods – Dangerous goods that may be carried at "Limited Quantity" when they comply with the restrictions provided in IATA, Section 5, Subsection 2.7, 4.1.5.2 and 4.1.4.3.

Sample label – An adhesive paper that is placed on sample containers (soil, water) or a tag that is tied to a sample container (air) to designate a sample identification number and other identifying information.

4.0 EQUIPMENT

Equipment needed for labeling, packaging, and shipping samples includes:

- Coolers
- Large plastic bags
- Plastic ziplock bags, small and large
- Duct tape
- Bubble wrap
- Wet ice (gel ice packs cannot be used unless packaged according to Section 5.2)
- Custody seals
- Completed chain of custody (COC) record
- Completed Bill of Lading
- Labels for general shipping and handling instructions as necessary (e.g., "Keep cool/refrigerate", "This end up", "Do not freeze", "Fragile", "Address", "Dangerous goods", "Excepted quantities", "Saturday delivery"
- Pre-labeled sample bottles provided by the laboratory

Note that this SOP is intended to be used in conjunction with the following SOPs, and as such, the equipment and materials needed for those activities are not included in this SOP:

- Logbook Documentation and Field Notes (No. 101)
- Sample Chain of Custody (No. 06)

5.0 PROCEDURE

5.1 Labeling

Samples should be labeled using nomenclature defined in the applicable project specific work plan. Pre-labeled sample bottles will be provided by the analytical laboratory. Using a ball point pen, label the ziplock bag with the following information:

- Sample name/identification
- Date/time (in 24-hour format)
- Sampler's initials
- Analysis requested
- Job name/number

As soon as possible after sample collection, place the sample in the ziplock bag, seal the bag, removing any excess air, and place the bagged sample inside the shipping container.

5.2 Packaging

The following steps must be followed when packing sample containers for shipment:

1. Choose a cooler with structural integrity that will withstand shipment. Secure and tape the drain plug with Duct tape from the inside and outside.
2. Be sure that the caps on all containers are tight and will not leak. Make sure not to over tighten and break the cap.
3. Check to make sure that the sample labels written on the ziplock are intact and legible, completed with the correct information, and that the identification exactly matches the COC record.
4. Use sufficient ice in the cooler to ensure that samples are received by the laboratory at the proper temperature of 0-6 °C.
5. Wrap and package containers sufficiently to prevent cross-contamination and ensure that containers remain intact during shipment.

To ship samples with wet ice, follow the steps below.

1. Double-bag ice to prevent leaking. This can be done with multiple ziplock bags, or ziplock bags placed within sealed garbage bags.
2. Each cooler should be approximately one-third full with ice. This is equal to approximately 20 pounds of ice in the average 50-quart cooler.
3. Seal each sample container in a ziplock bag to prevent melt water from getting into the sample or degrading the sample label. Taping the end of bags with Duct tape will provide added protection against melt water.

4. Place the containers into the cooler with caps up. No containers should be placed on their sides, as there is significantly less chance of breakage when packed vertically.
5. Fill excess space between sample containers, and between the containers and the cooler lid, with bubble wrap.
6. Seal the entire container with Duct tape, particularly the lid, to prevent leaks. Some package carriers will reject "wet" coolers due to the potential damage they may cause to other boxes.

To ship samples with gel ice, follow the steps below.

1. Bag ice packs within polyethylene zipper bags to prevent physical contact with the sample containers.
2. Each cooler should be approximately one-third full with ice. This is equal to approximately 20 pounds of ice in the average 50-quart cooler.
3. Seal each sample container in a ziplock bag to prevent melt water from getting into the sample or degrading the sample label.
4. Place the containers into the cooler with caps up. No containers should be placed on their sides, as there is significantly less chance of breakage when packed vertically.
5. Fill excess space between sample containers, and between the containers and the cooler lid, with bubble wrap.
6. Seal the entire container with Duct tape, particularly the lid, to prevent leaks. Some package carriers will reject "wet" coolers due to the potential damage they may cause to other boxes.

Avoid packing materials that contain PFAS and materials that absorb water, including paper, cardboard, and Styrofoam; as they become soggy, they lose cushioning properties.

5.3 Shipping

Environmental samples are shipped as non-hazardous material unless the samples meet the established DOT criteria for a "hazardous material" or the International Air Transport Association (IATA)/International Civil Aviation Organization (ICAO) for air definition of "dangerous goods". If the samples meet criteria for hazardous materials or dangerous goods, then DOT and IATA/ICAO regulations must be followed.

Soil samples preserved with methanol, and any excess methanol vials, must be shipped as "Dangerous Goods in Excepted Quantities" per the IATA regulations. The volume for excepted quantities of methanol is 30 mL per container and 300 mL per cooler. The class number is 3, flammable liquid, UN 1230.

Water samples preserved with hydrochloric acid or other de minimis amounts of preservative are not shipped as dangerous goods. However, excess pre-preserved sample containers with preservative must be shipped as "Dangerous Goods in Excepted Quantities" per the IATA regulations. The volume for excepted quantities of hydrochloric acid or nitric acid is 30 mL per container and 300 mL per cooler. The class number is 8, corrosive.

Samples that are being shipped as "Dangerous Goods in Excepted Quantities" must have the appropriate labeling and be declared as dangerous goods to the shipping carrier. However, no dangerous goods "candy-striped" form must be filled out and no Notification to Caption (NOTOC) is required.

Prior to shipping samples, complete the appropriate air waybill or manifest. Make sure to include the following:

- Laboratory name, address, email address, and phone number
- Ahtna contact name, address, email address, and phone number
- Project number
- Special handling requests

Keep a copy of the air waybill or manifest and submit it, with a copy of the chain of custody, to the FTL or PM.

Upon shipping samples, notify the laboratory point of contact that samples are en route and provide an estimated arrival time.

5.3.1 Air Transport

Transportation regulations followed by air carries is airline specific, some use only IATA and others allow either IATA or DOT. Due to this difference between shippers, it is recommended that IATA requirements are followed for all air shipments. Sample airway bills prepared in accordance with IATA regulations are provided at the end of this document.

Keep in mind that IATA requirements and the FAA and TSA “Prohibited Items List” will not allow you to check dangerous goods, in any quantity, as baggage on a commercial flight. You need to plan ahead and ship via an air cargo carrier.

5.3.2 Ground and Vessel Transportation

Ground and vessel transportation are guided by DOT regulations. If shipping by highway or rail, no shipping paperwork is required as stated in 49 CFR 173.4a(h)1. When shipping by vessel, “Dangerous Goods in Excepted Quantities” along with the number of packages must be listed. Sample DOT bill-of-ladings for vessel transport are provided at the end of this document.

5.3.3 Common Preservatives and Flammable Liquids Excepted Quantities Shipping Guidance

Common preservatives used in sampling include methanol, nitric acid, sulfuric acid, and hexane. Flammable liquid samples are common waste samples submitted for shipment. The volume of preservative per container from the lab are listed below (the largest possible volume from the lab), along with their **excepted quantity code** and the IATA shipping information:

- Methanol, 25 mL, **E2, UN1230, Methanol, 3 (6.1), PG II**
- Nitric Acid (<20%), 8 mL, **E2, UN2031, Nitric Acid, 8, PG II**
- Sulfuric Acid, 8 mL, **E2, UN1830, Sulfuric Acid, 8, PG II** (Concentrated)
- Sulfuric Acid, 8 mL **E2, UN2796, Sulfuric Acid, 8, PG II** (<51% acid)
- Hexane, 25 mL, **E2, UN1208, Hexanes, 3, PG II**

Preservatives with E2 exception codes have the following inner and outer packaging limits as described in Table 5-1. A maximum of 20 methanol or hexane preserved containers or samples may be placed in a single cooler. A maximum of 62 acid-preserved containers may be shipped in one cooler. Note: Once water has been added to containers with acid preservatives, the containers are no longer acidic, and therefore are no longer a hazardous material.

TABLE 5-1: IATA TABLE 2.6.A - EXCEPTED QUANTITY FOR E1 AND E2 CODES

Code	Maximum Quantity/Inner Package	Maximum Quantity/Outer Package
E1	30 g/30 mL	1kg/1 L
E2	30 g/30 mL	500 g/500 mL

Note: DOT excepted quantities for the preservatives listed above are identical to the IATA excepted quantities.

The following provides the standard shipping volume for waste flammable liquid samples, the excepted quantity code, and the IATA shipping name.

- Flammable Liquids, 118 mL, **E1, "UN1993 Flammable liquids, n.o.s., 3 PG III"**

Flammable liquids with the E1 exception codes have the inner and outer packaging limits as described in Table 5-1. The volume of waste flammable liquid submitted for analysis is typically 4 ounces (118 mL). This volume exceeds the excepted quantity limit and flammable liquids must be shipped at **Dangerous Goods in Limited Quantities.** The **Limited Quantity** limit for flammable liquids, n.o.s, PG III is 2.5 L per glass container and 10 L per cooler for passenger or cargo plane. The packaging, labeling, and shipping of Dangerous Goods in Limited Quantities is discussed in Section 7.0.

If shipping more than excepted quantity limits, you must follow the more stringent requirements for that particular preservative, or you must package the materials in separate outer containers. See the individual Hazardous Material & Dangerous Goods Shipping Guidelines for the acid or solvent being shipped if you include these materials in a single outer container. It is highly recommended to try and ship the packages as excepted quantities when possible. It saves time and money.

6.0 DOT AND IATA EXAMPLES FOR DANGEROUS GOOD IN EXCEPTED QUANTITIES

Preserved sample containers transported to the site, and samples preserved with methanol or hexane shipped from the site, are shipped as "Dangerous Goods in Excepted Quantities". When shipping items as Dangerous Goods in Excepted Quantities, the label must be:

- Placed on the shipping package, and overpack, with
- The Hazard Class written below the "E" in black permanent maker.
- The name and address of the shipper and consignee if there is not a shipping label.

The materials must then be declared as “Dangerous Goods in Excepted Quantities” to the airline and vessel carrier on the shipping paperwork (see samples at the end of this document). However, no dangerous goods “candy-striped” form is required and no Notification to Captain (NOTOC) is required.

Prior to shipping samples, complete the appropriate air waybill or bill-of-lading. Make sure to include the following:

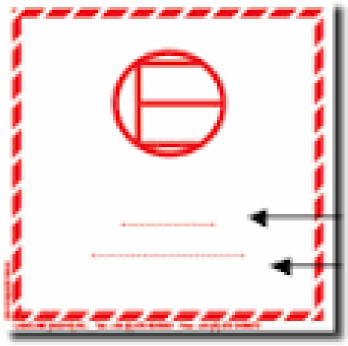
- Laboratory name, address, and phone number
- Ahtna contact name, address, and phone number
- Project number
- Special handling requests
- Include statement: “Dangerous Goods in Excepted Quantities

Keep a copy of the air waybill or bill of lading and submit it, with a copy of the COC, to the field Ahtna PM, the lab PM, and ahtna.lab@ahtna.net. Upon shipping samples, notify the laboratory contact that samples are en route and provide an estimated arrival time. Note that most labs are closed on weekends and holidays. Shipments should be coordinated with the laboratory contact to ensure timely delivery/pickup by the lab.

6.1 Marking and Labeling - Top View of Package or Cooler

To:
SGS North America
200 W. Potter Drive
Anchorage, AK 99518
907-562-2343

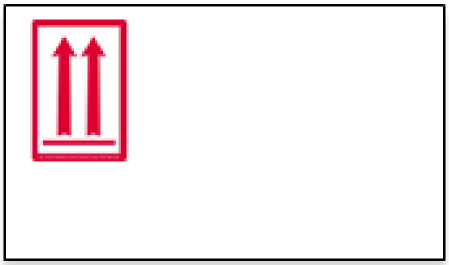
From:
Sam Jones - AES
110 W. 38th Avenue Suite 200A
Anchorage, AK 99503
907-646-2969
Project #20392-01



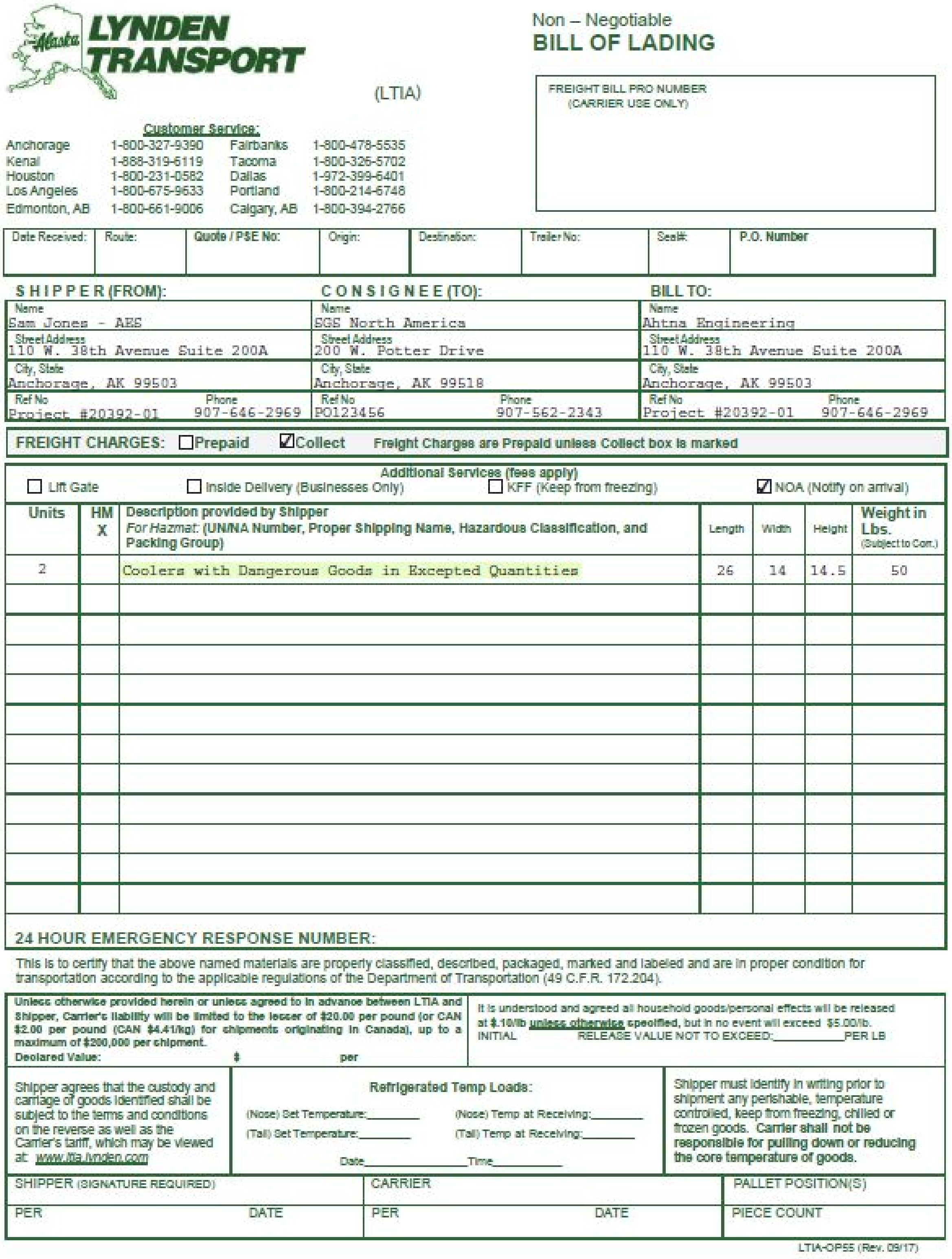
The Hazard Class Number goes here

Name/Address Shipper/Consignee goes here if not on a shipping label

6.2 Marking - Front and Side View of Package or Cooler



IATA and DOT (Vessel Only) Shipping Paperwork Example - Dangerous Goods in Excepted Quantities



Alaska LYNDEN TRANSPORT

(LTIA)

Non – Negotiable
BILL OF LADING

FREIGHT BILL PRO NUMBER
(CARRIER USE ONLY)

Customer Service:

Anchorage	1-800-327-9390	Fairbanks	1-800-478-5535
Kenai	1-888-319-6119	Tacoma	1-800-326-5702
Houston	1-800-231-0582	Dallas	1-972-399-6401
Los Angeles	1-800-675-9633	Portland	1-800-214-6748
Edmonton, AB	1-800-661-9006	Calgary, AB	1-800-394-2766

Date Received:	Route:	Quote / PSE No:	Origin:	Destination:	Trailer No:	Seal#:	P.O. Number

SHIPPER (FROM):	CONSIGNEE (TO):	BILL TO:
Name Sam Jones - AES	Name SGS North America	Name Ahtna Engineering
Street Address 110 W. 38th Avenue Suite 200A	Street Address 200 W. Potter Drive	Street Address 110 W. 38th Avenue Suite 200A
City, State Anchorage, AK 99503	City, State Anchorage, AK 99518	City, State Anchorage, AK 99503
Ref No Project #20392-01 Phone 907-646-2969	Ref No PO123456 Phone 907-562-2343	Ref No Project #20392-01 Phone 907-646-2969

FREIGHT CHARGES: ☐Prepaid ☑Collect **Freight Charges are Prepaid unless Collect box is marked**

Additional Services (fees apply)

☐ Lift Gate ☐ Inside Delivery (Businesses Only) ☐ KFF (Keep from freezing) ☑ NOA (Notify on arrival)

Units	HM X	**Description provided by Shipper** *For Hazmat:* **(UN/NA Number, Proper Shipping Name, Hazardous Classification, and Packing Group)**	Length	Width	Height	Weight in Lbs. (Subject to Corr.)
2		Coolers with Dangerous Goods in Excepted Quantities	26	14	14.5	50

24 HOUR EMERGENCY RESPONSE NUMBER:

This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation (49 C.F.R. 172.204).

Unless otherwise provided herein or unless agreed to in advance between LTIA and Shipper, Carrier's liability will be limited to the lesser of $20.00 per pound (or CAN $2.00 per pound (CAN $4.41/kg) for shipments originating in Canada), up to a maximum of $200,000 per shipment.
Declared Value: $ per

It is understood and agreed all household goods/personal effects will be released at **$.10/lb unless otherwise specified**, but in no event will exceed $5.00/lb.
INITIAL RELEASE VALUE NOT TO EXCEED:__________PER LB

Shipper agrees that the custody and carriage of goods identified shall be subject to the terms and conditions on the reverse as well as the Carrier's tariff, which may be viewed at: www.ltia.lynden.com

Refrigerated Temp Loads:
(Nose) Set Temperature:________
(Nose) Temp at Receiving:________
(Tail) Set Temperature:________
(Tail) Temp at Receiving:________
Date______________Time__________

Shipper must identify in writing prior to shipment any perishable, temperature controlled, keep from freezing, chilled or frozen goods. **Carrier shall not be responsible for pulling down or reducing the core temperature of goods.**

SHIPPER (SIGNATURE REQUIRED)	CARRIER	PALLET POSITION(S)
PER DATE	PER DATE	PIECE COUNT

LTIA-OP55 (Rev. 09/17)

7.0 IATA EXAMPLES FOR DANGEROUS GOOD IN LIMITED QUANTITIES

The volume of waste flammable liquid submitted for analysis is typically 4 ounces (118 mL). This volume exceeds the excepted quantity limit and flammable liquids must be shipped at Dangerous Goods in Limited Quantities. The Limited Quantity limit for flammable liquids, n.o.s, PG III is 2.5 L per glass container and 10 L per cooler for passenger or cargo plane. The packaging, labeling, and shipping of Dangerous Goods in Limited Quantities is discussed in the following sub-sections.

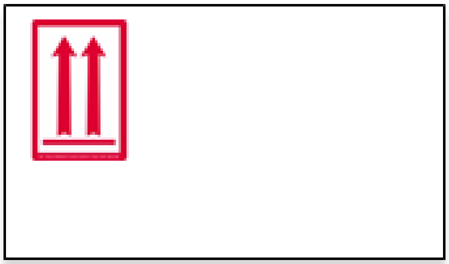
7.1 Marking and Labeling - Top View of Package or Cooler

Flammable Liquid n.o.s
UN1993
Net Qty: 1.2 Lp

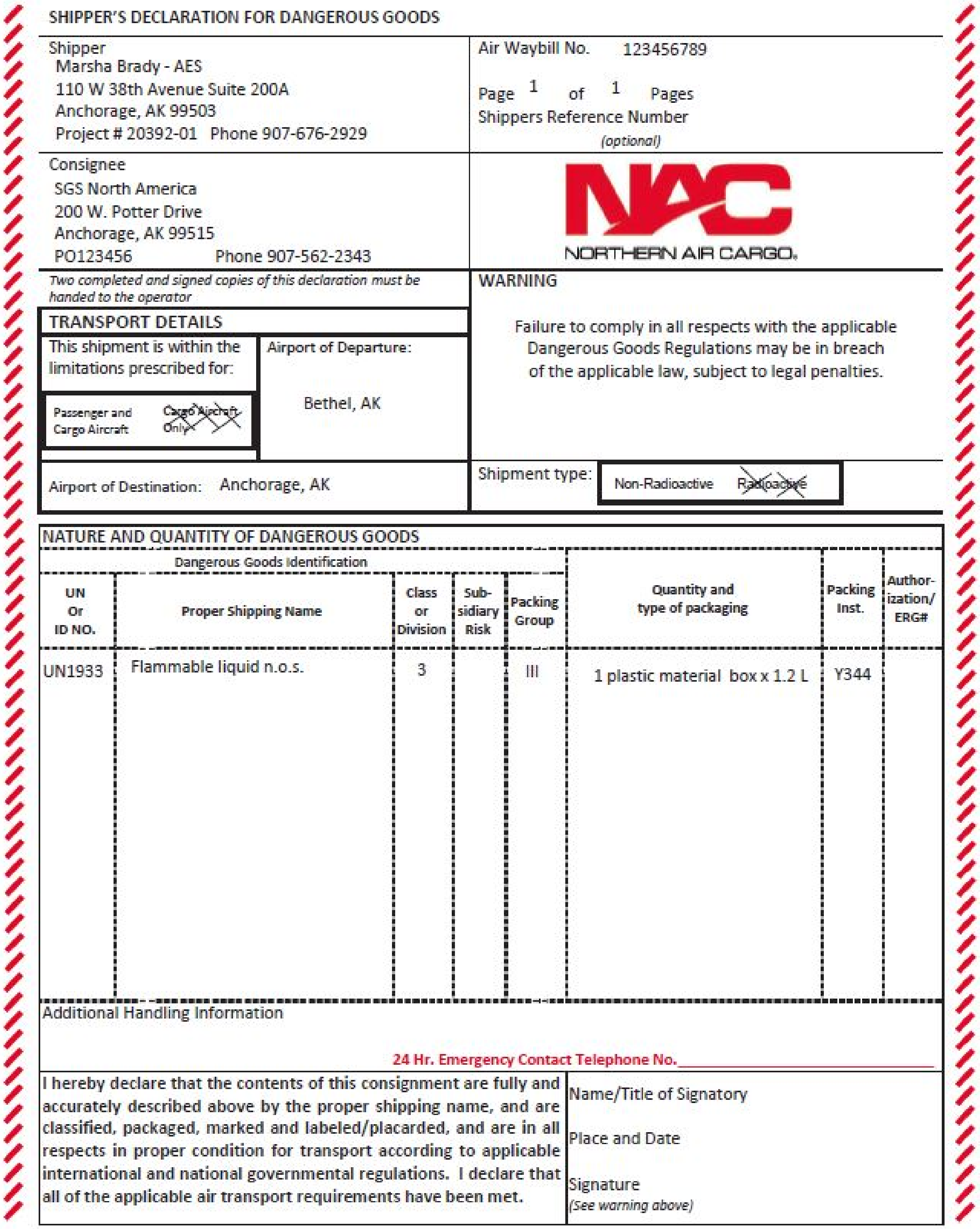
To:
SGS North America
200 W. Potter Drive
Anchorage, AK 99518
907-562-2343

From:
Sam Jones - AES
110 W. 38th Avenue Suite 200A
Anchorage, AK 99503
907-646-2969
Project #20392-01

7.2 Marking - Front and Side View of Package or Cooler



IATA and DOT (Vessel Only) Shipping Paperwork Example - Dangerous Goods in Limited Quantities



SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper
Marsha Brady - AES
110 W 38th Avenue Suite 200A
Anchorage, AK 99503
Project # 20392-01 Phone 907-676-2929

Air Waybill No. 123456789

Page 1 of 1 Pages

Shippers Reference Number
(optional)

Consignee
SGS North America
200 W. Potter Drive
Anchorage, AK 99515
PO123456 Phone 907-562-2343

NORTHERN AIR CARGO.

Two completed and signed copies of this declaration must be handed to the operator

TRANSPORT DETAILS

This shipment is within the limitations prescribed for:

Passenger and Cargo Aircraft ~~Cargo Aircraft Only~~

Airport of Departure: Bethel, AK

Airport of Destination: Anchorage, AK

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

Shipment type: Non-Radioactive ~~Radioactive~~

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification							
UN Or ID NO.	Proper Shipping Name	Class or Division	Sub-sidiary Risk	Packing Group	Quantity and type of packaging	Packing Inst.	Author-ization/ ERG#
UN1933	Flammable liquid n.o.s.	3		III	1 plastic material box x 1.2 L	Y344	

Additional Handling Information

24 Hr. Emergency Contact Telephone No.________________________

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory

Place and Date

Signature
(See warning above)

8.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2019. *Field Sampling Guidance*, October.

International Air Transport Association (IATA), 2021. *Dangerous Goods Regulations*.

Code of Federal Regulations (CFR), 2021. Chapter 49, Parts 100-185.

9.0 REVISION LOG

Revision Date	Author	Revision Details
1/2/2014	Brandie Hofmeister	Initial Issue
1/12/2015	Sara Perman	Removed wet ice shipping details.
6/2/2016	Andrew Weller	2016 ADEC Field Sampling Guidance Update and Minor Grammar Edits
12/1/2016	Ashley Olson	Updated Logo
9/5/2017	Lexie Lucassen	Updated to Aug 2017 ADEC *Field Sampling Guidance*
2/22/2018	Casey Greenstein	Modified for PFCs
4/9/2018	Alexa FitzGerald	Modified for PFAS
10/27/2019	Morgan Bruno	Added instructions for shipping PFAS samples with gel ice
1/8/2021	Mike Records	Updated IATA, CFR Chapter 49 references to 2021
2/19/2021	Mike Records	Added ADEC reference, sections 5.3.1 Air Transport, 5.3.2 Ground and Vessel Transport, 5.3.3 Excepted Quantities, 6.0 Excepted Quantities Examples, Limited Quantities Examples, AGL logo

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STANDARD OPERATING PROCEDURE
FOR EQUIPMENT DECONTAMINATION (PFAS-SPECIFIC)
No. 113

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide the step-by-step procedures for field decontamination of environmental sampling equipment and personal protective equipment (PPE) as applied to work conducted in modified Level D PPE during per- and polyfluoroalkyl substances (PFAS) investigations. Decontamination of equipment and PPE is designed to ensure that sample cross-contamination, human-health exposure, and contamination transport are minimized.

2.0 SCOPE

The scope of this SOP is to cover decontamination procedures conducted by Ahtna personnel and subcontractors while investigating areas for PFAS contamination. Decontamination procedures are generally applicable to field activities involving modified Level D PPE (steel-toed boots, hard hat, safety glasses, and disposable nitrile gloves) where contact with hazardous substances is limited. PPE decontamination is relatively straight-forward under these circumstances.

The techniques described in this SOP are in general accordance with the Alaska Department of Environmental Conservation (ADEC) *Field Sampling Guidance*, dated October 2019.

3.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the field staff and ensuring that field staff has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP, but are considered the best sampling methods for the current project.

Site Safety and Health Officer (SSHO) – The SSHO oversees site-specific health and safety activities and ensures compliance with the project requirements. The SSHO conducts personal protective equipment (PPE) evaluations, selects the appropriate PPE, lists the requirements in the site-specific safety and health plan (SSHP), and coordinates with the field team to implement the SSHP.

Field Team Lead (FTL) – The FTL shall ensure the use of decontamination procedures that are in accordance with the UFP-QAPP, installation-specific work plans, and applicable SOPs. The FTL shall also be required to make rational and justifiable decisions when deviations from these procedures are necessary because of field conditions or unforeseen issues and report the deviations to the PM.

Field Personnel – Field personnel assigned to sampling and decontamination activities are responsible for completing their tasks according to specifications outlined in the UFP-QAPP, installation-specific work plans, applicable SOPs, and other appropriate procedures. Field personnel are responsible for reporting deviations from procedures to the FTL.

4.0 DEFINITIONS

Decontamination area – A location that is not expected to be contaminated and is upwind of suspected contaminants.

Exclusion zone – A location designated to be used for decontamination of equipment and known to contain contaminated material.

Heavy equipment – Drill rigs, excavators, dozers, back-hoes, trucks, or other similar type machinery used to drill soil borings, break concrete, excavate soil or other similar type activity.

Investigation-derived waste (IDW) – Waste that is generated in the process of investigation or examining a contaminated site.

Personal protective equipment (PPE) – Personal health and safety equipment used to protect the individual from contaminant exposure and physical injury.

Potable water – Water dispensed from a municipal water system or a water supply well that is used and approved for drinking.

5.0 EQUIPMENT

The following equipment is typically used for decontamination, but does not include all types of equipment that may be used.

- Appropriate PPE, as specified in the installation-specific work plan
- Brushes, typically stiff bristle
- Buckets
- Laboratory-grade anionic detergent: Alconox or Liquinox
- Spray or rinse bottles, or pump sprayer
- Paper towels
- Clean tap water
- Distilled water
- Laboratory-certified PFAS-free water
- Garbage bags
- Polyethylene plastic sheeting
- Waste containers

6.0 PROCEDURE

All non-disposable sampling equipment used at the site should be decontaminated both before activities begin and after each sample is collected. Drilling and excavation equipment shall be decontaminated prior to beginning site activities, at the termination of site activities, and, if used for sampling, prior to each sampling event.

In general, all sampling equipment will be washed with potable water and detergents such as Alconox or Liquinox, and the final rinse will be conducted with laboratory-certified PFAS-free water. Potable water sources should be analyzed in advance for PFAS. Wherever possible, sampling equipment should also be rinsed with PFAS-free water immediately before use.

6.1 Decontamination Area

Identify a localized decontamination area for drill rigs and other sampling equipment. Select the decontamination area so that decontamination fluids and soil wastes can be managed in a controlled area with minimal risk to the surrounding environment. If possible, the decontamination area should be large enough to allow temporary storage of cleaned equipment and materials before use, as well as to stage drums of decontamination investigation-derived waste (IDW). In the case of large decontamination areas (e.g., for hollow-stem auger decontamination), line each area with a heavy-gauge polyethylene plastic sheeting and include a collection system designed to capture potential decontamination IDW.

Decontamination areas should be laid out in such a way as to prevent overspray while performing equipment and personnel decontamination.

Smaller decontamination tasks, such as surface water and sediment sampling equipment decontamination, may take place at the sampling locations. In this case, all required decontamination supplies and equipment must be mobilized to the site and smaller decontamination areas for personnel and portable equipment will be provided as necessary. These locations will include basins or tubs to capture decontamination IDW, which will be transferred to larger containers as necessary.

6.2 Personnel and Personal Protective Equipment

Personnel decontamination involves removal of gross contamination first. Contaminated solids such as mud should be scraped and wiped from boots, and gloves should be removed by rolling off the hands starting at the cuff in such a way that the gloves are turned inside out during removal. If necessary, a clean pair of gloves should be worn to complete the boot cleaning process. Boots can be cleaned while being worn or following removal. Any remaining contamination should be removed using water mixed with Alconox or Liquinox, brushes or other similar means such as a pressure washer, if available. Once all debris is removed they should be rinsed with clean potable water. If boots are not laden with gross solid materials, a brush can simply be used to knock off or remove any residual solid materials. If the boots have contacted liquid phase contaminants, it is important that the contaminants be removed using water mixed with Alconox or Liquinox and a brush followed by a clean water rinse. If the contaminants have adsorbed into the boots, the boots must be disposed of and a replacement pair obtained before conducting any further field activities.

Following removal and cleaning of reusable PPE, field personnel should wash their hands or any exposed body parts which may have been in contact with the associated hazardous substances.

6.3 Sampling Equipment Decontamination

All non-disposable/non-dedicated sampling equipment, such as oil/water interface meters, water level indicators, and pumps, must be cleaned prior to and between uses. The following step by step procedure should be followed:

1. Remove as much gross contamination (such as pieces of soil) as possible off equipment at the sampling site.
2. If heavy petroleum residuals are encountered during sampling, an appropriate solvent such as methanol should be used to remove any petroleum residues from sampling equipment.
3. Wash water-resistant equipment thoroughly and vigorously with potable water containing laboratory-grade detergent (Alconox or Liquinox) and using a bristle brush or similar utensil to remove any remaining residual contamination.
4. Rinse equipment thoroughly with potable water (1st rinse).
5. Rinse equipment thoroughly with laboratory-certified PFAS-free water (2nd rinse).
6. For sensitive field instruments, rinse again with laboratory-certified PFAS-free water (3rd rinse).
7. Air dry at a location where dust or other fugitive contaminants may not contact the sample equipment. Alternatively, wet equipment may be dried with a clean, disposable paper towel to assist the drying process. All equipment should be dry before reuse.

Clean, dry sampling equipment should be stored within a protective medium (e.g., plastic bag) or staged in a clean area for future use.

Cleaning and decontamination of the equipment should be accomplished in stages and in such a way that the contamination does not discharge into the environment. Cleaning and decontamination wastes must be properly contained and disposed of in accordance with applicable local, state and federal regulations, as well as the approved site-specific work plan.

Disposable sampling equipment should be used whenever possible (e.g., drum thieves, bailers, spoons) to minimize the need to decontaminate these items.

6.4 Heavy Equipment Decontamination

Heavy equipment, such as drill rigs, downhole drilling and sampling equipment, trucks, and earth moving equipment, must be decontaminated between whenever transporting or walking equipment within different areas of or between contaminated areas or exclusion zones, at the decontamination area upon arrival at the project site (installation) and before it leaves the project site at the end of the field event in accordance with the installation-specific work plan. Large equipment should be cleaned with potable water using a high-pressure washer or steam. To the extent practical, rinse parts of equipment that come into direct contact with samples with PFAS-free water. Decontaminated heavy equipment will be placed on clean plastic sheeting to prevent contact with contaminated media and allowed to air dry. If not used immediately, the equipment will be covered or wrapped in plastic sheeting to minimize airborne contamination.

When equipment is no longer needed on site and will be removed permanently from the site, it shall be decontaminated using brushes and/or a pressure washer with Alconox or Liquinox wash followed by a fresh water rinse. All areas of the equipment which were potentially contaminated shall be decontaminated as described in Section 6.3. Final decontamination shall occur within a decontamination pad in order to allow for the collection of decontamination materials, sludge, and water.

6.5 Dry Decontamination

In cases where dry decontamination is required, the following steps shall be followed at the sampling site:

1. Remove as much debris or contamination as possible using a dry brush or paper towel.
2. Spray equipment with water mixed with Alconox or Liquinox.
3. Wipe down with a clean, dry paper towel.
4. Spray equipment with potable water.
5. Wipe down with a clean, dry paper towel.
6. Spray equipment with laboratory-certified PFAS-free water.
7. Wipe down with a clean, dry paper towel.

Dispose of all paper towels with other IDW and disposable sampling supplies.

7.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2019. *Field Sampling Guidance*, October.

Amec Foster Wheeler Environment & Infrastructure, Inc., 2016. *Quality Program Plan: Site Investigation Of Potential Perfluorinated Compound (PFAS) Release Areas At Multiple United States Air Force (USAF) Base Realignment and Closure (BRAC) Installations*. Prepared for USAF. Revised September 2016.

American Society of Testing and Materials (ASTM), 2020. *Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites*, Standard D5088-20.

Interstate Technology Regulatory Council (ITRC), 2020. *Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)*. Fact Sheet, revised April 2020.

U.S. Air Force (USAF), HQ USAF/A7C, 2012. *Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations.* August.

8.0 REVISION LOG

Revision Date	Author	Revision Details

1/2/14	Brandie Hofmeister	Initial Issue
6/7/16	Andrew Weller	2016 ADEC Field Sampling Guidance Update
2/23/17	Katelyn Barnett Decker	Logo
9/5/2017	Lexie Lucassen	Updated ADEC *Field Sampling Guidance* to August 2017
2/22/2018	Casey Greenstein	Modified for PFCs
3/20/2018	Alexa FitzGerald	Modified for PFAS Sampling
12/10/2020	Mike Records	Updated ASTM, ITRC reference to current
2/19/2021	Mike Records	Removed NY specific references, added ADEC reference and AGL logo

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STANDARD OPERATING PROCEDURE
FOR WATER QUALITY MEASUREMENTS AND CALIBRATION
No. 120

1.0 INTRODUCTION

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to direct field personnel in the proper methods for calibrating, maintaining, and operating water quality meters and probes used for groundwater sampling.

1.2 Scope

The scope of this SOP applies to all Ahtna personnel engaged in collecting water quality parameters during well development, sampling, or for other purposes. The SOP was developed per the following U.S. Environmental Protection Agency (USEPA) guidance document:

- *General Field Sampling Guidelines* (USEPA, 1994)

This SOP focuses on the most commonly used field water quality measurement tasks and applications, and should be used in conjunction with other applicable SOPs, including the following:

- SOP No. 100, *Logbook Documentation and Field Notes*
- SOP No. 103, *Groundwater Well Sampling*
- SOP No. 106, *Surface Water Sampling*
- SOP No. 113, *Equipment Decontamination Procedures*

Qualified persons, as defined by California Code of Regulations Title 8 §5192, will be engaged in or directly supervise the collection and handling of environmental samples.

2.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the field staff and ensuring that field staff has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP, but are considered the best methods for the current project.

Site Safety and Health Officer (SSHO) – The SSHO oversees site-specific health and safety activities and ensures compliance with the project requirements. The SSHO conducts personal protective equipment (PPE) evaluations, selects the appropriate PPE, lists the requirements in the site-specific safety and health plan (SSHP), and coordinates with the field team to implement the SSHP.

Sampler/Technician – The sampler or technician is responsible for the collection of water quality data as specified in this SOP.

3.0 EQUIPMENT

The following equipment is required.

- MPS Multi-Parameter Instrument
- YSI 650 MDS Multi-Parameter Datalogger
- YSI 6-Series sonde or similar multi-parameter probe
- YSI 5083 Flow Cell or similar flow-thru cell
- Hach 21000P Portable Turbidimeter
- Data transfer connector cables
- Discharge hoses (2)
- Fittings to attach sample tubing to flow-through cell (barbs and master flex pump tubing)
- Distilled water
- Calibration solutions and buffers (ORP, conductance, pH, and confidence)

4.0 CALIBRATION

Calibration or verification of calibration using a confidence solution or standard for all instruments for all field parameters should be completed daily, according to the manufacturer calibration specifications, before collecting water quality data. . Should there be anomalous readings during sample collection, stop and recalibrate, if possible.

If an instrument will not calibrate, perform troubleshooting as described in the manufacturer's manual. Check that calibration standards have not expired. If the issue cannot be resolved, use a backup instrument. If one is not available, consult with the PM on whether data collection should continue and on any other corrective actions to be taken. Flag any data recorded from a meter with calibration problems.

4.1 pH Calibration

If the water being monitored is known to be either basic or acidic, calibrate using at minimum a 2-point calibration method. A 2-point calibration uses only two pH buffer calibration solutions. For example, if the pH is known to vary between 5.5 and 7, a 2-point calibration with a pH 7 and pH 4 buffer solutions is sufficient.

If the pH of the water being measured is unknown, use a 3-point calibration method. Using this calibration, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method accounts for the full pH range and assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. Typically, the procedure for a 3-point calibration is the same as for a 2-point calibration, but the instrument may prompt you to select a third pH buffer. Follow the recommended manufacturer pH calibration instructions for additional detailed instruction. Enter all pH calibration values based on the appropriate temperature as labeled on the pH calibration solutions used. Record the final pH calibration reading, with the corresponding temperature, on a Field Calibration Sheet.

4.2 Conductivity Calibration

Perform calibration for conductivity according to the recommended manufacturer's calibration instructions. Conductivity should be calibrated for specific conductance and is typically entered as mS/cm at 25°C. Typical conductivity standard solution has a specific conductance value of 1.413 mS/cm.

4.3 Calibration Check of the Oxidation Reduction Potential Probe

A calibration check of the ORP probe can be performed by placing it into a ORP solution that is within approximately 10°C of the expected groundwater temperature, or as close to groundwater temperature as practical. This is not a calibration solution, but a check that the probe is working properly. The reading is dependent upon temperature and should fall within a temperature-specific range described on the solution bottle before taking measurements. If readings are out of this range, then take a second reading with a backup electrode. If both instruments fail, replace the ORP solution and repeat the measurements. Record the ORP reading with the corresponding temperature, on the Field Calibration Sheet.

4.4 Dissolved Oxygen Calibration

Perform calibration for DO according to the recommended manufacturer's calibration instructions. It is not necessary to calibrate in both percent and milligrams per liter (mg/L) or parts per million (ppm). Calibrating in % percent will simultaneously calibrate mg/L and ppm and vice versa.

4.5 Turbidity Calibration Check

Perform routine calibration check of the turbidity instrument using the standards provided by the rental company. Record the calibration standard value and the calibrated turbidity value of each standard in the field logbook or calibration form.

5.0 WATER QUALITY INSTRUMENT FIELD MEASUREMENT AND USAGE

Obtain the following information before arriving on-site:

- Obtain the typical ranges for the water quality parameters at a well (or site) and, if possible, bring these values to the field for reference during sampling. Water quality parameter ranges can often be obtained from historical groundwater purging and sampling events. These previous values should be used as clues to determine if an

instrument is reading correctly and/or if it is drifting during water quality measurement.
- Identify down-gradient wells and up-gradient wells. Down-gradient wells should be purged before up-gradient wells, as to minimize possible cross-contamination.

The general procedures for measuring groundwater quality parameters and flow-through cell setup are as follows:

1. Before taking any field measurements, calibrate instruments according to the manufacturer's procedures and record the calibration on the Field Calibration Sheet.
2. Perform a saturated air check of the Dissolved Oxygen (DO) probe by placing a wet piece of cloth or paper towel in the cap that covers the probe. The DO probe should be reading 100% in a saturated air environment. If the instrument is not reading in the proper range (±5%), it should be recalibrated, or the DO probe membrane should be replaced.
3. Secure the multi-meter sonde (or analyte-specific probes) to the flow-through cell. Connect a short discharge tube to the effluent connector at the top of the flow-through cell and run the other end of the discharge tube into a 5-gallon purge water capture bucket.
4. Place the tube from the pump directly into the 5-gallon purge water bucket and start to purge (pump) for approximately 1 to 2 minutes or until the purge water begins to visually clear up. The intent is to limit any initially high turbidity water from filling and settling in the flow-through cell.
5. Once the turbidity has stabilized, briefly turn off the pump and secure the tube from the pump to the influent connector at the bottom of the flow-through cell. Turn on the pump again and allow the flow-through cell to completely fill with water. Try to keep air bubbles from collecting in the flow-through cell. To remove any collected air from the cell, disconnect the probes from the cell while pumping until all the air escapes and then reconnect the probes.
6. Continue pumping and begin low-flow purging of the monitoring well at a flow rate that maintains a stable drawdown.
7. Routinely measure and record the DO, ORP, conductivity, pH, turbidity, temperature, and current groundwater level throughout the purge at approximately 3- to 5-minute intervals. Record the purge groundwater parameters on a Groundwater Sampling Form. All water quality parameters except turbidity must be obtained using the flow-through cell. Turbidity measurements will be obtained before the water enters the flow-through cell.
8. Continue to measure and record the groundwater parameters and current groundwater level until the parameters stabilize according to the following stabilization criteria, or until three well casing volumes are purged. Groundwater parameters are considered stable when three parameters (four, if using temperature) are within the following parameters after three successive readings:

   - ± 3.0°C temperature (minimum of ±0.2°C)
   - ± 0.1 pH
   - ± 3% conductivity
   - ± 10 mV ORP
   - ± 10% DO
   - ± 10% turbidity

9. Note the following during water quality measurement and groundwater purging:
    - ORP and DO measurements should always correlate with each other. Generally ORP should be negative whenever DO is near or less than 1 mg/L; likewise, DO should be greater than 1 mg/L if ORP is positive.
    - The DO measurement should always be positive and should range between 0 and 14.62 mg/L.
    - ORP measurements should range between -500 mV and 275 mV.
    - The pH of environmental samples will typically range from 6 to 8 pH units
    - When measuring turbidity, be sure to clear any moisture or dust off of the turbidity sample cell and emplace the sample cell and light cover completely and securely. Keep the turbidity instrument out of direct sunlight (it should be shadowed) to avoid false readings from light interference.
10. When parameters have stabilized, record final measurements and collect samples as specified in SOP No. 103, *Groundwater Sampling* and SOP No. 106, *Surface Water Sampling*.
11. All purge water must be collected, containerized, and properly disposed in accordance with local, state, and federal regulations, as well as the CSP-approved site-specific work plan.

5.1 Storage

Perform the following tasks each day after using any water quality measurement instrument:

1. Decontaminate the instruments in accordance with SOP No. 113, *Equipment Decontamination*.
2. Moisten protective caps (that protect the tips of probes or sensors) with fresh water return them to their probes or sensors for storage.
3. Recharge or replace batteries on any instruments and meters to ensure full battery charge for next use.
4. Store the instrument or meter in the protective case provided with the instrument or meter.
5. Take any additional storage and maintenance steps recommended by the manufacturer as specified in the instruments operations and maintenance manual.

6.0 RECORDS

Record all instrument calibration information on the Instrument Calibration Log. Calibration information that should be recorded into the logbook for each instrument calibrated includes the brand and model number, unique identification number, type, lot number, expiration date of any calibration solutions, and results of the calibration. Record all field data collected during groundwater sampling on a Groundwater Sampling Record and Well Evacuation/Field Parameters Form.

7.0 REFERENCES

Hach Company, 2010. 2*100P Portable Turbidimeter*. http://www.hach.com/2100p-portable-turbidimeter/product?id=7640450099&callback=qs

Puls, R. W. and M. J. Barcelona, 1996, *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures.* EPA Ground Water Issue, EPA/540/S-95/504. April.

U.S. Environmental Protection Agency (USEPA), 1994. *General Field Sampling Guidelines.* August 11.

YSI Incorporated, 2010. *Applications: Groundwater, http://www.ysi.com/applicationsdetail.php?Groundwater-6*

8.0 REVISION LOG

Revision Date	Author	Revision Details
2/7/14	Lauren Hess	Initial Issue
7/27/15	Joel Brann	
2/23/17	Katelyn Barnett Decker	Logo
9/6/17	Lexie Lucassen	Updated ADEC references, incorporated into text. Removed Definitions section (nothing defined)
12/27/2017	Lexie Lucassen	Removed ADEC UST Procedures Manual reference. Updated Section 4.3 to remove brand-specific instructions and references to a figure that was not present.
4/26/18	Alexa FitzGerald	Modified for PFAS
2/9/2021	Mike Records	Updated ADEC references to current, added section 4.4 Dissolved Oxygen Calibration, updated Section 5.0 #2, updated title to include calibration. Added AGL logo.
6/7/2022	Margaret Lindh	Updated to USEPA and California specific language and guidance

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STANDARD OPERATING PROCEDURE
FOR MONITORING WELL INSTALLATION (PFAS-Specific)
No. 121

1.0 PURPOSE/SCOPE

The purpose of this standard operating procedure (SOP) is to direct field personnel in the proper methods for installing a groundwater monitoring well. The SOP was developed per the following ADEC guidance documents:

- *Field Sampling Guidance* (ADEC, 2019)
- *Monitoring Well Guidance* (ADEC, 2013)

This SOP shall be used in conjunction with other applicable SOPs, including:

- SOP 22, Monitoring Well Development
- SOP 100, Logbook Documentation and Field Notes (PFAS-specific)
- SOP 101, Field Sampling Protocols (PFAS-specific)
- SOP 113, Equipment Decontamination Procedures (PFAS-specific)

2.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the field staff and ensuring that the field staff has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP and are considered the best sampling methods for the current project.

Site Safety and Health Officer (SSHO) – The SSHO oversees site-specific health and safety activities and ensures compliance with the project requirements. The SSHO conducts personal protective equipment (PPE) evaluations, selects the appropriate PPE, lists the requirements in the site-specific safety and health plan (SSHP), and coordinates with the field team to implement the SSHP.

Field Team Lead (FTL)/Sampler – The FTL, and/or sampler, is responsible for the monitoring well installation as specified in this SOP and the project-specific work plan.

3.0 PROCEDURE

Monitoring wells will be installed under the direct supervision of a qualified geologist, engineer, or environmental scientist in accordance with the project-specific work plan. A monitoring well is generally composed of a well casing, well, screen, filter pack, and seal. All observations will be recorded on a Monitoring Well Installation Form and the logbook. Prior to mobilization, the responsible FTL (e.g., rig geologist or engineer) should review with the driller the proposed borehole and well design, and the details of the monitoring well installation plan, including any potential drilling or completion problems.

3.1 Field Preparation

Before mobilization of a rig to the well site, ensure that the monitoring well location has been appropriately cleared of all underground utilities, buried objects, and overhead utilities, and that drill permits (e.g., FAA permits) have been issued per the project-specific work plan. Review all forms and diagrams documenting the location of the cleared monitoring well site and the location of any identified underground utility lines, other buried objects, and overheard utilities.

Decontaminate drill rig and drilling equipment in accordance with SOP 113 *Equipment Decontamination*, including down-hole equipment and well construction materials, before borehole drilling and monitoring well installation. Clear the work area of brush and minor obstructions and then mobilize the rig to the planned monitoring well location. Once the area is clear for drilling, the FTL and driller should again discuss the drilling and well installation plan, including any potential drilling or completion problems.

Calibrate field equipment according to the instrument manufacturer's specifications. Document the calibration results on the appropriate form(s). Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

Workers will be provided with, and will wear, the appropriate PPE as specified by the installation-specific work plans. The minimum PPE includes a hard hat, safety glasses, gloves, hearing protection, and steel-toed boots.

This SOP should be used in conjunction with the project-specific work plan and/or UFP-QAPP, which will describe the project-specific materials to be used, permits, etc.

3.2 Advance Soil Boring

1. Advance soil boring using drill rig until desired depth is achieved, as described in the project-specific work plan.
2. Log soil and rock samples on lithologic logs/soil boring forms.
3. Remove all drill tooling from the borehole.

3.3 Install Monitoring Well

1. Properly decontaminate well construction materials prior to installation (see SOP 113).
2. Prevent contamination when joining casings and attaching the screen (see Section 3.5).
3. Lower screen and PVC casing (with an end plug or bottom cap) into the borehole. Ensure it is centered.
4. Place center of well screen at groundwater level to ensure that the groundwater level will be in the screened interval through seasonal variations.

5. Place the filter pack sand into the annulus to a minimum of 2 feet above the top of the screen and 1 foot beneath the well end cap (if necessary, reduce filter pack height to 6 inches, to allow enough annular space for sealant).
6. "Sound" the filter pack using a weighted tape for proper placement.
7. Apply three feet of grout or bentonite chips (unless otherwise specified in the installation-specific work plan) and hydrate to seal the annular space.
8. Fill to the ground surface with sand or gravel.
9. Install cement or asphalt surface seal, where appropriate (e.g., flush mounts).

3.4 Post-Installation Tasks

1. Complete an as built drawing/schematic of the constructed monitoring well.
2. Perform well development in accordance with SOP 22.
3. Permanently mark the monitoring well casing with a reference point to be used for accurate water level measurements.
4. Permanently mark the well with a unique identification number on both the inner and outer casings.
5. Survey monitoring well with a minimum vertical accuracy of 0.01 feet and horizontal accuracy of 1.0 foot.
6. Properly decontaminate all equipment in accordance with SOP 113.
7. Properly manage soil cuttings or water removed from the well in accordance with 18 Alaska Administrative Code 75, *Oil and Other Hazardous Substances Pollution Control* (ADEC, 2020).

3.5 Additional Installation Guidelines

Appropriate precautions should be taken during drilling to avoid movement or introduction of contaminants into the well. This includes:

- Preventing vertical movement of water or contaminants between water-bearing zones; and
- Avoiding the use of drilling aids that could act as potential contaminants, unless necessary (e.g. drilling mud, synthetic drilling fluids, or petroleum or metal-based pipe joint compounds). If necessary, use only high-yield sodium bentonite clay that is free of all organic polymer additives and potable water.

If contamination or sloughing is a potential issue, use permanent or temporary surface casing. If the borehole or monitoring well is advanced through an aquitard, it must be sealed at the penetration interval using grout or bentonite, unless otherwise approved by ADEC. Grouts and slurries should be poured freely. Use of a tremie pipe is optional.

4.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2013. *Monitoring Well Guidance*, September.

ADEC, 2019. *Field Sampling Guidance*, October.

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5.0 REVISION LOG

Revision Date	Author	Revision Details
7/28/15	Joel Brann	Initial Issue
2/23/17	Katelyn Barnett Decker	Logo
12/12/17	Lexie Lucassen	Deleted Definitions section – nothing defined. Added header.
4/9/18	Alexa FitzGerald	Modified for PFAS
2/18/2021	Mike Records	Removed NY project-specific references, added AK and PFAS-specific SOP references, updated SOP # to reflect PFAS-specific, added AGL logo

Ahtna
Global, LLC

STANDARD OPERATING PROCEDURE FOR MONITORING WELL DEVELOPMENT (PFAS-Specific)

No. 122

1.0 INTRODUCTION

1.1 Purpose

The purpose of this standard operating procedure (SOP) is to provide guidance for developing newly installed temporary and permanent monitoring wells.

1.2 Scope

The scope of this SOP is applied to all Ahtna personnel engaged in monitoring well development procedures. This SOP was developed in accordance to ADEC reference documents, including the following

- *Field Sampling Guidance* (ADEC, 2019)
- *Monitoring Well Guidance* (ADEC, 2013)

2.0 RESPONSIBILITIES

Project Manager (PM) – The PM is responsible for providing adequate resources to the sampler or technician and ensuring that the sampler or technician has adequate experience and training to successfully comply with the SOP. The PM is responsible for approving and documenting techniques that are not specifically described in this SOP, and are considered the best sampling methods for the current project.

Site Safety and Health Officer (SSHO) – The SSHO oversees site-specific health and safety activities and ensures compliance with the project requirements. The SSHO conducts personal protective equipment (PPE) evaluations, selects the appropriate PPE, lists the requirements in the site-specific safety and health plan (SSHP), and coordinates with the field team to implement the SSHP.

Sampler/Technician – The sampler or technician is responsible for monitoring well development as specified in this SOP and the project specific work plan.

3.0 DEFINITIONS

Bailer – A long, narrow, tubular device with an open top and a check valve at the bottom that is used to remove water and sediment from a borehole or well.

Bailing – A well development technique using a bailer that is raised and lowered in the well to create strong inward and outward movement of water from the formation, to break sand bridges and to remove water and fine-grained materials inside the filter pack and well casing.

Investigation derived waste (IDW) – Waste that is generated in the process of investigating or examining a contaminated site.

Mechanical surging – A process that uses a plunging motion (surge block) to force water to flow through a well screen. A pump or bailer is then used to remove dislodged sediment.

Mudwall – A layer of fine-grained soils formed around the boring annulus during drilling that can impede free flow of the formation water into the well.

Personal Protective Equipment (PPE) – Personal health and safety equipment used to protect the individual from contaminant exposure and physical injury.

Surging – A well development technique in which a surge block is alternately raised and lowered within the well casing or screen, or both, to create a strong inward and outward movement of water through the well screen.

Surge block – A weighted tool that is slightly smaller than the inside diameter of the well casing. Most surge blocks are 6 to 12 inches in length, as are some in-well pumps (Grundfos pumps) commonly used as surge blocks.

Turbidity – Cloudiness in water resulting from suspended and colloidal material.

Turbidimeter – An instrument that measures the turbidity, the cloudiness or haziness of fluid caused by individual particles, of a liquid suspension.

Well Casing – A durable pipe placed in a borehole to prevent the walls of the borehole from caving in, and to seal off surface drainage or undesirable water, gas, or other fluids and prevent entry into the well.

Well development – The act of repairing damage to the borehole caused by the drilling process and removing fine-grained materials or drilling fluids, or both, from formation materials so that natural hydraulic conditions are restored and well yields are enhanced.

Well screen – A filtering device that allows groundwater to flow freely into a well from the adjacent formation, while minimizing or eliminating the entry of fine-grained material into the well.

YSI 6-Series Sonde (or similar multiparameter probe) – A water quality monitoring instrument capable of measuring Dissolved Oxygen, Oxidation-Reduction Potential, conductivity, pH, and temperature. These water quality parameters area measured during well development and sampling activities.

4.0 EQUIPMENT

The following equipment is required:

- Surge block on a cable or line
- Submersible pump, peristaltic pump, and/or bailer (bladder and gear pumps are not recommended because of pump damage from fine sediments)
- Groundwater purge container, tank, or drum of known volume for flow estimation
- Water quality monitoring instrument(s) (YSI, Turbidimeter) capable of measuring Dissolved Oxygen, Oxidation-Reduction Potential, conductivity, pH, turbidity, and temperature
- Two clear PFAS-free containers
- Water level indicator
- Field logbook
- Well Development Log

5.0 PROCEDURE

Monitoring well development will be performed after a minimum of 24 hours, or as per the drilling permit, following each monitoring well installation.

The cap and all internal components of the well casing above the water table shall be rinsed with PFAS-free water to remove all traces of soil, sediment, and cuttings, before and/or during well development. Dedicated materials shall be used for well development.

1. Measure and record the water level and total depth of the well using a water level indicator. Note any accumulated sediment thickness, and record all information in a field logbook and on the Well Development Log.
2. Begin well development by surging (mechanically) the bottom of the well and removing any sediment/soil formed around the boring annulus during drilling (mudwall). To do this, slowly lower a decontaminated surge block into the well so that the surge block is within approximately 0.5 to 1 foot from the bottom of the well or measured sediment accumulation. Slowly raise and lower the surge block approximately 1 to 2 feet to create a mild surging effect at the bottom of the well; this will suspend any sediment that has settled at the bottom. Do not agitate the water violently. A general rule for well development is to start slowly and gently, and gradually increase agitation as the well is developed. After several surge strokes, remove the surge block and immediately begin to pump or bail the sediment-laden water. Contain all IDW for proper disposal, according to the project specific work plan. Repeat this process until accumulated sediment has been removed from the bottom of the well.
3. Develop the well from the bottom of the screened interval upward by alternately using the surge block and the bailer or pump. This will account for settlement that occurs as the filter pack is reworked through surging. Lower the surge block to the base of the well

screen interval and rapidly raise and lower the surge block across a 2 to 3 foot interval above the base of the well screen for approximately 2 to 3 minutes. However, do not overdevelop the well with overly aggressive surging. Record the surge interval and duration of surging.

4. Remove the surge block and lower the pump or bailer so that the intake is at the bottom of the surged screen interval. Turn the pump on or bail the well at the development interval until the purge water begins to clear up. Fill a clear PFAS-free container with development water to observe turbidity if necessary. Record the purge intake depth and the amount of water purged.
5. After the water clarity improves, move the surge block up in 2 to 3 foot intervals, and repeat Steps 3 and 4 until the entire screened interval has been developed. Surging will be conducted for a minimum of 10 minutes to ensure development of the entire well screen interval.
6. If the well is purged dry at any point during development, approximately one well casing of clean, potable water can be introduced into the well and surging can continue. After surging, purge the well dry to complete the development process by removing at least the amount of potable water added to the well. If there is sufficient well recharge, continue development with formation water only.
7. The well will be considered adequately developed and sampling may occur as soon as the groundwater is free of visible sediment, water quality parameters have stabilized (see SOP No. 120), or 24 hours have passed following development.
8. Measure and record a final depth to water and total well depth measurement after well development.
9. Record all well development data in the field logbook and Well Development Log.

5.1 Documentation

The following shall be recorded for development on the Well Development Log:

- Well designation
- Date of well installation
- Date of development
- Depth to water before, during, and after well development
- Quantity of drilling fluid lost during drilling (if applicable)
- Calculated well casing volume
- Initial and final total well depth from top of well casing
- Screen interval
- Initial and final depth from top of well casing to top of sediment inside well, if sediment is present
- Physical character of removed water during development, including clarity, color, particulates, and odor
- Type and size/capacity of pump and/or bailer used
- Height of well casing above/below ground surface
- Calculated pumping rate
- Estimate of recharge rate
- Total volume of water removed and time for removal

5.2 Developed Water Management

Manage development water generated during well development as IDW, in accordance with the project specific work plan or other regulatory document.

6.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2013, *Monitoring Well Guidance,* November.

ADEC, 2019. *Field Sampling Guidance*, October.

Amec Foster Wheeler Environment & Infrastructure, Inc., 2016. *Quality Program Plan: Site Investigation Of Potential Perfluorinated Compound (PFAS) Release Areas At Multiple United States Air Force (USAF) Base Realignment and Closure (BRAC) Installations*. Prepared for USAF. Revised September 2016.

7.0 REVISION LOG

Revision Date	Author	Revision Details
2/6/14	Lauren Hess	Initial Issue
2/23/17	Katelyn Barnett Decker	Logo
4/16/18	Alexa FitzGerald	Modified for PFAS
2/19/2021	Mike Records	Removed NY specific references, added AK references and AGL logo

Analytical SOPs

SOP #	**Title**
SGS SOP# ORLD-SAM-101-21-SOPT	Sample Receipt and Storage
SGS SOP# SAM108.11	Sample and Laboratory Waste Disposal
SGS SOP# FN: OP 075.1	Standard Operating Procedure for the Extraction of Per- and Polyfluorinated Alkyl Substances From Water Samples For LC/MS/MS Analysis
SGS SOP# FN: OP 076.0	Standard Operating Procedure for the Extraction of Per- and Polyfluorinated Alkyl Substances From Soil Samples For LC/MS/MS Analysis
SGS SOP# FN: MS024.2	Analysis of Per- and Polyfluorinated Alkyl Substances by LC/MS /MS and Isotope Dilution

SAMPLE RECEIPT AND STORAGE

Prepared by: Svetlana Izosimova Date: 03/12/2020

Approved by: Heather Wandrey Date: 03/12/2020

Annual Review

Reviewed by: Heather Wandrey Date: 3/12/2020

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Document Control

Issued to: QA Department Date: 03/12/2020

Issued to: Sample Management Date: * 03/12/2020 digital

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Effective 7 days after “*” date

TITLE: SAMPLE RECEIPT AND STORAGE

REFERENCES: TNI Standards 2009 and 2016, State of Florida DEP SOPs, 40 CFR Part 136, DoD QSM 5-series; SOP QA020, Subcontracting, current revision.

REVISED SECTIONS: Revised SOP name to original convention; added Attachments II, III and IV; added reference to SOP QA021, Subcontracting; Added sec. 2.2.8, referencing subcontracting process in SOP QA021; changed location of Foreign Soil storage to a stand-alone cooler #14 (2.10.2)

1.0 SCOPE AND APPLICATION

To maintain documentation of custody of all bottle sets, samples (domestic and foreign), digestates, distillates, and extracts that fall under the responsibility of SGS North America, Inc. - Orlando.

2.0 EXTERNAL CHAIN-OF-CUSTODY PROCEDURE

2.1 Samples are received via commercial carrier, client delivery, or are picked up by SGS - Orlando employees. Upon receipt, sample management inspects the outside of the container for signs of tampering, such as a torn or missing custody seal. The staff reviews Chain Of Custody (CoC) document for the following information:

2.1.1 Client Information- Name / Address, Phone and Fax contact numbers

2.1.2 Facility Information- Project name, Location, Project Number.

2.1.3 Field ID / Point of Collection- Date- Time- (HOLD TIMES) Samplers Initials- # of containers Shipped, Preservative types.

2.1.4 Matrix of samples: WW- water, GW-ground water, SW-surface water, DW-drinking water, SO-Soil, SOL-other solid, LIQ-other liquid, OI- Oil, AIR-air, WP- Wipe, FB-field blank, TB-trip blank.

2.1.5 Analytical Information- Samples with hold times of 72 hrs or less remaining on analyses upon receipt are considered Short Hold Samples and are listed on Short Hold Notification form in order of hold times, from ASAP to 7 days with less than 3 days left. These samples are processed immediately. Job Numbers are assigned, and the samples are given directly to the appropriate lab. Copy of CoC and completed Short Hold Notification Form are relinquished to the appropriate lab by the sample receiving technician. Laboratory personnel accept the samples, time of transfer is recorded, both parties sign SHNF and a copy of the SHNF is attached to CoC. (See Attachment I, Short Hold Notification Form, and Attachment IV, for container types and sizes, hold times and required preservatives.)

2.1.5.1 VOC soil sample vials must be frozen within 48 hours of collection. Receiving technicians review sample times and deliver samples with a SHNF if sufficient hold-time remains to process the samples. If samples are close to expiring the samples are immediately placed in the freezer with a card notating the time they were placed in the freezer. (See Attachment II, listing of tests associated with the requirement)

2.1.6 TURN AROUND TIME- Samples with a 6 day or less TAT are processed as soon as possible, depending on samples with short hold status.

2.1.7 Sample custody documentation signatures – relinquished/received in Client – Carrier – Laboratory sequence. Per FL DEP SOPs signature shall consist of full signature – no initials allowed – and business affiliation.

2.1.8 Special Requirements and or comments - Compositing, filtering or preservation of samples, Extended sample storage etc.

2.2 Samples are processed by a two-technician team, The sample custodian(s) accepts sample custody upon receipt of samples and verifies that the custody document is correct. Sample conditions, sample temperature, and other observations, including custody seal condition, are documented in detail on the electronic Sample Receipt Confirmation form (p-note).

2.2.1 Temperature is measured using IR thermometer against white label on temperature blank, or on the sample container, if temperature blank is absent. **NOTE: For jobs originated in West Virginia every sample container must be checked.** This thermometer is calibrated measuring the temperature off of white sample label against NIST-traceable liquid-in-glass thermometer – see SOP QA002, current revision. When recording the cooler temperature with the use of an IR gun the following needs to be documented on Sample Receipt Confirmation Form:

2.2.1.1 IR gun used.
2.2.1.2 Correction factor.
2.2.1.3 Observed cooler temperature.
2.2.1.4 Corrected cooler temperature.

2.2.2 Verify IR thermometer correction factor gains Correction factor recorded in Receipt utility to make sure it is correct in both locations. Notify QA/Department Manager if these values are not the same. Apply temperature correction factor for a face value – positive number to be added to direct reading temperature, negative correction factor to be subtracted.

2.2.3 **Samples must remain in coolers full of ice until it is time to process the job for login. Coolers received out of temperature range have initial temperature recorded and are then placed into a Walk-In cooler until resolution from client is received.** 40 CFR part 136, TNI Standards 2009, 2016 revision and DoD QSM 5.1 all designate acceptable temperature as “above freezing and below 6°C”.

Temperature is measured and recorded to first decimal place due to state-specific and client-specific requirements.

2.2.4 Any discrepancies or non-compliant situations are documented on the Sample Receipt Confirmation Form (p-note) which is automatically e-mailed to the SGS - Orlando Project Manager (PM) team. PM assigned to the particular client contacts the client for resolution. Major issues require the client to be contacted before the samples can be logged in, such as but not limited to missing COC's, samples being out of hold, insufficient sample volume, bottles received not on COC or out of temperature range. If resolution of the problem is taking time, the samples are labeled as is and placed into refrigerated storage until the problems are resolved. Samples are then removed and processed according to client's instructions. Minor issues identify discrepancies that do not interfere with log-in and/or analysis of the samples, such as 1 of 2 PAH bottles received broken or supplied. The resolution is documented and communicated to sample management for execution.

2.2.5 Once the sample custodian(s) is (are) satisfied with the information on the chain of custody document, the job number is generated from Receipt access-based utility with the next available SGS - Orlando sequential job ID in FXXXXXX convention.

2.2.6 First technician arranges samples on the counter in the order of CoC. Every different point of collection must have a different fraction number, i.e. -1, -2, etc. The assigned fraction number must be written on the chain of custody, to the left of the line identifying the point of collection (Client ID) unless there is insufficient space. The custodian then assigns a unique sample identifier to each sample container, i.e. FAXXXXX-1.4, where 4 is a unique container designation.

2.2.7 The same technician enters samples in the sample location database and prints the labels for the samples. A second technician then attaches the labels to the samples and re-verifies sample client ID and Lab fraction number against CoC. After all the steps in Sec. 3 are completed, first technician closes the Sample Receipt Confirmation Form and second technician reviews it for completeness and accuracy of recorded information.

2.2.7.1 Wherever samples are designated to be put on hold by the client, labels on these samples are highlighted in bright pink and additional bright pink **"HOLD – Do Not Dispose"** label is attached to the individual containers.

2.2.8 Identify samples with subcontracted parameters and process according to SOP QA021, current revision. Most common, but not limited to, subcontracted parameters are listed in Attachment III.

2.2.9 **After Hours Delivery Procedure**. Upon return to the lab SGS - Orlando-employed couriers will visually inspect the coolers and add ice if needed. Coolers will then be placed into Refrigerated storage until Sample Receiving Technicians can process the coolers. Sample Receiving technicians will arrive first thing in the morning to verify Short Holds, Rushes etc as per sec. 3.1.5 and 3.1.6.

2.3 When assigning a job number, the following information from the chain of custody is entered in the Access Receipt utility:

- 2.3.1 SGS - Orlando Assigned Job #
- 2.3.2 Client Name
- 2.3.3 Project Name
- 2.3.4 Date and Time Samples Received.
- 2.3.5 # of coolers Received.
- 2.3.6 Courier Information
- 2.3.7 Technician Initials

2.4 The sample custodian then checks the samples' preservation, except for the volatile samples, which are checked by the analyst after the sample is analyzed. Should a sample be received preserved incorrectly the following actions are taken:

2.4.1 pH and residual chlorine: For samples requiring preservation (HNO3, H2SO4, NAOH and NAOH/Zn Acetate) each container is tested by applying the sample with disposable capillary to narrow-range pH paper. Residual chlorine presence/absence is measured using potassium iodide/starch paper in all samples with EPA 600-series methods indicated on CoC and samples originated in North Carolina (one bottle per well). 45-ml VOC vials are exempt from this procedure and are being tested in the lab after the requested tests are completed (purge-and-trap GC and GC/MS, TOC/TC and EPA 504/8011).

2.4.2 Pesticides/PCB's/Semivolatile Organic aqueous samples with residual chlorine present: Immediately request an appropriate amount of 8% sodium thiosulfate solution to be prepared by WetChem department. Segregate affected samples on a cart in a walk-in cooler until solution is received. Add 1 ml of 8% sodium thiosulfate solution per 1liter (0.008%) to all containers except VOA. Record event on Sample Receipt Confirmation Form and in preservative adjustment log.

2.4.3 Organochlorine pesticides and PCBs by EPA 608 - samples that are not extracted within 72 hours of collection need to have pH checked and adjusted, if necessary, to a pH within 5.0-9.0 using H2SO4 or NaOH. Coordinate with Extraction department.

2.4.4 Cyanide is preserved to pH $\geq$ 12 using 10N NaOH, prepared by WetChem personnel.

2.4.5 Sulfide is preserved to pH $\geq$ 9 using 10N NaOH and Zn acetate, prepared by WetChem personnel.

2.4.6 Aqueous samples for metals are preserved to pH $\leq$ 2 with nitric acid, prepared by WetChem Personnel. These samples are marked with colored label "**Metals Sample Received Unpreserved. Preserved Date_____Time_____ Analyze after 24 hours".** For correctly preserved aqueous metals sampling date and time from COC is recorded as date and time of preservation.

2.4.7 Aqueous samples for TRPH and some WetChem parameters are preserved to a pH of $\leq$2 with H2SO4, prepared by WetChem Personnel.

2.4.8 To avoid using expired preservatives, in the beginning of the calendar month obtain no more than 100 ml of currently used preservative reagents from Shipping area, appropriately label the container with reagent identity and expiration date and discontinue its use at the end of the month. Turn unused portion to the Waste room for further disposal.

2.5 Incorrectly preserved samples have the proper amount of preservative added, upon confirmation from PM or client, volume added is recorded on the Sample Receipt Confirmation form and in preservative adjustment log. The same volume and type of preservative is then added to the Equipment Blank and/or Field Blank, regardless of pH reading. Volume added is recorded on the Sample Receipt Confirmation form and in the preservative adjustment log. Also see Sec. 3.4.5.

Job Number, Sample ID, Bottle Number, Parameter, Preservative Type, Preservative Lot, and Amount of Preservative Added, Date/Time Added and the technician's initials.

2.6 All bottles must be labeled. Each bottle will be labeled both on the cap and on the bottle. . The labels are generated by the electronic sample receipt log. The following information is entered into the electronic log:

2.6.1 Job #:
2.6.2 Client Name and Project
2.6.3 Date and time samples were received.
2.6.4 The number of coolers received
2.6.5 The temperature of each cooler
2.6.6 Initials of custodian logging in the job
2.6.7 Number of samples
2.6.8 Number of bottles
2.6.9 Bottle type
Preservative by code. From pull down menu in the receiving app.
2.6.10 Bottle storage location
2.6.11 Department to do the analysis
2.6.12 The information is saved and labels can be printed.

2.7 The following information must be on the bottle:

2.7.1 The sample number and bottle number
2.7.2 Storage location
2.7.3 The preservative used during sampling as indicated on the chain

2.8 The samples must be placed in their assigned locations and kept at above freezing and below 6.0°C until preparation and/or analysis. Water samples preserved with HNO_3 for metals analyses are stored at room temperature. Access to the area is limited.

2.9 The original chain of custody and any additional documented information relative to the job isthen placed in a bin in receiving for the Login personnel to pick up for entry into LIMS.

2.10 **Foreign samples** are referred to samples originated outside of continental United States. These samples must be segregated from domestic samples in storage, processing and disposal. Objective of such segregation is to keep agricultural pests and pathogens from entering continental US territory and interfering with animal and plant health.

2.10.1 Foreign Samples shall be shipped in securely closed watertight containers and free of debris and macro organisms (insects, mollusks, worms, ticks and mites).

2.10.2 Foreign samples are stored in lockable cooler #14 to prevent accidental disposal. This cooler is clearly marked *for foreign samples only*. Sample labels are colored green to stand out in the lab departments.

2.10.3 Keep lids tightly closed while in storage.

2.10.4 All unconsumed samples and containers must be separately collected for disposal. SGS - Orlando employs outside contractor to sterilize and dispose of foreign samples – see SOPs SAM108 and SAM109, current revision.

3.0 SAMPLE STORAGE TEMPERATURE AND CROSS-CONTAMINATION MONITORING

3.1 While in the laboratory, samples shall be stored in limited-access, temperature –controlled areas. Refrigerators shall be monitored for temperature daily. Acceptance criteria for the temperature of refrigerator is 0.5 to 6.0 °C * and is listed in the refrigerator log. Thermometers that have been calibrated with a NIST traceable thermometer monitor all cold storage areas. As indicated by the finding of the calibration, a correction factor is applied to each thermometer for a face value. Records that include acceptance criteria shall be maintained.

*According to TNI 2009 and 2016, V1M2, sec. 5.8.9.a.i) temperature should be above freezing point and below 6.0°C, when specified storage temperature is 4°C. Lowest temperature that can be practically read above freezing point is 0.5°C.

3.2 Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Acceptance criteria for the temperature of a volatile refrigerator is 0.5 to 6.0 °C and is listed in the refrigerator's log. VOC Soil freezers are maintained between –10.0°C and -20.0°C per SW-846 5035A. For further details refer to SOP QA004, current revision.

3.3 Sample storage area for volatile organics shall be monitored for cross contamination using refrigerator blanks. Refrigerator blanks shall be analyzed every other week.

3.3.1 If contamination of the refrigerator is confirmed, the samples must be removed from the refrigerator and placed in coolers with ice, or in alternate refrigerated storage.

3.3.2 All samples received after the date of the last clean refrigerator blank must be checked for the same contaminants. If present, they must be reported and flagged with a qualifier indicating possible lab contamination.

3.3.3 The source of the contamination must be located and removed.

3.3.4 A new refrigerator blank is then placed in the refrigerator and analyzed after 24 hours.

3.3.5 Samples may be returned to the refrigerator when all contaminants are removed as indicated by the analysis of a refrigerator blank without contamination.

4.0 DOCUMENTATION

All samples received by SGS - Orlando must come with a chain-of-custody (COC). Special attention shall be paid to client-specific COCs.

SGS - Orlando personnel MUST record dates and time in **mm/dd/yy 24:00** format, and both observed and corrected temperatures.

Current revisions of forms and label templates used in sample receipt process are maintained as controlled documents in limited access directory on LAN.

Attachment I

SHORT HOLD NOTIFICATION FORM **JOB #________________**

HOLD TIME	**ANALYTE**	**CHECK COC**	**COMMENTS**
ASAP	RedOx		
	Bacteria- Total Coliform/Fecal Coliform		
24 hrs	XCr / Hexachrome / Cr +6		
	Dissolved/Filtered Metals		
	Odor		
	Salinity (SCON+ Field Temp & Presure)		
48 hrs	BOD		
	CBOD		
	MBAS		
	Turbidity		
	Color		
	Nitrate (NO3)		
	Nitrite (NO2)		
	TN (NO2/NO3)		
	OPO4 / Orthophos		
	SS (Settleable Solids)		
	Chlorophyl A (Subcontract)		
72 hrs	Acrolein/Acrylonitrile (VOA from Alaska)		
	Formaldehyde (Subcontract)		
7 days Only for samples received after 5 days	Unpreserved Voa Vials		
	TDS/TSS/TS		
	Sulfide		
	8141 pesticides in soil		
	All the Water extractables		
	Soils		
48 Hours	5035 Field Kit (DI vials)		
	Encore Sampler VOA/VPH/GRO		
	Soil Jar (Bulk Sample) VOA/VPH/GRO		
	NO2/NO3 from WV (IC analysis)		

Relinquished by:______________________Date/Time relinquished:_______________

Received by:__________________________Date/Time received:__________________

Attachment II

SOIL SAMPLES

Samples associated with tests listed below need to be brought to Volatile Soil Prep or Frozen within 48 hours from Date/Time of Sampling. This requirement applies to soil Jars, 5035 Field Kits, Encores and Terracores

8260

8021

GRO

OK GRO

KS GRO

VPH

OA1

VOA

VOC

VOH

PRE-BURN

8015

5035

5030

TN GRO

MO GRO

Attachment III

SUBCONTRACT ANALYSES

BELOW IS A LIST OF THE MOST COMMON SUB PARAMETERS BUT IT IS NOT INCLUSIVE

TOX

TOC-SOILS

GROSS ALPHA, GROSS BETA (GR-A, GR-B)

Radium 226/228 (R-226/R-228)

ASBESTOS

CO2 (VIALS ONLY)

URANIUM (U)

60ML- PFAS (537 BOTTLES)

B-BORON

LI-LITHIUM

Attachment IV ORGANIC ANALYSIS

ANALYSIS	ANALYTICAL METHOD	MATRIX	MINIMUM VOLUME	CONTAINER TYPE	REQUIRED PRESERVATIVE	HOLDING TIME FROM DATE and TIME SAMPLED
SEMI-VOLATILE AND VOLATILE[1]						
Volatile Organic Compounds	624 8260 SM6200	Water	3 x 40 mL	Vials	HCl to pH<2 Cool 4° C	14 Days
	8260	Soil	3 x 40 mL[2]	Field Kit[2]	Freeze at -10° C	Freeze 48 hours, Analysis 14 Days
	MAVPH	Water	3 x 40 mL	Vials	HCl to pH<2 Cool 4° C	14 Days
		Soil	2 x 40 mL[2]	Field Kit[2]	MeOH Cool to 4° C	28 Days
Methane, Ethane, Ethene	RSK147	Water	3 x 40 mL	Vials	HCl to pH<2 Cool 4° C	14 Days
Gasoline Range Organics (GRO)	8015	Water	3 x 40 mL	Vials	HCl to pH<2 Cool 4° C	14 Days
		Soil	2 x 40 mL	Vials	MeOH Cool to 4° C	14 Days
Diesel Range Organics (DRO)	8015	Water	2 x 250 mL[3]	Amber Glass	H_2SO_4 to pH<2 Cool 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	14 Days
Acid Base Neutrals Extractable Organics	8270	Water	2 x 250 mL[3]	Amber Glass	Cool, 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	14 Days Analysis: 40 Days
Acid Base Neutrals Extractable Organics Organo Pesticides and PCBs by 608	608 625	Water	2 X 1 L	Amber Glass	Cool, 4° C	7 Days
Pesticides	8081	Water	2 x 250 mL[3]	Amber Glass	Cool, 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	14 Days Analysis: 40 Days
	8141	Water	2 x 250 mL[3]	Amber Glass	Cool, 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	7 Days Analysis: 40 Days
PCBs	8082	Water	2 x 250 mL[3]	Amber Glass	Cool, 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	14 Days Analysis: 40 Days
Herbicides	8151	Water	2 x 250 mL[3]	Amber Glass	Cool, 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	14 Days
Explosives	8330A/B	Water	2 x 1 L	Amber Glass	Cool, 4° C	7 Days
	8330A	Soil	1 x 8 oz	Clear Glass	Cool, 4° C	14 Days Analysis: 40 Days
	8330B	Soil	Approximately 500 g	Clear Glass or Double Plastic Bags	Cool, 4° C	14 Days Analysis: 40 Days
EDB/DBCP	504.1 8011	Water	3 x 40 mL	Vials	Cool, 4° C 10 mg Na_2S2O_3 For Residual Cl_2	14 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	14 Days
Acrylamide	8316	Water	2 x 40 mL	Vials	Cool, 4° C	7 days
		Soil	1 x 4 oz	Clear Glass	Cool, 4° C	14 days
Perchlorate	6850	Water	1 x 125 mL	Plastic 2/3 Full	Cool, 4° C	28 days
		Soil	1 x 4 oz	Plastic 2/3 Full	Cool, 4° C	28 days
Extractable Petroleum Hydrocarbons (EPH)	MAEPH	Water	2 x 1 L	Amber Glass	H_2SO_4 to pH<2 Cool 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	Extraction: 14 Days Analysis: 40 Days
Total Recoverable Petroleum Hydrocarbons (TRPH)	FLPRO 8015	Water	2 x 250 mL[3]	Amber Glass	H_2SO_4 to pH<2 Cool 4° C	7 Days
		Soil	1 x 8 oz	Clear Glass	Cool, 4° C	Extraction: 14 Days Analysis: 40 Days
Perfluorinated Compounds	DoD 5.3 Table B-15	Water	2 x 125 mL	HDPP	Cool 4° C	Extraction: 28 Days Analysis: 40 Days
		Soil	1 x 4 oz			
	EPA 537 MOD	Water	2 x 125 mL			Extraction: 14 Days Analysis: 28 Days
		Soil	1 x 4 oz			
TCLP AND SPLP						
TCLP/SPLP Extractables	8270 8081 8151		2 x 1 L	Amber Glass	Cool, 4° C	14 days for leaching, 7 days for extraction, 40 days for analysis
TCLP/SPLP Metals	6010		2 x 1 L	Amber Glass	Cool, 4° C	Extract. & Analysis: 6 Months Aqueous and Solid; Hg Extract. & Analysis: 28 Days Aqueous and Solid
TCLP/SPLP Volatiles	8260		2 x 40 mL	Vials	Cool, 4° C	Extract. & Analysis: 14 Days to leaching, 14 days to analysis
Full Water TCLP/SPLP		Water	5 x 1 L	Amber Glass	Cool, 4° C	See Above for Individual Analyses
			1 x 1 L	Plastic		
			2 x 40 mL	Glass Vials		
Full Soil TCLP/SPLP		Solid	2 x 8 oz + 1 x 4 oz	Glass Jars		
AIR						
Volatile Organics	TO3	Air	1 x 1 L	Tedlar Bag	None	72 Hours

INORGANIC ANALYSIS

IMMEDIATE TO 48 HOURS					
pH	SM4500-H; EPA 9040C	50 mL	Plastic, Glass	Cool, 4° C	15 minutes, Field Parameter
Biochemical Oxygen Demand	SM5210B	1 L	Plastic, Glass	Cool, 4° C	48 Hours
Color	SM2120B	100 mL	Plastic, Glass	Cool, 4° C	48 Hours
Ferrous Iron (Fe^{+2})	SM 3500-Fe B	100 mL	Plastic	Cool, 4° C	15 minutes, Field Parameter
Hexavalent Chromium	EPA 7196A	500 mL	Plastic, Glass	Cool, 4° C	24 Hours
Nitrate Nitrogen	EPA 300/9056A	50 mL	Plastic, Glass	Cool, 4° C	48 Hours
Nitrite Nitrogen	EPA 300/9056A	100 mL	Plastic, Glass	Cool, 4° C	48 Hours
Nitrite Nitrogen	EPA 353.2	50 mL	Plastic, Glass	Cool, 4° C	48 Hours
Orthophosphate	EPA 365.3	100 mL	Plastic, Glass	Cool, 4° C	Field Filtered 15 minutes, 48 Hours
Sulfite	SM4500SO3	200 mL	Plastic, Glass	Cool, 4° C	15 minutes, Field Parameter
Total Residual Chlorine	SM4500CL-F	200 mL	Plastic, Glass	Cool, 4° C	15 minutes, Field Parameter
Total Settleable Solids	SM2540F	2 x 1 L	Plastic, Glass	Cool, 4° C	48 Hours
Turbidity	EPA180.1	100 mL	Plastic, Glass	Cool, 4° C	48 Hours
7 DAYS					
Sulfide	SM4500S=F	3 x 250 mL	Plastic, Glass	NaOH to pH>=9 ZnAc/Cool, 4°. C	7 Days
Total Dissolved Solids (TDS)	SM2540C	1 L	Plastic, Glass	Cool, 4° C	7 Days
Total Mineral Solids	SM2540E/F	200 mL	Plastic, Glass	Cool, 4° C	7 Days
Total Solids (TS)	SM2540B	200 mL	Plastic, Glass	Cool, 4° C	7 Days
Total Suspended Solids (TSS)	SM2540D	1 L	Plastic, Glass	Cool, 4° C	7 Days
Total Volatile Solids (TVS)	SM2540E/F	200 mL	Plastic, Glass	Cool, 4° C	7 Days
Total Volatile Suspended Solids (TVSS)	SM2540E/F	200 mL	Plastic, Glass	Cool, 4° C	7 Days
GREATER THAN 7 DAYS					
Acidity/Alkalinity	SM 2310B	200 mL	Plastic, Glass	Cool, 4° C	14 Days
Amenable Cyanide	SW846 9012B	250 mL	Plastic, Glass	NaOH to pH>12/Cool, 4° C	14 Days
Ammonia Nitrogen	EPA 350.1	200 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Bromide	EPA 300/9056A	100 mL	Plastic, Glass	Cool, 4° C	28 Days
Bulk Density	ASTM D2937-94	8 OZ	Glass	Cool, 4° C	Not Regulated
Carbonate, Bicarbonate, CO2 calculation	SM2320B SM 4500-CO2	200 mL	Plastic, Glass	Cool, 4° C	14 Days
Chemical Oxygen Demand (COD)	SM5220C	100 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Chloride	EPA 300/9056A	100 mL	Plastic, Glass	Cool, 4° C	28 Days
Cyanide	EPA 335.4/9012B	250 mL	Plastic, Glass	NaOH to pH>12/Ascorbic Acid Cool, 4° C	14 Days
Fluoride	EPA 300/9056A	200 mL	Plastic	Cool, 4° C	28 Days
Hardness Calculation	SM 2340B	100 mL	Plastic, Glass	HNO_3 to pH<2/Cool, 4° C	6 Months
Hexavalent Chromium	EPA 3060A/7196A	4 oz	Glass	Cool, 4° C	Digestion 30 days, Digestate 7 days
Ignitability	SW846 1010A	100 mL	Plastic, Glass	Cool, 4° C	Not Regulated
Mercury	EPA 245.1/7470A	500 mL	Plastic, Glass	HNO_3 to pH<2/Cool, 4° C	28 Days
Nitrate + Nitrite Nitrogen	EPA 353.2	100 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Nitrate Nitrogen	EPA 353.2	50 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Oil & Grease	EPA 1664A/B/9070A	2 x 1 L	Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Organic Nitrogen	TKN - AMN	500 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Oxidation Reduction Potential	ASTM D1498-76	200 mL	Plastic, Glass	Cool, 4° C	Not Regulated
Paint Filter Test	EPA 9065	200 mL	Plastic, Glass	Cool, 4° C	Not Regulated
Percent Ash	ASTM D482-91/D2974-00	100 mL	Plastic, Glass	Cool, 4° C	Not Regulated
Phenols	EPA 420.4	250 mL	Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Reactive Cyanide	SW846 Chapter 7	100 mL	Plastic, Glass	Cool, 4° C	Not Regulated
Reactive Sulfide	SW846 Chapter 7	100 mL	Plastic, Glass	Cool, 4° C	Not Regulated
Specific Conductance	EPA 120.1	200 mL	Plastic, Glass	Cool, 4° C	28 Days
Sulfate	EPA 300/9056A	200 mL	Plastic, Glass	Cool, 4° C	28 Days
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	100 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Total Metals	EPA 6010/6020/200.7/200.8	500 mL	Plastic, Glass	HNO_3 to pH<2/Cool, 4° C	6 Months
Total Nitrogen	TKN + NO2 + NO3	500 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Total Phosphorus	EPA 365.3	200 mL	Plastic, Glass	H_2SO_4 to pH<2/Cool, 4° C	28 Days
Total, Dissolved Organic Carbon	SM5310B/9060A	2 x 40 mL	Amber VOC Vials	HCl to pH<2/Cool, 4° C	28 Days

Solids and soils may be analyzed for the above analytes with a general requirement of approximately 100 grams (60 ml) per analyte, or in combinations of analytes in 1-300 ml bottle.

[1] Multiple analyses can be performed from a single container, please contact SGS Orlando for guidance.

[2] Pre-weighed methanol preserved and/or DI water vials are available upon request (Method 5035 preservation) for volatile analysis.

[3] For South Carlolina EPA 8000 Series, use 2 x 1 L Amber Glass Bottles preserved as noted.

SAMPLE AND LABORATORY WASTE DISPOSAL

Prepared by: Jonathan Miller Date: 08/21/2020

Approved by: Svetlana Izosimova Date: 08/24/2020

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TITLE: SAMPLE AND LABORATORY WASTE DISPOSAL

REFERENCES: Florida DEP Hazardous Waste; 40 CFR, Part 261

REVISED SECTIONS: Multiple rewrites in Procedure – sec. 4.1, 4.2, 4.3; 4.5.2, Segregation of Foreign soils – see 4.2.5; Storage and Disposal of samples in "HOLD" status – sec. 4.7 (new), corrected facility name throughout the document; changed lab status to Large Quantity Generator, added detailed waste profiles to the back of the document.

1.0 SCOPE AND APPLICATION

The disposal of samples and lab waste adhering to Florida State and Federal Regulations.

2.0 SUMMARY

This SOP describes the procedures used by SGS - Orlando to properly and safely dispose of samples and laboratory wastes; hazardous and non-hazardous; domestic and foreign.

3.0 DEFINITIONS

3.1 Foreign sample: Samples from sites that are outside the continental United States.

3.2 Hazardous Sample or Waste: A material is considered hazardous if it is listed in the Code of Federal Regulations, 40 CFR, Part 261 or it demonstrates any of the hazardous characteristics including, ignitability, corrosivity, reactivity, or has demonstrated toxicity.

4.0 PROCEDURE

Sample Disposal: Samples are kept in appropriate storage for a minimum of 30 days after the report is sent to the client unless otherwise specified by client. The samples are divided into three categories: Aqueous, Soil, and Non-aqueous liquid.

4.1 Aqueous Samples

4.1.1 A disposal list is generated based on either reporting dates or sample number range (see attached).

4.1.2 Samples are then removed from the refrigerators and/or cabinets, and are separated as non-hazardous (non-detected or normal) and hazardous samples.

4.1.3 Non-hazardous samples are emptied into a drum. Once a series of satellite drums are full, they are pumped into a 500 gallon holding tank. Once the large holding tank is full, the tank is neutralized with sodium bicarbonate to pH 5-9. The contracted waste disposal company is then contacted to arrange for an on-site transfer. The contents are profiled as requested by the disposal firm unless a major change to the waste stream occurs.

4.1.4 VOA vials are processed through a glass crusher and into an open-top drum. The solid material (glass, plastic, and septa) is separated from the liquid and are disposed of separately. The liquid drum, when full, is then handled in the same way as described in section 4.1.3.

4.1.5 Hazardous waste is segregated into into multiple waste streams to be handled in the appropriate manner by the Contract Disposal Company used by SGS-Orlando.

4.1.6 Samples containing PCB in excess of 50 ppm are automatically flagged by LIMS on disposal list. These samples are labeled with distinct PCB label and segregated from the rest of waste samples to be disposed of in LabPak.

4.1.7 Some samples, on a case by case basis, are returned to the client for disposal.

4.2 Soil Samples

4.2.1 Domestic Soil Samples (DSS) are placed in drums after the storage period, either in a hazardous or non-hazardous drum per the samples' status as defined above.

4.2.2 When the drums are full, they are labeled accordingly, and the vendor contacted for removal.

4.2.3 Some samples, on a case by case basis, will be returned to the client for disposal,or may need specialized disposal such as LabPak. This would include samples of a proprietary nature, or those that contain excessive amounts of regulated or unregulated materials. (ie: Very high PFC content, PCBs in excess of 50ppm, elemental samples, etc.)

4.2.4 Foreign soil samples (FSS) come in vials (volatile organic analysis) or jars. These soils are segregated in in lockable cage (see also SAM101 and SAM109, current revisions)

4.2.5 After minimum 60-day hold period, but not to exceed 6 months, these FSS are disposed of in the following manner.

4.2.5.1 FSS vials: Vial samples are preserved either with methanol or DI water. Vials with water are uncapped and placed into a drum labeled specifically for foreign soils. No more than six months may elapse form the accumulation start date on the drum before the drum must be disposed. The contracted disposal company must be certified to handle and dispose of foreign soils. Vials with methanol must be filtered. The filtrate (methanol) is disposed of in the non-chlorinated solvent waste drum. The soil is then drummed per the hazard status on the disposal sheets.

4.2.5.2 FSS Solids: FSS in jars are emptied into drum labeled specifically for foreign soils. Once full, the drum is disposed of via the contracted disposal company. No more than six months may elapse from the accumulation start date on the drum to disposal.

4.3 Non-aqueous liquid samples

4.3.1 Non-aqueous samples are placed in drums after the hold period.

4.3.2 When the drums are full, they are labeled accordingly, and the vendor contacted for removal. Drums have a 6 month expiration time. If the drum is not full by then it is picked up by our contract disposal company.

4.3.3 Samples may, on a case by case basis, will be returned to the client for disposal.

4.4 Sample Containers

4.4.1 Containers from samples deemed Non-Hazardous are immediately disposed of into a waste container provided by waste management services specifically for SGS - Orlando direct use. A lock and key has been installed to keep the containers use limited to SGS - Orlando only.

4.4.2 Containers from samples deemed hazardous are disposed of into the Hazardous waste solids drum or other appropriate waste stream.

4.4.3 The contracted vendor picks the container up on a weekly basis and brings to the local sort facility where contents are destroyed - recycled.

4.5 Laboratory Waste Disposal:

4.5.1 All materials determined to be hazardous are containerized in appropriate vessels (i.e. drums). A waste is considered hazardous if it is listed in the Code of Federal Regulations, 40 CFR, Part 261 or it demonstrates any of the hazardous characteristics including, ignitability, corrosivity, reactivity, or has demonstrated toxicity. Our contract disposal company disposes of the drums.

4.5.2 WASTE DRUMS are separated by type. As of the date of this SOP, SGS-Orlando is separating wastes into several different waste streams. General descriptions of the primary stream types are below. A more descriptive list along with the corresponding profile numbers and primary generators within the labs can be found at the end of this document. If/when new profiles are needed, the contract vendor must be contacted and the appropriate information supplied.

Chlorinated Waste- Methylene Chloride

Non-Chlorinated Waste - Hexane, Methanol, and mixed solvents

Sodium Sulfate/Used Charcoal- Charcoal and paper filters used in the filtering of samples.

Non Hazardous Aqueous Vials - Primarily Acid Vials.

Hazardous Flammable Vials - Methylene Chloride, Hexane.

Hazardous Aqueous waste - High Odor Samples, Lachat Waste.

Non Hazardous Soil - Soils.

Hazardous Solid Waste - .

Non-Aqueous/Oil Samples-

Drums are closed at all times while in storage.

4.5.3 Disposal is done as conscientiously as possible following guidelines set forth by both the State of Florida and our contract disposal company. Management and proper handling is necessary to avoid any violation. The guidelines change depending on how much waste is generated on a monthly basis:

4.5.3.1 Less than 220 pounds (100 kilograms or about half a drum) is a “Conditionally Exempt Small Quantity Generator”.

4.5.3.2 A “Small Quantity Generator” generates 220-2,200 pounds (100-1,000 kilograms or about half a drum to 5 drums)

4.5.3.3 More than 2,200 pounds (100-1,000 kilograms or more than about 5 drums) is a “Large quantity Generator”.

4.5.3.4 SGS - Orlando is considered a “Large Quantity Generator”.

4.6 Waste Containers and Storage

4.6.1 Containers must be maintained in good condition at all times. Care must be taken to prevent leaks, ruptures, and the accumulation of rainwater on tops of the drums.

4.6.2 Waste containers must be kept closed at all times, except when waste is being transferred to drum.

4.6.3 The containers must be compatible with the waste being stored (i.e. acids should not be stored in metal drums). Never store incompatible wastes in the same container (i.e. acids and bases). Containers must be stored in such a way to accommodate inspection for leaks and damage from all sides

4.6.4 Each waste container must be labeled with the following information.

4.6.4.1 Type and nature of waste (soil, oil, hazardous, non-hazardous)

4.6.4.2 Waste generator's name and address

4.6.4.3 Manifest document number

4.6.4.4 Proper DOT shipping name and identification number

4.6.4.5 Accumulation start date (change to storage date when container is full)

4.6.4.6 In addition, a hazardous waste must have the words "HAZARDOUS WASTE. FEDERAL LAW PROHIBITS IMPROPER DISPOSAL. IF FOUND, PLEASE CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY" prominently displayed on the container.

4.6.5 Inspection and Records

4.6.5.1 Containers must be inspected weekly. All records must be kept on file for three years. The records, which must be kept on file, include:

4.6.5.1.1 A written log of the inspections
4.6.5.1.2 Manifests and shipping receipts

4.6.5.1.3 Land Disposal Restriction form

4.7 Samples in "HOLD" status

4.7.1 Wherever samples are designated to be put on hold by the client, labels on these samples are highlighted in bright pink and additional bright pink **"HOLD – Do Not Dispose"** label is attached to the individual containers.

4.7.2 Additionally, all Foreign Soils are kept in lockable cage in regardless of status (see 4.2.6).

4.7.3 When samples are removed from the temperature controlled storage and boxed for extended storage these boxes also receive same bright pink label as individual containers.

4.7.4 Samples are segregated into a designated quarantine area with clear signs to the nature of the stored samples.

4.7.5 Prior to removal and disposal from this area, personnel must first confirm with management (Sample Management Supervisor, Laboratory Manager or Operations Manager) that samples can indeed be disposed of.

4.7.5.1 Due to 6-months storage restriction on Foreign soils samples (see 4.2.7.1) Project Manager's input must be requested by Sample Management department in a timely manner.

5.0 HEALTH AND SAFETY

5.1 All employees who handle waste materials should wear full protective clothing including safety glasses &/or face shield, gloves, boots, lab coat or a Tyvek suit, and air-purifying respirator. Direct skin contact with waste materials should be avoided.

5.2 If an employee has accidentally been exposed to a hazardous waste, the individual should rinse the affected areas thoroughly under a safety shower for at least 15 minutes. If the individual begins to exhibit any adverse effects from the exposure, he should be immediately transported to the nearest hospital emergency room. Employees are referred to the Material Safety Data Sheets for specific instructions on exposure to hazardous substances.

WASTE PROFILES

NAME (Dept.)	DESCRIPTION	PROFILE NUMBER	Primary Constituents
Recovered Methylene Chloride/Chlorinated Solvents (EXT)	Waste Methylene Chloride (aka: Dichloromethane, DCM, CH_2Cl_2, Me-Cl) generated through extraction and analysis process. May be from Bucchi units and or wastes, or rinse products from Extractions or Semi-Volatiles labs. This waste stream should contain <1.0% material that is NOT Me-Cl.	**D191839TPA**	Should be >99% Me-Cl.
Solvent Contaminated Vials (SEMIS)	Glass Prep or Autosampler vials that may have residual solvent and/or sample in them. Solvents may be chlorinated or non-chlorinated in nature. Can be for Aq or solid samples.	**D191838TPA**	Could contain Acetone, Hexane, Acetonitrile, Me-Cl, Me-OH, Ether, etc.
Methanol Contaminated Plastic Vials (LCMS)	Plastic Prep or Autosampler vials that may have residual solvent and/or sample in them. Solvents may be chlorinated or non-chlorinated in nature. Can be for Aq or solid samples. Waste stream is primarily comprised of Sample vials used for LCMS prep and analysis.	**F191708TPA**	Waste contains mainly a mixture of Me-OH, water and spent samples.
Non-Chlorinated Solvent (EXT SEMIS LCMS)	Waste Solvent that is non-chlorinated. The bulk of this waste stream is generated as eluent for LCMS, but it can also include the flammable wastes generated in Semis and Extractions as well. FLAMMABLES.	**D190752TPA**	Typically >90% Me-OH, but can also contain up to 5% of other non-chlorinated solvents such as Acetone, Acetonitrile, Hexane, Ether, etc.
Sodium Sulphate contaminated with Methylene Chloride (EXT)	This is the product of the drying step in Extractions. It consists primarily of Na_2SO_4 solids along with the accompanying filter paper and waste sample dregs that have been rinsed with Me-Cl. Waste stream is typically gathered in small 2gal pails with liners inside them. The liners and waste are collected, and the pails are then reused with fresh liners.	**D191841TPA**	Waste is comprised almost entirely of sodium sulphate. No other solvents should be in this stream except Me-Cl.
Mixed inorganic Acids (MET GEN)	Mixed inorganic acids (HCl, HNO_3, H_2SO_4, H_3PO_4, etc.) that have been primarily used in the Inorganics department for digestion and or sample dissolution. Waste is typically more concentrated than preserved samples, and is not neutralized before disposal.	**F190687TPA**	Metals digests and ICP waste.
Non-Regulated Soil (Non-APHIS)	All spent soil samples that are not foreign in nature.	**ACCL 003**	Samples. Soils samples.
3-Door Waste Samples	Samples from 3-Door storage. Samples mainly comprised of contaminated solids that have petroleum type products on them such as spill pads, soaked rags, wipes, filters, soils and papers in plastic bags/containers. The samples may/will have free liquids that may be petroleum in nature.	**J191619TPA**	Samples. 3-Door Material. Solids and liquids.
APHIS Soils	Foreign Soils. Spent samples and lab items that have come into contact with foreign soils during the process of analysis. **All items are sequestered from other waste streams!**	**ACCL 004**	Expired 10-24-19
Broken Glass	Labware that has broken during standard usage and/or disposable glassware within the laboratories. May include pipets, beakers, jars, etc.	**ACCL 002**	Broken glass from labs. Beakers, cylinders, glass jars, etc.
Used Oil	Spent oil from the labs. Oils used for production purposes (pumps and standards), as well as spent samples and their associated wastes that are oil based.	**J190773TPA**	Samples. Used Oils. Samples and lab oils used in pumps, for stds, etc.
Used Photo Developer Solution	Spent photo development solutions. Typically containing very high amounts of heavy metals (Ag) and basic (pH>10) in nature. Separated from all other metals waste streams.	**J191664TPA**	Samples. Spent photo development solutions. Typically from samples.
Pyridine	Waste Pyridine solvent. Diluted with H_2O. Waste is generated in Inorganics department via the Lachat instrumentation.	**ACCL 007**	Pyridine and H_2O

STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM WATER SAMPLES FOR LC/MS/MS ANALYSIS

Prepared by: Norm Farmer Date: 04/07/2022

Approved by: Mike Eger Date: 04/08/2022

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TITLE: STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM WATER SAMPLES FOR LC/MS/MS ANALYSIS

REFERENCES: EPA draft Method 1633 and QSM 5.4 Table B-24

REVISED SECTIONS: 2.0, 3.1.2, 4.3, 7.2.10, 7.2.17 and 7.2.25

1.0 SUMMARY, SCOPE AND APPLICATION

1.1 Summary

A 500ml aliquot of sample (entire bottle) is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with basic methanol. The extract is carbon cleaned, filtered and the final volume is adjusted to 5.0ml, and then transferred to a centrifuge tube for storage.

1.2 Scope and Application

This procedure is applicable to low level aqueous samples submitted for Per- and Polyfluorinated Alkyl Substances (PFAS) analysis by LC/MS/MS using Isotope Dilution technique.

NOTE: For aqueous sample prep by in-house LCMSMS method see SOP OP069.

NOTE: For Drinking Water sample prep see SOP OP064 or OP072.

NOTE: This SOP was written to be compliant with QSM 5.4.

2.0 DISCUSSION AND COMMENTS

This method is adapted from draft EPA method 1633. Additions and modifications have been added for compliance with QSM 5.4 Table B-24.

Samples expected to contain high levels of PFAS compounds should be screened prior to extraction.

The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) or Teflon products, HPLC solvent lines, methanol, aluminum foil, SPE transfer lines, bottle caps, etc. All materials used for this method must be demonstrated to be free from interferences.

Contact with glass containers, pipettes, or syringes should be minimized since the PFAS compounds can potentially adsorb (stick) to glass surfaces.

SPE cartridges can be a source of interferences. The analysis of method and field blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent.

3.0 PRESERVATION AND HOLDING TIMES

3.1 Preservation

3.1.1 Samples shall be collected in 500ml HDPE bottles fitted with a polyethylene screw cap. Alternate size HDPE bottles may be used depending on project requirements. **Glass bottles with Teflon lined caps can NOT be used.**

3.1.2 The samples must be chilled to ≤6°C from the time of collection until arrival at the laboratory. The samples must be refrigerated at ≤ 6°C or frozen at ≤ -20°C from the time of receipt until extraction.

3.1.3 The extracts should be stored at ≤4°C. They must be allowed to come to room temperature prior to analysis. All extracts should be vortexed just prior to transfer to the autosampler vials.

3.2 Holding Time

3.2.1 Aqueous samples must be extracted within 28 days of collection if stored at ≤6°C or within 90 days of collection if stored at ≤ -20°C. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts should be analyzed within 28 days of extraction but must be analyzed within 90 days of extraction.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 12 hours whichever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS) or the Ongoing Precision and Recovery Standard (OPR).

4.3 Low Level Blank Spike (LLBS): An analyte-free matrix spiked with a known amount of analyte(s) at 2x LLOQ, processed simultaneously with the samples through all the steps of the analytical procedure. Low-Level Blank Spike Recoveries are used to document laboratory performance at the LLOQ for a given method. This may also be called a Low-Level Laboratory Control Sample (LLLCS) or the Low-Level Ongoing Precision and Recovery Standard (LLOPR).

4.4 Extracted Internal Standards (EIS): A standard containing isotopically labelled versions of the native target analytes. These isotopes are usually labelled with C13, d2, or O18 atoms. Isotope Dilution Standards are used to measure the extraction efficiency and to correct the concentrations of the native analytes based on the recovery of their isotopically labelled analogs.

4.5 Field Blank (FB): An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment.

4.6 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and are still considered valid.

4.7 Matrix Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.8 Matrix Spike (MS): A sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.9 Matrix Spike Duplicate (MSD): A replicate sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.10 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

5.1 Methanol – HPLC grade or equivalent

5.2 Reagent water – HPLC grade or equivalent - free of interference

5.3 SPE Cartridges – Wax (weak anion exchange) or equivalent

5.4 Acetic Acid - HPLC grade or equivalent

5.5 Ammonium Hydroxide – Fisher A669-212 or equivalent (28-30% Aqueous Ammonia)

5.6 3% v:v Ammonium Hydroxide Solution – add 10ml of 30% Ammonium Hydroxide to 90ml of reagent water. Store at room temperature for up to 1 month.

5.7 1% v:v Ammonium Hydroxide in Methanol Solution – mix 3.3ml NH_4OH and 97ml Methanol (based off 30%).

5.8 Dilution Mix - Methanol with 4% water, 1% ammonium hydroxide and 0.625% acetic acid

5.9 Formic Acid – ACS grade or equivalent

5.9.1 0.1M Formic acid – add 4.6g formic acid to 1L of reagent water. Store at room temperature for up to a year.

5.9.2 0.3M Formic acid – add 13.8g formic acid to 1L of reagent water. Store at room temperature for up to a year.

5.9.3 5% v:v Formic acid – mix 5ml formic acid and 95ml of reagent water. Store at room temperature for up to a year.

5.9.4 50% v:v Formic acid – mix 50ml formic acid and 50ml of reagent water. Store at room temperature for up to a year.

5.9.5 1:1 Formic Acid in Methanol Solution – mix 50ml 0.1M formic acid and 50ml of methanol. Store at room temperature for up to a year.

5.10 ENVI-carb – graphitized carbon powder

5.11 PFAS EIS Mix – prepared in methanol at various concentrations by the vendor. All EIS solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.12 PFAS Spike Solution – prepared in methanol at various concentration by the LC/MS/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.13 PFAS NIS Mix - prepared in methanol at various concentrations by the vendor. All EIS solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

6.0 GLASSWARE AND APPARATUS

6.1 Solid-phase cartridge extraction system – suitable for use with extraction cartridges

6.2 Vacuum pump

6.3 Vacuum Flasks – or equivalent

6.4 SPE reservoirs – various sizes

6.5 SPE cartridges – Weak Anion Exchange – must have pKa of >8 and 150mg bedsize

6.6 15ml and 50ml Polyethylene Centrifuge tubes with caps

6.7 10ml, 25ml, 250ml, and 1000ml Polyethylene graduated cylinder

6.8 250ml or 500ml Class A graduated cylinder (for sample volume determination only)

6.9 10ul, 25ul, 50ul, 250ul and 500ul syringes

6.10 Volumetric Pipettors and tips

6.11 1ml and 5ml Disposable polyethylene luer lock syringes

6.12 0.2um Nylon syringe filter 13mm and 25mm

6.13 10ml, 25ml, and 100ml Polyethylene or Polypropylene volumetric flasks

6.14 Disposable polyethylene transfer pipettes

6.15 Deactivated glass wool.

6.16 2.0ml polyethylene screw cap vials

6.17 HDPE Wash Bottles

6.18 Nitrogen Evaporator, TurboVap LV or ExcelVap

6.19 Balance +/- 0.1 gram

6.20 Centrifuge - 3000 rpm minimum speed

6.21 Micro-scoop 10mg

7.0 PROCEDURE

7.1 The extraction of all samples must be documented on a “prep sheet”. The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the LC/MS/MS analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

7.2 The 150mg WAX (weak anion exchange) SPE cartridge is considered the default cartridge for this method. Other bed sizes may be used if they have been fully validated.

7.2.1 Assemble the solid-phase extraction system.

7.2.2 Label the side of each cartridge with the sample ID.

7.2.3 Loosely pack deactivated glass wool to half the height of the SPE cartridge and attach each of them to the SPE manifold.

7.2.4 Condition each SPE cartridge with 15ml of 1% ammonium hydroxide in methanol solution followed by 5ml of 0.3M formic acid. Use gravity flow if possible or a 1 to 2 ml/min flow rate. Stop the flow just before the cartridge goes dry.

Do not allow the cartridge to go dry.

7.2.5 Using a reservoir adaptor, attach the sample reservoir to the top of the SPE cartridge.

7.2.6 Mark the level of the sample (upper edge) on the bottle with a marker. The entire contents of the sample bottle should be extracted, including any solids that may have been collected.

The volume may also be determined by weighing the sample, bottle, and cap and recording the weight to 0.1g. If determining the sample volume by weight, record the weight of the sample, bottle and cap.

7.2.7 Use 500ml HDPE bottles for the method blank (MB), blank spike (BS) and Low-Level Blank Spike (LLBS). Fill each of these bottles with 500ml of reagent water. Use 100ml HDPE bottles for MB, BS, LLBS if the project required smaller sample volumes.

7.2.8 Use separate bottles for the matrix spike (MS) and the matrix spike duplicate (MSD). **NOTE: Bottles must NOT be split.** If there are no samples with two extra bottles for the MS/MSD, then prepare a matrix spike (MS) and a duplicate

(DUP) from separate samples. Record the sample ID, bottle number, and volume on the prep sheet.

7.2.9 Using the dedicated surrogate syringe add **25ul** of isotope dilution standard to each of the samples including the QC samples. Record the isotope dilution standard lot number on the prep sheet. Cap and invert the samples to mix.

7.2.10 Using the dedicated spike syringe or volumetric pipettor add **32ul** of PFAS spike solution to the LLBS. Record the spike lot numbers on the prep sheet. Cap and invert the samples to mix.

7.2.11 Using the dedicated spike syringe or volumetric pipettor add **200ul** of PFAS spike solution to the BS, MS, and MSD. Record the spike lot numbers on the prep sheet. Cap and invert the samples to mix.

7.2.12 Check the pH of each sample by dipping a disposable polyethylene transfer pipette into the sample and touching it to the pH paper. Record the pH on the prep sheet.

7.2.13 The pH should be 6.5 +/- 0.5. If necessary, adjust the pH with 50% formic acid or 30% ammonium hydroxide solution OR with 5% formic acid or 3% ammonium hydroxide solution. Record this on the prep sheet.

7.2.14 Transfer an aliquot of each sample including the QC samples to the appropriate sample reservoirs.

7.2.15 Turn on the vacuum and draw the sample through the cartridge at a rate of about 5 ml/min. Add additional sample aliquots to the sample reservoirs until the entire sample has passed through the cartridge. As particulate clogs the cartridge, increase the vacuum to maintain a reasonable flow rate.

7.2.16 Once the entire sample has been pulled through the cartridge, shut off the vacuum. Rinse each sample bottle and reservoir with 2 x 5ml aliquots of reagent water. Draw the reagent water through the cartridge. Shut off the vacuum once the water has passed through the cartridge.

7.2.17 Rinse each sample bottle and reservoir with 5ml of the 1:1 0.1M Formic Acid/methanol solution. Turn on the vacuum. Draw the solution through the cartridge. Dry the cartridge by pulling air through the cartridge for another 15 seconds. Shut off the vacuum.

7.2.18 Open the SPE manifold and place an appropriately labeled 15.0ml centrifuge tube in the rack under the position for SPE cartridge.

7.2.19 Set the manifold top back on the system, make sure that each of the delivery tubes goes into the appropriate centrifuge tube.

7.2.20 Rinse each sample bottle and reservoir with 5ml of 1% ammonium hydroxide in methanol solution. Use a pipet to transfer the solution to the SPE cartridge. Allow it to pass through the cartridge under gravity flow, then apply a slight vacuum to draw the remaining solution through the cartridge.

7.2.21 Retain the sample bottle and cap for Initial Volume determination.

Fill each sample bottle to the sample mark with tap water. Transfer the water to a Class A graduated cylinder and record the sample volume. Discard the tap water.

If determining the sample volume by weight, record the weight of the empty sample bottle and cap. The volume in ml is equal to the difference in grams. Record the weights.

7.2.22 Open the SPE manifold and remove all the centrifuge tubes. If necessary, adjust the volume to 5ml with 1% ammonium hydroxide in methanol solution. Add 25ul of concentrated acetic acid to each centrifuge tube, cap and vortex to mix.

7.2.23 Using a 10mg micro-scoop, add 10mg of ENVI-Carb powder to each sample and QC extract. Cap and vortex each sample to thoroughly mix the contents.

Excessive contact time with the carbon (more than 5 minutes) may cause low recoveries.

7.2.24 Centrifuge the samples for 10 minutes at 2800 rpm to separate the ENVI-Carb from the extract.

7.2.25 Label another 15ml centrifuge tube for each sample and QC extract. Add 25ul of NIS solution to each centrifuge tube.

7.2.26 Attach 0.2um syringe filters to 5ml polypropylene syringes. Remove the barrel and pour the entire 5ml extract into the syringe. Insert the barrel and filter each extract into the appropriately labeled centrifuge tube.

7.2.27 Cap each centrifuge tube. Transfer the extracts to the LCMSMS lab for storage.

7.2.28 Store the extracts at ≤4°C. Extracts must be allowed to come to room temperature prior to analysis. All extracts should be vortexed just prior to transfer to the autosampler vials.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL

8.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 12 hours; however, samples should not be added after the QC set has been completed. **NOTE:** Some project plans may require different batch definitions.

8.2 A method blank (MB), blank spike (BS), low-level blank spike (LLBS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples. If there is insufficient sample to extract a matrix spike duplicate (MSD) then a sample duplicate (DUP) should be extracted.

9.0 SAFETY AND WASTE DISPOSAL

9.1 Safety

9.1.1 Safety glasses, gloves and lab coats must be worn when handling samples, standards or solvents.

9.1.2 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

9.1.3 Methanol is an inhalation hazard. Use in well ventilated area.

9.2 Waste Disposal

9.2.1 Waste methanol is placed in the “non-chlorinated waste” container.

9.2.2 Spent solid-phase extraction cartridges may be disposed of in the trash.

9.2.3 Extracted water samples are rinsed down the drain with large amounts of water.

9.2.4 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining aqueous samples are transferred to the appropriate drums for disposal.

10.0 REFERENCES

Draft EPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, August 2021

Revised Errata Sheet for Draft Method 1633, February 2022

DOD QSM 5.4, November 2021

STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM WATER SAMPLES FOR LC/MS/MS ANALYSIS

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be printed nor duplicated in any manner.

Internal SOPs referenced within this SOP: na

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM SOIL SAMPLES FOR LC/MS/MS ANALYSIS

Prepared by: Norm Farmer Date: 04/07/2022

Approved by: Mike Eger Date: 04/08/2022

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TITLE: STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM SOIL SAMPLES FOR LC/MS/MS ANALYSIS

REFERENCES: EPA draft Method 1633 and QSM 5.4 Table B-24

REVISED SECTIONS: new

1.0 SUMMARY, SCOPE AND APPLICATION

1.1 Summary

Soil samples are serially extracted with basic methanol using a shaker table, cleaned with graphitized carbon, concentrated and back extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with basic methanol, the volume is adjusted to 5.0ml, and stored in centrifuge tube.

1.2 Scope and Application

This procedure is applicable to soil samples submitted for Perfluorinated Alkyl Substances (PFAS) analysis by LC/MS/MS using an Isotope Dilution technique.

NOTE: For soil sample prep by in-house LCMSMS method see SOP OP070.

NOTE: This SOP was written to be compliant with QSM 5.4.

2.0 DISCUSSION AND COMMENTS

This method is adapted from draft EPA method 1633. Additions and modifications have been added for compliance with QSM 5.4 Table B-24.

Samples expected to contain high levels of PFAS compounds should be screened prior to extraction.

The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) or Teflon products, HPLC solvent lines, methanol, aluminum foil, SPE transfer lines, bottle caps, etc. All the materials used for this method must be demonstrated to be free from interferences.

Contact with glass containers, pipettes, or syringes should be minimized since the PFAS compounds can potentially adsorb (stick) to glass surfaces.

SPE cartridges can be a source of interferences. The analysis of method and field blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the soil or sediment. Humic and/or fulvic material can be co-extracted and can cause enhancement and/or suppression in the electrospray ionization source.

3.0 PRESERVATION AND HOLDING TIMES

3.1 Preservation

3.1.1 Samples shall be collected in wide mouth 4oz HDPE jars fitted with a HDPE or Polypropylene screw cap. Alternate size HDPE bottles may be used depending on project requirements. **Glass bottles with Teflon lined caps can NOT be used.**

3.1.2 The samples must be chilled to ≤6°C from the time of collection until arrival at the laboratory. The samples must be refrigerated at ≤ 6°C or frozen at ≤ -20°C from the time of receipt until extraction.

3.1.3 The extracts should be stored at ≤4°C. They must be allowed to come to room temperature prior to analysis. All extracts should be vortexed just prior to transfer to the autosampler vials.

3.2 Holding Time

3.2.1 Soil samples must be extracted within 28 days of collection if stored at ≤6°C or within 90 days of collection if stored at ≤ -20°C. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts should be analyzed within 28 days of extraction but must be analyzed within 90 days of extraction.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 12 hours whichever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Low Level Blank Spike (LLBS): An analyte-free matrix spiked with a known amount of analyte(s) at 2x LLOQ, processed simultaneously with the samples through all the steps of the analytical procedure. Low-Level Blank Spike Recoveries are used to document laboratory performance at the LLOQ for a given method. This may also be called a Low-Level Laboratory Control Sample (LLLCS) or the Low-Level Ongoing Precision and Recovery Standard (LLOPR).

4.4 Extracted Internal Standards (EIS): A standard containing isotopically labelled versions of the native target analytes. These isotopes are usually labelled with C13, d2, or O18 atoms. Isotope Dilution Standards are used to measure the extraction efficiency and to correct the concentrations of the native analytes based on the recovery of their isotopically labelled analogs.

4.5 Field Blank (FB): An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment.

4.6 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and are still considered valid.

4.7 Matrix Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.8 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.9 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.10 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

5.1 Methanol – HPLC grade or equivalent

5.2 Reagent water – HPLC grade or equivalent - free of interference

5.3 SPE Cartridges – Wax (weak anion exchange) or equivalent

5.4 Acetic Acid - HPLC grade or equivalent

5.5 Ammonium Hydroxide – Fisher A669-212 or equivalent (28-30% Aqueous Ammonia)

5.6 3% v:v Ammonium Hydroxide Solution – add 10ml of 30% Ammonium Hydroxide to 90ml of reagent water. Store at room temperature for up to 1 month.

5.7 0.3% v:v Ammonium Hydroxide in Methanol Solution – mix 1ml NH4OH and 99ml Methanol (based off 30%).

5.8 1% v:v Ammonium Hydroxide in Methanol Solution – mix 3.3ml NH4OH and 97ml Methanol (based off 30%).

5.9 Dilution Mix - Methanol with 4% water, 1% ammonium hydroxide and 0.625% acetic acid

5.10 Formic Acid – ACS grade or equivalent

5.10.1 0.1M Formic acid – add 4.6g formic acid to 1L of reagent water. Store at room temperature for up to a year.

5.10.2 0.3M Formic acid – add 13.8g formic acid to 1L of reagent water. Store at room temperature for up to a year.

5.10.3 5% v:v Formic acid – mix 5ml formic acid and 95ml of reagent water. Store at room temperature for up to a year.

5.10.4 50% v:v Formic acid – mix 50ml formic acid and 50ml of reagent water. Store at room temperature for up to a year.

5.10.5 1:1 Formic Acid in Methanol Solution – mix 50ml 0.1M formic acid and 50ml of methanol. Store at room temperature for up to a year.

5.11 ENVI-carb – graphitized carbon powder

5.12 PFAS EIS Mix – prepared in methanol at various concentrations by the vendor. All EIS solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.13 PFAS Spike Solution – prepared in methanol at various concentration by the LC/MS/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.14 PFAS NIS Mix - prepared in methanol at various concentrations by the vendor. All EIS solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use

6.0 GLASSWARE AND APPARATUS

6.1 Solid-phase cartridge extraction system – suitable for use with extraction cartridges

6.2 Vacuum pump

6.3 Vacuum Flasks – or equivalent

6.4 SPE reservoirs – various sizes

6.5 SPE cartridges – Weak Anion Exchange – must have pKa of >8 and 150mg bedsize

6.6 Mechanical Shaker or Shaker Table

6.7 Vortex Mixer

6.8 15ml and 50ml Polyethylene Centrifuge tubes with caps

6.9 25ul, 50ul, 250ul, and 500ul syringes

6.10 10ml, 25ml, 250ml, and 1000ml Polyethylene graduated cylinder

6.11 Volumetric Pipettor and tips

6.12 1ml and 5ml Disposable polyethylene luer lock syringes

6.13 0.2um Nylon syringe filter 13mm and 25mm

6.14 10ml, 25ml, and 100ml Polyethylene or Polypropylene volumetric flasks

6.15 Disposable polyethylene transfer pipettes

6.16 2.0ml polyethylene screw cap vials

6.17 HDPE Wash Bottles

6.18 Spatula – Stainless Steel or Wood

6.19 Top loading balance – capable of weighing samples to +/- 0.01 grams

6.20 Centrifuge – 3000 rpm minimum speed

6.21 Micro-scoop 10mg

6.22 Nitrogen Evaporator, TurboVap LV or ExcelVap

7.0 PROCEDURE

7.1 The extraction of all samples must be documented on a “prep sheet”. The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the LC/MS/MS analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

7.2 Remove any foreign objects such as twigs or rocks. Thoroughly mix the sample with a spatula. Refer to SOP QA034 for more information on sample homogenization. Do not homogenize samples in glass containers or on aluminum tray.

7.3 Transfer approximately 5.0 gram of each soil or sediment sample to the appropriately labeled 50ml centrifuge tube. Use a clean spatula for each sample. Record the weight to the nearest 0.01 gram on the prep sheet.

If the samples are biosolids or similar matrix use 0.5 gram. These samples should be prepared in their own batch with separate 0.5 gram QC samples.

7.4 It may be beneficial to add a small amount (10% of sample weight or less) of PFAS free water to unusually dry samples.

7.5 Use 5.0 gram of blank sand wetted with 2.5 gram (2.5ml) of PFAS free water for the method blank (MB), blank spike (BS) low level blank spike (LLBS). Use additional 5.0 gram aliquots for the matrix spike (MS) and matrix spike duplicate (MSD).

If the samples are biosolids or similar matrix use 0.5 gram of blank sand wetted with 0.25 gram (0.25ml) of PFAS free water for the method blank (MB), blank spike (BS) low level blank spike (LLBS). Use additional 0.5 gram aliquots for the matrix spike (MS) and matrix spike duplicate (MSD).

7.6 Using the dedicated surrogate syringe add **25ul** of isotope dilution standard to each of the samples including the QC samples. Record the isotope dilution standard lot number on the prep sheet. Cap and vortex the samples to mix.

7.7 Using the dedicated spike syringe or volumetric pipettor add **32ul** of PFAS spike solution to the LLBS. Record the spike lot numbers on the prep sheet. Cap and vortex the samples to mix.

7.8 Using the dedicated spike syringe or volumetric pipettor add **200ul** of PFAS spike solution to the BS, MS, and MSD. Record the spike lot numbers on the prep sheet. Cap and vortex the samples to mix.

7.9 Allow the samples and QC so equilibrate for at least 30 minutes before extracting.

7.10 Add 10ml of 0.3% ammonium hydroxide in methanol solution to each centrifuge tube. Cap and vortex each sample to thoroughly mix the contents.

7.11 Place the centrifuge tubes on the shaker table and shake for 30 minutes.

7.12 Remove the samples from the shaker table. Centrifuge the samples for 10 minutes at 2800 rpm to separate the solids from the extract.

7.13 Transfer supernatant to a clean appropriately labelled 50ml Centrifuge tube.

7.14 Add an additional 15ml of 0.3% ammonium hydroxide in methanol solution to the sample, cap and vortex.

7.15 Place the centrifuge tubes on the shaker table and shake for 30 minutes.

7.16 Remove the samples from the shaker table. Centrifuge the samples for 10 minutes at 2800 rpm to separate the solids from the extract.

7.17 Transfer the supernatant from the second extraction into the centrifuge tube with the supernatant from the fist extraction.

7.18 Add an additional 5ml of 0.3% ammonium hydroxide in methanol solution to the sample, cap and vortex.

7.19 Centrifuge the samples for 10 minutes at 2800 rpm to separate the solids from the extract.

7.20 Combine the final supernatant in the 50ml Centrifuge tube with the supernatant from the first and second extraction.

7.21 Using a 10mg micro-scoop, add 10mg of ENVI-Carb powder to each sample and QC extract. Cap and vortex each sample to thoroughly mix the contents.

Excessive contact time with the carbon (more than 5 minutes) may cause low recoveries.

7.22 Label another 50ml centrifuge tube for each sample and QC extract.

7.23 Centrifuge the extracts for 10 minutes at 2800 rpm to separate the ENVI-Carb from the extract. Immediately decant the extracts into the new centrifuge tube. Rinse the original tube with a small amount of 0.3% ammonium hydroxide in methanol being careful not to disturb the carbon at the bottom. Transfer the rinse to the new tube.

7.24 Place the centrifuge tubes in the rack for the nitrogen evaporator. The temperature of the evaporator should be set to ~55°C and the nitrogen flow rate to ~1.2 ml/min. Concentrate the extract to 12-15ml.

Evaporation of all the methanol can cause significant loss of the neutral compounds.

7.25 Label a 125ml HDPE bottle for each sample and QC extract. Fill each bottle with approximately 100ml of PFAS free water.

7.26 Transfer the extracts into the 125ml HDPE bottles. Rinse the original tube with a small amount of PFAS free water and transfer that to the bottle. This will result in an extract solution that is less than 10% methanol.

7.27 Check the pH of each extract by dipping a disposable polyethylene transfer pipette into the extract and touching it to the pH paper. Record the pH on the prep sheet.

7.28 The pH should be 6.5 +/- 0.5. If necessary, adjust the pH with 50% formic acid or 30% ammonium hydroxide solution OR with 5% formic acid or 3% ammonium hydroxide solution.

7.29 Assemble the solid-phase extraction system.

7.30 Label the side of each cartridge with the sample ID.

7.31 Loosely pack deactivated glass wool to half the height of the SPE cartridge and attach each of them to the SPE manifold.

7.32 Condition each SPE cartridge with 15ml of 1% ammonium hydroxide in methanol solution followed by 5ml of 0.3M formic acid. Use gravity flow if possible or a 1 to 2 ml/min flow rate. Stop the flow just before the cartridge goes dry.

Do not allow the cartridge to go dry.

7.33 Using a reservoir adaptor, attach the sample reservoir to the top of the SPE cartridge.

7.34 Transfer an aliquot of each extract including the QC extracts to the appropriate sample reservoirs.

7.35 Turn on the vacuum and draw the extract through the cartridge at a rate of about 5 ml/min. Add additional extract aliquots to the sample reservoirs until the entire extract has passed through the cartridge. If particulates clog the cartridge, increase the vacuum to maintain a reasonable flow rate.

7.36 Once the entire extract has been pulled through the cartridge, shut off the vacuum. Rinse each sample bottle and reservoir with 2 x 5ml aliquots of reagent water. Draw the reagent water through the cartridge. Shut off the vacuum once the water has passed through the cartridge.

7.37 Rinse each sample bottle and reservoir with 5ml of the 1:1 0.1M Formic Acid/methanol solution. Turn on the vacuum. Draw the solution through the cartridge. Dry the cartridge by pulling air through the cartridge for another 15 seconds. Shut off the vacuum.

7.38 Open the SPE manifold and place an appropriately labeled 15.0ml centrifuge tube in the rack under the position for SPE cartridge.

7.39 Set the manifold top back on the system, make sure that each of the delivery tubes goes into the appropriate centrifuge tube.

7.40 Rinse each sample bottle and reservoir with 5ml of 1% ammonium hydroxide in methanol solution. Use a pipet to transfer the solution to the SPE cartridge. Allow it to pass through the cartridge under gravity flow, then apply a slight vacuum to draw the remaining solution through the cartridge.

7.41 Open the SPE manifold and remove all the centrifuge tubes. If necessary, adjust the volume to 5ml with 1% ammonium hydroxide in methanol solution.

7.42 Add 25ul of NIS solution to each centrifuge tube. Then add 25ul of concentrated acetic acid to each centrifuge tube, cap and vortex.

7.43 Label another 15ml centrifuge tube for each sample and QC extract.

7.44 Attach 0.2um syringe filters to 5ml polypropylene syringes. Remove the barrel and pour the entire 5ml extract into the syringe. Insert the barrel and filter each extract into the appropriately labeled centrifuge tube.

7.45 Cap each centrifuge tube. Transfer the extracts to the LCMSMS lab for storage.

7.46 Store the extracts at ≤4°C. Extracts must be allowed to come to room temperature prior to analysis. All extracts should be vortexed just prior to transfer to the autosampler vials.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL

8.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 12 hours; however, samples should not be added after the QC set has been completed. **NOTE:** Some project plans may require different batch definitions.

8.2 A method blank (MB), blank spike (BS), low-level blank spike (LLBS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples. If there is insufficient sample to extract a matrix spike duplicate (MSD) then a sample duplicate (DUP) should be extracted.

9.0 SAFETY AND WASTE DISPOSAL

9.1 Safety

9.1.1 Safety glasses, gloves and lab coats must be worn when handling samples, standards or solvents.

9.1.2 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

9.1.3 Methanol is an inhalation hazard. Use in well ventilated area.

9.2 Waste Disposal

9.2.1 Waste methanol is placed in the “non-chlorinated waste” container.

9.2.2 Spent solid-phase extraction cartridges may be disposed of in the trash.

9.2.3 Extracted soil samples are placed in a waste container after the solvent has drained.

9.2.4 Waste soil from the homogenizing process should be placed in the “soil waste” container. **NOTE:** Waste soil from foreign soils must follow “foreign soil” disposal requirements.

9.2.5 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining aqueous samples are transferred to the appropriate drums for disposal.

10.0 REFERENCES

Draft EPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, August 2021

Revised Errata Sheet for Draft Method 1633, February 2022

DOD QSM 5.4, November 2021

STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM SOIL SAMPLES FOR LC/MS/MS ANALYSIS

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be printed nor duplicated in any manner.

Internal SOPs referenced within this SOP: QA034

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES (PFAS) IN AQUEOUS AND SOLID SAMPLES BY LC/MS/MS

Prepared by: Norm Farmer Date: 08/01/2022

Approved by: Mike Eger Date: 08/03/2022

Annual Review

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TITLE: ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES (PFAS) IN AQUEOUS AND SOLID SAMPLES BY LC/MS/MS

REFERENCES: EPA draft Method 1633 and QSM 5.4 Table B-24

REVISED SECTIONS: Tables 2 and 3.

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of select Per- and Polyfluorinated Alkyl Substances (PFAS) in aqueous, solid (soil, sediment, biosolids) and tissue matrices utilizing an HPLC equipped with a tandem mass spectrometer (MS/MS).

1.1.2 Analytes that may be reported under this method are listed in TABLE 1. Translations between analytes names and acronyms used in EPA 1633 versus the laboratory report and raw data are listed in TABLE 4.

1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are 0.002-0.050 ug/l for aqueous samples and 0.2-50 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.

1.1.4 **MeFOSA, EtFOSA, MeFOSE, and EtFOSE** tend to recover erratically by SPE cartridge. These analytes may also be lost during the evaporative step. Data for these analytes should be reviewed carefully.

1.1.5 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

1.1.6 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

1.1.7 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I” qualifier. Some program or project specifications may require that no values below the LLOQ be reported.

1.1.8 This method is “performance-based,” meaning that modifications may be made without additional EPA review to improve performance (e.g., overcome interferences, or improve the sensitivity, accuracy, or precision of the results) provided that all performance criteria in this method are met.

1.2 Summary

1.2.1 This method is adapted from draft EPA Method 1633 for the analysis of environmental water and soil samples. Additions and modifications have been added for compliance with QSM 5.4 Table B-24.

This SOP is not designed to be used to analyze aqueous and solid samples by the laboratory’s in-house LCMSMS method. Those samples should be analyzed by MS014 or MS019 with QSM 5.3 Table B-15.

This SOP is not designed to be used to analyze drinking water by EPA 537.1 or EPA 533. Drinking water samples should be analyzed by SOP MS017 or MS022

1.2.2 Samples are received, stored, and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with SGS – Orlando SOP OP075 and OP076.

1.2.4 Samples known to be high in PFAS (such as AFFF or AFFF impacted waters) should be screened by serial dilution and direct injection onto the LC/MS/MS in order to determine the appropriate subsample size.

High level water and soil samples require that a smaller sample aliquot be used so that the analytes fall within the instrument calibration range.

For definitive analysis AFFF samples must be subcontracted to a laboratory certified for AFFF analysis by QSM 5.4.

1.2.5 Per- and Polyfluorinated Alkyl Analytes are separated, detected and quantitated using an LC/MS/MS. After HPLC separation and ionization, the specific Perfluorinated compound is isolated in the first mass spectrometer and transferred to a collision cell for fragmentation. The resulting fragments are introduced into the second mass spectrometer where they are detected and quantified.

1.2.6 Per- and Polyfluorinated Alkyl Analytes may exist in branched and/or linear form. Fluorotelomer production results in linear isomers only but electrochemical fluorination results in branched and linear isomers. The branched isomers may account for up to 30% of the total analyte. The branched isomers will elute just before the linear isomer. A qualitative branched/linear RT standard with additional branched isomers is used to help establish transition windows.

1.2.7 Manual integrations are performed in accordance with SOP QA029.

2.0 COLLECTION, PRESERVATION, STORAGE, AND HOLDING TIME

2.1 Collection

2.1.1 Aqueous samples should be collected in 500mL high density polyethylene bottles (HDPE). Caps must not have Teflon liners. Alternate size bottles may be used depending on project requirements.

Additional bottles should be provided for solids determination, dilutions, and pre-screening of samples.

2.1.2 Solid samples shall be collected in 4oz or 2oz HDPE wide mouth jars. Caps must not have Teflon liners.

2.1.3 The samples must be chilled to ≤ 6°C from the time of collection until arrival at the laboratory.

2.2 Storage

2.2.1 Samples may be stored in the dark at either ≤ 6°C or ≤ -20°C.

Issues were observed with MeFOSE, EtFOSE, MeFOSAA and EtFOSAA after 7 days when stored at ≤ 6°C. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.

2.2.2 The extracts should be stored in the dark at ≤ 4°C. All extracts must be allowed to come to room temperature and vortexed just prior to transfer to the autosampler vials.

2.3 Holding Time

2.3.1 Aqueous and solid samples must be extracted within 28 days of collection if stored at ≤ 6°C.

2.3.2 Aqueous and solid samples must be extracted within 90 days of collection if stored at ≤ -20°C.

2.3.3 Extracts should be analyzed within 28 days of extraction but must be analyzed within 90 days of extraction.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences. Method interferences may be caused by contaminants in solvents, reagents, or glassware. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) or Teflon products, HPLC solvent lines, methanol, aluminum foil, SPE transfer lines, bottle caps, etc. All materials must be demonstrated to be free from interferences.

3.2 Contact with glass containers, pipettes, or syringes should be minimized since the Perfluorinated compounds can potentially adsorb to glass surfaces.

3.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the sample. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of the humic content of the sample. High levels of iron have been shown to reduce the d5-EtFOSAA recoveries.

3.4 When establishing the chromatographic conditions, it is important to consider the potential interference of bile salts during analyses of tissue samples. A standard containing TDCA should be injected to ensure that TDCA does not coelute with any of the target analytes, EIS, or NIS standards. Analytical conditions must be set to allow a separation of at least 1 minute between the bile salts and PFOS.

3.5 SPE cartridges can be a source of interferences. The analysis of field and method blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices must be tested to ensure that contamination does not preclude analyte identification and quantitation.

3.6 Water and containers used for equipment blanks or field blanks must be tested prior to use. For smaller sampling events DI water will be provided in the same type of bottle used for sample collection. For larger sampling events four-liter HDPE containers should be used. Containers should be filled with DI water and allowed to sit for several hours before testing. If the bottles are from the same lot and filled with DI on the same day, then one analysis per 10 containers should suffice. The DI water and container blanks must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable.

3.7 A field blank should be collected with each set of samples. Each field blank consists of 4 bottles. Two bottles are filled with DI water at the lab and the other two bottles are empty. At the sampling site the sampler should open then two empty bottles and transfer the DI water from the full bottles into them. Cap the bottles, label as field blanks, and return them to the laboratory along with the samples for analysis.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS) or the Ongoing Precision and Recovery Standard (OPR).

4.3 Low Level Blank Spike (LLBS): An analyte-free matrix spiked with a known amount of analyte(s) at 2x LLOQ, processed simultaneously with the samples through all the steps of the analytical procedure. Low-Level Blank Spike Recoveries are used to document laboratory performance at the LLOQ for a given method. This may also be called a Low-Level Laboratory Control Sample (LLLCS) or the Low-Level Ongoing Precision and Recovery Standard (LLOPR).

4.4 Bile Salt Check: A Retention Time Standard containing Taurodeoxycholic Acid (TDCA) and PFOS used to verify separation between TDCA and PFOS.

4.5 Branched/Linear RT Check: A qualitative standard that contains various commercially available branched and linear PFAS analytes which is used to help identify branched isomers and to ensure that the transition windows are wide enough to capture the branched peaks.

4.6 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.7 Continuing Calibration Blank (CCB): An instrument blank analyzed immediately after a CCV used to verify that there is no carry-over from the CCV.

4.8 Extracted Internal Standards (EIS): A standard containing isotopically labelled versions of the native target analytes. These isotopes are usually labelled with C13, d2, or O18 atoms. Isotope Dilution Standards are used to measure the extraction efficiency and to correct the concentrations of the native analytes based on the recovery of their isotopically labelled analogs.

The terms isotope dilution standards and extracted internal standard are used interchangeably throughout this SOP. Technically if a direct mass labelled analog is used to quantitate the native analyte it is an isotope dilution technique; however, if a direct mass labelled analog is not available for quantitation and a similar mass labelled analog is used, it is an extracted internal standard technique.

4.9 Field Blank (FB): An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment.

4.10 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still considered valid.

4.11 Isotope Dilution Standards (IDS): See Extracted Internal Standard.

4.12 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the LLOQ.

4.13 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.14 Instrument Blank (IBLK): An instrument blank analyzed immediately after the High Standard used to verify that there is no carry-over.

4.15 Matrix Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.16 Matrix Spike (MS): A sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.17 Matrix Spike Duplicate (MSD): A replicate sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.18 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.19 Non-Extracted Internal Standards (NIS): Labeled PFAS compounds spiked into the concentrated extract immediately prior to injection of an aliquot of the extract into the LC-MS/MS.

4.20 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

5.1 Acetonitrile – HPLC grade or equivalent (Eluent A)

5.2 Water – HPLC grade or equivalent

5.3 Ammonium Acetate – LCMS grade or equivalent

5.4 Ammonium Hydroxide – Fisher A669-212 or equivalent (28-30% Aqueous Ammonia)

5.5 Eluent A - Acetonitrile

5.6 Eluent B – 2mM Ammonium Acetate in 95:5 Water:Acetonitrile

Dissolve 0.154 grams of ammonium acetate in 950ml of water and 50ml of acetonitrile.

5.7 Dilution Mix - Methanol with 4% water, 1% ammonium hydroxide and 0.625% acetic acid

Add ammonium hydroxide (3.3ml of 30%), reagent water (1.7ml) and acetic acid (0.625ml) to methanol (92ml). Store at room temperature, replace after 1 month.

5.8 Nitrogen – various grades

5.9 Perfluorinated Alkyl Substances stock standards – Traceable to Certificate of Analysis.

5.10 Mass labeled – Non-Extracted Internal Standards

$^{13}C_3$-PFBA	$^{13}C_4$-PFOA	$^{13}C_2$-PFDA	$^{13}C_4$-PFOS
$^{13}C_2$-PFHxA	$^{13}C_5$-PFNA	$^{18}O_2$-PFHxS	

5.11 Mass labeled – Extracted Internal Standards

$^{13}C_4$-PFBA	$^{13}C_9$-PFNA	$^{13}C_3$-PFBS	$^{13}C_2$-8:2 FTS	D_5-NEtFOSAA
$^{13}C_5$-PFPeA	$^{13}C_6$-PFDA	$^{13}C_3$-PFHxS	$^{13}C_8$-PFOSA	D_7-NMeFOSE
$^{13}C_5$-PFHxA	$^{13}C_7$-PFUnA	$^{13}C_8$-PFOS	D_3-NMeFOSA	D_9-NEtFOSE
$^{13}C_4$-PFHpA	$^{13}C_2$-PFDoA	$^{13}C_2$-4:2 FTS	D_5-NEtFOSA	$^{13}C_3$-HFPO-DA
$^{13}C_8$-PFOA	$^{13}C_2$-PFTeDA	$^{13}C_2$-6:2 FTS	D_3-NMeFOSAA	

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1260 or 1290

Suitable HPLC equipped with an autosampler, pump, and column compartment. System may have a membrane degasser if shown to not adversely affect the analysis.

6.2 MS/MS – Agilent Technologies 6470A or 6495B

LC/MS/MS must be capable of negative ion electrospray ionization near the required flow rate of the HPLC Column. The system must be capable of performing MS/MS to produce unique precursor and product ions for the PFAS method analytes within the specified retention time segments. A minimum of 10 scans across each peak is required to ensure adequate precision.

6.3 Data System – Agilent Technologies MassHunter B10.0x

6.3.1 A computer system interfaced to the HPLC/MS/MS that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.3.2 The software must allow for the viewing of the specific MS/MS Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.3.3 Data is archived to a backup server for long term storage.

6.4 Columns: Agilent Poroshell 120 EC C18 2.7um, 100 x 2.1 mm ID or equivalent

6.5 Delay Columns: Agilent Poroshell or Eclipse C18 50 x 4.6 mm ID or equivalent

6.6 Disposable polyethylene transfer pipettes

6.7 15ml Centrifuge tubes

6.8 HDPE or Polypropylene screw cap and autosampler vials

6.9 Volumetric Pipettors and volumetric “plasticware” for dilutions of standards and extracts.

6.10 Class A volumetric flasks.

6.11 HDPE bottles – various sizes, shown to be PFAS free

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified neat or reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards must be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and isotope dilution standard concentrations, preparation information, and vendor part numbers can be found in the LCMS STD Summary in the Active SOP directory. A summary of the calibration concentrations can be found in Table 3.

7.1.1 Stock Standard Solutions

Stock standards are available from some commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold time is reduced to one year or the vendor’s expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with methanol. The hold time for intermediate standards is six months or the vendor’s expiration date (whichever is shorter). Intermediate standards may need to be remade if comparisons to other standards indicate analyte degradation or concentration changes. Intermediate standards should be prepared using the dilution mix and stored in polyethylene vials.

7.1.3 Calibration Standards

Calibration standards for Perfluorinated analytes are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in methanol. The low standard is at a concentration at or below the RL and the remaining standards defines the working range of the detector. Calibration standards should be prepared using the dilution mix and be stored in polyethylene vials. See Table 3 for levels.

Calibration standards concentrations for the sulfonates may need to be corrected for the molecular weight of the cation in the salt. Check the vendor’s Certificate of Analysis to see if their nominal concentration is based on the acid or salt

$$\text{Mass}_{\text{acid}} = \text{Mass}_{\text{salt}} \mathbf{X}\ \text{MW}_{\text{acid}}/\text{MW}_{\text{salt}}$$

MW_{acid} = Molecular weight of PFAA
MW_{salt} = Molecular weight of the salt

Perfluorinated analytes may exist in branched and/or linear form. If a branched form is commercially available, then the calibration standards

must contain the branched and linear form. PFHxS, PFOS, MeFOSAA and EtFOSAA are currently available in mixes of branched and linear isomers.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC/MS/MS Conditions

7.2.1 HPLC Conditions

6-10ul autosampler injection Column temperature – 50.0 °C

Gradient Program

Eluent A – Acetonitrile

Eluent B – 2mM ammonium acetate in 95:5 water:acetonitrile

Time (min)	**A (%)**	**B (%)**	**Flow (mL/min)**
0.20 min	10.0 %	90.0 %	0.350 mL/min
4.00 min	30.0 %	70.0 %	0.350 mL/min
7.00 min	55.0 %	45.0 %	0.350 mL/min
9.00 min	75.0 %	25.0 %	0.350 mL/min
10.00 min	95.0 %	5.0 %	0.400 mL/min
10.30 min	95.0 %	5.0 %	0.400 mL/min
10.40 min	2.0 %	98.0 %	0.400 mL/min
11.80 min	2.0 %	98.0 %	0.400 mL/min
13.00 min	2.0 %	98.0 %	0.350 mL/min

7.2.2 MS/MS Conditions

Parameter	Value	Parameter	Value
Gas Temp C	250	Sheath Gas Flow (l/min)	10
Gas Flow (l/min)	10	Capillary (V)	3500
Nebulizer (psi)	50	V Charging	500
Sheath Gas Heater	300	Ionization Mode	Neg ESI
Collision Cell Gas (psi)	40	Collision Cell Gas	UHP N2

Fragmentation voltages and collisions energies are optimized for each analyte and are stored in the instrument method. Precursor ions and transition masses are listed in Table 2.

LC/MS/MS conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Sample Preparation

7.3.1 Low Level Aqueous Samples

A 500ml aliquot of sample (entire bottle) is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with basic methanol. The extract is carbon cleaned, filtered and the final volume is adjusted to 5.0ml, and then transferred to a centrifuge tube for storage. Refer to SOP OP075.

7.3.2 Solid Samples

A 5-gram aliquot of sample is extracted with basic methanol utilizing vortex mixer and a shaker table. The extract is carbon cleaned, SPE cleaned, filtered and the final volume is adjusted to 5.0ml, and then transferred to a centrifuge tube for storage. Refer to SOP OP076.

7.4 HPLC/MS/MS Analysis

Instrument calibration consists of four major sections:

Mass Tuning and Calibration
Transition Window Selection
Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Mass Calibration and Transition Window Selection

The instrument must have a valid mass calibration prior to any sample analysis. The mass calibration must be updated as needed. (i.e. QC failures, ion masses showing large deviations from known masses, or after major instrument maintenance is performed). It is recommended that the mass calibration be verified weekly through the analysis of a Check Tune. The Agilent Check Tune Masses range from 112.99 to 2233.91 amu for MS1 and 69.00 to 2233.91 for MS2.

The Check Tune Report may show both Positive and Negative ESI Results. Only the Negative results need to be evaluated. Unit resolution is demonstrated when the value of the peak width at half-height is within 0.5 ± 0.1 amu of the true value.

MS1 (UNIT)	MS2 (UNIT)
	69.00
112.99	112.99
302.00	302.00
601.98	601.98
1033.99	1033.99
1633.95	1633.95
2233.91	2233.91

Since masses greater than 1033.99 amu are not used for this method, the 1633.95 and 2233.91 amu masses must be present but do not need to be within 0.1 amu of the true value.

The Branched/Linear RT Check and mid-point calibration standard are used to check the analyte retention times. These retention times are used to update the transition windows. The windows must be wide enough to ensure that the branched and linear isomer the PFAS analytes are completely within the transition window. The branched isomers will elute just prior to the linear isomer. If they are partially cut off, adjust the retention time of the linear isomer or the width of the transition window. Use a similar size window for the other analytes that do not have a branched standard. Later eluting peaks are broader and require a slightly wider transition windows because of peak broadening.

7.4.2 Initial Calibration Procedures

Before samples can be run, the LC/MS/MS system must be calibrated.

7.4.2.1 Isotope Dilution Standard (Extracted Internal Standard) Calibration

A minimum 7-point calibration curve is created for the native PFAS compounds using an Isotope Dilution or Extracted Internal Standard technique. SGS - Orlando routinely performs an 8-point calibration to maximize the calibration range and to allow for quadratic fits. See Table 3.

The calibration standards for PFHxS, PFOS, MeFOSAA, and EtFOSAA must consist of both branched and linear isomers. The branched isomer elutes just prior to the linear isomer. These four PFAS are currently being reported as the sum of the branched and linear isomers so both the branched and linear isomers in the calibration standards must be integrated.

Response factors (RF) for each analyte at each calibration level are determined as follows:

$$RF = (A_{analyte} \mathbf{X}\ C_{ids})/(A_{ids} \mathbf{X}\ C_{analyte})$$

$A_{analyte}$ = area of the analyte
A_{ids} = area of the isotope dilution standard
$C_{analyte}$ = concentration of the analyte
C_{ids} = concentration of the isotope dilution standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of RF X 100) / Mean RF

If the %RSD ≤ 20%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples.

Alternatively, a calibration curve of response vs. amount can be plotted. Linear regressions may be unweighted or weighted as 1/x or $1/x^2$. If a linear or non-linear regression is used, then the Relative Standard Error (%RSE) must be calculated.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^{n} \left[\frac{x'_i - x_i}{x_i}\right]^2 \Big/ (n-p)}$$

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

p = Number of terms in the fitting equation.
(average = 1, linear = 2, quadratic = 3)

n = Number of calibration points.

If Relative Standard Error (%RSE) ≤ 20%, then the curve can be used to quantitate target analytes in the samples.

This method allows for the use of average response factors, linear regressions, and non-linear regressions.

Regardless of which model is used, each point should be refitted against the initial calibration. Use % Error to evaluate the difference between the measured and the true amounts or concentrations used to create the model. The MassHunter software will do this automatically.

Calculation of the % Error

% ERR = (xi-x'i) / xi * 100

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte should be ≤ ±30% (70-130% of True Value) for all standard levels, except the lowest point which should be ≤ ±50% (50-150% of True Value).

7.4.2.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV must be prepared from a second source at a mid-range concentration.

NOTE: Second source standards may consist of linear isomers only.

The %D for the compound of interest must be ≤ ±30% (70-130% of True Value). If the ICV does not meet criteria, a fresh standard must be prepared. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, make fresh calibration standards. Recalibrate the instrument.

NOTE: Analyze the branched/linear standard to identify the branched isomers. This is a qualitative standard only. Currently is should contain branched isomers of PFOA, PFNA, PFOSA, MeFOSE, EtFOSE, MeFOSA and EtFOSA. This standard is loaded into LIMS as an ICV.

7.4.2.3 Bile Salt Interference Check and Branched/Linear Retention Time Check.

The separation between Taurodeoxycholic Acid (TDCA) and PFOS must be verified with each ICAL.

Inject a mid-level PFAS standard that has been fortified with 1 ug/ml TDCA. The standard may also contain Taurochenodeoxycholic Acid (TCDCA) and Tauroursodeoxycholic Acid (TUDCA) as well.

PFOS and TDCA must be separated by at least 1 minute.

7.4.2.4 Branched/Linear RT Check

Analyze the branched/linear RT standard to identify the branched isomers. This is a qualitative standard only. Currently is should contain branched isomers of PFOA, PFNA, PFOSA, MeFOSE, EtFOSE, MeFOSA and EtFOSA. This standard is loaded into LIMS as an RT Check.

7.4.2.5 Highest Standard and Instrument Blank

Analyze an instrument blank (IBLK) immediately following the highest standard analyzed. The highest standard analyzed may be analyzed as part of the calibration curve or following the calibration curve. The highest standard may be at or above the concentration of highest level of the calibration. It cannot be used to extend the calibration range.

The instrument blank must be analyzed immediately following the highest standard. The instrument blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable.

If the acceptance criteria is not met, the concentration of the standard should be lowered and another blank analyzed.

The highest standard and instrument blank pair are used only to document a highest concentration at which carryover does not occur. If a sample concentration exceeds this range and the sample(s) following have reportable detections for that analyte, then they must be reanalyzed.

7.4.2.6 Retention Time Windows

The retention time of each analyte and extracted internal standard must fall within **0.4 minutes** of the predicted retention times from the daily calibration verification or from the midpoint standard of the ICAL (on days when an ICAL is performed).

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and extracted internal standard from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Initial peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (extracted internal standards) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

The retention time of the target analyte must fall within **0.1 minutes** of the associated isotope dilution standard (for analytes that have an exact isotopic counterpart).

7.4.2.7 Ion Ratios and Signal to Noise

A minimum of two transition ions are monitored for each target analyte except for those analytes in Table 2 which only have a single transition ion.

The ratio of the primary and secondary transition masses should be updated from the initial calibration. They may be updated from the midpoint standard or from an average of all levels. Additionally, the ion ratio may be updated from the opening daily CCV.

Isotope Ratio criteria is still being developed for EPA method 1633. The MassHunter software calculates the ratio as the response of the primary transition mass divided by the response of the secondary transition mass times 100. It is set to flag the analyte if the ratio of these ions is not within ± 50% of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 25 and 75%).

Primary and secondary transition masses must maximize within ± 2 seconds.

The signal to noise ratio for the primary transition mass must be at least 3 times that of the background and the secondary transition mass must be at least 3 times that of the background.

7.4.3 Daily Calibration and Carryover Verifications

7.4.3.1 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the Perfluorinated compounds are prepared at low and mid-range concentration. CCV standards are prepared from the same stock as the initial calibration standards.

A low level CCV must be analyzed at the beginning of each analytical sequence (prior to sample analysis) and at least once every 24 hours during the sequence to ensure accuracy at the LOQ.

The CCV must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, the mid-point CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| must be ≤ ±30% for the target analytes and EIS in each CCV.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria, then the system is considered in control and results may be reported.

If the |%D| is outside the control limits, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Qualifying the data should only be done if the sample cannot be reanalyzed. Under certain circumstances, the data may be reported, i.e. The CCV failed high, the associated QC passed, and the samples were ND.

For QSM 5.4 all samples must be bracketed with passing CCV.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.3.2 Carryover Verification

A high standard and an instrument blank (IBLK) must be analyzed each day prior to the analysis of samples. The high standard may be at or above the concentration of highest level of the calibration.

The instrument blank must be analyzed immediately following the high standard. The instrument blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable.

If the acceptance criteria are not met, the concentration of the standard should be lowered, and another blank analyzed.

The highest standard and instrument blank pair are used only to document a highest concentration at which carryover does not occur. If sample concentrations exceed this range and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.

7.4.3.3 Continuing Calibration Blank (CCB)

An additional blank must be analyzed after each CCV to ensure no carry over from the standard. The instrument blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable. The CCB is loaded into LIMS as “ICCB”.

If the acceptance criteria are not met, the system should be checked. Any samples bracketed by the failing CCB must be reanalyzed.

Review the data to see if there was a high sample prior to the CCV/CCB pair that may have contaminated the system? If so, clean the system and run additional blanks to see if the system is in control.

7.4.3.4 Bile Salt Interference Check.

For QSM 5.4 the separation between Taurodeoxycholic Acid (TDCA) and PFOS must be verified daily.

Inject a mid-level PFAS standard that has been fortified with 1 ug/ml TDCA. The standard may also contain Taurochenodeoxycholic Acid (TCDCA) and Tauroursodeoxycholic Acid (TUDCA) as well.

PFOS and TDCA must be separated by at least 1 minute.

7.4.3.5 Branched.Linear RT Check

Analyze the branched/linear RT standard daily to identify the branched isomers. This is a qualitative standard only. Currently is should contain branched isomers of PFOA, PFNA, PFOSA, MeFOSE, EtFOSE, MeFOSA and EtFOSA. This standard is loaded into LIMS as an RT Check

7.4.4 Sample Extract Analysis

7.4.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV and low level CCV)
Carryover Check Standard
Instrument Blank (IBLK)
Bile Salt Interference Check
Branched/Linear RT Check
CCV Standards
    Low-Level (LOQ)
    Mid-Level
QC Extracts
Sample Extracts
Bracketing CCV Standards
Bracketing CCB Standards

7.4.4.2 Six to ten microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.4.3 Tentative identification of an analyte occurs when the peak from the sample extract falls within the retention time window of the target compound.

7.4.4.4 Positive identification is confirmed by comparing the ion ratio in the sample to the ion ratio of the standards. For the linear isomer, the primary and secondary transition masses must both be present. For the branched isomers the primary and secondary transition masses should both be present. In rare circumstances a particular branched peak may only exhibit the primary transition ion. These should be omitted from the quantitation.

The MassHunter software is set to flag the analyte if the ratio of these ions is not within ± 30% of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 20 and 80%).

The signal to noise ratio for the primary transition mass must be at least 3 times that of the background and the secondary transition mass must be at least 3 times that of the background.

7.4.4.5 Some of the PFASs may have multiple chromatographic peaks due to the presence of linear and branched isomers. This is prevalent in PFHxS and PFOS. The areas of all the linear and branched isomers peaks must be included and the concentrations reported as a total for each of these analytes.

NOTE: The branched isomers must be included in the quantitation even if the calibration is based on just the linear isomer.

7.4.4.6 If the compound identification does not confirm, then the result should be reported as ND or “U”.

7.4.4.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

Dilutions for this method are performed differently depending on the concentration of the target analytes in the extract. For dilutions in the 2x to 10x range, the extract is diluted with the dilution mix. No additional EIS nor NIS are added.

If the responses for each EIS in the diluted extract meet the S/N requirements in Section 7.4.2.6 and retention time requirements in Section 7.4.2.5, and the EIS recoveries from the analysis of the diluted extract are greater than 5%, then the compounds associated with those EISs may be quantified using isotope dilution.

Use the EIS recoveries from the original analysis to select the dilution factor, with the objective of keeping the EIS recoveries in the dilution above that 5% lower limit (i.e., if the EIS recovery of the affected analyte in the undiluted analysis is 50%, then the sample cannot be diluted more than 10:1; if the if the EIS recovery of the affected analyte in the undiluted analysis is 30%, then the sample cannot be diluted more than 6:1).

For dilutions greater than 10-fold, a smaller aliquot should be extracted. The estimated analyte concentration from below can be used to determine the best aliquot size.

If no additional sample is available, then additional EIS and NIS are added, and the sample re-analyzed. The theoretical concentration of the isotope dilution standards in the extract will need to be entered into MassHunter so that the software can correctly calculate the native analyte concentration. This result is estimated based on an internal standard approach. The results should be footnoted as such.

7.4.4.8 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.5 Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate “Instrument Repair and Maintenance” log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the “Instrument Repair and Maintenance” log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), low-level blank spikes (LLBS), matrix spikes (MS), matrix spike duplicates (MSD) and sample duplicates (DUP). The MB, BS, LLBS are used to monitor overall method performance, while the MS and MSD or DUP are used to evaluate the method performance and reproducibility in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of isotope dilution standards and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), matrix spike duplicate (MSD) or sample duplicate (DUP). All control limits are updated annually and are listed in the LIMS.

9.1 Non-Extracted Internal Standards (NIS)

9.1.1 The analytes listed in section 5.10 are used as the Non-Extracted Internals Standards for this method. The response of the NIS in all subsequent runs must be 30-200% of the average response from the initial calibration.

9.1.2 If the NIS responses are not within limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.

9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.1.2.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.2.4 If upon reanalysis, the responses are still not within limits, reanalyze the sample at a dilution.

9.1.2.5 If upon analysis of the dilution the responses are within limits, then the sample or select analytes may need to be reported from the dilution or qualified.

9.2 Extracted Internal Standard (EIS)

9.2.1 The analytes listed in section 5.11 are used as the Extracted Internal Standards for this method.

A known amount of isotope dilution standard is added to each sample including the QC set prior to extraction. The recovery (corrected for dilution) for each isotope dilution standard must be 20% to 150%.

The % recovery may be calculated are calculated from the calculated concentrations.

% Recovery = (Sample Amount / Amount Spiked) X 100

Only those isotope dilution standards that directly link to the native analytes being reported need to pass. For example, 13C4-PFBA only needs to pass if PFBA is being reported.

9.2.2 If any isotope dilution standard response/recovery is not within the established control limits, the following are required.

9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, isotope dilution standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.2.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.2.2.3 Check for instrument suppression or enhancement by reanalyzing the sample at a dilution.

9.2.2.4 If no problem is found re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.2.2.5 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Isotope dilution standards from both sets of analysis must be reported on the final report.

9.2 Method Blank

9.2.1 The method blank is either HPLC water or cleaned sand (depending upon sample matrix). The method blank is then taken through all procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination must be investigated and documented. The samples may need to be re-extracted and reanalyzed for confirmation. **For any DoD QSM projects the resulting data must be qualified accordingly.** If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination must be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination must be investigated and documented. The samples must be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

9.3.1 The blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added. The blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable. As additional analytes are added to this method, the recoveries will need to be carefully evaluated.

9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.3.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. **For any DoD QSM projects the resulting data must be qualified accordingly.**

9.3.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.3.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.4 Low-Level Blank Spike

9.4.1 The low-level blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added at no more than 2 times the LLOQ. The low-level blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable. As additional analytes are added to this method, the recoveries will need to be carefully evaluated.

9.4.2 If the low-level blank spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. **For any DoD QSM projects the resulting data must be qualified accordingly.**

9.4.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.4.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the spike standard has been added. The matrix spike and spike duplicate are then taken through all procedures along with the other samples to monitor the precision and accuracy of the procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are indications of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte OR sample result and duplicate result are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for each Perfluorinated compound must be less than 30%. If the RPDs fall outside of the established control limits, the MS/MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

9.5 Matrix Duplicate

9.5.1 The duplicate is a replicate sample that is taken through all procedures along with the other samples to monitor the precision. The matrix duplicates are analyzed with each batch of samples.

9.5.2 Matrix spike and spike duplicate recoveries for each analyte OR sample result and duplicate result are used to calculate the relative percent difference (RPD) for each compound.

$$RPD = [| \text{Sample Result} - \text{DUP Result} | / \text{Average Result}] \times 100$$

The RPD for each Perfluorinated compound must be less than 30%. If the RPDs fall outside of the established control limits, the DUP should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each Perfluorinated compound in the original sample is calculated as follows:

$$\text{Water (ug/l)} = (CONC_{inst}) \times (V_F / V_I) \times DF$$

$$\text{Soil (ug/kg)} = [(CONC_{inst}) \times (V_F / W_I) \times DF] / \%solids$$

$CONC_{inst}$ = Instrument concentration calculated from the initial calibration using mean CF or curve fit (ppb)
DF = Dilution Factor
V_F = Volume of final extract (ml)
V_I = Volume of sample extracted (ml)
W_I = Weight of sample extracted (g)
%solids = Dry weight determination in decimal form

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst must follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample must be treated as a potential health hazard. Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment must be used by all analysts.

11.2 Pollution Prevention

Wastewater and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 30 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

Draft EPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, August 2021

2nd Draft EPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, June 2022

Revised Errata Sheet for Draft Method 1633, February 2022

DOD QSM 5.4, November 2021

TABLE 1: Target Analytes

PFAS Analyte	Acronym	CAS #
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTriA	72629-94-8
Perfluorotetradeconoic acid	PFTeA	376-06-7
Perfluorobutane sulfonate	PFBS	29240-43-3
Perfluoropentane sulfonate	PFPeS	2706-91-4
Perfluorohexane sulfonate	PFHxS	108427-53-8
Perfluoroheptane sulfonate	PFHpS	375-92-8
Perfluorooctane sulfonate	PFOS	1763-23-1
Perfluorononane sulfonate	PFNS	68259-12-1
Perfluorodecane sulfonate	PFDS	67906-42-7
Perfluorododecanesulfonate	PFDoDS	79780-39-5
4:2 Fluorotelomer sulfonate	4:2 FTS	757124-72-4
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4

TABLE 1: Target Analytes

PFAS Analyte	Acronym	CAS #
3:3 Fluorotelomer carboxylate	3:3 FTCA	356-02-5
5:3 Fluorotelomer carboxylate	5:3 FTCA	914637-49-3
7:3 Fluorotelomer carboxylate	7:3 FTCA	812-70-4
N-ethyl perfluorooctanesulfonamido acetic acid	EtFOSAA	2991-50-6
N-methyl perfluorooctanesulfonamido acetic acid	MeFOSAA	2355-31-9
Perfluorooctane sulfonamide	PFOSA	754-91-6
N-Ethyl perfluorooctane sulfonamide	EtFOSA	4151-50-2
N-Methyl perfluorooctane sulfonamide	MeFOSA	31506-32-8
N-Ethyl perfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2
N-Methyl perfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
11-chloroicosafluoro-3-oxaundecade-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	RT	Primary Transition	Secondary Transition	Reference Compound
13C3-PFBA	NIS	3.34	216.0 -> 172.0		
13C4-PFBA	EIS	3.34	216.8 -> 171.9		13C3-PFBA
PFBA	Target	3.34	212.8 -> 168.9		13C4-PFBA
PFMPA	Target	3.99	229.0 -> 84.9		13C5-PFPeA
3:3FTCA	Target	4.32	241.0 -> 177.0	241.0 -> 117.0	13C5-PFPeA
13C5-PFPeA	EIS	4.93	268.3 -> 223.0		13C2-PFHxA
PFPeA	Target	4.93	263.0 -> 219.0		13C5-PFPeA
PFMBA	Target	5.38	279.0 -> 85.1		13C5-PFPeA
13C2-4:2FTS	EIS	5.85	329.1 -> 80.9		18O2-PFHxS
4:2FTS	Target	5.85	327.1 -> 307.0	327.1 -> 80.9	13C2-4:2FTS
NFDHA	Target	6.08	295.0 -> 201.0	295.0 -> 84.9	13C5-PFHxA
13C3-PFBS	EIS	6.15	302.1 -> 79.9		18O2-PFHxS
PFBS	Target	6.15	298.7 -> 79.9	298.7 -> 98.8	13C3-PFBS
13C2-PFHxA	NIS	6.20	315.1 -> 270.0		
13C5-PFHxA	EIS	6.20	318.0 -> 273.0		13C2-PFHxA
PFHxA	Target	6.20	313.0 -> 269.0	313.0 -> 118.9	13C5-PFHxA
13C3-HFPO-DA	EIS	6.59	286.9 -> 168.9		13C2-PFHxA
HFPO-DA	Target	6.59	284.9 -> 168.9	284.9 -> 184.9	13C3-HFPO-DA
PFEESA	Target	6.71	314.8 -> 134.9	314.8 -> 82.9	13C5-PFHxA
5:3FTCA	Target	6.82	341.0 -> 237.1	341.0 -> 217.0	13C5-PFHxA
13C4-PFHpA	EIS	7.14	367.1 -> 322.0		13C2-PFHxA
PFHpA	Target	7.14	363.1 -> 319.0	363.1-> 169.0	13C4-PFHpA
PFPeS	Target	7.22	349.1 -> 79.9	349.1 -> 98.9	13C3-PFHxS
ADONA	Target	7.40	376.8 -> 250.9	376.8 -> 84.8	13C3-HFPO-DA
13C2-6:2FTS	EIS	7.56	429.1 -> 80.9		18O2-PFHxS
6:2FTS	Target	7.56	427.1 -> 407.0	427.1 -> 80.9	13C2-6:2FTS
13C4-PFOA	NIS	7.81	417.1 -> 172.0	417.1 -> 372.0	
13C8-PFOA	EIS	7.81	421.0 -> 376.0		13C4-PFOA
PFOA	Target	7.81	413.0 -> 369.0	413.0 -> 169.0	13C8-PFOA
PFHxS	Target	7.96	398.9 -> 79.9	398.9 -> 98.9	13C3-PFHxS
18O2-PFHxS	NIS	7.97	403.0 -> 83.9		
13C3-PFHxS	EIS	7.97	402.1 -> 79.9		18O2-PFHxS
7:3FTCA	Target	8.27	441.0 -> 316.9	441.0 -> 336.9	13C5-PFHxA
13C5-PFNA	NIS	8.40	468.0 -> 427.0		
13C9-PFNA	EIS	8.40	472.1 -> 427.0		13C5-PFNA
PFNA	Target	8.40	463.0 -> 419.0	463.0 -> 219.0	13C9-PFNA

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	RT	Primary Transition	Secondary Transition	Reference Compound
PFHpS	Target	8.58	449.0 -> 79.9	449.0 -> 98.8	13C8-PFOS
13C2-8:2FTS	EIS	8.69	529.1 -> 80.9		18O2-PFHxS
8:2FTS	Target	8.70	527.1 -> 507.0	527.1 -> 80.8	13C2-8:2FTS
13C2-PFDA	NIS	8.95	515.1 -> 470.1		
13C6-PFDA	EIS	8.95	519.1 -> 474.1		13C2-PFDA
PFDA	Target	8.95	512.9 -> 469.0	512.9 -> 219.0	13C6-PFDA
d3-MeFOSAA	EIS	8.97	573.2 -> 419.0		13C4-PFOS
MeFOSAA	Target	8.97	570.1 -> 419.0	570.1 -> 483.0	d3-MeFOSAA
13C4-PFOS	NIS	9.14	503.8 -> 79.9		
13C8-PFOS	EIS	9.13	507.1 -> 79.9		13C4-PFOS
PFOS	Target	9.14	498.9 -> 79.9	498.9 -> 98.8	13C8-PFOS
d5-EtFOSAA	EIS	9.19	589.2 -> 419.0		13C4-PFOS
EtFOSAA	Target	9.20	584.2 -> 419.1	584.2 -> 526.0	d5-EtFOSAA
13C7-PFUnDA	EIS	9.44	570.0 -> 525.1		13C2-PFDA
PFUnDA	Target	9.44	563.1 -> 519.0	563.1 -> 269.1	13C7-PFUnDA
9Cl-PF3ONS	Target	9.49	530.8 -> 351.0	532.8 -> 353.0	13C3-HFPO-DA
PFNS	Target	9.63	548.8 -> 79.9	548.8 -> 98.8	13C8-PFOS
13C2-PFDoDA	EIS	9.87	615.1 -> 570.0		13C2-PFDA
PFDoDA	Target	9.87	613.1 -> 569.0	613.1 -> 319.0	13C2-PFDoDA
PFDS	Target	10.05	599.0 -> 79.9	599.0 -> 98.8	13C8-PFOS
13C8-FOSA	EIS	10.23	506.1 -> 77.8		13C4-PFOS
FOSA	Target	10.23	498.1 -> 77.9	498.1 -> 478.0	13C8-FOSA
PFTrDA	Target	10.26	663.0 -> 619.0	663.0 -> 168.9	13C2-PFDoDA
11Cl-PF3OUdS	Target	10.32	630.9 -> 451.0	632.9 -> 453.0	13C3-HFPO-DA
13C2-PFTeDA	EIS	10.60	715.1 -> 670.0		13C2-PFDA
PFTeDA	Target	10.60	713.1 -> 669.0	713.1 -> 168.9	13C2-PFTeDA
PFDoDS	Target	10.75	699.1 -> 79.9	699.1 -> 98.8	13C8-PFOS
d7-MeFOSE	EIS	11.21	623.1 -> 58.9		13C4-PFOS
MeFOSE	Target	11.22	616.1 -> 58.9		d7-MeFOSE
d3-MeFOSA	EIS	11.30	515.0 -> 219.0		13C4-PFOS
MeFOSA	Target	11.30	512.0 -> 219.0	512.0 -> 169.0	d3-MeFOSA
d9-EtFOSE	EIS	11.45	639.1 -> 58.9		13C4-PFOS
EtFOSE	Target	11.46	630.0 -> 58.9		d9-EtFOSE
d5-EtFOSA	EIS	11.53	531.1 -> 219.0		13C4-PFOS
EtFOSA	Target	11.53	526.0 -> 219.0	526.0 -> 169.0	d5-EtFOSA

TABLE 3: Standard Levels (Targets)

Compound	CS1	CS2	CS3	CS4 (CV$_1$)	CS5	CS6	CS7	CS8
Perfluoroalkyl carboxylic acids								
PFBA	0.8	2.0	5.0	10	20	50	100	250
PFPeA	0.4	1.0	2.5	5	10	25	50	125
PFHxA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFHpA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFOA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFNA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFDA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFUnA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFDoA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFTrDA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFTeDA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
Perfluoroalkyl sulfonic acids								
PFBS	0.177	0.444	1.109	2.218	4.435	11.0875	22.175	55.438
PFPeS	0.188	0.471	1.176	2.353	4.705	11.7625	23.525	58.813
PFHxS	0.183	0.457	1.143	2.285	4.570	11.4250	22.850	57.125
PFHpS	0.191	0.477	1.191	2.383	4.765	11.9125	23.825	59.563
PFOS	0.186	0.464	1.160	2.320	4.640	11.6000	23.200	58.000
PFNS	0.192	0.481	1.203	2.405	4.810	12.0250	24.050	60.125
PFDS	0.193	0.483	1.206	2.413	4.825	12.0625	24.125	60.313
PFDoS	0.194	0.485	1.213	2.425	4.850	12.1250	24.250	60.625
Fluorotelomer sulfonic acids								
4:2FTS	0.750	1.875	4.688	9.375	18.750	46.875	93.750	234.375
6:2FTS	0.760	1.900	4.750	9.500	19.000	47.500	95.000	237.500
8:2FTS	0.768	1.920	4.800	9.600	19.200	48.000	96.000	240.000
Perfluorooctane sulfonamides								
PFOSA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
NMeFOSA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
NEtFOSA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
Perfluorooctane sulfonamidoacetic acids								
NMeFOSAA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
NEtFOSAA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
Perfluorooctane sulfonamide ethanols								
NMeFOSE	2	5.0	12.5	25	50	125	250	625
NEtFOSE	2	5.0	12.5	25	50	125	250	625
Per- and polyfluoroether carboxylic acids								
HFPO-DA	0.8	2.0	5.0	10	20	50	100	250
ADONA	0.756	1.89	4.725	9.45	18.9	47.25	94.5	236.25
PFMPA	0.4	1.0	2.5	5.0	10	25	50	125
PFMBA	0.4	1.0	2.5	5.0	10	25	50	125
NFDHA	0.4	1.0	2.5	5.0	10	25	50	125
Ether sulfonic acids								
9Cl-PF3ONS	0.748	1.87	4.675	9.35	18.7	46.75	93.5	233.75
11Cl-PF3OUdS	0.756	1.89	4.725	9.45	18.9	47.25	94.5	236.25
PFEESA	0.356	0.89	2.225	4.45	8.90	22.25	44.50	111.25
Fluorotelomer carboxylic acids								
3:3FTCA	0.9984	2.496	6.24	12.48	25.0	62.4	124.8	312.0
5:3FTCA	4.992	12.40	31.20	62.4	124.8	312.0	624.0	1560
7:3FTCA	4.992	12.40	31.20	62.4	124.8	312.0	624.0	1560

TABLE 3: Standard Levels (EIS and NIS)

	CS1	CS2	CS3	CS4 (CV$_1$)	CS5	CS6	CS7	CS8
Extracted Internal Standard (EIS) Analytes								
$^{13}C_4$-PFBA	10	10	10	10	10	10	10	10
$^{13}C_5$-PFPeA	5	5	5	5	5	5	5	5
$^{13}C_5$-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_4$-PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_8$-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_9$-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$^{13}C_6$-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$^{13}C_7$-PFUnA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$^{13}C_2$-PFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$^{13}C_2$-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$^{13}C_3$-PFBS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_3$-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_8$-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_2$-4:2 FTS	5	5	5	5	5	5	5	5
$^{13}C_2$-6:2 FTS	5	5	5	5	5	5	5	5
$^{13}C_2$-8:2 FTS	5	5	5	5	5	5	5	5
$^{13}C_8$-PFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D_3-NMeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D_5-NEtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D_3-NMeFOSAA	5	5	5	5	5	5	5	5
D_5-NEtFOSAA	5	5	5	5	5	5	5	5
D_7-NMeFOSE	25	25	25	25	25	25	25	25
D_9-NEtFOSE	25	25	25	25	25	25	25	25
$^{13}C_3$-HFPO-DA	10	10	10	10	10	10	10	10
Non-extracted Internal Standard (NIS) Analytes								
$^{13}C_3$-PFBA	5	5	5	5	5	5	5	5
$^{13}C_2$-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_4$-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_5$-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$^{13}C_2$-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$^{18}O_2$-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
$^{13}C_4$-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

TABLE 4: Method Names vs Lab Names

METHOD		LABORATORY		
ANALYTE NAME	ACRONYM	LIMS REPORT NAME	RAW DATA NAME	RAW DATA EIS as ISTD
Perfluorobutanoic acid	PFBA	Perfluorobutanoic acid	PFBA	
Perfluoropentanoic acid	PFPeA	Perfluoropentanoic acid	PFPeA	
Perfluorohexanoic acid	PFHxA	Perfluorohexanoic acid	PFHxA	
Perfluoroheptanoic acid	PFHpA	Perfluoroheptanoic acid	PFHpA	
Perfluorooctanoic acid	PFOA	Perfluorooctanoic acid	PFOA	
Perfluorononanoic acid	PFNA	Perfluorononanoic acid	PFNA	
Perfluorodecanoic acid	PFDA	Perfluorodecanoic acid	PFDA	
Perfluoroundecanoic acid	PFUnA	Perfluoroundecanoic acid	PFUnDA	
Perfluorododecanoic acid	PFDoA	Perfluorododecanoic acid	PFDoDA	
Perfluorotridecanoic acid	PFTrDA	Perfluorotridecanoic acid	PFTrDA	
Perfluorotetradecanoic acid	PFTeDA	Perfluorotetradecanoic acid	PFTeDA	
Perfluorobutanesulfonic acid	PFBS	Perfluorobutanesulfonic acid	PFBS	
Perfluoropentanesulfonic acid	PFPeS	Perfluoropentanesulfonic acid	PFPeS	
Perfluorohexanesulfonic acid	PFHxS	Perfluorohexanesulfonic acid	PFHxS	
Perfluoroheptanesulfonic acid	PFHpS	Perfluoroheptanesulfonic acid	PFHpS	
Perfluorooctanesulfonic acid	PFOS	Perfluorooctanesulfonic acid	PFOS	
Perfluorononanesulfonic acid	PFNS	Perfluorononanesulfonic acid	PFNS	
Perfluorodecanesulfonic acid	PFDS	Perfluorodecanesulfonic acid	PFDS	
Perfluorododecanesulfonic acid	PFDoS	Perfluorododecanesulfonic acid	PFDoDS	
1*H*,1*H*,2*H*,2*H*-Perfluorohexane sulfonic acid	4:2FTS	4:2 Fluorotelomer sulfonate	4:2FTS	
1*H*,1*H*,2*H*,2*H*-Perfluorooctane sulfonic acid	6:2FTS	6:2 Fluorotelomer sulfonate	6:2FTS	
1*H*,1*H*,2*H*,2*H*-Perfluorodecane sulfonic acid	8:2FTS	8:2 Fluorotelomer sulfonate	8:2FTS	
Perfluorooctanesulfonamide	PFOSA	PFOSA	FOSA	
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	EtFOSAA	EtFOSAA	
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	MeFOSAA	MeFOSAA	
N-ethyl perfluorooctanesulfonamide	NEtFOSA	EtFOSA	EtFOSA	
N-methyl perfluorooctanesulfonamide	NMeFOSA	MeFOSA	MeFOSA	
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	EtFOSE	MeFOSE	
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	MeFOSE	EtFOSE	
Hexafluoropropylene oxide dimer acid	HFPO-DA	HFPO-DA (GenX)	HFPO-DA	
4,8-dioxa-3H-perfluorononanoic acid	ADONA	ADONA	ADONA	
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	9Cl-PF3ONS (F-53B Major)	9Cl-PF3ONS	
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	11Cl-PF3OUdS (F-53B Minor)	11Cl-PF3OUdS	
Perfluoro-3-methoxypropanoic acid	PFMPA	PFMPA	PFMPA	
Perfluoro-4-methoxybutanoic acid	PFMBA	PFMBA	PFMBA	
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	NFDHA	NFDHA	
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	PFEESA	PFEESA	
3-Perfluoropropyl propanoic acid	3:3FTCA	3:3 Fluorotelomer carboxylate	3:3FTCA	
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	5:3 Fluorotelomer carboxylate	5:3FTCA	
3-Perfluoroheptyl propanoic acid	7:3FTCA	7:3 Fluorotelomer carboxylate	7:3FTCA	

TABLE 4: Method Names vs Lab Names

METHOD		LABORATORY		
ANALYTE NAME	ACRONYM	LIMS REPORT NAME	RAW DATA NAME	RAW DATA EIS as ISTD
Perfluoro-n-[13C4]butanoic acid	13C4-PFBA	13C4-PFBA	13C4-PFBA	M4-PFBA
Perfluoro-n-[13C5]pentanoic acid	13C5-PFPeA	13C5-PFPeA	13C5-PFPeA	M5-PFPeA
Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	13C5-PFHxA	13C5-PFHxA	13C5-PFHxA	M5-PFHxA
Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	13C4-PFHpA	13C4-PFHpA	13C4-PFHpA	M4-PFHpA
Perfluoro-n-[13C8]octanoic acid	13C8-PFOA	13C8-PFOA	13C8-PFOA	M8-PFOA
Perfluoro-n-[13C9]nonanoic acid	13C9-PFNA	13C9-PFNA	13C9-PFNA	M9-PFNA
Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	13C6-PFDA	13C6-PFDA	13C6-PFDA	M6-PFDA
Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	13C7-PFUnA	13C7-PFUnDA	13C7-PFUnDA	M7-PFUnDA
Perfluoro-n-[1,2-13C2]dodecanoic acid	13C2-PFDoA	13C2-PFDoDA	13C2-PFDoDA	M2-PFDoDA
Perfluoro-n-[1,2-13C2]tetradecanoic acid	13C2-PFTeDA	13C2-PFTeDA	13C2-PFTeDA	M2-PFTeDA
Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	13C3-PFBS	13C3-PFBS	13C3-PFBS	M3-PFBS
Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	13C3-PFHxS	13C3-PFHxS	13C3-PFHxS	M3-PFHxS
Perfluoro-1-[13C8]octanesulfonic acid	13C8-PFOS	13C8-PFOS	13C8-PFOS	M8-PFOS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexanesulfonic acid	13C2-4:2FTS	13C2-4:2FTS	13C2-4:2FTS	M2-4:2FTS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octanesulfonic acid	13C2-6:2FTS	13C2-6:2FTS	13C2-6:2FTS	M2-6:2FTS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decanesulfonic acid	13C2-8:2FTS	13C2-8:2FTS	13C2-8:2FTS	M2-8:2FTS
Perfluoro-1-[13C8]octanesulfonamide	13C8-PFOSA	13C8-FOSA	13C8-FOSA	M8-FOSA
N-ethyl-d5-perfluoro-1-octanesulfonamide	D5-NEtFOSA	d5-EtFOSA	d5-EtFOSA	M5-EtFOSA
N-methyl-d3-perfluoro-1-octanesulfonamide	D3-NMeFOSA	d3-MeFOSA	d3-MeFOSA	M3-MeFOSA
N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	D5-NEtFOSAA	d5-EtFOSAA	d5-EtFOSAA	M5-EtFOSAA
N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	D3-NMeFOSAA	d3-MeFOSAA	d3-MeFOSAA	M3-MeFOSAA
N-methyl-d7-perfluorooctanesulfonamidoethanol	D7-NMeFOSE	d7-MeFOSE	d7-MeFOSE	M7-MeFOSE
N-ethyl-d9-perfluorooctanesulfonamidoethanol	D9-NEtFOSE	d9-EtFOSE	d9-EtFOSE	M9-EtFOSE
Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	13C3-HFPO-DA	13C3-HFPO-DA	13C3-HFPO-DA	M3-HFPO-DA
Perfluoro-n-[2,3,4-13C3]butanoic acid	13C3-PFBA	13C3-PFBA	13C3-PFBA	
Perfluoro-n-[1,2,3,4-13C4]octanoic acid	13C4-PFOA	13C4-PFOA	13C4-PFOA	
Perfluoro-n-[1,2-13C2]decanoic acid	13C2-PFDA	13C2-PFDA	13C2-PFDA	
Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	13C4-PFOS	13C4-PFOS	13C4-PFOS	
Perfluoro-1-hexane[18O2]sulfonic acid	18O2-PFHxS	18O2-PFHXS	18O2-PFHxS	
Perfluoro-n-[1,2-13C2]hexanoic acid	13C2-PFHxA	13C2-PFHXA	13C2-PFHxA	
Perfluoro-n-[1,2,3,4,5-13C5]nonanoic acid	13C5-PFNA	13C5-PFNA	13C5-PFNA	

ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES BY LC/MS/MS AND ISOTOPE DILUTION

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be printed nor duplicated in any manner.

Internal SOPs referenced within this SOP: OP075, OP076, GC001, QA029

Print Name	**Signature**	**Date**

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

ATTACHMENT B

Field Documentation Forms

1. Example Field Daily Logbook
2. Water Level Field Data Worksheet
3. Water Level Indicator Calibration by Steel Tape
4. Ahtna Daily Site Safety Tailgate / Inspection Log
5. Fort Ord Munitions and Explosives of Concern (MEC) Incident Reporting Form
6. Ahtna Chain of Custody (Water / Soil)
7. Example Sample Labels
8. Project Field Report
9. Well Construction Details Form
10. Well Development Form

Former Ft. Ord, CA
3/1/2020
1Q 2020 Groundwater Monitoring
Project #
Weather: (am) Clear, cool 48°
(pm) Overcast, 63°
Team #2
Ahtna Rep. - Shaelyn Hession
Blaine Tech Rep. - Ross Mikovich

0800 - Arrived at MW-002-18-A
W.L. = 78.40 T.D. = 110.6
0810 - Sample collected from station #2
#2010Y0U2100F
0815 - Duplicate sample #2010Y0U2101D
0820 - Labled Trip Blank #2010Y0U2102A
Lid requires new paint & I.D.

0835 - Arrived at MW-BW-75-A
W.L. = 84.32 T.D. = 126.3
Required new lock - replaced.

0845 - Arrived at MW-BW-14-A
W.L. = 63.11 T.D. = 97.5

3/1/2020
1Q 2020 FO GWM
Team #2
S. Hession
R. Mikovich

0900 - Arrived at MW-BW-07-180
W.L. = 121.63 T.D. = 194.6
0910 - Sample collected from station #1
#2010Y0BW103F
0915 - Station #2 sample #2010Y0BW104F
0920 - Station #3 sample #2010Y0BW105F
0925 - Station #4 sample #2010Y0BW106F
0930 - Station #5 sample #2010Y0BW107F
No PDB's installed.

1000 - Return to staging area.
Unload equipment
QC all samples, placed in refrigerator.
1030 - Team #2 offsite

Steve Korlay

Ahtna

Water Level/NAPL Measurements

Project Number		Field Team Leader	
Installation/Site		QAPP SOP No.	
Event Name		Date	
Field Team (name/affiliation)			
Weather Condition			

Type of Meter **(check those that apply)**

☐ Water Level Make/Serial# __________ Correction (in) ______ Last Calibration __________

☐ Interface Make/Serial# __________ Correction (in) ______ Last Calibration __________

Field Measurements

Location ID	Time	Ref. Point	Depth to		Total Depth (ft)	Location-Specific Comment
		TOC[1]	NAPL (ft)	Water (ft)		

[1] If other than TOC, explain in location-specific comment

Non-aqueous phase layer (NAPL)—either light (LNAPL) or dense (DNAPL); top of casing (TOC)

(Comment)

Initial ______ Signature ____________________________ Date __________

Fort Ord Groundwater Monitoring Program

Water Level Indicator Calibration by Steel Tape

Event:	
Well #:	
Steel Tape DTW:	
Date:	

Serial #	Measured DTW	Calibration Correction

Reviewed By:	
Date:	

Ahtna

Site Safety Tailgate Meeting

Installation/Site Name		Project Number	
Event Name		Safety Representative	
Date		Field Team Leader	
Weather Forecast:			

Participants (attach loose-leaf sheet if additional space is needed)

Printed Name and Initials	Affiliation	Role	Signature

Scope of Today's Work

Health and Safety Topics Discussed (✓ applicable topics)

- ☐ Weather Factors
- ☐ AHA Review
- ☐ Site emergency SOP, rally point, etc.
- ☐ Changed Conditions
- ☐ Equipment Hazards
- ☐ Chem. of Concern
- ☐ PPE Requirements
- ☐ Slip/Trip/Fall Hazards
- ☐ Site Controls
- ☐ Biological Hazards
- ☐ COVID 19 SOPs
- ☐ Lifting Safety
- ☐ Recent near miss/injuries/lessons
- ☐ BBS Hazard Triggers[1]
- ☐ BBS Trigger Controls[2]
- ☐ Traffic Control
- ☐ Sanitation
- ☐ ____________________
- ☐ ____________________
- ☐ ____________________
- ☐ ____________________
- ☐ ____________________

---

[1] Behavior-based Safety Hazard Triggers: Distractions, rushing, short-cuts, frustration, exhaustion, complacency, anger, multi-tasking, not focusing on task

[2] Behavior-based Safety Trigger Controls: Communicating, accountability, patience, relaxation techniques, healthy lifestyle, and adequate sleep

Comments:

Individual in the Safety Representative role acknowledges that the checked (✓) topics were discussed.

Name (Print) ______________________ Signature ______________________________ Date __________

FORT ORD MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)
INCIDENT REPORTING FORM

If you recognize any object that resembles munitions or explosives on current or former Fort Ord property, retreat to a safe location, and report the finding to the **appropriate agencies immediately** (see below)

A. PROVIDE THE FOLLOWING INFORMATION:

Name of Person Reporting:	Telephone:
Agency:	Fax:
Date & Time of Incident/Discovery:	
Description of Item Found (refer to the "Safety Alert" pamphlet if possible):	
Location (direction from nearest road/building, attach map if possible):	
GPS Coordinate Location: (Type of Instrument, NAD83 California State Plan Coordinates Zone IV, feet)	
Describe how the item was found:	

CONTACT THE APPROPRIATE AGENCIES IMMEDIATELY:

Initial when completed	Mon– Thu (6 a.m. – 5 p.m.) Contact and FAX Form to:	Contact Number	Date & Time Called
	USACE Ordnance Safety Specialist or MMRP Site Safety Manager	Ph: (831) 884-9925 ext.226 Cell: (831) 760-2571 Fax:(831) 884-9030 Ph: (831) 242-7919 Fax:(831) 242-7019 Cell: (831) 760-2575	
	Fri – Sun (24 Hours) 60th Civ Engr Sqdn EOD	Phone: (707) 424-5517	
	Note: If 60th Civ Engr Sqdn EOD is contacted, notify the MMRP Site Safety Manager: (831) 242-7919, Cell (831) 760-2575.		

B. To be completed by USACE Ordnance Safety Specialist when applicable (Mon – Thu)

Form Received By:		Date & Time:
Identification of Item Found:		
Extent of Area Surveyed:		Name of digital file for picture (date):
Disposition of Item:		
Fax completed form to MMRP Site Safety Mgr Bldg 4463 Gigling Rd, POM (Fort Ord) when response complete	Fax: (831) 242-7091 Phone: (831) 242-7919	Date & Time:

C. To be completed by MMRP Site Safety Manager:

Acknowledge Completed Form Received:	Date & Time:
Regulatory Agencies Notified (Date):	

Ahtna

Chain of Custody Record

COC Number ____________

COC Form ________ of ________

Project Number		Lab Work Order	
Installation/Site		Lab Turnaround Time	● 2 w ○ 1 w ○ 3 d ○ 2 d ○ 24 h ○ _____
Activity		Transporter Name	
Purchase Order#		Waybill Number	
Field Team Leader *(name, phone, email)*		Ahtna POC *(name, phone, email)*	

Laboratory Point of Contact

(Laboratory Organization)

(Laboratory Project Manager)

(Telephone)

(Email address)

						Preservation Used [1]												
Laboratory Sequence No.	Field Sample ID	Date	Time	Matrix[2]	#.Bottles/Canisters												Use for Matrix Spike/Dup	Sample Specific Comments

(Comments)

(Relinquished by Field Team/Company)	*(Date/Time)*	*(Received By Field or Laboratory Sample Custodian/Organization)*	*(Date/Time)*	*(Relinquished by/Organization)*	*(Date/Time)*
(Received by/Organization)	*(Date/Time)*	*(Relinquished By/Organization)*	*(Date/Time)*	*(Received by/Organization)*	*(Date/Time)*

[1] Preservation Used: HCl (1), HNO3 (2), H2SO4 (3), NaOH (4), H3PO4, Other ________ (6), Other ________ (7), Other ________ (8), Other ________ (9)

[2] Ambient air (AA), indoor air (AI), soil gas (GS), sediment (SE), soil (SO), ground water (WG), surface water (WS), process water (WT)

Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: _________
Sample #:

Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: _________
Sample #:

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Ft Ord GW Monitoring-
Samplers:
Date: Time: _________
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Samplers:
Date: Time: _________
Sample #:

Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: _________
Sample #:

Ahtna

PROJECT FIELD REPORT

GENERAL

1) USACE Contract No.:	**2) Date:**
3) Program Manager	**4) Report No.:**
5) Project Manager:	**6) SSHO (Designee):**
7) Superintendent:	**8) QC Manager:**
9) Weather:	**10) Temperature:**

SUMMARY

11) Work Performed:

12) Project Issues:

13) Unresolved Issues:

14) Hours Worked:	**15) Accumulated Hours:**

CONTRACTOR PERSONNEL

16) Prime Contractor and Subcontractor Onsite:

Name	Company	Position/Title	Hours

GOVERNMENT PERSONNEL

17) Government Personnel Onsite:

Name	Company	Position/Title	Arrive/Depart (Day)

VISITING PERSONNEL

18) Visitors Onsite:

Name	Company	Position/Title	Arrive/Depart (Day)

DETAIL

19) Equipment Status:	MOB'D	ACTIVE	DEMOB'D
1.			
2.			
3.			
4.			

20) Work Planned for Following Workday: None

1.

2.

21) Safety Issues:

22) Quality Control:
1.
2.
23) Other:
1.
24) Attachments:
1. 2. 3.
25) Report Submitted by:

Photos:
Description:
Description:
Description:
Description:

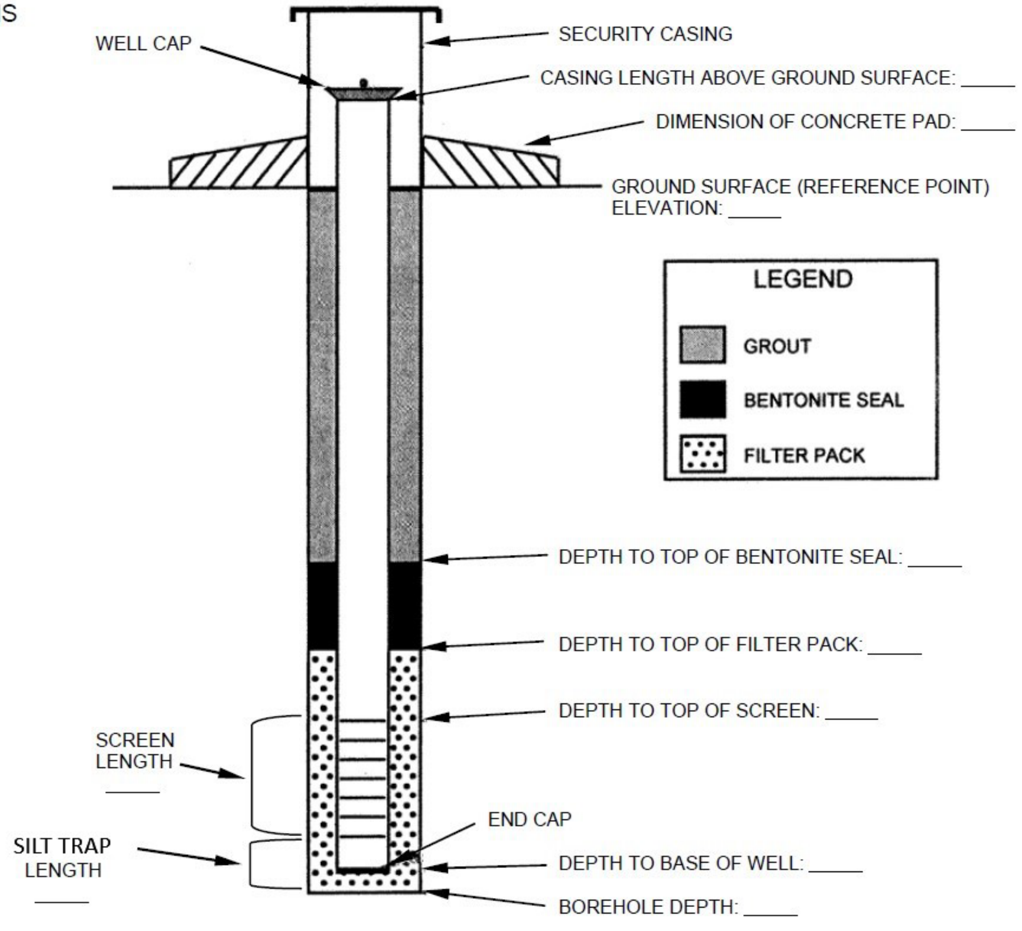
Ahtna

Well Installation Log

Project Number		Location ID	
Installation/Site		Construction Start Date	
Driller		Well Completion Date	
Field Geologist		Borehole Diameter (in)	
Casing Material		Casing Diameter (in)	
Screen Material		Slot Size (in)	
Type of Bentonite		Amt. of Bentonite (linear ft)	
Filter Pack Type		Amt. of Filter Pack (linear ft)	
Well Cap Type		End Cap Type	
Description/Dimension of Security Casing			

(ALL MEASUREMENTS IN FEET, UNLESS INDICATED OTHERWISE)

SPECIAL CONDITIONS
(describe and draw)



Comments:

Reviewed By		Date	

BORING NUMBER

CLIENT United States Army Corps of Engineers
PROJECT NAME
PROJECT NUMBER
PROJECT LOCATION
DATE STARTED **COMPLETED**
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	DESCRIPTION	DEPTH (ft)
0					0
5					5
10					10
15					15
20					20
25					25
30					30
35					35

(Continued Next Page)

Ahtna

Well Development

Project Number		Well Location Name	
Installation/Site		SOP No.	
Field Team Leader		Date	
Contractor/Technician			

Description of Technique and Equipment Used (e.g., surge block, pump, bailer description, sizes, etc.)

Well Parameters

1-ft Casing Vol. (gal/ft) [1]		Total Depth (ft TOC)	Initial	Final
Water Column (ft)		Depth to Water (ft TOC)	Initial	Final
One Well Volume (gal) [2]		Screened Interval (ft TOC)	Top	Bottom
Pump Depth/s		Total Volume Removed		

Well Diam. (ID)	1-ft Casing Vol. (gal/ft)**	
	Sch 40	Sch 80
2	0.17	0.15
3	0.38	0.34
4	0.66	0.59
6	1.50	1.35
8	2.60	2.37

[1] 1-ft casing volume (gal/ft) = (π × r2 × h × CF); where r = I.D. radius (in); h = 1-ft well height (i.e., 12 in); CF = conversion factor for cubic inch to gallon (0.00433 gal/cubic inch)

[2] One well volume (gal) = h × 1-ft casing volume (gal/ft) × height of water column (ft)

Example: 100ft well, Water Level at 80ft, 4” diameter
100-80 = 20 20 x 0.66 = 13.2 gallons (1 well volume)
Typical Development is 10 volumes or 132 gallons for this example
*Check with PM and review work plan to determine what criteria constitutes the completion of development.

**Confirm inner diameter to calculate the volume

Field Measurements

Time	DTW	Purge Vol.	Flow Rate	Temp.	pH	Spec. Cond.	DO	ORP	Turbidity
(hh:mm)	(ft TOC)	(Gal)	(gpm)	(°C) ±3%	(S.U.) ±0.1	(µS/cm) ±3%	(mg/L) ±0.2	(mV) ±10	(NTU) <5

Observations (color, odor, NAPL, other)

Ahtna

Well Development

Time	DTW	Purge Vol.	Flow Rate	Temp.	pH	Spec. Cond.	DO	ORP	Turbidity
(hh:mm)	(ft TOC)	(Gal)	(gpm)	(°C) ±3%	(S.U.) ±0.1	(µS/cm) ±3%	(mg/L) ±0.2	(mV) ±10	(NTU) <5

Observations (color, odor, NAPL, other)

ATTACHMENT C

Habitat and Biological Monitoring Forms

- Habitat Checklist Example
- Habitat and Biological Monitoring Training Fact Sheet
- Biological Observation Form – CTS/BLL

SITE HABITAT CHECKLIST

The following are requirements to minimize biological disturbances to protected species and habitat. Please notify the Ahtna Biologist (Denise Duffy and Associates) at 831-373-4341 *before* proceeding, if work tasks or work boundaries change, additional vegetation removal is necessary, vegetation cutting methods change, or any other conditions change.

SITE:	University of California – Fort Ord Natural Reserve - North	**Date:**	XX-XX-2021
Work to be conducted:	Drilling and Installation of A- Aquifer Monitoring Wells, Operable Unit Carbon Tetrachloride (OUCTP)		

1. LAND USE:	☒ **Habitat Reserve**	☐ **Development Area**	☐ **Other (specify):**

2. LAND OWNER:	☐ **Army**	**Location:**	
	☐ **BLM**	**Location:**	
	☒ **Other:**	**Location:**	University of California, Santa Cruz

3. ENDANGERED SPECIES/	☐ **Yes**	☐ **No**	☐ **Flagged/Marked**
HMP Listed Species:			
Location:			
Grid Numbers:			

Restrictions:

- Restrict all vehicle access and staging to designated flagged routes, and staging areas.
- Stay on roads.
- Report all black legless lizard or California Tiger Salamander encounters to Ahtna field supervisor and biologist immediately.
- Coordinate with biologist first, if additional areas are needed for access or staging of equipment or vehicles.
- Contact number for Ahtna Biologist (Denise Duffy and Associates) is 831-373-4341.
- Contact number for the BRAC Office Biologist is 831-242-7918

4. VERNAL POOLS/PONDS PRESENT	☐ **Yes**	☐ **No**	☐ **Flagged/Marked**
Location:			
Grid Numbers:			
Work Can Proceed in Pools/Ponds:	☐ **Yes**	☐ **No**	

Restrictions:

5. VEGETATION REMOVAL	
☐ **No Removal Needed**	**Location:**
☐ **Manual Removal Needed**	**Location:**
Restrictions:	
☐ **Mechanical Removal Needed:**	**Location:**
Mechanical Removal Restrictions:	

6. EROSION CONCERNS/SITE RESTORATION:

7. SITE ACCESS:

8. ADDITIONAL SITE CONCERNS:

This checklist has been read, approved, and signed by the following:

☐ **Ahtna Biologist:** ______________________________________ **Date:** __________
☐ **Ahtna Field Supervisor:** ____________________________ **Date:** ___________
☐ **Army Natural Resources Specialist:** _________________________ **Date:** ___________

Fort Ord Species of Concern Identification and Procedures

Fort Ord Animal Species of Concern

California Tiger Salamander (CTS) and Black Legless Lizard (BLL) are species of concern at Fort Ord. CTS are endemic to California and are a threatened species. CTS larvae are yellowish gray typically habitat in vernal pools and metamorphisms into adults in summertime growing to a 3 to 5 inch salamander with yellow spots. As adults during the day CTS spends time underground in animal burrows. BLLs are a California protected species that are small slender lizards 4 to 7 inches long with no legs which forages in loose soil, sand, and leaf litter during the day and may come to the surface at dusk and night. If a CTS or BLL is found, notify Base Realignment and Closure (BRAC) Biologist Bart Kowalski at (831) 595-5569 who will coordinate an approved Biologist to visit the site and handle and remove the CTS as necessary from the work area. BLL may be relocated by onsite personnel.

FONR Plant Species of Concern

There are two plant species in the Fort Ord Natural Reserve (FONR) which is owned by University of California, Santa Cruz (UCSC) with monitored populations, Sand Gilia and Monterey Spineflower. Stay on the driving paths in the FONR, do not drive where prohibited and try not to walk on species of concern plants. Both plants are annual herbs that are native and endemic to California and typically bloom starting in March/April through June/July, but depending on weather conditions may bloom earlier. FONR questions may be directed to Gage Dayton with UCSC at (831) 227-5887.

CA Tiger Salamander

Black Legless Lizard

Monterey Spineflower

Sand Gilia

Coast Horned Lizard

The California species of concern Coast Horned Lizard has a 4-inch rounded flat body, blunt snout, tail, and toad-like body with horns. When moving vehicles or heavy equipment into the inner roads of the northern FONR, have personnel walk in front of the vehicle as directed by UCSC to scare out Coast Horned Lizards that may be in the roadway before the vehicle passes. Notify Bart Kowalski of observances who will notify UCSC. Work does not need to be stopped if encountered, just relocated away from moving vehicles.

BIOLOGICAL OBSERVATION FORM – CTS/BLL

If a California tiger salamander (CTS) or black legless lizard (BLL) is found, notify Bart Kowalski, the BRAC Office Biologist. Only service approved biologist should fill out the CTS field observation form, and only service approved biologist can handle and move CTS out of the way. If CTS is encountered all work needs to stop until service approved biologist gets to the location and relocates the CTS. After completing this form attach a photograph of the specimen (if possible) and a map showing the location of the sighting, and return to BRAC:

Mr. Bart Kowalski
Building 4463, Gigling Rd, Rm 101, Monterey, CA 93944-5004
Office: (831) 242-7918 Cell: (831) 595-5569

Location ____ **Date/Time** __________________
(OE site, Range # etc)

Grid # ________________________ **Northing/Easting or Approx. Coordinates (ft)** ___________________

Type of Activity (check one or write in)

- ☐ Well Installation/Drilling
- ☐ Vegetation clearance
- ☐ Other ____

Weather: Air Temp.__________ Wind ___________ Sunny/Cloudy _______________

Depth if known __________________

Habitat Description (e.g. Maritime chaparral, oak woodland, grassland, vegetation height, presence of surface litter/debris, soil type, plant species where specimen found, etc.):

____
____
____

Description of specimen (live/ injured/ dead, color, condition, behavior etc.):

____
____
____

Length (inches): ____

Other Notes: ____
____

Disposition: Found by: ____

- ☐ Observed, released to same location or adjacent habitat
- ☐ Observation form completed By:___________________________________
- ☐ Injured or killed (placed in a Ziploc or plastic bag, and refrigerated)
- ☐ Other ____

Attachments: ☐ Location map ☐ Photograph (specimen and habitat in which found)

ATTACHMENT D

Analytical Laboratory Certifications

CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

SGS North America Inc. - Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811

Fulfills the requirements of

ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.4)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 15 December 2024
Certificate Number: L2229

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

U.S. DEPARTMENT OF DEFENSE (DOD) QUALITY SYSTEMS MANUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V 5.4)

SGS North America Inc. - Orlando

4405 Vineland Road, Suite C-15
Orlando, FL 32811
Svetlana Izosimova, Ph. D., QA Officer
407-425-6700

TESTING

Valid to: **December 15, 2024** Certificate Number: **L2229**

Environmental

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 rev. 1.1	N-Ethyl perfluorooctanesulfonamidoacetic acid

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	ADONA
LC/MS/MS	EPA 537.1	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	EPA 537.1	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	EPA 537.1	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	EPA 533	Perfluorobutanoic acid
LC/MS/MS	EPA 533	Perfluoropentanoic acid
LC/MS/MS	EPA 533	Perfluorohexanoic acid
LC/MS/MS	EPA 533	Perfluoroheptanoic acid
LC/MS/MS	EPA 533	Perfluorooctanoic acid
LC/MS/MS	EPA 533	Perfluorononanoic acid

Drinking Water

Technology	Method	Analyte
LC/MS/MS	EPA 533	Perfluorodecanoic acid
LC/MS/MS	EPA 533	Perfluoroundecanoic acid
LC/MS/MS	EPA 533	Perfluorododecanoic acid
LC/MS/MS	EPA 533	Perfluorobutanesulfonic acid
LC/MS/MS	EPA 533	Perfluoropentanesulfonic acid
LC/MS/MS	EPA 533	Perfluorohexanesulfonic acid
LC/MS/MS	EPA 533	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 533	Perfluorooctanesulfonic acid
LC/MS/MS	EPA 533	4:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	6:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	8:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	Perfluoro-3-methoxypropanoic acid
LC/MS/MS	EPA 533	Perfluoro-4-methoxybutanoic acid
LC/MS/MS	EPA 533	Nonafluoro-3,6-dioxaheptanoic acid
LC/MS/MS	EPA 533	Perfluoro(2-ethoxyethane)sulfonic acid
LC/MS/MS	EPA 533	Hexafluoropropylene oxide dimer acid
LC/MS/MS	EPA 533	4,8-Dioxa-3H-perfluorononanoic acid
LC/MS/MS	EPA 533	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid
LC/MS/MS	EPA 533	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid

Non-Potable Water

Technology	Method	Analyte
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2-Dibromoethane (EDB)
GC/ECD	EPA 504.1	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2,3-Trichloropropane (1,2,3-TCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDD
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDE
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDT
GC/ECD	EPA 608.3; EPA 8081B	Aldrin
GC/ECD	EPA 608.3; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	delta-BHC
GC/ECD	EPA 608.3; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608.3; EPA 8081B	alpha-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	Dieldrin
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan I
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan II
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608.3; EPA 8081B	Endrin
GC/ECD	EPA 608.3; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608.3; EPA 8081B	Endrin ketone
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 608.3; EPA 8081B	Methoxychlor
GC/ECD	EPA 608.3; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	Total PCB

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	KS LRH	Low-Range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,1-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,2-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1-Dichloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1-Dichloropropene
GC/MS	EPA 624.1; EPA 8260B/C/D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,3-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,3-Trichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichloroethene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichloropropane
GC/MS	EPA 8260B/C/D	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,3-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2,2-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2-Butanone (Methyl ethyl ketone MEK)

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; EPA 8260B/C/D	2-Chloroethyl vinyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	4-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Acetone
GC/MS	EPA 8260B/C/D	Acetonitrile
GC/MS	EPA 624.1; EPA 8260B/C/D	Acrolein (Propenal)
GC/MS	EPA 624.1; EPA 8260B/C/D	Acrylonitrile
GC/MS	EPA 8260B/C/D	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Benzene
GC/MS	EPA 8260B/C/D	Benzyl Chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromodichloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromoform
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	n-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	sec-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Carbon disulfide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Carbon tetrachloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Chlorobenzene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Chloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Chloroform
GC/MS	EPA 8260B/C/D	Chloroprene
GC/MS	EPA 624.1; EPA 8260B/C/D	Cyclohexane
GC/MS	EPA 8260B/C/D	Cyclohexanone
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	cis-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	trans-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	cis-1,3-Dichloropropene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C/D	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C/D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Di-isopropylether (DIPE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Dibromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Dichlorodifluoromethane
GC/MS	EPA 8260B/C/D	Diethyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C/D	Ethyl acetate
GC/MS	EPA 8260B/C/D	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Ethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Hexachlorobutadiene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260B/C/D	Hexane
GC/MS	EPA 8260B/C/D	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	p-Isopropyltoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Isopropylbenzene
GC/MS	EPA 8260B/C/D	Methacrylonitrile
GC/MS	EPA 624.1; EPA 8260B/C/D	Methyl Acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methyl bromide (Bromomethane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methyl chloride (Chloromethane)
GC/MS	EPA 624.1; EPA 8260B/C/D	Methylcyclohexane
GC/MS	EPA 8260B/C/D	Methyl methacrylate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methylene chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Naphthalene
GC/MS	EPA 8260B/C/D	Pentachloroethane
GC/MS	EPA 8260B/C/D	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	n-Propylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Styrene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Amyl alcohol (TAA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Butyl alcohol (TBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Butyl formate (TBF)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C/D	Tetrahydrofuran

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Toluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Trichlorofluoromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Vinyl acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Vinyl chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Xylene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	m,p-Xylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	o-Xylene
GC/MS	EPA 625.1; EPA 8270D/E	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625.1; EPA 8270D/E	1,2-Diphenylhydrazine
GC/MS	EPA 8270D/E	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 625.1; EPA 8270D/E	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625.1; EPA 8270D/E	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,4-Naphthoquinone
GC/MS	EPA 8270D/E	1,4-Phenylenediamine
GC/MS	EPA 8270D/E	1-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	1-Methylnaphthalene
GC/MS	EPA 8270D/E	1-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D/E	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4,5-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4,6-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dimethylphenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dinitrophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D/E	2,6-Dichlorophenol

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D/E	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D/E	2-Acetylaminofluorene
GC/MS	EPA 625.1; EPA 8270D/E	2-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D/E	2-Chlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	2-Methylnaphthalene
GC/MS	EPA 625.1; EPA 8270D/E	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D/E	2-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D/E	2-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D/E	2-Nitrophenol
GC/MS	EPA 8270D/E	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625.1; EPA 8270D/E	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D/E	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D/E	3-Methylcholanthrene
GC/MS	EPA 625.1; EPA 8270D/E	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625.1; EPA 8270D/E	3-Nitroaniline
GC/MS	EPA 8270D/E	4-Aminobiphenyl
GC/MS	EPA 625.1; EPA 8270D/E	4-Bromophenyl phenyl ether
GC/MS	EPA 625.1; EPA 8270D/E	4-Chloro-3-methylphenol
GC/MS	EPA 625.1; EPA 8270D/E	4-Chloroaniline
GC/MS	EPA 625.1; EPA 8270D/E	4-Chlorophenyl phenylether
GC/MS	EPA 8270D/E	4-Dimethyl aminoazobenzene
GC/MS	EPA 625.1; EPA 8270D/E	4-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D/E	4-Nitrophenol
GC/MS	EPA 8270D/E	5-Nitro-o-toluidine
GC/MS	EPA 8270D/E	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Acenaphthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Acenaphthylene
GC/MS	EPA 625.1; EPA 8270D/E	Acetophenone
GC/MS	EPA 625.1; EPA 8270D/E	Aniline
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Anthracene
GC/MS	EPA 8270D/E	Aramite

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D/E	Atrazine
GC/MS	EPA 625.1; EPA 8270D/E	Benzaldehyde
GC/MS	EPA 625.1; EPA 8270D/E	Benzidine
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)anthracene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)pyrene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(b)fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(k)fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E	Benzoic acid
GC/MS	EPA 625.1; EPA 8270D/E	Benzyl alcohol
GC/MS	EPA 625.1; EPA 8270D/E	Biphenyl(1,1’-Biphenyl)
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroethyl) ether
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625.1; EPA 8270D/E	Butyl benzyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Carbazole
GC/MS	EPA 625.1; EPA 8270D/E	Caprolactam
GC/MS	EPA 8270D/E	Chlorobenzilate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Chrysene
GC/MS	EPA 8270D/E	Diallate
GC/MS	EPA 625.1; EPA 8270D/E	Di-n-butyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Di-n-octyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D/E	Dibenz(a,j)acridine
GC/MS	EPA 625.1; EPA 8270D/E	Dibenzofuran
GC/MS	EPA 625.1; EPA 8270D/E	Diethyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Dimethyl phthalate
GC/MS	EPA 8270D/E	a,a-Dimethylphenethylamine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D/E	Diphenyl Ether
GC/MS	EPA 8270D/E	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D/E	Ethyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Fluorene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorobutadiene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorocyclopentadiene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachloroethane
GC/MS	EPA 8270D/E	Hexachlorophene
GC/MS	EPA 8270D/E	Hexachloropropene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625.1; EPA 8270D/E	Isophorone
GC/MS	EPA 8270D/E	Isosafrole
GC/MS	EPA 8270D/E	Kepone
GC/MS	EPA 8270D/E	Methapyrilene
GC/MS	EPA 8270D/E	Methyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Naphthalene
GC/MS	EPA 625.1; EPA 8270D/E	Nitrobenzene
GC/MS	EPA 8270D/E	Nitroquinoline-1-oxide
GC/MS	EPA 8270D/E	n-Nitroso-di-n-butylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D/E	n-Nitrosodiethylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodimethylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodiphenylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D/E	n-Nitrosomethylethylamine
GC/MS	EPA 8270D/E	n-Nitrosomorpholine
GC/MS	EPA 8270D/E	n-Nitrosopiperidine
GC/MS	EPA 8270D/E	n-Nitrosopyrrolidine
GC/MS	EPA 8270D/E	Pentachlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D/E	Pentachloroethane
GC/MS	EPA 8270D/E	Pentachloronitrobenzene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Pentachlorophenol
GC/MS	EPA 8270D/E	Phenacetin
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Phenanthrene
GC/MS	EPA 625.1; EPA 8270D/E	Phenol
GC/MS	EPA 8270D/E	Pronamide (Kerb)
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Pyrene
GC/MS	EPA 625.1; EPA 8270D/E	Pyridine
GC/MS	EPA 8270D/E	Safrole
GC/MS	EPA 8270D/E	Simazine
GC/MS	EPA 8270D/E	Thionazin (Zinophos)
GC/MS	EPA 8270D/E	o-Toluidine
GC/MS	EPA 8270D/E	Dimethoate
GC/MS	EPA 8270D/E	Disulfoton
GC/MS	EPA 8270D/E	Famphur
GC/MS	EPA 8270D/E	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D/E	Parathion ethyl
GC/MS	EPA 8270D/E	Phorate
GC/MS	EPA 8270D/E	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanoic Acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanesulfonic Acid (PFOS)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanesulfonic Acid (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	6:2 Fluorotelomer Sulfonate (FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	3:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	5:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	7:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	10:2 Fluorotelomer sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanesulfonic acid

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctadecanoic acid (PFOcDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4-PFecHS (Perfluoro-4-ethylcyclohexanesulfonate)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	Draft EPA Method 1633	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	Draft EPA Method 1633	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	Draft EPA Method 1633	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	Draft EPA Method 1633	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	Draft EPA Method 1633	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	Draft EPA Method 1633	Perfluorononanoic Acid (PFNA)
LC/MS/MS	Draft EPA Method 1633	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	Draft EPA Method 1633	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	Draft EPA Method 1633	Perfluorododecanoic Acid (PFDoA)
LC/MS/MS	Draft EPA Method 1633	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	Draft EPA Method 1633	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	Draft EPA Method 1633	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	Draft EPA Method 1633	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	Draft EPA Method 1633	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	Draft EPA Method 1633	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	Draft EPA Method 1633	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	Draft EPA Method 1633	Perfluoroheptanesulfonic acid (PFHpS)

Non-Potable Water

Technology	Method	Analyte
LC/MS/MS	Draft EPA Method 1633	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	Draft EPA Method 1633	Perfluorododecanesulfonic Acid (PFDoS)
LC/MS/MS	Draft EPA Method 1633	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	Draft EPA Method 1633	6:2 Fluorotelomer Sulfonate (FTS 6:2)
LC/MS/MS	Draft EPA Method 1633	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	Draft EPA Method 1633	3:3 Fluorotelomer carboxylate (3:3 FTCA)
LC/MS/MS	Draft EPA Method 1633	5:3 Fluorotelomer carboxylate (5:3 FTCA)
LC/MS/MS	Draft EPA Method 1633	7:3 Fluorotelomer carboxylate (7:3 FTCA)
LC/MS/MS	Draft EPA Method 1633	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	Draft EPA Method 1633	N-Methyl perfluorooctane sulfonamide (NMeFOSA)
LC/MS/MS	Draft EPA Method 1633	N-Ethyl perfluorooctane sulfonamide (NEtFOSA)
LC/MS/MS	Draft EPA Method 1633	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	Draft EPA Method 1633	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	Draft EPA Method 1633	N-Methyl perfluorooctane sulfonamidoethanol (NMeFOSE)
LC/MS/MS	Draft EPA Method 1633	N-Ethyl perfluorooctane sulfonamidoethanol (NEtFOSE)
LC/MS/MS	Draft EPA Method 1633	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	Draft EPA Method 1633	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	Draft EPA Method 1633	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
LC/MS/MS	Draft EPA Method 1633	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	Draft EPA Method 1633	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	Draft EPA Method 1633	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	Draft EPA Method 1633	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	Draft EPA Method 1633	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7; EPA 6010C/D	Aluminum
ICP	EPA 200.7; EPA 6010C/D	Antimony
ICP	EPA 200.7; EPA 6010C/D	Arsenic
ICP	EPA 200.7; EPA 6010C/D	Barium
ICP	EPA 200.7; EPA 6010C/D	Beryllium
ICP	EPA 200.7; EPA 6010C/D	Cadmium
ICP	EPA 200.7; EPA 6010C/D	Calcium
ICP	EPA 200.7; EPA 6010C/D	Chromium
ICP	EPA 200.7; EPA 6010C/D	Cobalt
ICP	EPA 200.7; EPA 6010C/D	Copper
ICP	EPA 200.7; EPA 6010C/D	Iron
ICP	EPA 200.7; EPA 6010C/D	Lead
ICP	EPA 200.7; EPA 6010C/D	Magnesium
ICP	EPA 200.7; EPA 6010C/D	Manganese
ICP	EPA 200.7; EPA 6010C/D	Molybdenum
ICP	EPA 200.7; EPA 6010C/D	Nickel
ICP	EPA 200.7; EPA 6010C/D	Potassium
ICP	EPA 200.7; EPA 6010C/D	Selenium
ICP	EPA 200.7; EPA 6010C/D	Silver
ICP	EPA 200.7; EPA 6010C/D	Sodium
ICP	EPA 200.7; EPA 6010C/D	Strontium
ICP	EPA 200.7; EPA 6010C/D	Thallium
ICP	EPA 200.7; EPA 6010C/D	Tin
ICP	EPA 200.7; EPA 6010C/D	Titanium
ICP	EPA 200.7; EPA 6010C/D	Vanadium
ICP	EPA 200.7; EPA 6010C/D	Zinc
ICP/MS	EPA 200.8; EPA 6020A/B	Aluminum
ICP/MS	EPA 200.8; EPA 6020A/B	Antimony
ICP/MS	EPA 200.8; EPA 6020A/B	Arsenic
ICP/MS	EPA 200.8; EPA 6020A/B	Barium
ICP/MS	EPA 200.8; EPA 6020A/B	Beryllium
ICP/MS	EPA 200.8; EPA 6020A/B	Cadmium
ICP/MS	EPA 200.8; EPA 6020A/B	Calcium
ICP/MS	EPA 200.8; EPA 6020A/B	Chromium
ICP/MS	EPA 200.8; EPA 6020A/B	Cobalt
ICP/MS	EPA 200.8; EPA 6020A/B	Copper

Non-Potable Water

Technology	Method	Analyte
ICP/MS	EPA 200.8; EPA 6020A/B	Iron
ICP/MS	EPA 200.8; EPA 6020A/B	Lead
ICP/MS	EPA 200.8; EPA 6020A/B	Magnesium
ICP/MS	EPA 200.8; EPA 6020A/B	Manganese
ICP/MS	EPA 200.8; EPA 6020A/B	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A/B	Nickel
ICP/MS	EPA 200.8; EPA 6020A/B	Potassium
ICP/MS	EPA 200.8; EPA 6020A/B	Selenium
ICP/MS	EPA 200.8; EPA 6020A/B	Silver
ICP/MS	EPA 200.8; EPA 6020A/B	Sodium
ICP/MS	EPA 200.8; EPA 6020A/B	Strontium
ICP/MS	EPA 200.8; EPA 6020A/B	Thallium
ICP/MS	EPA 200.8; EPA 6020A/B	Tin
ICP/MS	EPA 200.8; EPA 6020A/B	Titanium
ICP/MS	EPA 200.8; EPA 6020A/B	Vanadium
ICP/MS	EPA 200.8; EPA 6020A/B	Zinc
CVAA	EPA 7470A	Mercury
CVAA	EPA 245.1	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
IC	EPA 300; EPA 9056A	Orthophosphate
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 350.1	Ammonia, Gas Diffusion Option
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Manual Colorimetry	EPA 365.3	Orthophosphate
Automated Colorimetry	EPA 365.1	Orthophosphate

Non-Potable Water

Technology	Method	Analyte
Automated Colorimetry	EPA 365.1	Total Phosphorus
Manual Colorimetry	EPA 365.3	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 1664B; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)
Electrometric Methods	EPA 120.1	Specific conductivity
Combustion	EPA 9060A	Total Organic Carbon
Combustion	SM 5310B-11	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Ignitability	EPA 1020B/ASTM D3278-78	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct injection
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock

Non-Potable Water		
Technology	**Method**	**Analyte**
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 8081B	4,4`-DDD
GC/ECD	EPA 8081B	4,4`-DDE
GC/ECD	EPA 8081B	4,4`-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	Total PCB
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)

Solid and Chemical Materials

Technology	Method	Analyte
GC/FID	KS LRH	Low-range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 8260B/C/D	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C/D	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C/D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C/D	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C/D	1,1-Dichloroethane
GC/MS	EPA 8260B/C/D	1,1-Dichloroethylene
GC/MS	EPA 8260B/C/D	1,1-Dichloropropene
GC/MS	EPA 8260B/C/D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 8260B/C/D	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C/D	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C/D	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C/D	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C/D	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B/C/D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260B/C/D	1,2-Dichloroethane
GC/MS	EPA 8260B/C/D	1,2-Dichloroethene (total)
GC/MS	EPA 8260B/C/D	1,2-Dichloropropane
GC/MS	EPA 8260B/C/D	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B/C/D	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C/D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260B/C/D	1,3-Dichloropropane
GC/MS	EPA 8260B/C/D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C/D	1-Chlorohexane
GC/MS	EPA 8260B/C/D	2,2-Dichloropropane
GC/MS	EPA 8260B/C/D	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B/C/D	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C/D	2-Chlorotoluene
GC/MS	EPA 8260B/C/D	2-Hexanone
GC/MS	EPA 8260B/C/D	2-Nitropropane
GC/MS	EPA 8260B/C/D	4-Chlorotoluene

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B/C/D	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260B/C/D	Acetone
GC/MS	EPA 8260B/C/D	Acetonitrile
GC/MS	EPA 8260B/C/D	Acrolein (Propenal)
GC/MS	EPA 8260B/C/D	Acrylonitrile
GC/MS	EPA 8260B/C/D	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B/C/D	Benzene
GC/MS	EPA 8260B/C/D	Benzyl Chloride
GC/MS	EPA 8260B/C/D	Bromobenzene
GC/MS	EPA 8260B/C/D	Bromochloromethane
GC/MS	EPA 8260B/C/D	Bromodichloromethane
GC/MS	EPA 8260B/C/D	Bromoform
GC/MS	EPA 8260B/C/D	n-Butylbenzene
GC/MS	EPA 8260B/C/D	sec-Butylbenzene
GC/MS	EPA 8260B/C/D	tert-Butylbenzene
GC/MS	EPA 8260B/C/D	Carbon disulfide
GC/MS	EPA 8260B/C/D	Carbon tetrachloride
GC/MS	EPA 8260B/C/D	Chlorobenzene
GC/MS	EPA 8260B/C/D	Chloroethane
GC/MS	EPA 8260B/C/D	Chloroform
GC/MS	EPA 8260B/C/D	Chloroprene
GC/MS	EPA 8260B/C/D	Cyclohexane
GC/MS	EPA 8260B/C/D	Cyclohexanone
GC/MS	EPA 8260B/C/D	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/C/D	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B/C/D	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C/D	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C/D	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C/D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C/D	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/C/D	Dibromochloromethane
GC/MS	EPA 8260B/C/D	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260B/C/D	Dichlorodifluoromethane
GC/MS	EPA 8260B/C/D	Diethyl ether
GC/MS	EPA 8260B/C/D; EPA 8260B/C/D SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260B/C/D	Ethanol (Ethyl Alcohol)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C/D	Ethyl acetate
GC/MS	EPA 8260B/C/D	Ethyl methacrylate
GC/MS	EPA 8260B/C/D	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260B/C/D	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C/D	Ethylbenzene
GC/MS	EPA 8260B/C/D	Ethylene Oxide
GC/MS	EPA 8260B/C/D	Hexachlorobutadiene
GC/MS	EPA 8260B/C/D	Hexane
GC/MS	EPA 8260B/C/D	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B/C/D	p-Isopropyltoluene
GC/MS	EPA 8260B/C/D	Isopropylbenzene
GC/MS	EPA 8260B/C/D	Methacrylonitrile
GC/MS	EPA 8260B/C/D	Methyl Acetate
GC/MS	EPA 8260B/C/D	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C/D	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C/D	Methylcyclohexane
GC/MS	EPA 8260B/C/D	Methyl methacrylate
GC/MS	EPA 8260B/C/D	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/C/D	Methylene chloride
GC/MS	EPA 8260B/C/D	Naphthalene
GC/MS	EPA 8260B/C/D	Pentachloroethane
GC/MS	EPA 8260B/C/D	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B/C/D	n-Propylbenzene
GC/MS	EPA 8260B/C/D	Styrene
GC/MS	EPA 8260B/C/D	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260B/C/D	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/C/D	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260B/C/D	tert-Butyl formate (TBF)
GC/MS	EPA 8260B/C/D	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C/D	Tetrahydrofuran
GC/MS	EPA 8260B/C/D	Toluene
GC/MS	EPA 8260B/C/D	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C/D	Trichlorofluoromethane
GC/MS	EPA 8260B/C/D	Vinyl acetate
GC/MS	EPA 8260B/C/D	Vinyl chloride

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B/C/D	Xylene (total)
GC/MS	EPA 8260B/C/D	m,p-Xylene
GC/MS	EPA 8260B/C/D	o-Xylene
GC/MS	EPA 8270D/E	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D/E	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D/E	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,2-Diphenylhydrazine
GC/MS	EPA 8270D/E	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D/E	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D/E	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,4-Naphthoquinone
GC/MS	EPA 8270D/E	1,4-Phenylenediamine
GC/MS	EPA 8270D/E	1-Chloronaphthalene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	1-Methylnaphthalene
GC/MS	EPA 8270D/E	1-Naphthylamine
GC/MS	EPA 8270D/E	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D/E	2,4,5-Trichlorophenol
GC/MS	EPA 8270D/E	2,4,6-Trichlorophenol
GC/MS	EPA 8270D/E	2,4-Dichlorophenol
GC/MS	EPA 8270D/E	2,4-Dimethylphenol
GC/MS	EPA 8270D/E	2,4-Dinitrophenol
GC/MS	EPA 8270D/E	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D/E	2,6-Dichlorophenol
GC/MS	EPA 8270D/E	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D/E	2-Acetylaminofluorene
GC/MS	EPA 8270D/E	2-Chloronaphthalene
GC/MS	EPA 8270D/E	2-Chlorophenol
GC/MS	EPA 8270D/E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	2-Methylnaphthalene
GC/MS	EPA 8270D/E	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D/E	2-Naphthylamine
GC/MS	EPA 8270D/E	2-Nitroaniline
GC/MS	EPA 8270D/E	2-Nitrophenol
GC/MS	EPA 8270D/E	2-Picoline (2-Methylpyridine)

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D/E	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D/E	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D/E	3-Methylcholanthrene
GC/MS	EPA 8270D/E	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D/E	3-Nitroaniline
GC/MS	EPA 8270D/E	4-Aminobiphenyl
GC/MS	EPA 8270D/E	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D/E	4-Chloro-3-methylphenol
GC/MS	EPA 8270D/E	4-Chloroaniline
GC/MS	EPA 8270D/E	4-Chlorophenyl phenylether
GC/MS	EPA 8270D/E	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D/E	4-Nitroaniline
GC/MS	EPA 8270D/E	4-Nitrophenol
GC/MS	EPA 8270D/E	5-Nitro-o-toluidine
GC/MS	EPA 8270D/E	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Acenaphthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Acenaphthylene
GC/MS	EPA 8270D/E	Acetophenone
GC/MS	EPA 8270D/E	Aniline
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D/E	Aramite
GC/MS	EPA 8270D/E	Atrazine
GC/MS	EPA 8270D/E	Benzaldehyde
GC/MS	EPA 8270D/E	Benzidine
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)anthracene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)pyrene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D/E	Benzoic acid
GC/MS	EPA 8270D/E	Benzyl alcohol
GC/MS	EPA 8270D/E	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 8270D/E	bis(2-Chloroethoxy) methane
GC/MS	EPA 8270D/E	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D/E	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D/E	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D/E	Butyl benzyl phthalate
GC/MS	EPA 8270D/E	Carbazole
GC/MS	EPA 8270D/E	Caprolactam
GC/MS	EPA 8270D/E	Chlorobenzilate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Chrysene
GC/MS	EPA 8270D/E	Diallate
GC/MS	EPA 8270D/E	Di-n-butyl phthalate
GC/MS	EPA 8270D/E	Di-n-octyl phthalate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D/E	Dibenz(a,j)acridine
GC/MS	EPA 8270D/E	Dibenzofuran
GC/MS	EPA 8270D/E	Diethyl phthalate
GC/MS	EPA 8270D/E	Dimethyl phthalate
GC/MS	EPA 8270D/E	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D/E	Diphenyl Ether
GC/MS	EPA 8270D/E	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D/E	Ethyl methanesulfonate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Fluoranthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Fluorene
GC/MS	EPA 8270D/E	Hexachlorobenzene
GC/MS	EPA 8270D/E	Hexachlorobutadiene
GC/MS	EPA 8270D/E	Hexachlorocyclopentadiene
GC/MS	EPA 8270D/E	Hexachloroethane
GC/MS	EPA 8270D/E	Hexachlorophene
GC/MS	EPA 8270D/E	Hexachloropropene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D/E	Isodrin
GC/MS	EPA 8270D/E	Isophorone
GC/MS	EPA 8270D/E	Isosafrole
GC/MS	EPA 8270D/E	Kepone
GC/MS	EPA 8270D/E	Methapyrilene
GC/MS	EPA 8270D/E	Methyl methanesulfonate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Naphthalene
GC/MS	EPA 8270D/E	Nitrobenzene
GC/MS	EPA 8270D/E	Nitroquinoline-1-oxide

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D/E	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D/E	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D/E	n-Nitrosodiethylamine
GC/MS	EPA 8270D/E	n-Nitrosodimethylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D/E	n-Nitrosomethylethylamine
GC/MS	EPA 8270D/E	n-Nitrosomorpholine
GC/MS	EPA 8270D/E	n-Nitrosopiperidine
GC/MS	EPA 8270D/E	n-Nitrosopyrrolidine
GC/MS	EPA 8270D/E	Pentachlorobenzene
GC/MS	EPA 8270D/E	Pentachloroethane
GC/MS	EPA 8270D/E	Pentachloronitrobenzene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Pentachlorophenol
GC/MS	EPA 8270D/E	Phenacetin
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Phenanthrene
GC/MS	EPA 8270D/E	Phenol
GC/MS	EPA 8270D/E	Pronamide (Kerb)
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Pyrene
GC/MS	EPA 8270D/E	Pyridine
GC/MS	EPA 8270D/E	Safrole
GC/MS	EPA 8270D/E	Simazine
GC/MS	EPA 8270D/E	o-Toluidine
GC/MS	EPA 8270D/E	Dimethoate
GC/MS	EPA 8270D/E	Disulfoton
GC/MS	EPA 8270D/E	Famphur
GC/MS	EPA 8270D/E	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D/E	Parathion ethyl
GC/MS	EPA 8270D/E	Phorate
GC/MS	EPA 8270D/E	Sulfotepp
GC/MS	EPA 8270D/E	Thionazin (Zinophos)
GC/MS	EPA 8270D/E	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanoic Acid (PFDoA)

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanesulfonic Acid (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	6:2 Fluorotelomer Sulfonate (FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	3:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	5:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	7:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	10:2 Fluorotelomer sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanesulfonic acid
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctadecanoic acid (PFOcDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4-PFecHS (Perfluoro-4-ethylcyclohexanesulfonate)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	Draft EPA Method 1633	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	Draft EPA Method 1633	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	Draft EPA Method 1633	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	Draft EPA Method 1633	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	Draft EPA Method 1633	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	Draft EPA Method 1633	Perfluorononanoic Acid (PFNA)
LC/MS/MS	Draft EPA Method 1633	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	Draft EPA Method 1633	Perfluoroundecanoic Acid (PFUnA)

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	Draft EPA Method 1633	Perfluorododecanoic Acid (PFDoA)
LC/MS/MS	Draft EPA Method 1633	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	Draft EPA Method 1633	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	Draft EPA Method 1633	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	Draft EPA Method 1633	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	Draft EPA Method 1633	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	Draft EPA Method 1633	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	Draft EPA Method 1633	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	Draft EPA Method 1633	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	Draft EPA Method 1633	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	Draft EPA Method 1633	Perfluorododecanesulfonic Acid (PFDoS)
LC/MS/MS	Draft EPA Method 1633	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	Draft EPA Method 1633	6:2 Fluorotelomer Sulfonate (FTS 6:2)
LC/MS/MS	Draft EPA Method 1633	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	Draft EPA Method 1633	3:3 Fluorotelomer carboxylate (3:3 FTCA)
LC/MS/MS	Draft EPA Method 1633	5:3 Fluorotelomer carboxylate (5:3 FTCA)
LC/MS/MS	Draft EPA Method 1633	7:3 Fluorotelomer carboxylate (7:3 FTCA)
LC/MS/MS	Draft EPA Method 1633	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	Draft EPA Method 1633	N-Methyl perfluorooctane sulfonamide (NMeFOSA)
LC/MS/MS	Draft EPA Method 1633	N-Ethyl perfluorooctane sulfonamide (NEtFOSA)
LC/MS/MS	Draft EPA Method 1633	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	Draft EPA Method 1633	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	Draft EPA Method 1633	N-Methyl perfluorooctane sulfonamidoethanol (NMeFOSE)
LC/MS/MS	Draft EPA Method 1633	N-Ethyl perfluorooctane sulfonamidoethanol (NEtFOSE)
LC/MS/MS	Draft EPA Method 1633	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	Draft EPA Method 1633	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	Draft EPA Method 1633	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	Draft EPA Method 1633	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	Draft EPA Method 1633	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	Draft EPA Method 1633	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	Draft EPA Method 1633	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	Draft EPA Method 1633	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
ICP	EPA 6010C/D	Aluminum
ICP	EPA 6010C/D	Antimony
ICP	EPA 6010C/D	Arsenic
ICP	EPA 6010C/D	Barium
ICP	EPA 6010C/D	Beryllium
ICP	EPA 6010C/D	Cadmium
ICP	EPA 6010C/D	Calcium
ICP	EPA 6010C/D	Chromium
ICP	EPA 6010C/D	Cobalt
ICP	EPA 6010C/D	Copper
ICP	EPA 6010C/D	Iron
ICP	EPA 6010C/D	Lead
ICP	EPA 6010C/D	Magnesium
ICP	EPA 6010C/D	Manganese
ICP	EPA 6010C/D	Molybdenum
ICP	EPA 6010C/D	Nickel
ICP	EPA 6010C/D	Potassium
ICP	EPA 6010C/D	Selenium
ICP	EPA 6010C/D	Silver
ICP	EPA 6010C/D	Sodium
ICP	EPA 6010C/D	Strontium
ICP	EPA 6010C/D	Thallium
ICP	EPA 6010C/D	Tin
ICP	EPA 6010C/D	Titanium
ICP	EPA 6010C/D	Vanadium
ICP	EPA 6010C/D	Zinc

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP/MS	EPA 6020A/B	Aluminum
ICP/MS	EPA 6020A/B	Antimony
ICP/MS	EPA 6020A/B	Arsenic
ICP/MS	EPA 6020A/B	Barium
ICP/MS	EPA 6020A/B	Beryllium
ICP/MS	EPA 6020A/B	Cadmium
ICP/MS	EPA 6020A/B	Calcium
ICP/MS	EPA 6020A/B	Chromium
ICP/MS	EPA 6020A/B	Cobalt
ICP/MS	EPA 6020A/B	Copper
ICP/MS	EPA 6020A/B	Iron
ICP/MS	EPA 6020A/B	Lead
ICP/MS	EPA 6020A/B	Magnesium
ICP/MS	EPA 6020A/B	Manganese
ICP/MS	EPA 6020A/B	Molybdenum
ICP/MS	EPA 6020A/B	Nickel
ICP/MS	EPA 6020A/B	Potassium
ICP/MS	EPA 6020A/B	Selenium
ICP/MS	EPA 6020A/B	Silver
ICP/MS	EPA 6020A/B	Sodium
ICP/MS	EPA 6020A/B	Strontium
ICP/MS	EPA 6020A/B	Thallium
ICP/MS	EPA 6020A/B	Tin
ICP/MS	EPA 6020A/B	Titanium
ICP/MS	EPA 6020A/B	Vanadium
ICP/MS	EPA 6020A/B	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite

Solid and Chemical Materials

Technology	Method	Analyte
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Ignitability	EPA 1010A MOD	Flash Point
Ignitability	EPA 1020B MOD	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2229.

R. Douglas Leonard Jr., VP, PILR SBU

ATTACHMENT E

Three-Phase Quality Control Process and Documentation

Preparatory Inspections

Project Number		Field Team Leader	
Installation/Site		QC Lead	
Event Name		Project Lead	
Date		Safety Representative	

Meeting Attendees *(list additional attendees on second page)*

Name and Initials	Event Role/Position	Organization

Preparatory Steps

Planning Documents/Submittals Completed with Approvals

Item	Comments

Planning Documents/Submittals Reviewed by Field Team (Ahtna and Subcontractors)

Item	Comments

Preliminary Work Completed in Accordance with Plans

Item	Comments

Ahtna

Preparatory Inspections

DFOW/Tasks Discussed, and Field Team to Implement Work According to Plans	
Item	Comments

Equipment/Supplies/Materials Procured, Available, in Working Order, and Conforming to Standards (list)	
Item	Comments

Action Items

Additional Meeting Attendees

Name and Initials	Event Role/Position	Organization

Approved By

Initial ____________ Signature ____ Date ____________

Ahtna

Initial/Follow-Up QC Inspections

Project Number		Field Team Leader	
Installation/Site		QC Lead	
Event Name		Project Lead	

List of Applicable Inspection Items

Item	Inspection	Spec. Document and/or Section	QC Category & Frequency[1]
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

[1] (W) Workmanship; (S) Safety; (M/E) Materials and Equipment; (P) Plan Compliance. Depending on the item, list one or more categories (W, S, M/E, or P) and specify the frequency of follow-up inspections.

Project Lead Approval

Initial ___________ Signature ______________________________ Date ______________

Ahtna

Initial/Follow-Up QC Inspections

Project Number			
Installation/Site		QC Representative	
Event Name		Date of Inspection(s)	

Item Number and Inspection	Phase	Inspect. Type[2]				Basis[3]	Variance	Deficient	Inspector
	(I/F)[1]	W	S	M/E	P	E/N/P/O	(Y/N)[4]	(Y/N)[5]	Initial/Time
Details:									
Details:									
Details:									
Details:									
Details:									
Details:									

Notes:

[1] **Phase:** Initial (I); Follow-up (F)

[2] **Inspection Type:** (W) Workmanship; (S) Safety; (M/E) Materials/Equipment; (P) Plan Compliance

[3] **Basis:** (E) Existing DFOW or task; (N) New DFOW or task; (P) New personnel; (O) Other (specify) _____________

[4] **Variance:** Contact FTL/PL for variance approval, document resolution. Complete field form SWE-FFRM-004, “Work Variance” as directed by FTL..

[5] **Deficiency:** Contact FTL/PL before proceeding with work, note resolution. Complete field form SWE-FFRM-102, “Corrective Action” as directed.

Approved By

Initial ___________ Signature ____ Date ___________

ATTACHMENT F

Automated Data Review Electronic Data Deliverable Specifications

Data Qualifiers List and Definitions

ADR Electronic Data Deliverable (EDD) File Specifications

The ADR EDD consists of three separate, comma-delimited ASCII text files or Excel CSV files (two, if instrument calibration information is not required by the project). Each file corresponds to a table in the ADR application. These tables are identified as the Analytical Results Table (A1), Laboratory Instrument Table (A2), and Sample Analysis Table (A3). Each file follows the naming convention of using the Laboratory Reporting Batch ID (SDG Number or some other identifier for the EDD) followed by the table identifier (A1, A2, or A3), and then a ".txt" or ".csv" extension. For example, the EDD file names for a laboratory reporting batch identified as SDG001 that includes instrument calibration data would be as follows.

SDG001A1.txt or SDG001A1.csv
SDG001A2.txt or SDG001A2.csv (A2 file is optional)
SDG001A3.txt or SDG001A3.csv

Analytical Results Table (A1 File)

The Analytical Results table contains analytical results and related information on an analyte level for field samples and associated laboratory quality control samples (excluding calibrations and tunes). Field QC blanks and laboratory method blanks must report a result record for each analyte reported within a method. The method target analyte list is matrix dependent and specified in the project library. Laboratory control samples (LCS and LCSD) and matrix spike samples (MS and MSD) must report a result record for every analyte specified as a spiked analyte in the project library. The project library is a reference table ADR uses for both EDD error checking and automated data review. The project library is populated with information from the project QAPP. Refer to the User Manual for detailed information on project libraries. Table 1 in this document lists all field names and their descriptions for the Analytical Results Table (A1).

Laboratory Instrument Table (A2 File)

The Laboratory Instrument table contains results and related information on an analyte level for instrument initial calibration standards, initial calibration verification standards, continuing calibration standards, and GC/MS tunes. A record must exist for each target analyte reported in a method (specified in the project library), for every calibration type (the field named QCType) associated to samples reported in the EDD. Initial calibrations, initial calibration verifications, and associated samples are linked to each other using a unique Run Batch ID for every distinct initial calibration within a method. Continuing calibrations and associated samples are linked to each other using a unique Analysis Batch ID for every distinct continuing calibration within a method. GC/MS tunes are linked to initial and continuing calibrations (and hence samples) using the Run Batch and Analysis Batch IDs respectively. The Laboratory Instrument Table (A2) is optional. Depending on the level of validation required by the data user, the Laboratory Instrument table may not be requested in the deliverable. Table 2 in this document lists field names and descriptions for the Laboratory Instrument Table (A2).

Sample Analysis Table (A3 File)

The Sample Analysis table contains information on a sample level for field samples and laboratory quality control analyses (excluding calibrations and tunes). A sample record exists for each sample/method/matrix/analysis type combination. Table 3 in this document lists field names and descriptions for the Sample Analysis Table (A3).

EDD Field Properties

Tables 1, 2, and 3 in this document specify the EDD field properties for each file. These include the field name and sequence, field name description, data type and length for each field, and whether or not a particular field requires a standard field. Field elements in the EDD must be sequenced according to the order they appear in Tables 1, 2, and 3. For example, in the Analytical Result table (the A1 file), the field “ClientSampleID” will always be the first piece of information to start a new line of data (or database record), followed by the fields “LabAnalysisRefMethodID”, “AnalysisType”, and so on.

Table 4 in this document lists standard values for those fields that hold standard values. Required field constraints depend on the combination of sample, matrix, method, analyte type, and calibration or QC type information reported in a record. Tables 5 through 9 in this document indicate required fields for each EDD file (table) according to the method category, matrix, analyte type, sample, and QC or calibration type reported in a record.

When creating an EDD as a text file, use the ASCII character set in a file of lines terminated by a carriage return and line feed. No characters are allowed after the carriage return and line feed. Enclose each data set in double quotes (") and separate each field by a comma (comma delimited). Data fields with no information (null) may be represented by two consecutive commas. For example, in the Sample Analysis table, since the “Collected”, “ShippingBatchID”, and “Temperature” fields do not apply to laboratory generated QA/QC samples, the record for a Laboratory Control Sample by Method 8270C would be entered as follows. Note that the first two fields (“ProjectNumber” and “ProjectName”) are omitted in this example.

…“LCSW100598”,,”AQ”,”LCSW100598”,”LCS”,,”8270C”,… (and so on)

Do not pad fields with leading or trailing spaces if a field is populated with less than the maximum allowed number of characters. In the above example, although the “MatrixID” field can accommodate up to 10 characters, only 2 characters were entered in this field.

The EDD can be constructed within Excel and saved as .csv file for import into the application. Be sure to format all cells as text beforehand, otherwise Excel will reformat entered values in some cases.

Table 1
Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ClientSampleID	Client or contractor's identifier for a field sample as reported on the chain-of-custody If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the AnalysisType field is used for this distinction). For example, MW01<u>DL</u> and MW01<u>RE</u> are not allowed Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Analytical Results table for both EDDs.	Text	25	NO
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or a Lab Identifier for a method such as a SOP Number, however; method ID is specified by the project. The method ID must be entered into the standard list.	Text	25	YES (specified in project plan)
AnalysisType	Defines the analysis type (i.e., Dilution, Reanalysis, etc.). This field provides distinction for sample result records when multiple analyses are submitted for the same sample, method, and matrix; for example dilutions, re-analyses, and re-extracts.	Text	10	YES (See Table 4)
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. There are no restrictions for the LabSampleID except for field length and that the LabSampleID must be distinct for a given field sample or lab QC sample and method. Suffixes may be applied to the LabSampleID to designate dilutions, reanalysis, etc.	Text	25	NO
LabID	Identification of the laboratory performing the analyses.	Text	7	NO
ClientAnalyteID	CAS Number or unique client identifier for an analyte or isotope. If a CAS Number is not available, use a unique identifier provided by the client or contractor. The ClientAnalyteID for a particular target analyte or isotope should be specified by the project and must exist in the standard value tables for Analytes. For the LCS, LCSD, MS, and MSD, it is only necessary to report the compounds designated as spikes in the library (and surrogates for organic methods.) For TICs from GC/MS analyses, enter the retention time in decimal minutes as the Client Analyte ID.	Text	12	YES (specified by project)

Table 1
Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
AnalyteName	Chemical name for the analyte or isotope. The project specifies how an analyte or isotope is named. The analyte name must be associated to a ClientAnalyteID in the standard values table for Analytes (excluding compounds designated as TIC's).	Numeric	60	YES (specified by project)
Result	Result value for the analyte or isotope. Entries must be numeric. For non-detects of target analytes or isotopes and spikes, do not enter "ND" or leave this field blank. If an analyte or spike was not detected, enter the reporting limit value corrected for dilution and percent moisture as applicable. Do not enter "0"	Text	10	NO
ResultUnits	The units defining how the values in the Result, DetectionLimit, and ReportingLimit fields are expressed. For radiochemistry this also includes how the value in the Error field is expressed.	Text	10	YES (specified by project in the library)
LabQualifiers	A string of single letter result qualifiers assigned by the lab based on client-defined rules and values. The "U" Lab Qualifier must be entered for all non-detects. Other pertinent lab qualifiers may be entered with the "U" qualifier. Order is insignificant. Lab qualifiers other than those listed in the standard values table may be used. If so, these must be added to the standard value table in the application.	Text	7	YES (See Table 4)
DetectionLimit	For radiochemistry methods, the minimum detectable activity for the isotope being measured. For all other methods: The minimum detection limit value for the analyte being measured. **For DoD QSM enter the Limit of Detection (LOD)**	Numeric	10	NO
DetectionLimitType	Specifies the type of detection limit (i.e., MDA, MDL, IDL, etc.).	Text	10	YES (See Table 4)
RetentionTime or Error	For radiochemistry methods only, enter the 2 Sigma Counting Error. The units for error are entered in the ResultUnits field. For GC/MS methods only, enter the time expressed in decimal minutes between injection and detection for GC/MS TICs only For target analytes in all other methods, leave this field blank. Note: GC retention times are not evaluated at this time.	Text	5	NO
AnalyteType	Defines the type of result, such as tracer, surrogate, spike, or target compound.	Text	7	YES (See Table 4)

Table 1
Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
PercentRecovery	For radiochemistry methods: The tracer yield, if applicable. For all other analytical methods: The percent recovery value of a spiked compound or surrogate. If the spike or surrogate was not recovered because of dilution, enter "DIL". If a spike or surrogate was not recovered because of matrix interference, enter "INT". If a spike or surrogate was not recovered because it was not added to the sample, enter "NS".	Numeric	5	NO
RelativePercentDifference	The relative percent difference (RPD) of two QC results, such as MS/MSD, LCS/LCSD, and Laboratory Duplicates. Report RPD in Laboratory Duplicate, LCSD, and MSD records only. If the RPD is not calculable, enter "NC".	Numeric	5	NO
ReportingLimit	Reporting limit value for the measured analyte or isotope Factor in the dilution factor and percent moisture correction, if applicable. The Reporting Limit for each analyte and matrix in a given method is specified in the project library or QAPP. **For DoD QSM enter the Limit of Quantitation (LOQ)**	Numeric	10	NO
ReportingLimitType	Specifies the type of reporting limit (i.e., CRQL, PQL, SQL, RDL, etc). The Reporting Limit Type for each method and matrix is specified in the project library or QAPP.	Text	10	YES (specified by the project)

Table 1
Field Descriptions for the Analytical Results Table (A1 file)

Contains laboratory test results and related information for field and QC samples (excluding instrument calibrations) on an analyte level for environmental chemistry including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ReportableResult	This field indicates whether or not the laboratory chooses an individual analyte or isotope result as reportable. Enter "YES" if the result is reportable. Enter "NO" if the result is not reportable. This field applies to target analytes only. If only one analysis is submitted for a particular sample and method, enter "YES" for all target compounds (where Analyte Type = TRG). For GC/MS methods enter yes for tentatively identified compounds (where Analyte Type = TIC). If two or more analyses are submitted for a particular sample and method (i.e. initial analysis, reanalysis and/or dilutions), enter "YES" from only <u>one</u> of the analyses for each target compound. For example: a sample was run a second time at dilution because benzene exceeded the calibration range in the initial, undiluted analysis. All target analytes are reported in each analysis. For the initial analysis, (Analysis Type = RES), enter "NO" for benzene and enter "YES" for all other compounds. For the diluted analysis (Analysis Type = DL), enter "YES" for benzene and enter "NO" for all other compounds. For TICs (Analyte Type = TIC), if more than one analysis is submitted for a particular sample and method, choose only one of the analyses where Reportable Result = YES for <u>all</u> TICs. For example, a sample was run a second time because one or more target compounds exceeded the calibration range in the undiluted analysis. Choose a particular analysis and enter "YES" for all TICS. In the other analysis enter "NO" for all TICs. Note that it is not necessary to report the full target analyte list for the initial result, dilution, re-analysis, or re-extraction. However, each target analyte must be reported YES once and once only in the case of multiple analyses for a given sample, method, and matrix. In the case of organics, all surrogates must be reported for all analyses submitted for a given sample, method, and, matrix.	Text	3	YES (See Table 4)
MDL_DoD	This field is not part of the standard ADR EDD format. **For DoD QSM enter the MDL, otherwise leave blank. (ADR does not perform error checks on this field)**	Numeric	10	NO

Table 2

Field Descriptions for the Laboratory Instrument Table (A2 file)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
InstrumentID	Laboratory instrument identification.	Text	15	NO
QCType	Type of instrument QC (i.e., Instrument_Performance_Check or type of calibration standard).	Text	10	YES (See Table 4)
Analyzed	Analysis date/time for BFB, DFTPP, initial calibration verification standards, calibration verification standards, and continuing calibration standards. For the initial calibration, enter date and time of the last standard analyzed. Also, see comments about initial calibrations in the Alternate_Lab_Analysis_ID field name description.	Date/ Time	*	NO
AlternateLab_AnalysisID	Common laboratory identification used for standards (i.e., VOA STD50, CCAL100, BFB50, etc). For initial calibration, enter ICAL. Information from the initial calibration is entered as one record for each analyte that summarizes the results of the initial calibration (i.e. %RSD, correlation coefficient, and avg RF). Records are not entered for each individual standard within the initial calibration.	Text	12	NO
LabAnalysisID	Unique identification of the raw data electronic file associated with the calibration standard or tune (i.e., 9812101MS.DV). Leave this field blank for the initial calibration. See comments about initial calibrations in the Alternate_Lab_Analysis_ID field description. This field is only applicable where an electronic instrument file is created as part of the analysis.	Text	15	NO
LabAnalysisRefMethodID	Laboratory reference method ID (i.e., 8260B, 8270C, 6010B, etc.). The method ID is specified by the project. The LabAnalysisRefMethodID must be in the standard value list for Method IDs.	Text	25	YES (specified by the project)
ClientAnalyteID	CAS number or unique client identifier for an analyte. If a CAS number is not available, use a unique identifier provided by the client. The unique identifier for a particular analyte should be specified by the project and must exist in the standard value list for ClientAnalyteID. Records for each calibration must report the full target analyte list including surrogates as applicable. The target analyte list is specified for each method and matrix in the project	Text	12	YES (specified by the project)
AnalyteName	The chemical name for the analyte. The project specifies how an analyte is named. The AnalyteName must be associated to a ClientAnalyteID in the standard values.	Text	60	YES (specified by the project)

Table 2
Field Descriptions for the Laboratory Instrument Table (A2 file)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
RunBatch	Unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The Run Batch ID links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the Run_Batch ID also links a BFB or DFTPP tune and the initial calibration and initial calibration verification standards to associated samples and method QC analyses. A new and unique Run Batch ID must be used with every new initial calibration.	Text	12	NO
AnalysisBatch	Unique laboratory identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The Analysis Batch ID links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the Analysis Batch ID also links the BFB or DFTPP tune. A new and unique Analysis Batch ID must be used with every new continuing calibration or continuing calibration verification. For GC methods, only report opening standards, do not include closing standards (unless the closing standard functions as the opening standard for a subsequent set of analyses, in which case a new and unique Analysis Batch ID is assigned). When dual or confirmation columns/detectors are used, enter results from the primary column/detector only (this is similar to CLP Pesticide reporting).	Text	12	NO
LabReportingBatch	Unique laboratory identifier for a batch of samples including associated calibrations and method QC, reported as a group by the lab (i.e., lab work order #, log-in #, or SDG). Links all instrument calibrations, samples, and method QC reported as a group or SDG.	Text	12	NO
PercentRelativeStandard Deviation	The standard deviation relative to the mean used to evaluate initial calibration linearity. Organic methods may use either %RSD or Correlation Coefficient. If applicable, enter the %RSD. Leave this field blank if the Correlation Coefficient is used.	Numeric	5	NO
CorrelationCoefficient	The correlation coefficient resulting from linear regression of the initial calibration. For metals by ICAP, enter '1.0' if a two-point initial calibration was analyzed. Organic methods may use either %RSD or Correlation Coefficient. If applicable, enter the Correlation Coefficient. Leave this field blank if the %RSD is used	Numeric	5	NO
RelativeResponseFactor	This field applies to GC/MS only. For continuing calibration enter the relative response factor. For initial calibration enter the average relative response factor. Refer to comments about initial calibration records in the field description for Alternate_Lab_Analysis_ID.	Numeric	5	NO

Table 2

Field Descriptions for the Laboratory Instrument Table (A2 file)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
Percent_Difference (or Percent Recovery)	For organic methods, this field is the difference between 2 measured values expressed as a percentage. If %RSD is reported, enter the % difference between the average response factor of the initial calibration (IC) and the response factor of the initial calibration verification (ICV) or continuing calibration (CCV). If correlation coefficient is used, enter the % difference between the true value and the measured value. The Percent_Difference is expressed as a negative or positive value. Do not express Percent_Difference as an absolute value. Use a negative value if the CCV or ICV response factor is less than the IC average response factor or, in the case of correlation coefficient, the CCV or ICV measured value is less than the true value. Use a positive value if the CCV or ICV response factor is greater than the IC average response factor, or in the case of correlation coefficient, the CCV or ICV measured value is greater than the true value. For inorganic methods, this field is the recovery of an analyte expressed relative to the true amount (i.e., %R for a metal in the continuing calibration or initial calibration verification by Method 6010B).	Numeric	5	NO
PeakID01	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 50, for DFTPP enter 51.	Numeric	10	NO
PercentRatio01	For BFB enter the relative percent abundance of m/z 50 measured relative to the raw abundance of m/z 95. For DFTPP enter the relative percent abundance of m/z 51 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID02	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 75, for DFTPP enter 68.	Numeric	10	NO
PercentRatio02	For BFB enter the relative percent abundance of m/z 75 measured relative to the raw abundance of m/z 95. For DFTPP enter the relative percent abundance of m/z 68 measured relative to the raw abundance of m/z 69.	Numeric	10	NO
PeakID03	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 95, for DFTPP enter 69.	Numeric	10	NO
PercentRatio03	For BFB enter the ion abundance of m/z 95 as 100 percent. For DFTPP enter the relative percent abundance of m/z 69 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID04	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 96, for DFTPP enter 70.	Numeric	10	NO

Table 2
Field Descriptions for the Laboratory Instrument Table (A2 file)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
PercentRatio04	For BFB enter the relative percent abundance of m/z 96 measured relative to the raw abundance of m/z 95. For DFTPP enter the relative percent abundance of m/z 70 measured relative to the raw abundance of m/z 69	Numeric	10	NO
PeakID05	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 173, for DFTPP enter 127.	Numeric	10	NO
PercentRatio05	For BFB enter the relative percent abundance of m/z 173 measured relative to the raw abundance of m/z 174. For DFTPP enter the relative percent abundance of m/z 127 measured relative to the raw abundance of m/z 198	Numeric	10	NO
PeakID06	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 174, for DFTPP enter 197.	Numeric	10	NO
PercentRatio06	For BFB enter the relative percent abundance of m/z 174 measured relative to the raw abundance of m/z 95. For DFTPP enter the relative percent abundance of m/z 197 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID07	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 175, for DFTPP enter 198.	Numeric	10	NO
PercentRatio07	For BFB enter the relative percent abundance of m/z 175 measured relative to the raw abundance of m/z 174. For DFTPP enter the ion abundance of m/z 198 as 100 percent.	Numeric	10	NO
PeakID08	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 176, for DFTPP enter 199.	Numeric	10	NO
PercentRatio08	For BFB enter the relative percent abundance of m/z 176 measured relative to the raw abundance of m/z 174. For DFTPP enter the relative percent abundance of m/z 199 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID09	Identifies individual m/z ions for GC/MS tuning compounds. For BFB enter 177, for DFTPP enter 275.	Numeric	10	NO
PercentRatio09	For BFB enter the relative percent abundance of m/z 177 measured relative to the raw abundance of m/z 176. For DFTPP enter the relative percent abundance of m/z 275 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID10	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 365.	Numeric	10	NO

Table 2

Field Descriptions for the Laboratory Instrument Table (A2 file)

Contains related to laboratory instrument calibration on an analyte level and GC/MS Tune information. This table is optional depending on project requirements. Do not report Table A2 for radiochemistry methods.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
PercentRatio10	For BFB leave blank. For DFTPP enter the relative percent abundance of m/z 365 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID11	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 441.	Numeric	10	NO
PercentRatio11	For BFB leave blank. For DFTPP the percent abundance of m/z 441 measured relative to the raw abundance of m/z 443	Numeric	10	NO
PeakID12	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 442.	Numeric	10	NO
PercentRatio12	For BFB leave blank. For DFTPP enter the relative percent abundance of m/z 442 measured relative to the raw abundance of m/z 198.	Numeric	10	NO
PeakID13	Identifies individual m/z ions for GC/MS tuning compounds. For BFB leave blank, for DFTPP enter 443.	Numeric	10	NO
PercentRatio13	For BFB leave blank. For DFTPP enter the relative percent abundance of m/z 443 measured relative to the raw abundance of m/z 442.	Numeric	10	NO

* Date/time format is: MM/DD/YYYY hh:mm where MM = month, DD = day, YYYY = four digits of the year, hh = hour in 24 hour format, and mm = minutes.

Table 3
Field Description for the Sample Analysis (A3 file)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ProjectNumber	Project number assigned by the client.	Text	30	YES (specified by project)
ProjectName	Project name assigned by the client.	Text	90	YES (specified by project)
ClientSampleID	Client or contractor's identifier for a field sample If a sample is analyzed as a laboratory duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the Client Sample ID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). For Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID into this field Do not append suffixes to the ClientSampleID for dilutions, reanalyses, or re-extracts (the Analysis_Type field is used for this distinction). For example, MW01DL and MW01RE are not allowed Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in the Sample Analysis table for both EDDs.	Text	25	NO
Collected	For radiochemistry methods the Date of sample collection. Refer to the date format for radiochemistry methods at the end of this table. For all other methods the Date and Time of sample collection. Refer to the date/time format at the end of this table. Leave this field blank for Method Blank, LCS, and LCSD	Date/ Time	16*	NO
MatrixID	Sample matrix (i.e., AQ, SO, etc.)	Text	10	YES (See Table 4)
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. There are no restrictions for the LabSampleID except field length and that the LabSampleID must be unique for a given field sample or lab QC sample and method.	Text	25	NO
QCType	This record identifies the type of quality control sample QC (i.e., Duplicate, LCS, Method Blank, MS, or MSD). For regular samples, leave this field blank.	Text	10	YES (See Table 4)
ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport client or field samples. Links all samples to a cooler or shipping container. No entry for method blanks, LCS, and LCSD. This field is optional.	Text	25	NO
Temperature	Temperature (in centigrade degrees) of the sample as received. This field is not required for radiochemistry methods.	Numeric	10	NO

Table 3
Field Description for the Sample Analysis (A3 file)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
LabAnalysisRefMethodID	Laboratory reference method ID. The method ID may be an EPA Method number or laboratory identifier for a method such as a SOP number, however; values used for Laboratory Method IDs are specified by the project and must be contained in the standard value list for method IDs.	Text	25	YES (Specified by the project)
PreparationType	Preparation Method Number (i.e., 3010A, 3510C, 3550C, 5030B, etc.) For analytical procedures that do not have a specific preparation method number, use “Gen Prep”.	Text	25	YES (See Table 4)
AnalysisType	Defines the type of analysis such as initial analysis, dilution, re-analysis, etc. This field provides distinction for sample records when multiple analyses are submitted for the same sample, method, and matrix, for example: dilutions, re-analyses, and re-extracts.	Text	10	YES (See Table 4)
Prepared	<u>For radiochemistry leave this field blank.</u> For all other methods enter the date and time of sample preparation or extraction. Refer to the date/time format at the end of this table.	Date/ Time	16*	NO
Analyzed	<u>For radiochemistry methods</u> the date of sample analysis. Refer to the date format for radiochemistry methods at the end of this table. <u>For all other methods</u> the date and time of sample analysis. Refer to the date and time format at the end of this table.	Date/ Time	*	NO
LabID	Identification of the laboratory performing the analysis.	Text	7	NO
QCLevel	The level of laboratory QC associated with the analysis reported in the EDD. If only the Analytical Results Table (A1) and the Sample Analysis Table (A3) information are submitted for the sample, enter “COA”. If the Laboratory Instrument Table (A2) information is also submitted for the sample, enter “COCAL”	Text	6	YES (See Table 4)
ResultBasis	Indicates whether results associated with this sample record are reported as wet or percent moisture corrected. This field is only required for soils and sediments. Enter “WET” if results are not corrected for percent moisture. Enter “DRY” if percent moisture correction is applied to results.	Text	3	YES (See Table 4)
TotalOrDissolved	This field indicates if the results related to this sample record are reported as a total or dissolved fraction. This field is only required for metal methods. For all other methods leave this field blank.	Text	3	YES (See Table 4)
Dilution	Dilution of the sample aliquot. Enter “1” for method blanks, LCS, and LCSD, or if the field samples was analyzed without dilution.	Numeric	10	NO
HandlingType	Indicates the type of leaching procedure, if applicable (i.e., SPLP, TCLP, WET). Leave this field blank if the sample analysis was <u>not</u> performed on a leachate.	Text	10	YES (See Table 4)

Table 3
Field Description for the Sample Analysis (A3 file)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
HandlingBatch	Unique laboratory identifier for a batch of samples prepared together in a leaching procedure (i.e., SPLP, TCLP, or WET preparation). The HandlingBatch links samples with leaching blanks. Leave this field blank if the sample analysis was <u>not</u> performed on a leachate	Text	12	NO
LeachateDate	Date and time of leaching procedure (i.e., date for SPLP, TCLP, or WET preparation). Refer to the date and time format at the end of this table. Leave this field blank if the sample analysis was <u>not</u> performed on a leachate	Date /Time	16*	NO
Percent_Moisture	Percent of sample composed of water. Enter for soil and sediment samples only.	Numeric	10	NO
MethodBatch	Unique laboratory identifier for a batch of samples of similar matrices analyzed by one method and treated as a group for matrix spike, matrix spike duplicate, or laboratory duplicate association The method batch links the matrix spike and/or matrix spike duplicate or laboratory duplicates to associated samples. Note, the MethodBatch association may coincide with the PreparationBatch association. The MethodBatch is specifically used to link the MS/MSD and/or DUP to associated samples.	Text	12	NO
PreparationBatch	Unique laboratory identifier for a batch of samples prepared together for analysis by one method and treated as a group for method blank, LCS and LCSD association. The PreparationBatch links method blanks and laboratory control samples (blank spikes) to associated samples. Note, the PreparationBatch association may coincide with the MethodBatch association but the PreparationBatch specifically links the Method Blank and LCS to associated samples.	Text	12	NO
RunBatch	<u>For radiochemistry methods leave this field blank.</u> <u>For all other methods</u> the RunBatch is the unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The RunBatch links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the RunBatch also links a BFB or DFTPP tune. A distinct RunBatch must used with every new initial calibration within a method The value entered in this field links a particular sample/method/analysis type record to a set of associated initial calibration and initial calibration verification records from Table A2. This field is only required if the A2 table is included with the EDD.	Text	12	NO

Table 3

Field Description for the Sample Analysis (A3 file)

This table contains information related to analyses of field samples and laboratory QC samples (excluding calibrations and tunes) on a sample level for environmental chemical analyses including radiochemistry

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
AnalysisBatch	For radiochemistry methods leave this field blank. For all other methods the AnalysisBatch is the unique identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The AnalysisBatch links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the AnalysisBatch also links the BFB or DFTPP tune. A distinct AnalysisBatch must be used with every new continuing calibration or continuing calibration verification within a method The value entered in this field links a particular sample/method/analysis type record to a set of associated continuing calibration records in the Laboratory Instrument table. This field is only required if the A2 table is included with the EDD.	Text	12	NO
LabReportingBatch	Unique laboratory identifier for the EDD. This is equivalent to the sample delivery group, lab work number, login ID, etc. The LabReportingBatch links all records in the EDD reported as one group. The value entered in this field must be the same in all records.	Text	12	NO
LabReceipt	Date and time the sample was received in the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/ Time	16*	
LabReported	Date and time hard copy reported delivered by the lab. A time value of 00:00 may be entered. Refer to the date/time format at the end of this table.	Date/ Time	16*	

* For radiochemistry methods format Date as MM/DD/YYYY (where MM = two digit month, DD = two digit day, and YYYY = four digit year)

For all other methods format Date and Time as MM/DD/YYYY hh:mm YYYY (where MM = two digit month, DD = two digit day, and YYYY = four digit year, hh = hour in 24 hour format, and mm = minutes)

Table 4
Standard Value List

Field Name	Standard Value	Standard Value Description
Analysis_Type	DL	Dilution of the original sample
	DL2	Second dilution of the original sample
	DL3	Third dilution of the original sample
	DL4	Fourth dilution of the original sample
	RE	Reanalysis/re-extraction of sample
	RE2	Second reanalysis/re-extraction of sample
	RE3	Third reanalysis/re-extraction of sample
	RE4	Fourth reanalysis/re-extraction of the original sample
	RES	The initial or original sample.
Analyte_Name	Refer to QAPP and Project Library	Analyte names are specified by the project and entered into the library for each method and matrix. Analyte Names used in project libraries must first exist in the standard value table. The same holds true for the ClientAnalyteID
Analyte_Type	IS	Internal standard as defined per CLP usage
	SPK	Spiked analyte
	SURR	Surrogate as defined as per CLP usage
	TIC	Tentatively identified compound for GC/MS analysis
	TRG	Target compound
Detection_Limit_Type [1]	CRDL	Contract required detection limit
	IDL	Instrument detection limit
	MDA	Minimum detectable activity
	MDL	Method detection limit
Handling_Type [2]	WET	Wet leaching procedure
	SPLP	Synthetic Precipitation Leaching Procedure
	TCLP	Toxicity Characteristic Leaching Procedure
Lab_Analysis_Ref_Method_ID	Refer to QAPP and Project Library	Method IDs are specified by the project and entered into the library. Methods used in project libraries must first exist in the standard value table
Lab_Qualifiers [3]	*	INORG: Duplicate analysis was not within control limits
	*	ORG: Surrogate values outside of contract required QC limits
	+	INORG: Correlation coefficient for the method of standard additions (MSA) was less than 0.995
	A	ORG: Tentatively identified compound (TIC) was a suspected aldol-condensation product
	B	INORG: Value less than contract required detection limit but greater than or equal to instrument detection limit
	B	ORG: Compound is found in the associated blank as well as in the sample
	C	ORG: Analyte presence confirmed by GC/MS
	D	Result from an analysis at a secondary dilution factor
	E	INORG: Reported value was estimated because of the presence of interference
	E	ORG: Concentrations exceed the calibration range of the instrument
	H	Analysis performed outside method or client-specified holding time requirement
	J	Estimated value
	M	INORG: Duplicate injection precision was not met
	N	INORG: Spiked sample recovery was not within control limits
	N	ORG: Presumptive evidence of a compound
	P	ORG: Difference between results from two GC columns unacceptable (>25% Difference)
	S	Reported value was determined by the method of standard additions (MSA)
	U	Compound was analyzed for but not detected. Analyte result was below the Reporting Limit.
	W	INORG: Post digestion spike was out of control limits
	X	Reserved for a lab-defined data qualifier
	Y	Reserved for a lab-defined data qualifier
	Z	Reserved for a lab-defined data qualifier
Matrix_ID	AIR	Air
	AQ	Water
	ASH	Ash

Table 4
Standard Value List

Field Name	Standard Value	Standard Value Description
Matrix_ID (continued)	BIOTA	Biological matter
	FILTER	Filter
	LIQUID	Non-aqueous liquid
	OIL	Oil
	SED	Sediment
	SLUDGE	Sludge
	SO	Soil
	SOLID	Non-soil/sediment solid
	TISSUE	Tissue
	WASTE	Waste
	WIPE	Wipe
Preparation_Type [4]	3005A	Acid Digestion of Waters for Total Recoverable or Dissolved Metals by FLAA or ICP
	3010A	Acid of Aqueous Samples and Extracts for Total Metals by FLAA or ICP
	3015	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts
	3020A	Acid Digestion of Aqueous Samples and Extracts for Total Metals by GFAA
	3031	Acid Digestion of Oils for Metals Analysis by AA or ICP
	3050B	Acid Digestion of Sediments, Sludges, and Soils
	3051	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils and Oils
	3052	Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices
	3060A	Alkaline Digestion for Hexavalent Chromium
	3510C	Separatory Funnel Liquid-Liquid Extraction
	3520C	Continuous Liquid-Liquid Extraction
	3535	Solid Phase Extraction
	3540C	Soxhlet Extraction
	3541	Automated Soxhlet Extraction
	3545	Pressurized Fluid Extraction
	3550B	Ultrasonic Extraction
	3560	Supercritical Fluid Extraction of Total Recoverable Petroleum Hydrocarbons
	5030B	Purge and Trap for Aqueous Samples
	5035	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
	7470A	Acid digestion of waters for Mercury analysis
	7471A	Acid digestion of soils and solids for Mercury analysis
	Gen Prep	Generic preparation type when a preparation method ID does not exist (used mostly for general chemistry methods)
QC_Level	COA	Certificate of Analysis (accuracy and precision, no calibration)
	COACAL	Certificate of Analysis (accuracy and precision including calibration)
QC_Type	MB	Analytical control consisting of all reagents and standards that is carried through the entire procedure (Method Blank)
	CV	(Calibration Verification) Analytical standard run at a specified frequency to verify the calibration of the analytical system
	CCV	(Continuing Calibration Verification) Analytical standard run every 12 hours to verify the calibration of the GC/MS system
	DUP	A second aliquot of a sample that is treated the same as the original aliquot to determine the precision of the method
	IC	(Initial Calibration) Analysis of analytical standards for a series of different specified concentrations
	ICV	(Initial Calibration Verification) Analytical standard run at a specified frequency to verify the accuracy of the initial calibration of the analytical system
	IPC	(Instrument Performance Check) Analysis of DFTPP or BFB to evaluate the performance of the GC/MS system
	LCS	(Laboratory Control Sample) A control sample of known composition
	LCSD	(Laboratory Control Sample Duplicate) A duplicate control sample of known composition
	MS	(Matrix Spike) Aliquot of a matrix spiked with known quantities and subjected to the entire analytical procedure to measure recovery
	MSD	(Matrix Spike Duplicate) A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method
Reporting_Limit_Type [1]	CRDL	Contract required detection limit
	CRQL	Contract required quantitation limit

Table 4
Standard Value List

Field Name	Standard Value	Standard Value Description
Reporting_Limit_Type (continued)	PQL	Practical quantitation limit
	SQL	Sample quantitation limit
	RDL	Reportable detection limit
Result_Basis	DRY	Result was calculated on a dry weight basis
	WET	Result was calculated on a wet weight basis
Result_Units [5]	ug/L	Micrograms per liter
	mg/L	Milligrams per liter
	ug/Kg	Micrograms per kilogram
	mg/Kg	Milligrams per kilogram
	pg/L	Picograms per liter
	ng/Kg	Nanograms per kilogram
Total_Or_Dissolved	DIS	Dissolved
	TOT	Total

1 Additional Detection Limit Types and Reporting Limit Types may be used. These must be added to the application standard values.

2 Additional Handling Types (leachate procedures) may be used. These must be added to the application standard values

3 Additional Lab Qualifiers may be used, or listed Lab Qualifiers may be used in a different manner than described in this table. New lab qualifiers must be added to the application standard value tables. NOTE: The "U" Lab Qualifier must be used for all non-detects.

4 Additional Preparation Types may be used. These must be added to the application standard value tables.

5 Additional Result Units may be used. The project library specifies the reporting limit used for each method and matrix

Note: If new standard values are used then these standard values must be entered in the software standard values for both the lab and contractor. The application will automatically update the standard values tables if an importing library contains standard values (method, client analyte ID, and analyte name) that do not exist in the software importing the new library.

Table 5
Required Fields in the Analytical Results Table for GC/MS, GC, and HPLC Methods

	GC/MS Methods			GC and HPLC Methods		
Field	**Regular Sample***	**MS/MSD**	**Method Blank, LCS/LCSD**	**Regular Sample***	**MS/MSD**	**Method Blank, LCS/LCSD**
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time	T		T			
Analyte_Type	X	X	X	X	X	X
Percent_Recovery	S	R	R	S	R	R
Relative_Percent_Difference		D	D		D	D
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

Key

X	Required Field
D	Required field for spiked compounds in the LCSD and MSD only
Q	Required field if laboratory has qualified result. The “U” qualifier MUST be entered if the result is non-detect.
R	Required field if Analyte_Type = “SPK” or “SURR”
S	Required field for surrogate compounds only
T	Required field for tentatively identified compounds by GC/MS only
*	Also includes Equipment Blanks, Field Blanks, and Trip Blanks

Table 6
Required Fields in the Analytical Results Table for ICAP, AA, and IC Methods

	ICAP and AA Methods			IC and Wet Chemistry Methods		
Field	**Regular Sample***	**Sample Duplicate, MS/MSD**	**Method Blank, LCS/LCSD**	**Regular Sample***	**Sample Duplicate MS/MSD**	**Method Blank, LCS/LCSD**
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time						
Analyte_Type	X	X	X	X	X	X
Percent_Recovery		S	S		S	S
Relative_Percent_Difference		R	R		R	R
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

<u>Key</u>

X	Required field
Q	Required field if laboratory has qualified result. The “U” qualifier MUST be entered if the result is non-detect
R	Required field for spiked compounds in LCSD or MSD, or target compounds in the Sample Duplicate only
S	Required field if Analyte_Type = “SPK”
*	Also includes Trip Blanks, Equipment Blanks, and Field Blanks

Table 7
Required Fields in the Laboratory Instrument Table

	GC/MS Tunes		Initial Calibration				Initial Calibration Verification				Calibration Verification, Continuing Calibration
Field	**VOA**	**SVOA**	**GC/MS**	**GC HPLC**	**ICP/AA**	**IC***	**GC/MS**	**GC HPLC**	**ICP/AA**	**IC***	**ALL METHODS**
Instrument_ID	X	X	X	X	X	X	X	X	X	X	X
QC_Type	X	X	X	X	X	X	X	X	X	X	X
Analyzed	X	X	X	X	X	X	X	X	X	X	X
Alternate_Lab_Analysis_ID	X	X	X	X	X	X	X	X	X	X	X
Lab_Analysis_ID	X	X					X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X	X	X	X	X	X
Run_Batch	X	X	X	X	X	X	X	X	X	X	X
Analysis_Batch	C	C									X
Lab_Reporting_Batch	X	X	X	X	X	X	X	X	X	X	X
Percent_Relative_Standard_Deviation			X	X							
Correlation_Coefficient			B	B	X	X					
Relative_Response_Factor			X				X				M
Percent_Difference							X	X	X	X	X
Peak_ID_01	X	X									
Percent_Ratio_01	X	X									
Peak_ID_02	X	X									
Percent_Ratio_02	X	X									
Peak_ID_03	X	X									
Percent_Ratio_03	X	X									
Peak_ID_04	X	X									
Percent_Ratio_04	X	X									
Peak_ID_05	X	X									
Percent_Ratio_05	X	X									
Peak_ID_06	X	X									
Percent_Ratio_06	X	X									
Peak_ID_07	X	X									
Percent_Ratio_07	X	X									
Peak_ID_08	X	X									
Percent_Ratio_08	X	X									
Peak_ID_09	X	X									
Percent_Ratio_09	X	X									
Peak_ID_10		X									
Percent_Ratio_10		X									
Peak_ID_11		X									
Percent_Ratio_11		X									
Peak_ID_12		X									
Percent_Ratio_12		X									
Peak_ID_13		X									
Percent_Ratio_13		X									

Key

X	Required field (some fields are not applicable to some General (Wet) Chemistry tests)
B	Required field if reporting best fit
C	Required field if BFB or DFTPP associated with a continuing calibration only
M	Required field for GC/MS continuing calibration only

*IC Includes Ion Chromatography and Classical or Wet Chemistry methods. Methods such as pH, Conductivity, and others do not use traditional calibration procedures: therefore some fields marked as a required field under the "IC" column do not apply for these methods.

Table 8
Required Fields in the Sample Analysis Table

	GC, GC/MS, HPLC Methods		ICAP and AA Methods		IC and Wet Chemistry Methods	
Field	**Method Blanks, LCS/LCSD**	**Regular Samples*, Sample Duplicate, MS/MSD**	**Method Blanks, LCS/LCSD**	**Regular Samples*, Sample Duplicate, MS/MSD**	**Method Blanks, LCS/LCSD**	**Regular Samples*, Sample Duplicate, MS/MSD**
Client_Sample_ID	X	X	X	X	X	X
Collected		X		X		X
Matrix_ID	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
QC_Type	X	Q	X	Q	X	X
Shipping_Batch_ID		X		X		X
Temperature		X				X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Preparation_Type	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Prepared	A	A	X	X	N	N
Analyzed	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
QC_Level	X	X	X	X	X	X
Results_Basis		S		S		S
Total_Or_Dissolved			W	W		
Dilution	X	X	X	X	X	X
Handling_Type	L	L	L	L	L	L
Handling_Batch	L	L	L	L	L	L
Leachate_Date	L	L	L	L	L	L
Percent Moisture		S		S		S
Method_Batch	X	X	X	X	X	X
Preparation_Batch	X	X	X	X	X	X
Run_Batch	C	C	C	C	C	C
Analysis_Batch	C	C	C	C	C	C
Lab_Reporting_Batch	X	X	X	X	X	X
Lab_Receipt		X		X		X
Lab_Reported	X	X	X	X	X	X

Key

X	Required field
A	Required field for samples prepared by methanol extraction
C	Required field if Instrument Calibration Table (A2) is included in EDD
L	Required field if analysis performed on SPLP, TCLP, or WET extracts
N	Required field only for samples that require preparation before analysis
Q	Required field for Sample Duplicate, MS, and MSD only
S	Required field if “Matrix_ID” = “SO” or “SED”
W	Required field for aqueous samples only
*	Includes Trip Blanks, Equipment Blanks, and Field Blanks

Reviewed EDD Export File Specifications - Analytical Results (A1)
Comma Delimited Text File

Order	Field Name*	Field Description
1	RecordID	Record number.
2	ClientSampleID	Client field sample identifier.
3	LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 6010B, etc.).
4	AnalysisType	Defines type of analysis (i.e. dilution, reanalysis, etc.).
5	LabSampleID	Internal laboratory sample tracking number for samples and lab generated QC.
6	LabID	Identifier of laboratory performing the analysis.
7	ClientAnalyteID	CAS number or unique analyte identifier.
8	AnalyteName	Chemical name for analyte.
9	Result	Reportable result for the analyte.
10	ResultUnits	Units of measure for the result (i.e. mg/Kg, ug/L, etc.).
11	LabQualifiers	A string of letter or symbol qualifiers assigned by the lab based on contractor defined rules and values.
12	DetectionLimit	Detection limit for the analyte being measured.
13	DetectionLimitType	Specifies the type of detection limit (i.e. MDL, IDL, etc.).
14	RetentionTime	The time expressed in decimal minutes between injection and detection for GC/MS TICs only.
15	AnalyteType	Defines the type of result such as surrogate, spike, or target analyte.
16	PercentRecovery	The percent recovery of a spiked QC compound such as a matrix spike, LCS spike, or surrogate.
17	RelativePercentDifference	RPD between to QC results such as MS/MSD.
18	ReportingLimit	Analyte reporting limit.
19	ReportingLimitType	Defines the type of reporting limit (PQL, CRQL, etc.).
20	ReportableResult	(YES or NO) Indicates which result is the useable result when results from two or more analyses for the same sample and method (ie dilutions, reanalyses, etc) are reported in the EDD.
21	**Filename**	File name of the EDD. The same as the LabReportingBatch in the Sample Analysis table (A3).
22	**DVModifiedConcentration**	ADR modified analyte result due to blank contamination.
23	**DVQualTemperature**	Data review qualifier for temperature outlier.
24	**DVQualPreservation**	Data review qualifier for preservation anomaly.
25	**DVQualHTSamplingToAnalysis**	Data review qualifier for holding time violation from sampling time to analysis time.
26	**DVQualHTSamplingToExtraction**	Data review qualifier for holding time violation from sampling time to extraction.
27	**DVQualHTExtractionToAnalysis**	Data review qualifier for holding time violation from extraction time to analysis time.
28	**DVQualHoldingTime**	Overall data review qualifier for holding time violation.
29	**DVQualMethodBlanks**	Data review qualifier for contamination in an associated method blank.
30	**DVQualSurrogateRecovery**	Data review qualifier for surrogate recovery outlier.
31	**DVQualMS**	Overall data review qualifier for associated MS and MSD recovery and/or RPD outlier.
32	**DVQualMSRecovery**	Data review qualifier for MS and/or MSD recovery outlier.
33	**DVQualMSRPD**	Data review qualifier for MS/MSD RPD .outlier.
34	**DVQualLCS**	Overall data review qualifier for LCS and LCS recovery and/or RPD outlier.
35	**DVQualLCSRecovery**	Data review qualifier for associated LCS and/or LCSD recovery outlier.
36	**DVQualLCSRPD**	Data review qualifier for LCS/LCSD RPD outlier.
37	**DVQualRepLimits**	Data review qualifier for result reported below the reporting limit.
38	**DVQualReportingLimits**	Data review comment (“OutX”) when reporting limit exceeds the project reporting limit.
39	**DVQualFieldQC**	Overall data review qualifier for Field QC.
40	**DVQualFieldBlank**	Data review qualifier for contamination in an associated Field Blank.
41	**DVQualEquipmentBlank**	Data review qualifier for contamination in an associated Equipment Rinsate or Equipment Blank.
42	**DVQualTripBlank**	Data review qualifier for contamination in an associated Trip Blank.
43	**DVQualFieldDuplicate**	Data review qualifier for an associated Field Duplicate RPD outlier.
44	**DVQualIC**	Overall data review qualifier for associated initial calibration outliers.
45	**DVQualInitialCalibrationRRF**	Data review qualifier for an associated initial calibration relative response

Order	Field Name*	Field Description
		factor outlier.
46	**DVQualInitialCalibrationRSD**	Data review qualifier for an associated initial calibration relative percent difference outlier.
47	**DVQualInitialCalibrationCC**	Data review qualifier for an associated initial calibration corrrelation coefficient outlier.
48	**DVQualICV**	Overall data review qualifier for an associated initial calibration verification.
49	**DVQualInitialCalibration VerificationRRF**	Data review qualifier for an associated initial calibration verification relative response factor outlier.
50	**DVQualInitialCalibration VerificationPD**	Data review qualifier for an associated initial calibration verification percent difference outlier.
51	**DVQualCCV**	Overall data review qualifier for associated continuing calibration outliers.
52	**DVQualContinuingCalibration VerificationRRF**	Data review qualifier for an associated continuing calibration relative response factor outlier.
53	**DVQualContinuingCalibration VerificationPD**	Data review qualifier for an associated continuing calibration percent difference outlier.
54	**DVQualOverall**	Overall data review qualifier for all QC and calibration qualifiers.
55	**TagLabSampleID (see comment)**	Temporary placeholder.
56	**TagDetQual01 (see comment)**	Temporary placeholder.
57	**TagNonDetQual01 (see comment)**	Temporary placeholder.
58	**TagDetQual02 (see comment)**	Temporary placeholder.
59	**TagNonDetQual02 (see comment)**	Temporary placeholder.
60	**surDVQualDet (see comment)**	Temporary placeholder.
61	**surDVQualNonDet (see comment)**	Temporary placeholder
62	**DVQualInstrumentPerformance CheckRunBatch**	Data review qualifier for GC/MS Tune outlier related to initial calibration.
63	**DVQualInstrumentPerformance CheckAnaBatch**	Data review qualifier for GC/MS Tune outlier related to continuing calibration.
64	**DVQualIPC**	Overall data review qualifier for GC/MS tune outliers.
65	**DVQualLabDup**	Data review qualifier for RPD outlier in laboratory duplicate.
66	**DVQualCode**	User-defined Reason Code
67	**FieldDupRPD**	RPD calculated from Field duplicate and parent sample
68	**DVQualMergedQualifier**	Merged lab and data review qualifiers
69	**DVQualMergedResult**	Final result (modified concentration if applicable)
70	**DVQualPercMoi**[1]	Data review qualifier for percent moisture
71	**DVQualLabDupNR**[1]	Data review qualifier for laboratory duplicate not reported
72	**DVQualLcsNR**[1]	Data review qualifier for laboratory control sample(s) not reported
73	**DVQualDissTotDiff**[1]	Data review qualifier for dissolved and total fraction differing by more than 10%
74	**Error**	Radiochemistry error
75	**DVQualSampleDupCount**[1]	Data review qualifier for sample count being >20 in a duplicate batch
76	**DVQualMsSampleCount**[1]	Data review qualifier for sample count being >20 in a matrix spike batch
77	**DVQualLcsCount**[1]	Data review qualifier for sample count being >20 in a laboratory control sample batch
78	**DVQualMbMissing**[1]	Data review for missing method blank
79	**DVQualPercMoiDissTotDiff**[1]	Combined data review qualifier for percent moisture and total vs dissolved difference outliers
80	**DVQualInternalStandard**[2]	Data review qualifier for internal standard outlier
81	**DVQualCalibrationBlank**[2]	Data review qualifier for calibration blank contamination
82	**DVQualRcm**[2]	Data review qualifier for resolution check mixture problem
83	**DVQualPem**[2]	Data review qualifier for performance evaluation mixture problem
84	**DVQualProfessionalJudgement**[2]	Data review qualifier for any reason deemed necessary by data-review chemist
85	**DOD_MDL**	Method detection limit for QSM 4.2

Comment: Fields that contain temporary placeholders hold information contributed during the review process that is used in generating reports. This information is kept with the output file so that if the file is ever imported back into the application, reports can be generated without having to rerun the review module.

* Field Names in bold font are added to the EDD during review and included in the exported reviewed EDD file

[1] Data review qualifiers in these cases are added for EPA Region II assessment. ADR.Net does not currently perform EPA Region II assessment.

[2] Data review qualifiers in these cases are added manually by the user and not assessed by automated data review.

Reviewed EDD Export File Specifications - Sample Analysis (A3)
Comma Delimited Text File

Order	Field Name*	Field Description
1	RecordID	Record number.
2	ProjectNumber	Project Number assigned by client.
3	ProjectName	Project Name assigned by client.
4	ClientSampleID	Client field sample identifier.
5	Collected	Date and time sample was collected.
6	MatrixID	Sample matrix.
7	LabSampleID	Internal laboratory sample tracking number for samples and lab generated QC.
8	QCType	Identifies the type of quality control sample, regular field samples are null.
9	ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport field samples.
10	Temperature	Temperature in degrees C of the samples as received in the lab.
11	LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 6010B, etc.).
12	**PreparationType**	Preparation method number (i.e. 3010A, 3510C, etc.).
13	**AnalysisType**	Defines type of analysis (i.e. dilution, reanalysis, etc.).
14	**Prepared**	Date and time of sample preparation/extraction.
15	**Analyzed**	Date and time of sample analysis.
16	**LabID**	Identifier of laboratory performing analysis.
17	**QCLevel**	Level of analytical QC associated with analysis (i.e. Level III, etc.).
18	**ResultBasis**	Indicates if a result is expressed as wet or dry.
19	**TotalorDissolved**	Indicates if a result is expressed as total or dissolved (for metals only).
20	**Dilution**	Sample dilution during analysis.
21	**HandlingType**	Type of leaching procedure, if applicable (i.e. SPLP, TCLP, etc.).
22	**HandlingBatch**	Unique laboratory identifier for a batch of samples prepared together for a leaching procedure.
23	**LeachateDate**	Date and time of leaching procedure.
24	**PercentMoisture**	Percent moisture of sample.
25	**MethodBatch**	Unique laboratory identifier for a batch of samples with similar matrix and analyzed together by one method. Links samples to matrix spikes and duplicates.
26	**PreparationBatch**	Unique laboratory identifier for a batch of samples prepared together for analysis by one method. Links samples with method blanks and laboratory control samples.
27	**RunBatch**	Unique laboratory identifier for a batch of analyses performed on one instrument under the control of on an initial calibration. Links the initial calibration to associated samples.
28	**AnalysisBatch**	Unique laboratory identifier for a batch of analyses performed on one instrument under the control of a continuing calibration. Links continuing calibrations to associated samples.
29	**LabReportingBatch**	Unique laboratory identifier for a batch of samples, QC, and calibration standards reported as a group by the lab (i.e. order number, SDG #, etc.).
30	**LabReceipt**	Date samples received in laboratory.
31	**LabReported**	Date laboratory hardcopy submitted.
32	DataReviewCompany**	Company running the automated review software.
33	DataReviewDate	Date and time EDD was validated.
34	ValidatedBy**	Person running the automated review.
35	ValidationDate**	Date and time when automated data review qualifiers were reviewed
36	ApprovedBy**	Person performing secondary review of data review flags.
37	ApprovalDate**	Date and time of secondary review by "ApprovedBy".
38	FileName	File name of EDD (same as LabReportingBatch).
39	TagLabSampleID (see comment)	Temporary place holder.
40	TagDetQual (see comment)	Temporary place holder.
41	TagNonDetQual (see comment)	Temporary place holder.
42	TempFlag (see comment)	Temporary place holder.
43	LabMethodCategory	The category of the method, used by EDMS

Comment: Fields that contain temporary placeholders hold values created during the validation process. These values are used in generating reports. This information is kept with the output file so that if the file is ever imported back into the application, reports can be generated without having to rerun the validation module.

* Field Names in bold font are added to the EDD during automated data review and included in the exported data-reviewed EDD file

**Automated data review does not update these fields with any information but these fields are still part of the exported data-reviewed file. These fields may be populated manually by the user from various forms in the application prior to exporting.

*** Date/Time format: MM/DD/YYYY hh:mm

Qualifiers Applied During Data Validation

Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result was an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been "tentatively identified" or "presumptively" as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

ADR Data Qualification Table

Description	VOA	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Difference Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Difference Lower Rejection	J-	X
Continuing Calibration Verification Percent Difference Upper Estimation	J+	
Continuing Calibration Verification Percent Difference Upper Rejection	J+	No qual
Continuing Calibration Verification Relative Response Factor	J	UJ
Continuing Tune	J	X
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	X
Field Blank Contamination	U	
Initial calibration Correlation Coefficient	J	UJ
Initial Calibration Percent Relative Standard Deviation	J	UJ
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Difference Lower Estimation	J-	UJ
Initial Calibration Verification Percent Difference Lower Rejection	J-	X
Initial Calibration Verification Percent Difference Upper Estimation	J+	
Initial Calibration Verification Percent Difference Upper Rejection	J+	No qual
Initial Calibration Verification Relative Response Factor	J	UJ
Initial Tune	J	X
Internal Standard Estimation	J	UJ
Internal Standard Rejection	J	X
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	X
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	No qual
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	X
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	No qual
Method Blank Contamination	U	
Preservation	J-	UJ
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	X
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	X
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	X
Surrogate Recovery Lower Estimation	J-	UJ
Surrogate Recovery Lower Rejection	J-	X
Surrogate Recovery Upper Estimation	J+	
Surrogate Recovery Upper Rejection	J+	No qual
Temperature Estimation	J-	UJ
Temperature Rejection	J-	X
Trip Blank Contamination	U	

Description	Metals	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Recovery Lower Rejection	J-	X
Continuing Calibration Verification Percent Recovery Upper Estimation	J+	
Continuing Calibration Verification Percent Recovery Upper Rejection	X	No qual
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	X
Field Blank Contamination	U	
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Initial Calibration Verification Percent Recovery Lower Rejection	J-	X
Initial Calibration Verification Percent Recovery Upper Estimation	J+	
Initial Calibration Verification Percent Recovery Upper Rejection	X	No qual
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	X
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	No qual
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	X
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	
Method Blank Contamination	U	
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	X
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	X
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	X
Trip Blank Contamination	U	

Description	GenChem	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Recovery Lower Rejection	J-	X
Continuing Calibration Verification Percent Recovery Upper Estimation	J+	
Continuing Calibration Verification Percent Recovery Upper Rejection	X	
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	X
Field Blank Contamination	U	
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Initial Calibration Verification Percent Recovery Lower Rejection	X J-	X
Initial Calibration Verification Percent Recovery Upper Estimation	J+	
Initial Calibration Verification Percent Recovery Upper Rejection	X	
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	X
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	X
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	X
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	X
Method Blank Contamination	U	
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	X
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	X
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	X
Trip Blank Contamination	U	

ATTACHMENT G

Responses to Comments on the Draft QAPP submitted by the United States Environmental Protection Agency, Region IX

Responses to Comments on the Draft QAPP submitted by the U.S. Environmental Protection Agency (USEPA)[1]

GENERAL COMMENTS

General Comment 1: The numbering of sections and worksheets throughout the Draft QAPP is confusing as the section numbers are not consistent with the worksheet numbers (e.g., Section 7.0 is Worksheet #10 and includes Sections 7.1, 7.2, etc.). It would be helpful to QAPP readers if the sections and worksheets were numbered consistently (e.g., Worksheet #10 is also Section 10.0, 10.1, 10.2, etc.). Please consider revising the section numbers throughout the Draft QAPP to be consistent with the worksheet numbers.

Response to General Comment 1: *The discrepancy between section numbers and worksheet numbers is acknowledged, but the section numbers cannot be revised. The Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix E Preliminary Draft Revision 0, Site Inspection for Per- and Polyfluoroalkyl Substances (PFAS SI Work Plan/QAPP) was prepared per the* Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets*; therefore, many worksheets are combined (e.g., Worksheet #4, 7, and 8), which does not allow the section numbering to be the same as worksheet numbering. Additionally, the section and subsection numbering format is consistent with other former Fort Ord QAPPs approved by the U.S. Environmental Protection Agency (USEPA) and is useful for navigating the PFAS SI Work Plan/QAPP given the amount of information presented.*

General Comment 2: According to Section 7.3.1 of the Draft QAPP, effluent from the Main Garrison Sewerage Treatment Plant was discharged into a storm drain that emptied onto Indian Head Beach during low tide and directly into Monterey Bay during high tide. Since the Sewerage Treatment Plant operated from the 1930s through 1990, per- and polyfluoroalkyl substances (PFAS) may have been contained in the sewerage effluent and impacted the beach and sediments of Monterey Bay. Please provide a rationale why sampling of soil and sediment near the effluent discharge was omitted from the Draft QAPP.

Response to General Comment 2: *It is unlikely residual PFAS remains in soil on Indian Head Beach because:*

- *There has been no discharge of treated wastewater at this location since at least 1990.*
- *There has been ongoing beach erosion during the Main Garrison Sewage Treatment Plant (STP) operational period (1930s to 1990) and since the STP discontinued operations in 1990. The southern Monterey Bay has the highest coastal erosion rates in the state of California for at least the last century, averaging about 4 feet per year.*[2]

Ponding Area 1 is relatively protected from erosional forces and soil samples from this location are therefore expected to be representative for evaluating potential historical PFAS discharges from the Main Garrison STP, whereas soil samples from Indian Head Beach would not be representative for the reasons listed above. PFAS SI Work Plan/QAPP Section 13.1.1 was revised to include this information.

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[1] In a letter dated May 24, 2022 (see Administrative Record No. BW-2912.2). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

[2] https://www.montereyherald.com/2020/11/14/closing-the-cemex-plant-the-sands-will-be-shifting/

General Comment 3: Four Marina Coast Water District (MCWD) drinking water supply wells (Wells # 29 through 31 and #34) are located near the areas of investigation; however, in many cases distances are not provided in the text. For example, Section 7.5.3 of the Draft QAPP states the drinking water supply wells are located downgradient of Site 10, but no distances are provided. In Section 7.5.3 and all other applicable sections, please include the distances of the wells from the respective sites.

Response to General Comment 3: *PFAS SI Work Plan/QAPP Section 7.5 was revised per the comment. Please note that MCWD drinking water supply wells and site locations are depicted in Figure 2, which includes a bar scale so that distances between points on the figure can be measured.*

General Comment 4: Depth to groundwater is not consistently described in the Draft QAPP. For example, in Section 7.5.3, depth to groundwater is expressed in feet above mean sea level (msl), but in Section 7.5.2, depth to groundwater is described as feet below ground surface (bgs). Please revise the applicable text to be consist in describing depth to groundwater.

Response to General Comment 4: *Descriptions of depth to groundwater in the PFAS SI Work Plan/QAPP were reviewed and revised for consistency as appropriate; however, in parts of the text, depth to groundwater with respect to ground surface or groundwater elevation with respect to MSL is contextually appropriate and was not revised.*

General Comment 5: Worksheet #17 (Sampling Design and Rationale) of the Draft QAPP states that soil samples will be collected from 5 and 10 feet bgs using a hand auger; however, the soil sampling procedure is not discussed in Worksheet #17. Please revise Worksheet #17 to include a brief description of soil sampling procedures using a hand auger.

Response to General Comment 5: *The soil sampling procedure is described in Attachment A, SOP 103. PFAS SI Work Plan/QAPP Section 13.2 was revised to clarify that soil samples will be collected using a hand auger and to reference SOP 103.*

SPECIFIC COMMENTS

Specific Comment 1. Section 3.0, Worksheet #3 and 5, Project Organization and QAPP Distribution, Page 6: Reporting relationships are not always clear in the project organization chart. For example, there is a line of communication from the Ahtna field supervisor to the laboratory project manager and the Ahtna quality control (QC) manager but no lines of communication or authority to any other project personnel. As such, it is unclear why there is no reporting relationship between the Ahtna field supervisor and the Ahtna project chemist and project manager. Please revise the project organization chart to clarify reporting relationships between all project personnel.

Response to Specific Comment 1: *Worksheet #3 & 5 was revised to add a line of authority between the Ahtna Global, LLC (Ahtna) field supervisor and the Ahtna project manager and to include the database manager and GIS manager per Specific Comment 2. Otherwise, Worksheet #3 & 5 is consistent with other former Fort Ord QAPPs approved by the USEPA and the lines of authority and lines of communication presented are understood by the individuals identified on the worksheet.*

Specific Comment 2. Section 3.0, Worksheets #3 and #5, Project Organization and QAPP Distribution, Page 6, and Section 4.0, Worksheets #4, #7, and #8, Personnel Qualifications and Sign-Off Sheet, Pages 7 and 8: Some individuals are identified in Worksheets #4, #7, and #8 who are not identified in

Worksheets #3 and #5, and therefore, their roles on this project are unclear (i.e., Holly Dillon, Ahtna Task Lead, Michael Eger, SGS General Manager, and Norman Farmer, SGS Corporate Technical Director). In addition, Section 11.4 (Data Management Tasks) in Worksheets #14 and #16 (Project Tasks and Schedule) discusses the responsibilities of the database manager and geographic information system (GIS) manager, but these individuals are not identified in Worksheets #3 and #5 or Worksheets #4, #7, and #8. In accordance with Section 2.3 (Distribution List and Project Personnel Sign-Off Sheet) of the Uniform Federal Policy for Quality Assurance Project Plans Manual, dated March 2005 (UFP-QAPP Manual), a complete copy of the QAPP should be sent to all key project personnel, and all key project personnel should sign-off that they have read the applicable sections of the QAPP and will perform the tasks as described. Please revise these worksheets to identify all key project personnel, and ensure that all key project personnel sign-off that they have read the applicable sections of the QAPP and will perform the tasks as described.

Response to Specific Comment 2: *Michael Eger and Norman Farmer are not key project personnel and were deleted from the PFAS SI Work Plan/QAPP. Holly Dillon was removed from the PFAS SI Work Plan/QAPP as a Task Lead but was added to Worksheet #6 as the Ahtna Site Safety and Health Officer. Worksheet #3 & 5 and Worksheet #4, 7 & 8 were revised to include the database manager and GIS manager. Per the Optimized UFP-QAPP Worksheets, Worksheet #3 & 5 serves to identify key project personnel that will receive a copy of the PFAS SI Work Plan/QAPP and to demonstrate the relationships between organizations, and Worksheet #4, 7, & 8 identifies key project personnel for each organization performing tasks defined in the PFAS SI Work Plan/QAPP. As such, Worksheet #4, 7 & 8 must only include key project personnel from the prime contractor (Ahtna) and the laboratory (SGS North America, Inc. [SGS]), and does not need to include all key project personnel within each organization identified in Worksheet #3 & 5.*

Specific Comment 3. Section 5.0, Worksheet #6, Communication Pathways, Pages 9 and 10: This worksheet is insufficiently detailed. Examples of insufficient information include, but may not be limited to, the following:

a. This worksheet does not always indicate the form of communication or timeframe for notification. For example, the procedure for QAPP changes in the field states, “Ahtna Project Manager will be notified of proposed field changes to the QAPP and will notify the USACE [U.S. Army Corps of Engineers] Technical Lead and USACE Project Chemist prior to implementation.” However, it is unclear how (e.g., phone or email) or when (e.g., within 24 hours) this notification should occur.
b. It appears that some communication may occur via email; however, email addresses are not provided in the Draft QAPP for all key project personnel.
c. This worksheet does not discuss all communication drivers. For example, there are no procedures for approving amendments to the QAPP or stopping work due to health and safety issues.
d. The procedure for QAPP changes in the field states, “Ahtna Project Manager will be notified of proposed field changes to the QAPP and will notify the USACE Technical Lead and USACE Project Chemist prior to implementation.” Similar procedures are described for changes to the QAPP on page 10; however, QAPP changes should be submitted to the regulatory agencies for review and comment prior to implementation.

e. Footnote (1) indicates that regulatory agencies will be notified of significant corrective actions within 30 days of the event or during the next scheduled Base Realignment and Closure (BRAC) Cleanup Team; however, regulatory agencies should be notified of significant corrective actions more quickly, especially if the corrective action results in changes to the QAPP.

Please revise Worksheet #6 to include sufficient information to ensure successful communication during all phases of the project.

> ***Response to Specific Comment 3a:*** *PFAS SI Work Plan/QAPP Section 5.0, Worksheet #6 was revised per the comment.*
>
> ***Response to Specific Comment 3b:*** *PFAS SI Work Plan/QAPP Section 5.0, Worksheet #6 was revised per the comment.*
>
> ***Response to Specific Comment 3c:*** *Worksheet #6 was revised for consistency with the Optimized UFP-QAPP Worksheets.*
>
> ***Response to Specific Comment 3d:*** *For consistency with the Optimized UFP-QAPP Worksheets, Worksheet #6 was revised to include the communication drivers "QAPP changes prior to fieldwork" and "QAPP changes during project execution." For QAPP changes prior to fieldwork, the procedure was revised to include submittal to the regulatory agencies for review and comment. The notification process for QAPP changes during project execution, as outlined in Worksheet #6, is consistent with other former Fort Ord QAPPs that the regulatory agencies have approved. This process was developed for the former Fort Ord because, in most cases, it is logistically difficult or impossible to suspend fieldwork to allow for regulatory agency review and comment prior to implementation of a QAPP change. Accordingly, QAPP changes or deviations are typically reported to the regulatory agencies during the next scheduled Fort Ord Base Realignment and Closure (BRAC) Cleanup Team (BCT) meeting or in the relevant draft report documenting field activities, whichever comes first.*
>
> ***Response to Specific Comment 3e:*** *This notification timeline described in Note 1 to Worksheet #6 is consistent with other former Fort Ord QAPPs that have been approved by the regulatory agencies. The PFAS SI Workplan/QAPP was not revised per the comment.*

Specific Comment 4. Section 5.0, Worksheet #6, Communication Pathways, Page 10, and Attachment B, Field Documentation Forms: The procedure for changes to the QAPP indicates that significant changes to the QAPP must be documented in a Field Change Request; however, the Field Change Request form is not provided in Attachment B. Please revise the Draft QAPP to ensure all field forms that may be used during the project are provided in Attachment B.

Response to Specific Comment 4: *There is no Field Change Request form per se. The PFAS SI Workplan/QAPP Worksheet #6 was revised to clarify that significant changes to the QAPP must be documented and approved by the Ahtna Project Manager, USACE Technical Lead, and USACE Project Chemist via email correspondence that includes "Field Change Request" in the subject line prior to implementation.*

Specific Comment 5. Section 6.0, Worksheet #9, Project Planning Session Summary, Page 14: The consensus of the June 22, 2021 project scoping conference call was that eight new monitoring wells will be installed; however, Worksheet #18 lists five new monitoring wells. Please include a statement about why the number of new monitoring wells reduced from eight to five.

Response to Specific Comment 5: *The consensus decisions made during the June 22, 2021 conference call were to install five new A-Aquifer monitoring wells and one new Upper 180-Foot Aquifer monitoring well for a total of six new wells, not eight. Since then, it was determined only four new A-Aquifer monitoring wells are needed, for a total of five new monitoring wells. Worksheet #9 was revised to include summaries of additional planning sessions where critical decisions were made, including the change from five to four new A-Aquifer monitoring wells.*

Specific Comment 6. Section 6.0, Worksheet #9, Project Planning Session Summary, Page 14: The consensus of the June 22, 2021 project scoping conference call was a total of ten 10-foot soil borings will be advanced; however, in Worksheets #11 and #18, twelve 10-foot soil borings are listed. Please revise the Draft QAPP to clarify why the number of 10-foot soil borings increased from 10 to 12.

Response to Specific Comment 6: *Worksheet #9 was revised to include summaries of additional planning sessions where critical decisions were made, including the change from ten to twelve 10-foot soil borings.*

Specific Comment 7. Section 7.3.6, Worksheet #10, Conceptual Site Model, Fritzsche Army Airfield Fire Drill Area, Page 20: Groundwater remediation by pump and treat was conducted but it is unclear where the treated water discharged or whether PFAS could have been removed (e.g., by granular activated carbon [GAC]). PFAS contamination could be associated with the area where treated groundwater was discharged. Please revise the text to discuss the treatment method, where the treated groundwater was discharged, and consider whether additional groundwater sampling is necessary near the discharge area.

Response to Specific Comment 7: *Groundwater remediation using pump and treat systems with GAC was conducted from 1988 through 2014 at the former Operable Unit 1 (OU1), which included the Fritzsche Army Airfield (FAAF) Fire Drill Area (FDA). Treated water from OU1 was discharged at different locations within OU1 depending on the specific treatment system that was in operation at the time. Treated water discharge facilities included two infiltration trench areas in the Fort Ord Natural Reserve (FONR), one infiltration basin in the OU1 Off-Post Area (Armstrong Ranch to the northwest of the FONR), two injection wells in the FONR, and a spray irrigation system in the former FAAF FDA. Treatment facilities at OU1 utilized GAC to remove several chemicals of concern (COC), though PFAS were not COCs and were not monitored during OU1 operations. However, sampling and analysis for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) at the Operable Unit 2 (OU2) groundwater treatment plant in 2019 demonstrated that GAC was effective at removing PFAS (see Administrative Record No. BW-2904A). In 2015, samples were collected at OU1 for PFOA and PFOS analysis and the results did not indicate the discharge facilities were a source of PFAS in groundwater (see Administrative Record No. OU1-631A). Based on site history and the results of the sampling for PFOA and PFOS at OU1 in 2015 and at OU2 in 2019, the three proposed groundwater sampling points downgradient of the FAAF FDA are sufficient to determine if PFAS releases occurred at the former FAAF FDA and no additional groundwater sampling is necessary near the discharge areas for the purposes of the SI. The PFAS SI Workplan/QAPP was revised to include this information.*

Specific Comment 8. Section 7.5.1, Worksheet #10, Conceptual Site Model, Contaminant Transport Model, Page 21: The text states that the PFAS in aqueous film-forming foam (AFFF) are not volatile, but that may not be true, depending on the specific constituents in AFFF, including fluorotelomer precursors discussed later in this section. While perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are not volatile, fluorotelomer alcohols (FTOHs) and some shorter chain (C4) compounds have been demonstrated to be volatile. Also, based on the Status of EPA Research and Development on PFAS website (https://www.epa.gov/chemical-research/status-epa-research-and-development-pfas), a United States Environmental Protection Agency (USEPA) report on subsurface migration potential of PFAS into buildings and residences is expected in 2022. Please revise the text to discuss the potential that volatile PFAS compounds are present in AFFF.

Response to Specific Comment 8: *The text does not state that PFAS in AFFF are not volatile, but that most of the major PFAS releases of concern at U.S. Department of the Army (Army) installations are likely to contain a variety of PFAS that do not volatilize. Regardless, discussion about potentially volatile PFAS in AFFF is not relevant to the SI because Fort Ord closed in 1994 and any PFAS releases to the air due to Army operations while Fort Ord was an active installation would have dispersed and no longer pose an unacceptable threat to human health or the environment via the air pathway (Administrative Record No. BW-2904A). The PFAS SI Workplan/QAPP was not revised per the comment.*

Specific Comment 9. Section 7.5.2, Site 2: Main Garrison Sewage Treatment Plant Potential Receptors and Exposure Pathways, Worksheet #10, Page 22: The Hydrogeologic Setting subsection states that pumping testing results for the Upper 180-foot Aquifer does not influence the Lower 180-foot Aquifer; however, the text does not mention if a pump test was conducted on the Lower 180-foot Aquifer. Please revise the text to discuss whether any pump tests have been conducted on the Lower 180-foot Aquifer and if any have been conducted, please include the results.

Response to Specific Comment 9: *Pump tests were not conducted in the Lower 180-Foot Aquifer in the Site 2 area, though the Lower 180-Foot Aquifer was monitored during pump testing in the Upper 180-Foot Aquifer. PFAS SI Workplan/QAPP Section 7.5.2 was revised to include this information.*

Specific Comment 10. Section 7.5.2, Site 2: Main Garrison Sewage Treatment Plant Potential Receptors and Exposure Pathways, Worksheet #10, Page 24: The Potential Soil Targets subsection states that the Main Garrison Sewage Treatment Plant Site is part of the Fort Ord Dunes State Park, and currently, access is restricted based on habitat restriction efforts; however, it is unclear how access is being restricted (e.g., fence) and if access to the site will change after habitat restoration is complete. Please include text discussing how access is restricted and if future access will change after habitat restoration efforts resulting in a potential for human exposure.

Response to Specific Comment 10: *Access to Site 2 by the general public is restricted by signage and fencing. It is expected that this area will remain a habitat reserve after habitat restoration is complete and general public access to the site will remain restricted. PFAS SI Workplan/QAPP Section 7.5.2 was revised per the comment.*

Specific Comment 11. Section 7.5.6, Main Garrison Fire Station Potential Receptor and Exposure Pathways, Worksheet #10, Page 31: The Potential Soil Targets subsection states that the site worker population is a potential receptor; however, according to Section 7.6.5, the Main Garrison Fire Station site is zoned for mixed use, including residential therefore, future receptors may include residents. Please include a discussion of future potential residential receptors at the Main Garrison Fire Station. In addition, please update Figure 14 since future residents may come into contact with soil.

Response to Specific Comment 11: *PFAS SI Workplan/QAPP Section 7.5.6 and Figure 14 were revised per the comment; however, a pathway to potential future residential receptors appears unlikely. The Main Garrison Fire Station and Site 10 are within a designated commercial center that is part of the larger commercial mixed-use (CMX) Campus Town development. Per the Campus Town specific plan, residential use is permitted but would be limited to levels above commercial spaces (second floor or higher) and the Main Garrison Fire Station and Site 10 area will be hardscaped (i.e., there are no expected exposure points for residential receptors).[3] The PFAS SI Workplan/QAPP was revised to include this information.*

Specific Comment 12. Section 7.5.6, Main Garrison Fire Station Potential Receptor and Exposure Pathways, Worksheet #10, Page 31: The Potential Soil Targets subsection states that the site worker population is a potential receptor; however, fire fighters working on call at the fire station may spend 24 to 48 hours at the fire station per shift, and may be considered residential receptors; therefore, current receptors at the site may include residents. Please include a discussion of the potential for on-site fire fighters to be considered residential receptors at the Main Garrison Fire Station.

Response to Specific Comment 12: *Firefighters are not considered to be residential receptors. Per the USEPA Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual (Part A) (RAGS), a reasonable maximum daily exposure period for a worker is 8 hours (a typical work day), or 40 hours per week (a typical work week). The firefighters at the Main Garrison Fire Station (now the Presidio of Monterey Fire Station at the Ord Military Community) are Department of Defense (DoD) employees and therefore have a regular tour of duty consisting of three 24-hour shifts per week (72 hours per week).[4] While this is more hours per week than the typical worker, according to RAGS a maximum daily exposure period for a resident of 24 hours (168 hours per week) is possible and the exposure duration is assumed to be 30 years, or up to a lifetime exposure of 70 years in some cases, when calculating reasonable maximum residential exposures.[5] Conversely, the career of a firefighter in federal service can be reasonably assumed to be 20 years or less due the physically demanding aspects of the profession and federal requirements for maximum entry age and mandatory separation based on age.[6] Additionally, per the USEPA Hazard Ranking System Guidance Manual, a worker is defined as a person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination, and a resident is defined as a person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center is on or within 200 feet of the area of observed contamination.[7] Based on the USEPA guidance and federal requirements, firefighters are considered to be workers and cannot be reasonably characterized as residential receptors. The PFAS SI Workplan/QAPP was revised to include this information.*

Specific Comment 13. Section 7.5.8, OU2: Fort Ord Landfills Potential Receptors and Exposure Pathways, Worksheet #10, Page 36: The Potential Soil Targets subsection states that one source of PFAS in soil at the Fort Ord Landfill is from the discharge of AFFF to extinguish historical fires and is limited to the footprint of the landfills; however, the text does not discuss the possibility that an AFFF/water mixture may have flowed into uncapped areas within Operable Unit 2 (OU2) and areas surrounding the

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[3] https://www.ci.seaside.ca.us/DocumentCenter/View/10703/Attachment-5a---Campus-Town-Specific-Plan-Book
[4] https://www.dcpas.osd.mil/sites/default/files/2021-04/FederalFirefighterPay.pdf
[5] https://www.epa.gov/sites/default/files/2015-09/documents/rags_a.pdf
[6] https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/140025/140025_vol336.pdf
[7] https://semspub.epa.gov/work/HQ/100002484.pdf

landfill. Please evaluate the possibility of PFAS impacts to surface soil within OU2 and surrounding the landfills in the text.

Response to Specific Comment 13: *As described in Section 7.3.7, the discharge of AFFF at the OU2 Fort Ord Landfills to extinguish fires occurred in the 1970s or 1980s and the engineered cover system was constructed from 1997 to 2002. Prior to this, the cover system for the OU2 Fort Ord Landfills consisted only of the native sandy soil; therefore, an AFFF/water mixture discharged at the Landfills would have been quickly absorbed due to the high permeability of soils at the former Fort Ord and PFAS impacts to surface soil in the area surrounding the OU2 Fort Ord Landfills due to surface water runoff is unlikely. PFAS SI Workplan/QAPP Section 7.5.8 was revised for clarification.*

Specific Comment 14. Section 8.3, Step 3: Identify Information Inputs, Worksheet #11, Page 40: The text states that soil samples will be collected from soil borings; however, no proposed sample depths are provided. Please include the proposed sample depth for soil sampling in the text.

Response to Specific Comment 14: *Sample depths for soil sampling are identified in Worksheet #18b and do not need to be reiterated in Worksheet #11, which is consistent with the Optimized UFP-QAPP Worksheets. The PFAS SI Work Plan/QAPP was not revised per the comment.*

Specific Comment 15. Section 8.3, Step 3: Identify Information Inputs, Worksheet #11, Page 40: The text states that five monitoring wells will be installed; however, Section 8.7 states six monitoring wells will be installed. Please resolve this discrepancy.

Response to Specific Comment 15: *Section 8.7 was corrected to state that there will be five new groundwater monitoring wells. The PFAS SI Workplan/QAPP was reviewed and revised as needed to ensure the number of proposed groundwater monitoring wells is consistent throughout.*

Specific Comment 16. Section 8.5, Step 5: Develop the Analytic Approach, Proposed Study Question 1, bullet point two, Page 40: If the soil is coarse grained sand, it is possible that all of the PFAS has been flushed from soil; therefore, this decision rule may lead to a misleading conclusion. Please consider revising this decision rule to include the possibility of evaluating groundwater regardless if PFAS are detracted in soil, or provide a new decision rule for this case.

Response to Specific Comment 16: *Recent data regarding PFAS transport through the vadose zone indicates that the vertical mobility of PFAS compounds actually decreases with decreasing clay content. Additionally, sites with low levels of flushing (i.e., low precipitation), such as the former Fort Ord, exhibit higher than expected PFAS concentrations in the vadose zone soil relative to groundwater.*[8] *Based on the low clay content of the soils present at the former Fort Ord and the low flushing levels observed regionally, it is unlikely complete flushing of PFAS from site soil has occurred. The PFAS SI Workplan/QAPP was not revised per the comment.*

Specific Comment 17. Section 8.5, Step 5: Develop the Analytic Approach, Proposed Study Question 4: Is there a need for further Superfund action?, Worksheet #11, Page 41: The text states that samples will be compared to Department of Defense (DoD) screening levels to determine if further Superfund action will be recommended; however, it is unclear if samples will also be compared to EPA Regional Screening Levels (RSLs),which were updated in May 2022 to include five additional PFAS compounds,

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[8] Arcadis, 2019. Final PFAS Fate and Transport White Paper, Active Army Installations, Nationwide. July 7.

and EPA lifetime health advisories. Please clarify whether soil and groundwater results will be compared to RSLs and EPA lifetime health advisories, and if exceedances are detected, additional Superfund actions will be recommended.

Response to Specific Comment 17: *Please note the USEPA Regional Screening Levels (RSLs) were updated in May 2022, after the draft PFAS SI Workplan/QAPP was issued in April 2022. The PFAS SI Workplan/QAPP was revised to include the May 2022 RSLs for five PFAS and the June 2022 USEPA lifetime health advisory levels for four PFAS as project screening levels (PSLs).*

Specific Comment 18. Section 11.5, Project Schedule, Worksheet #14, Page 52: The project schedule shows the Baseline Habitat Survey will be completed by Mary 13, 2022; however, it appears the date needs to be changed since the review of the Draft QAPP has not been completed. Please revise the date of the Baseline Habitat Survey, and consider revising the dates of remaining activities contained in the schedule.

Response to Specific Comment 18: *Note that the project schedule is presented in Section 11.15. The Baseline Habitat Survey was completed on May 12, 2022 because, as noted in Section 13.10.4, the baseline survey must occur during the peak blooming period for Monterey gilia and Monterey spineflower. The rest of the schedule in Worksheet #14 &16, Section 11.15 was updated per the comment.*

Specific Comment 19. Section 13.1.6, FAAF Fire Drill Area, Worksheet #17, Page 60: The text states that three monitoring wells will be installed at the FAAF [Fritzsche Army Airfield] Fire Drill Area; however, according to Figure 6 and Worksheet #18a, only two wells will be installed at the FAAF Fire Drill Area. Please revise the text to refer to the installation of two new monitoring wells.

Response to Specific Comment 19: *PFAS SI Workplan/QAPP Section 13.1.6 was revised to state that two new monitoring wells will be installed at the FAAF FDA.*

Specific Comment 20. Section 13.1, Investigation Areas, Worksheet #17, Page 66 to 70: According to the text, the installation of seven wells is proposed, including one well at Site 10, two wells at Site 40A/FAAF Fire and Rescue, and three new wells at the FAAF area. However, according to Worksheet #18, and in other worksheets of the Draft QAPP, five wells will be installed. Please revise the Draft QAPP to clarify the number of wells that will be installed.

Response to Specific Comment 20: *The PFAS SI Workplan/QAPP was reviewed and revised as needed to ensure the number of proposed groundwater monitoring wells is consistent throughout.*

Specific Comment 21. Section 13.2.1, Sampling, Worksheet #17, Page 61: The text states that groundwater sampling will be collected with the HydraSleeve™ passive diffuser samplers; however, some HydraSleeves™ are constructed with low density polyethylene (LDPE), which may contain PFAS and should not be used. Please include a statement that states HydraSleeves™ made of high density polyethylene (HDPE) or polypropylene will be used.

Response to Specific Comment 21: *PFAS SI Workplan/QAPP Section 13.2.1 was revised per the comment.*

Specific Comment 22. Section 13.2.1, Sampling, Worksheet #17, Page 66: The text states that seven monitoring wells will be installed using a rotosonic or hollow stem auger drill rig; however, according to

Worksheet #18, and in other worksheets of the Draft QAPP, five wells will be installed. Please revise the text to refer to the installation of five wells.

Response to Specific Comment 22: *The PFAS SI Workplan/QAPP was reviewed and revised as needed to ensure the number of proposed groundwater monitoring wells is consistent throughout.*

Specific Comment 23. Section 13.2.1, Sampling, Worksheet #17, Page 66: The text states that two borings will be advanced to collect soil samples; however, according to Worksheet 18b, three borings will be advanced with a drill rig to collect soil samples. Please revise the text to refer to the advancement of three borings for soil collection.

Response to Specific Comment 23: *PFAS SI Workplan/QAPP Section 13.12.1 was revised per the comment. The PFAS SI Workplan/QAPP was reviewed and revised as needed to ensure the number of proposed soil borings is consistent throughout.*

Specific Comment 24. Section 13.13.1, Well Development, Worksheet #17, Page 69: The total depth of the well should be measured prior to and after development to determine how much sediment was removed; however, the text does not mention total depth measurements. Please include a statement to measure the total depth of the well prior to and after development.

Response to Specific Comment 24: *This information is provided in Attachment A, SOP 122. The PFAS SI Workplan/QAPP was not revised per the comment.*

Specific Comment 25. Section 13.13.1, Well Development, Worksheet #17, Page 69: The text does not discuss how long each well will be allowed to equilibrate prior to sampling. Please revise the text to specify how long the each well will be allowed to equilibrate prior to sampling.

Response to Specific Comment 25: *This information is provided in Attachment A, SOP 122. The PFAS SI Workplan/QAPP was not revised per comment.*

Specific Comment 26. Section 14.1, Worksheet #18a, Page 72: Worksheet #18a indicates that extraction well EW-OU2-03-180 will be sampled for PFAS; however, this extraction well is not shown on Figure 7. Please add extraction well EW-OU2-03-180 to Figure 7.

Response to Specific Comment 26: *PFAS SI Workplan/QAPP Figure 7 was revised per comment.*

Specific Comment 27. Section 14.2, Worksheet #18b, Page 73: Worksheet #18b indicates that 12 soil borings will be advanced to 10 feet using a hand auger; however, advancing a hand auger to this depth may be difficult as the borehole may collapse or obstructions may be encountered; therefore, a contingency plan should be considered. Please consider adding direct push technology (DPT) drilling as a contingency to advance soil borings to 10 feet if hand augering is not feasible.

Response to Specific Comment 27: *Based on previous soil sampling experience at the former Fort Ord, it is reasonably expected that a depth of 10 feet bgs can be achieved using a hand auger. However, in the unlikely event of borehole collapse or obstructions, an alternative nearby location will be selected for soil sampling or alternative methods will be used per SOP 103. The PFAS SI Workplan/QAPP was revised accordingly.*

Specific Comment 28. Section 14.2, Worksheet #18b, Page 73: Worksheet #18b refers to standard operating procedure (SOP) SOP#34; however, this is an incremental sampling SOP, and incremental sampling is not discussed in the Draft QAPP. In addition, Worksheet #18b appears to indicate that discrete samples will be collected. As such, it is unclear whether discrete or incremental sampling will be performed. Please revise the Draft QAPP to clarify whether discrete or incremental sampling will be performed, and ensure the Draft QAPP includes the applicable procedures for the sampling method.

Response to Specific Comment 28: *Only discrete (no incremental) soil sampling will be performed. SOP 34 was removed from the PFAS SI Workplan/QAPP.*

Specific Comment 29. Section 15.0, Worksheet #19 and 30, Sample Container, Preservation, and Hold Times, Page 74: While this worksheet indicates that both water and soil samples will be collected in HDPE containers, it should specify that caps should not be lined with Teflon™, in accordance with Section 2.1.1 of SOP FN: MS014.10. Please revise this worksheet to specify that the caps of the sample containers will not be lined with Teflon™.

Response to Specific Comment 29: *A note was added to Worksheet #19 and 30 to specify that the caps of the sample containers will not be lined with Teflon™.*

Specific Comment 30. Section 16.0, Worksheet #20, Field Quality Control Summary, Page 75: The number of required field QC samples is unclear. For example, the number of field duplicates for both water and soil samples states, "Two per preparatory batch as feasible or a minimum of 10%of project samples;" however, "preparatory batch" is directly related to laboratory analysis and should have no influence on the number of samples that are collected in the field. As such, if the required frequency of field duplicates is 10%, then the number of field duplicates to be collected should be listed as three for both water and soil samples. Similarly, the number of water and soil matrix spike/matrix spike duplicate (MS/MSD) samples is indicated as, "One per preparatory batch of 20 samples," but it is unclear if this means the required frequency of MS/MSD samples is one pair per 20 samples (i.e., 5%). Please revise this worksheet to clarify the required number of field QC samples.

Response to Specific Comment 30: *The term "preparatory batch" was replaced with "batch of field samples." It is assumed there are 20 field samples per batch; therefore, "two per batch of field samples" is equivalent to 10% of the project samples. However, if the batch is smaller than 20 field samples, the statement "a minimum 10% of project samples" ensures that the correct percentage of field samples will be field duplicates. This also ensures the collection of field duplicates is not put off until the end of the project. For MS/MSD samples, the statement "One per preparatory batch of 20 samples" was revised to "One MS/MSD pair per batch of field samples, or a minimum of 5% of project samples."*

Specific Comment 31. Section 17.0, Worksheet #21, Field SOPs, Page 76, and Attachment A, Standard Operating Procedures (SOPs): SOPs 034 and 101 are listed in Worksheet #21 but not provided in Attachment A. In addition, SOP 009 is provided in Attachment 1 but not listed in Worksheet #21. Please revise the Draft QAPP to ensure all field SOPs that will be used for this project are listed in Worksheet #21 and provided in Attachment A.

Response to Specific Comment 31: *SOP 009 and SOP 034 and all corresponding references were removed from the PFAS SI Workplan/QAPP. SOP 101 was added to Attachment A per the comment.*

Specific Comment 32. Section 18.0, Worksheet #22, Field Equipment Calibration, Maintenance, Testing, and Inspection, Page 78: The Draft QAPP indicates that global positioning system (GPS) units will be used during different phases of the project (e.g., Section 13.10.4, Habitat Clearance, Section

13.13.2, Surveying); however, calibration, maintenance, testing, and inspection requirements for the GPS unit are not listed in this worksheet. Please revise Worksheet #22 to include calibration, maintenance, testing, and inspection requirements for the GPS unit. In addition, an SOP for the GPS unit should be identified in Worksheet #21 (Field SOPs) and provided in Attachment A (Standard Operating Procedures).

Response to Specific Comment 32: *PFAS SI Workplan/QAPP Section 18.0 was revised per the comment. A manufacturer guide is referenced and is listed in PFAS SI Workplan/QAPP Section 30.0.*

Specific Comment 33. Attachment D, Analytical Laboratory Certifications: The accreditation certification for SGS Orlando was only valid through December 15, 2021. Please ensure the current accreditation certification is provided in the Final QAPP.

Response to Specific Comment 33: *Attachment D was updated with the current accreditation certificate.*

ATTACHMENT H

Responses to Comments on the Draft QAPP submitted by the California Department of Toxic Substances Control

Response to Comments submitted by the Department of Toxic Substances Control (DTSC) Geological Services Unit (GSU)[1]

COMMENT 1: PFAS Planning Meeting. The Report should be revised to include a summary of the Base Realignment and Closure Cleanup Team (BCT) Meeting that occurred on April 11, 2022 and include the scope of work that was agreed upon during the meeting.

RESPONSE TO COMMENT 1: *Worksheet #9 was revised per the comment and to include summaries of additional planning sessions where critical decisions were made.*

COMMENT 2: Monitoring Wells. During the BCT meeting, eight new monitoring wells were proposed; however, Worksheet #18 proposes only five new monitoring wells. Worksheet #18 should be revised to account for the additional three wells, or further clarification should be provided that states why only five monitoring wells are proposed.

RESPONSE TO COMMENT 2: *It was not the U.S. Department of the Army's (Army) intent to state or imply during the meeting on April 11, 2022 that eight new groundwater monitoring wells would be installed as part of the Site Inspection (SI) for per- and polyfluoroalkyl substances (PFAS) at the former Fort Ord, and the Army regrets any misunderstanding regarding this. PFAS SI Quality Assurance Project Plan (QAPP) Worksheet #17 and Worksheet #18 (Section 13 and Section 14 of the SI QAPP) describe the full scope of the PFAS investigation work to be done at the former Fort Ord. Accordingly, five new groundwater monitoring wells, in addition to thirteen existing monitoring wells and three Marina Coast Water District (MCWD) water supply wells, will be sampled for PFAS analysis. There were no revisions to the SI QAPP based on Comment 2.*

COMMENT 3: Inconsistencies Between Text, Worksheets, and Figures. The Report should be revised to address inconsistencies between the text and worksheets with regards to the number of proposed monitoring wells and soil samples. For example, the text states that three monitoring wells are proposed for the Fritzsche Army Airfield (FAAF) Fire Drill Area; however, Worksheet #18 and Figure 6 proposes two monitoring wells. Please address inconsistencies throughout the Report in the Draft Final submittal.

RESPONSE TO COMMENT 3: *The text was reviewed for inconsistencies and, where applicable, was updated per the comment.*

COMMENT 4: Site 10 and Main Garrison Fire Station. The Report should be revised to state that an additional groundwater monitoring well, or groundwater grab sample will be collected down gradient of Site 10 and Main Garrison Fire Station. The Report proposes to install a new monitoring well, MW-10-07-180, approximately 5,000 feet northeast of Site 10 and Main Garrison Fire Station. This assumes a groundwater flow rate that would have potentially migrated a release of PFAS from this area downgradient towards OU2. An additional monitoring well or groundwater sample should be collected in the area approximately midway between Site 10 and Main Garrison Fire Station and MW-10-07-180 to address a potential data gap if the groundwater flow rate is lower than anticipated in this area.

RESPONSE TO COMMENT 4: *No groundwater monitoring wells are proposed within or immediately downgradient of Site 10 or the Main Garrison Fire Station complex because it is unlikely groundwater*

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[1] In a letter dated May 26, 2022 (Administrative Record No. BW-2912.4). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

sampling at this location would show evidence of a PFAS release. Soil samples will be collected in the Site 10 former burn pit area and at the Main Garrison Fire Station because, as described in Section 7.3.2 and Section 7.3.5 of the PFAS SI Work Plan/QAPP, PFAS-containing aqueous film-forming foam was likely discharged in these areas and longer-chain PFAS could be retained in vadose zone soils, which would indicate a localized release. The proposed location for downgradient monitoring well MW-10-07-180 was determined based on groundwater modeling, as noted in Section 13.1.2 and Section 13.1.5, and demonstrated by groundwater sampling for PFAS at Operable Unit 2 (OU2) in 2019, which indicated PFAS compounds had migrated at least 13,500 feet downgradient from the Fort Ord Landfills within 60 years or less (see Administrative Record No. BW-2904A). PFAS SI Work Plan/QAPP Section 13.1.2 and Section 13.1.5 were revised to include this information.

COMMENT 5: Site 2 Groundwater Sampling. The Report should be revised to state a groundwater grab sample will be collected from Site 2 Main Garrison Treatment Plant. The Report proposed that monitoring wells MW-02-13-180M and MW-02-13-180U will be sampled to determine if a potential PFAS release has migrated approximately 1,000 feet down gradient from Ponding Area 1. An additional groundwater sample should be collected either from the area of Ponding Area 1, or midway between Ponding Area 1 and the monitoring wells, to address a potential data gap if the groundwater flow rate is lower than anticipated at this location.

RESPONSE TO COMMENT 5: *No groundwater monitoring wells or grab samples are proposed in Ponding Area 1 or midway between Ponding Area 1 and the monitoring wells because it is unlikely groundwater sampling at these locations would show evidence of a PFAS release. Soil samples will be collected in Ponding Area 1 because, as described in Section 7.3.1 of the PFAS SI Work Plan/QAPP, effluent from the sludge drying beds discharged to Ponding Area 1 and longer-chain PFAS could be retained in vadose zone soils. Groundwater samples will be collected from monitoring wells MW-02-13-180M and MW-02-13-180U because of the mobility of PFAS and aquifer recharge at the Site 2 infiltration galleries inducing groundwater flow to the northeast, as noted in Section 13.1.1 and demonstrated by groundwater modeling (e.g., see simulated groundwater capture figures in Administrative Record Nos. BW-2843, BW-2861B, BW-2881A, BW-2894B, and BW-2909A). Infiltration gallery INF-02-01-180 is located within Ponding Area 3, infiltration gallery INF-02-02-180 is located within Ponding Area 1, and infiltration gallery INF-02-03-180 is located on the west side of the former sludge drying beds (note that Figure 3 was revised to show the locations of the Site 2 infiltration galleries). The last discharge of effluent from the sludge drying beds to Ponding Area 1 would have occurred over 30 years ago, and the infiltration galleries have been operational for over 22 years, with groundwater modeling showing travel time from Ponding Area 1 to MW-02-13-180M and MW-02-13-180U to be significantly less than this. PFAS SI Work Plan/QAPP Section 13.1.1 was revised to include this information.*

COMMENT 6: Hand Auger Depths. The Report should be revised to state if the total depth of the proposed hand auger borings does not reach the planned 10 feet below ground surface, then a sample will be collected from the deepest practical depth encountered. Alternatively, a contingency plan should be added to use a limited-access direct-push rig to collected soil samples at the planned depth interval.

RESPONSE TO COMMENT 6: *Based on previous soil sampling experience at the former Fort Ord, it is reasonably expected that a depth of 10 feet below ground surface (bgs) can be achieved using a hand auger. However, in the unlikely event of borehole collapse or obstructions, an alternative nearby location* *will be selected for soil sampling or alternative methods will be used per Standard Operating Procedure (SOP) 103 in Attachment A. The PFAS SI Workplan/QAPP was revised accordingly.*

COMMENT 7a: Figure 3. Groundwater gradient arrow should be displayed on the figure. The title should be revised to Figure 3 – Main Garrison Sewage Treatment Plant to provide additional clarity.

RESPONSE TO COMMENT 7a: *Figure 3 was revised per the comment.*

COMMENT 7b: Figure 5. The title of the figure should be revised to Figure 5 – Site 40A – East FAAF Helicopter Refueling Area and FAAF Fire and Rescue Station to provide additional clarity.

RESPONSE TO COMMENT 7b: *Figure 5 was revised per the comment.*

COMMENT 7c: Figure 6. The Figure should be revised to show the suspected PFAS release area consistent with the other figures in the Report.

RESPONSE TO COMMENT 7c: *Figure 6 was revised per the comment.*

COMMENT 7d: Figure 7. The Figure should be revised to show extraction well EW-OU2-13-180 that is proposed for sampling in Worksheet #18a.

RESPONSE TO COMMENT 7d: *Figure 7 was revised to show the location of extraction well EW-OU2-03-180, as listed in Worksheet #18a.*

ATTACHMENT I

Responses to Comments on the Draft QAPP submitted by the Central Coast Regional Water Quality Control Board

Responses to Comments on the Draft Report submitted by the California Regional Water Quality Control Board – Central Coast Region (CCRWQCB)[1]

General Comment 1: Overall, there is a discrepancy between the number of groundwater monitoring wells to be sampled and/or installed and the number of soil samples to be collected on various worksheets and figures provided in the PFAS SI Work Plan/QAPP. Please review and update as appropriate so the numbers are consistent.

Response to General Comment 1: *The Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix E Preliminary Draft Revision 0, Site Inspection for Per- and Polyfluoroalkyl Substances (PFAS SI Work Plan/QAPP) was reviewed and revised to resolve discrepancies per the comment.*

General Comment 2: The proposed groundwater assessment activities at Site 2 – Main Garrison Sewage Treatment Plant, Site 10 – Former Burn Pit, Main Garrison Fire Station (Buildings 4400, 4401, and S-4403), and Fritzsche Army Airfield Fire (FAAF) Fire and Rescue Station (Building 514) will not adequately confirm whether a PFAS release has occurred at these sites as the proposed groundwater assessment locations are either significantly far away (ranging from approximately 1,000 feet to 5,000 feet) from the suspected PFAS release site or are not directly downgradient of the suspected PFAS release site. Specific comments on the proposed groundwater assessment activities at these sites are provided in further detail below.

Response to General Comment 2: *The U.S. Department of the Army (Army) disagrees with the CCRWQCB's assessment. Please see the response to Specific Comment 4.*

Specific Comment 1: Section 6.0, Worksheet #9: Project Planning Session Summary – Please update this section to include a summary of the project planning to add Site 2, Main Garrison Wastewater Treatment Plant to the scope of the PFAS SI Work Plan/QAPP. Additionally, if available, please provide a link to or copy of the *Final PFAS Fate and Transport White Paper* by Arcadis that is referenced in the notes/comments for Worksheet #10 in this section.

Response to Specific Comment 1: *Worksheet #9 was revised per the comment. The* PFAS Fate and Transport White Paper *was prepared by Arcadis U.S., Inc. (Arcadis) for the U.S. Army Corps of Engineers (USACE), Baltimore District and the U.S. Army Environmental Command (USAEC). Since this document was not produced by or for the Army Base Realignment and Closure (BRAC) Division, USACE Sacramento District is consulting with USAEC regarding distribution protocol to confirm the white paper is suitable for public release. It is expected this issue will be resolved by time the final version of the PFAS SI Work Plan/QAPP is issued. In the meantime, the Army can send the white paper to CCRWQCB upon request to verify the references in the PFAS SI Work Plan/QAPP.*

Specific Comment 2: Section 9.1, Worksheet #12a – If available, please provide a link to or copy of the *Final PFAS Sampling and Analysis White Paper, Active Army Installations, Nationwide* by Arcadis that is referenced in the notes for Worksheet #12a.

Response to Specific Comment 2: *The* PFAS Sampling and Analysis White Paper, Active Army Installations, Nationwide *was prepared by Arcadis for USACE Baltimore District and USAEC. Since this*

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[1] In a letter dated May 25, 2022 (see Administrative Record No. BW-2912.3). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

document was not produced by or for the Army BRAC Division, USACE Sacramento District is consulting with USAEC regarding distribution protocol to confirm the white paper is suitable for public release. It is expected this issue will be resolved by time the final version of the PFAS SI Work Plan/QAPP is issued. In the meantime, the Army can send the white paper to CCRWQCB upon request to verify the references in the PFAS SI Work Plan/QAPP.

Specific Comment 3: Section 11.2, Investigation Derived Waste Management and Equipment Decontamination – Please provide a link or copy of *Final- PFAS-Containing Investigation Derived Waste Management and Treatment Options White Paper* by Arcadis that is referenced in this section. Additionally, please provide additional details in the PFAS SI Work Plan/QAPP on the plans for handling investigation derived waste.

Response to Specific Comment 3: *The* PFAS-Containing Investigation Derived Waste Management and Treatment Options White Paper *was prepared by Arcadis for USACE Baltimore District and USAEC. Since this document was not produced by or for the Army BRAC Division, USACE Sacramento District is consulting with USAEC regarding distribution protocol to confirm the white paper is suitable for public release. It is expected this issue will be resolved by time the final version of the PFAS SI Work Plan/QAPP is issued. In the meantime, the Army can send the white paper to CCRWQCB upon request to verify the references in the PFAS SI Work Plan/QAPP; however, the PFAS SI Work Plan/QAPP was revised to include additional details regarding management of investigation-derived waste.*

Specific Comment 4: Section 14.1, Worksheet #18a, Groundwater – Please revise the PFAS SI Work Plan/QAPP to include the installation of one or more groundwater monitoring wells at the potential PFAS release area and immediately downgradient to collect samples to confirm whether a release of PFAS has occurred and evaluate the migration of PFAS from the suspected PFAS release site(s). Comments on specific suspected release sites are provided below.

> **Specific Comment 4a: Site 2, Sampling Locations –** As shown on Figure 3, no groundwater samples are planned from within the suspected PFAS release site identified as Ponding Area 1. The groundwater monitoring well locations (MW-02-13-180M and MW-02-13-180U) to the northeast that are proposed for sampling are approximately 1,000 feet from Ponding Area 1. Based on the distance from the suspected PFAS release site and a limited information provided to support PFAS fate and transport to these wells, a release of PFAS to groundwater at Ponding Area 1 may not be detected by only sampling these two wells.
>
> ***Response to Specific Comment 4a:*** *No groundwater monitoring wells are proposed in Ponding Area 1 because it is unlikely groundwater sampling at this location would show evidence of a PFAS release. Soil samples will be collected in Ponding Area 1 because, as described in Section 7.3.1 of the PFAS SI Work Plan/QAPP, effluent from the sludge drying beds discharged to Ponding Area 1 and longer-chain PFAS could be retained in vadose zone soils. Groundwater samples will be collected from monitoring wells MW-02-13-180M and MW-02-13-180U because of the mobility of PFAS and aquifer recharge at the Site 2 infiltration galleries inducing groundwater flow to the northeast, as noted in Section 13.1.1 and demonstrated by groundwater modeling (e.g., see simulated groundwater capture figures in Administrative Record Nos. BW-2843, BW-2861B, BW-2881A, BW-2894B, and BW-2909A). Infiltration gallery INF-02-01-180 is located within Ponding Area 3, infiltration gallery INF-02-02-180 is located within Ponding Area 1, and infiltration gallery INF-02-03-180 is located on the west side of the*

former sludge drying beds (per the response to Specific Comment 8, the locations of the Site 2 infiltration galleries were added to Figure 3). The last discharge of effluent from the sludge drying beds to Ponding Area 1 would have occurred over 30 years ago and the infiltration galleries have been operational for over 22 years, with groundwater modeling showing travel time from Ponding Area 1 to MW-02-13-180M and MW-02-13-180U to be less than this, with treated water discharged at the infiltration galleries potentially traveling to Site 12 extraction wells within 15 years. Based on this, the PFAS SI Work Plan/QAPP was revised to include PFAS sampling at extraction wells EW-12-05-180M and EW-12-08-180U. PFAS SI Work Plan/QAPP Section 13.1.1 was revised to include this information.

Specific Comment 4b: Site 10 and Main Garrison Fire Station, Sampling Locations – As shown on Figure 4, no groundwater samples are planned from within or immediately downgradient of the suspected PFAS release site. Additionally, the proposed new downgradient well is located over 5,000 feet from the suspected PFAS release sites and is, therefore, unlikely to provide data to evaluate a localized release of PFAS.

Response to Specific Comment 4b: *No groundwater monitoring wells are proposed within or immediately downgradient of Site 10 or the Main Garrison Fire Station complex because it is unlikely groundwater sampling at this location would show evidence of a PFAS release. Soil samples will be collected in the Site 10 former burn pit area and at the Main Garrison Fire Station because, as described in Section 7.3.2 and Section 7.3.5 of the PFAS SI Work Plan/QAPP, PFAS-containing aqueous film-forming foam was likely discharged in these areas and longer-chain PFAS could be retained in vadose zone soils, which would indicate a localized release. The proposed location for downgradient monitoring well MW-10-07-180 was determined based on groundwater modeling, as noted in Section 13.1.2 and Section 13.1.5, and demonstrated by groundwater sampling for PFAS at Operable Unit 2 (OU2) in 2019, which indicated PFAS compounds had migrated at least 13,500 feet downgradient from the Fort Ord Landfills within 60 years or less (see Administrative Record No. BW-2904A). PFAS SI Work Plan/QAPP Section 13.1.2 and Section 13.1.5 were revised to include this information.*

Specific Comment 4c: Site 40A and FAAF Fire & Rescue Station – Based on the proposed new groundwater monitoring well locations shown on Figure 5, there is not a groundwater sampling location immediately downgradient of the FAAF Fire and Rescue Station and therefore, unlikely to provide data to confirm whether a release to groundwater has occurred from this suspected PFAS release site. Please also see Comment 5b below related to groundwater sampling in the suspected PFAS release site.

Response to Specific Comment 4c: *The proposed location of groundwater monitoring well MW-40A-01-A was moved approximately 200 feet to the west so samples will be representative of both Site 40A and the FAAF Fire & Rescue Station.*

Specific Comment 5: Section 14.1, Worksheet #18b, Soil –

Specific Comment 5a: Figure 3 shows soil sampling locations within suspected PFAS release site, Ponding Area 1, but does not include Indian Head Beach. In Section 7.3.1 of the PFAS SI Work Plan/QAPP it is reported that effluent was discharged into a storm drain that emptied onto Indian Head Beach. Based on this information, residual PFAS could remain in soil at this location.

Please provide additional information on the rationale for not including Indian Head Beach in the proposed sampling locations and revise the PFAS SI Work Plan/QAPP, as appropriate.

Response to Specific Comment 5a: *It is unlikely residual PFAS remains in soil on Indian Head Beach because:*

- *There has been no discharge of treated wastewater at this location since at least 1990.*
- *There has been ongoing beach erosion during the Main Garrison Sewage Treatment Plant (STP) operational period and since the STP discontinued operations in 1990. The southern Monterey Bay has the highest coastal erosion rates in the state of California for at least the last century, averaging about 4 feet per year.*[2]

Ponding Area 1 is relatively protected from erosional forces and soil samples from this location are therefore expected to be representative for evaluating potential historical PFAS discharges from the Main Garrison STP, whereas soil samples from Indian Head Beach would not be representative for the reasons listed above. PFAS SI Work Plan/QAPP Section 13.1.1 was revised to include this information.

Specific Comment 5b: Figure 5 shows soil sampling location SB-40A-07 (TBD) however this location is not included in Worksheet #18b. Please update this worksheet to include this deeper sampling location. Additionally, please update the PFAS SI Work Plan/QAPP to indicate the rationale as to why and how this location is to be determined. Based on the information provided it appears that this will be a deeper soil boring advanced to groundwater and that it is located on the cross-gradient edge of the suspected PFAS release site. To provide information on a suspected PFAS release in this area this boring should be located within or on the downgradient edge of the suspected release site and a groundwater grab sample should be collected once groundwater is reached.

Response to Specific Comment 5b: *Worksheet #18b was corrected to list SB-40A-07 instead of SB-40A-08. As stated in Worksheet #18b, the final location of SB-40A-07 is to be determined (TBD) based on the analytical results from the shallow soil samples to be collected at the FAAF Fire & Rescue Station (SB-40A-04, SB-40A-05, and SB-40A-06). Therefore, Figure 5 is only intended to show the general area where SB-40A-07 will be located, not the actual location. Figure 5 was revised to clarify this. The PFAS SI Work Plan/QAPP was revised to include collection of groundwater "grab" samples from SB-40A-07 and SB-FDA-01 at the FAAF Fire Drill Area (FDA).*

Specific Comment 6: Section 16.0, Worksheet #20: Field Quality Control Summary – Please revise this worksheet as applicable as the number of field samples appears to be the numbers prior to adding Site 2 to the site inspection phase.

Response to Specific Comment 6: *Worksheet #20 was revised per the comment.*

Specific Comment 7: Figure 2, Suspected PFAS Release Sites and Nearby Drinking Water Supply Wells – Please update this figure based on the following comments:

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[2] https://www.montereyherald.com/2020/11/14/closing-the-cemex-plant-the-sands-will-be-shifting/

a. If available, add arrows to indicate the groundwater flow direction for the 180-Foot/400-Foot Aquifer in the vicinity of the FAAF Drill Area, Building (Bldg) 514 and Site 40A - East FAAF Helicopter Defueling Area.
b. Add FAAF Fire and Rescue Station to the label for Bldg 514 or provide this information in the figure notes.
c. Add East FAAF Helicopter Defueling Area to the label for Site 40A or provide this information in the figure notes.
d. Add Site 2 to the label for the Main Garrison Sewage Treatment Plant or provide this information in the figure notes.
e. Add Former Burn Pit to the label for Site 10 or provide this information in the figure notes.

Response to Specific Comment 7: *Figure 2 was revised per the comments.*

Specific Comment 8: Figure 3, Sampling Locations, Site 2 – Please update this figure based on the following comments:

a. Modify the title to Site 2 - *Main Garrison Sewage Treatment Plant*;
b. Show the infiltration galleries that are referenced in the PFAS SI Work Plan/QAPP.
c. Include groundwater contours or modeling to show the groundwater mounding from the infiltration galleries; and
d. Include groundwater flow direction arrows.

Response to Specific Comment 8: *Figure 3 was revised per the comments.*

Specific Comment 9: Figure 4, Sampling Locations, Site 10 and Main Garrison Fire Station – Please update the title to Site 10 – *Former Burn Pit* and Main Garrison Fire Station *(Buildings 4400, 4401, and S-4403)* and label Building 4400 on the figure.

Response to Specific Comment 9: *Figure 4 was revised per the comment except that the building numbers were not included in the figure title because they are labeled on the figure.*

Specific Comment 10: Figure 5, Sampling Locations, Site 40A and FAAF Fire & Rescue Station – Please update the title to Site 40A - *East FAAF Helicopter Defueling Area and FAAF Fire & Rescue Station – Building 514*.

Response to Specific Comment 10: *Figure 5 was revised per the comment except that the building number was not included in the figure title as this is redundant with the label on the figure.*

Specific Comment 11: Figure 6, Sampling Locations, FAAF Fire Drill Area – Please update the figure to show the red hatched area of the suspected PFAS release site for the FAAF Fire Drill Area.

Response to Specific Comment 11: *Figure 6 was revised per the comment.*

Specific Comment 12: Figure 7, Sampling Locations, OU2 – Please update the figure to show the location of extraction well EW-OU2-13-180 as it is listed in Worksheet #18a as a well that will be sampled for PFAS as part of the OU2 area site investigation.

Response to Specific Comment 12: *Figure 7 was revised to show the location of extraction well EW-OU2-03-180, as listed in Worksheet #18a.*

ATTACHMENT J

Responses to Comments on the Draft QAPP submitted by the Fort Ord Community Advisory Group

Responses to Comments and Questions submitted by the Fort Ord Community Advisory Group (FOCAG)[1]

COMMENT 1: We do not find former Site #39 multi-range area being on the list for investigation areas. Why?

RESPONSE TO COMMENT 1*: Site 39, the former Fort Ord Inland Ranges, is not currently recommended for investigation for per- and polyfluoroalkyl substances (PFAS) because, as concluded in the Preliminary Assessment (PA) Narrative Report for PFAS (Administrative Record No. BW-2904A), potential storage, use, or disposal of PFAS-containing materials at Site 39 does not pose a potential threat of release to the environment and further investigation is not warranted. Historically, fires in the Inland Ranges have been a frequent occurrence, and these fires would be contained using heavy equipment, such as bulldozers, and soldiers with hand tools to cut fuel breaks, along with water trucks and aircraft applying fire retardant. However, the retardants used were Class A foams or retardants designed for use on combustible materials, such as wood, and not PFAS-containing AFFF, which is a Class B foam designed for use on flammable liquids. Additionally, per California State Water Resources Control Board and Division of Drinking Water orders, samples were collected from water supply wells adjacent to Site 39 and analyzed for PFAS in 2019 and 2020. All PFAS analyzed for were not detected. Based on this information, there is no suspected release of PFAS due to prescribed burning or wildfires in the Inland Ranges.*

COMMENT 2: Former Site #39 directly overlies the Seaside Groundwater Basin which is now the largest source for potable water for the greater Monterey Peninsula Area. Given its history of munition uses of all types, coupled with clearance burns and/or accidental burns, in addition to pesticide and herbicide use, this area should be put on the investigation list for PFAS, Per and Polyfluoroakyl substances. Don't you agree? If not, why not?

RESPONSE TO COMMENT 2: *As stated in the PA Narrative Report, samples were collected from water supply wells adjacent to Site 39 and analyzed for PFAS in 2019 and 2020 per California State Water Resources Control Board and Division of Drinking Water orders and all PFAS analyzed for were not detected. Additionally, as described in the PA Narrative Report, there is no evidence that PFAS-containing firefighting foams or retardants were used during prescribed burns or for wildfires in the Site 39 area, nor evidence of significant use of PFAS-containing munitions. Based on this information, further investigation for PFAS as Site 39 is not warranted.*

COMMENT 3: When were MCWD wells 10, 11, and 12 drilled into the 900-ft aquifer? For what specific purpose were these very deep, very expensive, wells drilled?

RESPONSE TO COMMENT 3: *The water supply wells referred to in the comment were installed and are owned by the Marina Coast Water District (MCWD). Please contact MCWD for information about its water supply wells.*

COMMENT 4: On page 11 it states required reporting limits and laboratory limits are 18 PFAS compounds. How many PF compounds are there the FOCAG wondered?

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[1] In a letter dated May 26, 2022 (see Administrative Record No. BW-2912.5). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

In 2018 the ATSDR released their 852-page report on PFAS that the EPA and DOD tried to block from publication because the report opened a can of worms.

There are approximately 3000+ known PFAS chemical constituents. Not all 3000 are health risks. But they're discovering that a number of them are health risks as ATSDR and academia do more research.

The biggest worries the DOD have are:

- PFAS being regulated in 2023 or later by the EPA as a class of hazardous substances because then CERCLA will make the DOD responsible for cleanup if ATSDR studies the health impacts of a combination of PFAS with one another or with other hazardous substances typically found in close proximity

RESPONSE TO COMMENT 4: *Please note that Worksheet #9, starting on page 11 of the PFAS Site Inspection (SI) Quality Assurance Project Plan (QAPP), only provides summaries of planning sessions that were conducted to prepare for writing the SI QAPP and does not necessarily represent the final SI QAPP elements described in subsequent worksheets. At the time Planning Session No. 1 was held in May of 2021, it was anticipated that 18 PFAS compounds would be analyzed for per the U.S. Department of the Army's (Army) PFAS guidance; however, since then several PFAS were added to the list. As can be seen in Worksheet #15 (page 54 of the SI QAPP), there are 24 PFAS to be analyzed for. While the Army acknowledges there are more known PFAS compounds, these 24 PFAS are expected to be indicators of whether or not a release of PFAS occurred at a site. If or when PFAS compounds become regulated, then the Army will address them consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process for the former Fort Ord. Note that Worksheet #9 was updated with additional planning session summaries to reflect when critical decisions were made regarding the scope of the SI QAPP.*

COMMENT 5: Page 12, Worksheet #17 -Sampling Design and Rationale

This section of the Plan limits the number of groundwater sampling to be done in this Project Plan.

We learn 2-3 new down gradient wells MAY be sampled.

We learn MCWD drinking water wells #29, 30 and 31 MAY also be sampled.

The FOCAG doesn't find a rationale for limiting sampling when the issue is public health. What is the rationale for this? Is it because; Right now the DOD is focusing on foam and that's all they want to deal with. But research - ASTDR's own 852-page report, for example - has shown that PFAS chemical constituents exist in other commonly used substances like pesticides and fertilizers and virgin [not recycled] dry cleaning solvents etc., etc. It seems the DOD doesn't want to be on the hook for cleaning up a range of PFAS chemical constituents that were used on their bases. Forever means those constituents may still be in the soil, aquifers, and landfills of their decommissioned bases.

RESPONSE TO COMMENT 5: *Please note that Worksheet #9, starting on page 11 of the SI QAPP, only provides summaries of planning sessions that were conducted to prepare for writing the SI QAPP and does not necessarily represent the final SI QAPP elements described in subsequent worksheets. In this case, Worksheet #17 and Worksheet #18 (Section 13 and Section 14 of the SI QAPP) describe the full scope of the PFAS investigation work to be done at the former Fort Ord. Accordingly, five new groundwater monitoring wells, in addition to thirteen existing monitoring wells and the three MCWD water supply wells, will be sampled for PFAS analysis. Also, as described in Section 1.0 of the SI QAPP,* *and consistent with U.S. Environmental Protection Agency (USEPA) SI guidance,[2] the purpose of the SI is to determine if there is evidence of a PFAS release and whether further investigation is warranted under CERCLA (i.e., the Army would determine the full extent of PFAS contamination in a future phase of the CERCLA process).*

Per the Army PFAS Guidance, the primary mechanism for releases of PFAS at Army installations is through the historical use of AFFF. Other known sources of environmental releases identified in the Army PFAS Guidance include mist suppressants for chrome plating operations and landfills and wastewater treatment plants that may have inadvertently accepted PFAS-containing material. The scope of the PFAS SI is consistent with current Department of Defense (DoD) and Army policy and guidance regarding PFAS; however, other sources of PFAS may be considered in future phases of the CERCLA process pending new DoD guidance.

COMMENT 6: Page 12 Worksheet #17

The Soil Sampling Plan seems ill-defined. “Deeper borings MAY be necessary.”

“A SINGLE soil boring to the water table is recommended”

What specifically triggers your changes of the number and depth of soil borings?

RESPONSE TO COMMENT 6: *Please note that Worksheet #9, starting on page 11 of the SI QAPP, only provides summaries of planning sessions that were conducted to prepare for writing the SI QAPP and does not necessarily represent the final SI QAPP elements described in subsequent worksheets. In this case, Worksheet #17 and Worksheet #18 (Section 13.0 and Section 14.0 of the SI QAPP) describe the full scope of the PFAS investigation work to be done at the former Fort Ord. Accordingly, three deeper borings will be drilled with two of those drilled to the water table and soil samples collected for PFAS analysis. The number and depth of soil borings was determined based on site-specific history and conditions with respect to potential or suspected PFAS releases as described in Worksheet #10 (Section 7.0 of the SI QAPP).*

COMMENT 7: Page 13 of the Plan states, “Shallow soil sampling is recommended at the grassy areas near the Main Garrison Fire Station and FAAF Fire and Rescue Station based on AFFF discharges.” How much shallow sampling?

FOCAG question: Why are BRAC and the consultants minimizing/marginalizing the investigation for PFAS substances?

RESPONSE TO COMMENT 7: *Please note that Worksheet #9, starting on page 11 of the SI QAPP, only provides summaries of planning sessions that were conducted to prepare for writing the SI QAPP and does not necessarily represent the final SI QAPP elements described in subsequent worksheets. In this case, Worksheet #17 and Worksheet #18 (Section 13.0 and Section 14.0 of the SI QAPP) describe the full scope of the PFAS investigation work to be done at the former Fort Ord. Accordingly, shallow soil sampling will be accomplished at twelve locations that were determined based on site-specific history and conditions with respect to potential or suspected PFAS releases as described in Worksheet #10 (Section 7.0 of the SI QAPP). Additionally, as described in Section 1.0 of the SI QAPP, and consistent with*

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[2] USEPA, 1992. *Guidance for Performing Site Inspections Under CERCLA*. September. EPA/540-R-92-021, Publication 9345.1-05.

USEPA SI guidance, the purpose of the SI is to determine if there is evidence of a PFAS release and whether further investigation is warranted under CERCLA (i.e., the Army would determine the full extent of PFAS contamination in a future phase of the CERCLA process).

COMMENT 8: Page 14 of the Plan; "…has the lateral and vertical extent of PFAS-impacted media been defined? **The goal of the question is not to determine the actual lateral and vertical extent of PFAS-media."**

The entirety of this section is unclear to the FOCAG. Given the number of historical fires on former Fort Ord, i.e., range fires that were either accidental or got out of control and the resulting fire retardants sprayed on them, some of which are unknown, why then aren't more soils and groundwater sources on and immediately surrounding former Fort Ord being included in this Plan for investigation sampling? For example;

a) The Canyon del Rey Aquifer that generally aligns with the border of Fort Ord and State Routes 68 and 218
b) The Toro Creek Aquifer, now often referred to as the greater Corral de Tierra watershed. This borders former Fort Ord and State Route 68.

This is a relevant article. Here's the link:

https://www.eenews.net/articles/pfas-pose-watershed-moment-for-superfund-liability/

Quote from this referenced link;"Last fall, EPA Administrator Michale Regan announced a sprawling "road map" to clamp down on PFAS through multiple avenues, including drinking water rules and Superfund law (Greenwire, October 18, 2021)

Regulations under the Comprehensive Environmental Response, Compensation and Liability Act, or Superfund law, have drawn particular attention. That statute oversees cleanup of the nation's most contaminated sites. EPA has said it plans to propose that both PFOA and PFOS, the most well studied of the chemicals, be listed as hazardous substances under CERCLA. The designation, expected to be finalized in 2023, would have major implications, including applying broad notification requirements for a wide array of facilities when chemicals are released in certain amounts."

RESPONSE TO COMMENT 8: *Please note that Worksheet #9, starting on page 11 of the SI QAPP, only provides summaries of planning sessions that were conducted to prepare for writing the SI QAPP and does not necessarily represent the final SI QAPP elements described in subsequent worksheets. As described in Section 1.0 of the SI QAPP, and consistent with USEPA SI guidance, the purpose of the SI is to determine if there is evidence of a PFAS release and whether further investigation is warranted under CERCLA (i.e., the Army would determine the full extent of PFAS contamination in a future phase of the CERCLA process).*

Historically, fires in the Inland Ranges have been a frequent occurrence, and these fires would be contained using heavy equipment, such as bulldozers, and soldiers with hand tools to cut fuel breaks, along with water trucks and aircraft applying fire retardant. However, retardants used were Class A foams or retardants designed for use on combustible materials, such as wood, and not PFAS-containing AFFF, which is a Class B foam designed for use on flammable liquids. Additionally, per California State Water Resources Control Board and Division of Drinking Water orders, samples were collected from *water supply wells along the State Route 68 and State Route 218 corridors and analyzed for PFAS in 2019 and 2020. All PFAS analyzed for were not detected. Based on this information, there is no suspected release of PFAS due to prescribed burning or wildfires at the former Fort Ord (see the PA Narrative Report for more information).*

The article in E&E News that is linked to in the comment is informative; however, this article primarily concerns "passive receivers" of PFAS, such as water and wastewater treatment and solid waste facilities, and their potential liability or exemption from liability for the cleanup of PFAS under CERCLA. The Army and other DoD components are already following the CERCLA process to identify, investigate, and potentially remediate sites impacted by PFAS. As such, the article is not directly relevant to potential PFAS issues at the former Fort Ord or other active or former military installations.

COMMENT 9: The FOCAG questions the Army's narrow/limited testing of Fort Ord grounds, using the Orange County Water District's experience.

At first OCWD thought PFAS might have been isolated to a few wells in the northern area of the county. But with further testing and lower state health advisory PFAS limits, OCWD found much more PFAS well contamination - over 75 wells had to be shut down. Now OCWD is working on a massive PFAS water purification system for its county.

https://www.waterworld.com/drinking-water/treatment/press-release/14233514/orange-county-launches-pfas-water-treatment-plant

"These wells are among dozens throughout Orange County that were removed from service in 2020 after the state of California lowered the Response Level advisories of PFOA and PFOS; two legacy PFAS compounds no longer produced in the United States."

RESPONSE TO COMMENT 9: *As described in Section 1.0 of the SI QAPP, and consistent with USEPA SI guidance, the purpose of the SI is to determine if there is evidence of a PFAS release and whether further investigation is warranted under CERCLA (i.e., the Army would determine the full extent of PFAS contamination in a future phase of the CERCLA process). However, as described in the SI QAPP, the Army will be collecting samples from a series of groundwater monitoring wells that are downgradient of suspected PFAS release sites and upgradient of MCWD water supply wells 29, 30, and 31 and also sampling wells 29, 30, and 31 to determine whether there is a potential PFAS threat to the drinking water supply. Regardless, the PFAS issue identified by the Orange County Water District (OCWD) that required treatment of millions of gallons per day of PFAS-contaminated water is not comparable to the former Fort Ord. As described in the PA Narrative Report, samples were collected from water supply wells within and adjacent to the former Fort Ord and analyzed for PFAS in 2019 and 2020 per California State Water Resources Control Board and Division of Drinking Water orders. All PFAS analyzed for were either not detected or were detected at concentrations below levels requiring treatment.*

COMMENT 10: Also why is the Army rushing to test for a comparatively few number of PFAS constituents? The EPA is expected to provide MCLs for PFAS next year:

https://www.waterworld.com/drinking-water/treatment/press-release/14276697/pfas-remediation-spending-forecasted-to-triple-by-2030

"The EPA is now well underway in setting guidance on these chemicals, including implementing drinking water maximum contaminant levels (MCLs) by fall 2023."

"California's forecasted $888 million of spending (highest of all states in the U.S.) is driven by the state's high number of confirmed contamination sites, the state WaterBoard's proactive testing for PFAS contamination, and a more rigid regulatory environment.

RESPONSE TO COMMENT 10: *As can be seen in Worksheet #15 (page 54 of the SI QAPP), there are 24 PFAS to be analyzed for. While the Army acknowledges there are more known PFAS compounds, these 24 PFAS are expected to be indicators of whether or not a release of PFAS occurred at a site. If or when the USEPA publishes MCLs for PFAS compounds, the Army will address such PFAS consistent with the CERCLA process for the former Fort Ord.*

The quote from the article cited in the comment is misleading by stating "these chemicals," implying guidance or MCLs will be established for all PFAS, when there are only two PFAS compounds that USEPA plans to publish MCLs for in 2023 (perfluorooctanoic acid [PFOA] and perfluorooctane sulfonate [PFOS]). PFOA and PFOS are two of the 24 compounds that will be sampled and analyzed for as part of the SI. It is noted that the USEPA recently published Regional Screening Levels (RSLs) for five PFAS (https://www.epa.gov/risk/regional-screening-levels-rsls-whats-new) and the SI QAPP was revised to reference these RSLs.

ATTACHMENT K

Responses to Comments on the Draft Final QAPP submitted by the United States Environmental Protection Agency, Region IX

Responses to Comments on the Draft QAPP submitted by the U.S. Environmental Protection Agency (EPA)[1]

Comment 1: EPA has reviewed the *Quality Assurance Project Plan, Volume I, Appendix E, Draft Final Revision 0, Site Inspection for Per- and Polyfluoroalkyl Substances (PFAS), Former Fort Ord, California*, dated July 12, 2022. Many of our May 2022 comments on the draft version of the document were addressed, except where noted in the attached comments.

However, EPA concerns regarding the use of HydraSleeve™ samplers to collect groundwater samples at PFAS sites, as transmitted to the Army on June 30, 2022 via email, have not been addressed. We understand that the Army intends to proceed with HydraSleeve sampling as described in the document. Preliminary information available to EPA indicates that the use of HydraSleeves and other passive collection methods may have the potential to bias PFAS groundwater samples low compared to non-passive sampling methods. The results of groundwater samples collected with HydraSleeves during the site investigation may not be sufficient to exclude areas from the remedial investigation phase of the Superfund process. Additional lines of evidence will be needed before EPA can agree that further investigation is not warranted.

Response to Comment 1: *The U.S. Department of the Army (Army) brought up EPA's concerns regarding the use of HydraSleeves during the Base Realignment and Closure (BRAC) Cleanup Team (BCT) meeting on July 22, 2022 but consensus on the issue was not achieved at that time. Two documents were transmitted to the Army on June 30, 2022 via email:*

- *May 19, 2021 EPA Federal Facilities Superfund Program – RPM Bulletin 2021-03: Use of the No Purge Samplers for PFAS Groundwater Sampling (hereinafter referred to as "the Bulletin")*
- *January 11, 2022 letter addressed to Kimberly Horsely, PhD, Restoration Program Manager, AFCEC/CZOW/Nellis ISS (hereinafter referred to as "the Letter").*

These documents summarize the two EPA concerns with the use of high density polyethylene (HDPE) HydraSleeves for collecting samples for PFAS analysis:

1) *PFAS contaminants have a tendency to attach to soil particles or exist as microscopic colloids that may have lower concentrations in no-purge samples than in purged samples; and*
2) *Since the HydraSleeves are made with HDPE, there is a potential for PFAS to adsorb to the inside (and outside) of the sampler.*

EPA believes both issues may result in analytical data that are biased low due to turbidity and colloids in sampled water and PFAS adhering to the HDPE.

The Letter references several papers, but states without providing any references that colloidal settling can occur due to the potential order-of-magnitude groundwater velocity drop within a well (due to changes in porosity and elimination of tortuosity). A colloid is defined as very small (1 – 1,000 nanometers [nm] in diameter), finely divided solids (particles that do not dissolve) that remain dispersed in a liquid for a long time due to their small size and electrical charge. These particles have negligible settling velocity because their small mass has a low gravitational force compared to surface frictional

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[1] In a letter dated August 15, 2022 (see Administrative Record No. BW-2912A.4). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

forces. Settling can occur at rates directly related to size, ranging from 8 days (1,000 nm) to 200 years (1 nm). To remove colloids, small particles must be destabilized first. Then they will form larger and heavier flocks, which can be removed by conventional physical treatment. This process can be described by clarification mechanisms that include coagulation, flocculation and sedimentation (Koohestanian et al., 2008). The characteristics of colloids are diverse (hydrophobic, hydrophilic, positively charged, negatively charged, etc.). Due to their size, when light passes through water containing colloids, the light is dispersed. Therefore, turbidity is one measure to quantify colloids present in groundwater. As stated in the Bulletin, EPA is concerned that the PFAS analytical results may be biased low due to turbidity and colloids in sampled water. A review of groundwater data in the Fort Ord Data Integration System (FODIS) shows a median turbidity of 9.6 Nephelometric Turbidity Units (NTU), only one order of magnitude greater than drinking water standards, indicating there are very few colloids present.

Per Borthakur et al., 2021 (hereinafter referred to as "the Colloid Paper," referenced in the Letter), concentrations of colloids (if present) would ***increase*** *due to differential groundwater flow rates within the screened areas of the well. The Colloid Paper summarizes a study performed by spiking groundwater with PFAS compounds that flowed through "clay-rich soil," not through sandy soil, which is the common soil matrix for the former Fort Ord. Based on this information, it is unlikely colloids of varying sizes and types with PFAS attached will be an issue if HDPE HydraSleeves are used.*

In addition, EPA is concerned about PFAS bonding to HDPE and the potential result of biased-low data. However, for the Fort Ord PFAS SI, the short residence time between the groundwater and the sampling device will not result in any meaningful data bias. The adsorption of perfluoroalkyl substances on microplastics under environmental conditions was studied with HDPE, polystyrene (PS), and polystyrene carboxylate (PS-COOH) (Llorca et al., 2018). Microplastics have significantly higher surface area for adsorption compared to HydraSleeves; therefore, the results of the study present a conservative estimate of adsorption for passive sampling devices. The adsorption is a result of combined effects that include hydrophobic and van der Waals forces, PFASs self-aggregations as micelles or hemimicelles, and competition between the adsorption rates in natural organic material on HDPE. The study determined that HDPE had the least affinity for PFAS, and that affinity was compound specific. In addition, and most importantly, the amount of adsorption was measured at 1, 4, 7, and 50 days. It was found that there was no adsorption of PFAS to HDPE microplastic until after day 4. For the Fort Ord PFAS SI, the residence time of the HDPE HydraSleeves will be 4 days or less and will therefore result in no data biases due to adsorption. The QAPP was revised to include this information.

Based on this analysis, the Army concludes that the use of HDPE HydraSleeves at Fort Ord for the PFAS SI will provide sound, usable, defensible, and unbiased data.

<u>References:</u>

Borthakur et al., 2021. *Release of Soil Colloids During Flow Interruption Increases the Pore-Water PFAS Concentration in Saturated Soil.* May

Koohestanian et al., 2008. *The Separation Method for Removing of Colloidal Particles from Raw Water*.

Llorca et al., 2017. *Adsorption of perfluoroalkyl substances on microplastics under environmental conditions*. December.

EVALUATION OF THE RESPONSES TO COMMENTS [on the Draft QAPP][2]

Specific Comment 2. Section 3.0, Worksheets #3 and #5, Project Organization and QAPP Distribution, Page 6, and Section 4.0, Worksheets #4, #7, and #8, Personnel Qualifications and Sign-Off Sheet, Pages 7 and 8: Some individuals are identified in Worksheets #4, #7, and #8 who are not identified in Worksheets #3 and #5, and therefore, their roles on this project are unclear (i.e., Holly Dillon, Ahtna Task Lead, Michael Eger, SGS General Manager, and Norman Farmer, SGS Corporate Technical Director). In addition, Section 11.4 (Data Management Tasks) in Worksheets #14 and #16 (Project Tasks and Schedule) discusses the responsibilities of the database manager and geographic information system (GIS) manager, but these individuals are not identified in Worksheets #3 and #5 or Worksheets #4, #7, and #8. In accordance with Section 2.3 (Distribution List and Project Personnel Sign-Off Sheet) of the Uniform Federal Policy for Quality Assurance Project Plans Manual, dated March 2005 (UFP-QAPP Manual), a complete copy of the QAPP should be sent to all key project personnel, and all key project personnel should sign-off that they have read the applicable sections of the QAPP and will perform the tasks as described. Please revise these worksheets to identify all key project personnel, and ensure that all key project personnel sign-off that they have read the applicable sections of the QAPP and will perform the tasks as described.

Response to Specific Comment 2: *Michael Eger and Norman Farmer are not key project personnel and were deleted from the PFAS SI Work Plan/QAPP. Holly Dillon was removed from the PFAS SI Work Plan/QAPP as a Task Lead but was added to Worksheet #6 as the Ahtna Site Safety and Health Officer. Worksheet #3 & 5 and Worksheet #4, 7 & 8 were revised to include the database manager and GIS manager. Per the Optimized UFP-QAPP Worksheets, Worksheet #3 & 5 serves to identify key project personnel that will receive a copy of the PFAS SI Work Plan/QAPP and to demonstrate the relationships between organizations, and Worksheet #4, 7, & 8 identifies key project personnel for each organization performing tasks defined in the PFAS SI Work Plan/QAPP. As such, Worksheet #4, 7 & 8 must only include key project personnel from the prime contractor (Ahtna) and the laboratory (SGS North America, Inc. [SGS]), and does not need to include all key project personnel within each organization identified in Worksheet #3 & 5.*

Evaluation of Response to Specific Comment 2: The response addresses the comment; however, please ensure that all key project personnel sign-off that they have read the applicable sections of the QAPP and will perform the tasks as described.

Response to Evaluation of Response to Specific Comment 2: *Key project personnel identified in Worksheet #3 & 5 will receive a copy of the final QAPP. As noted in Worksheet #4, 7 & 8, key personnel are acknowledging that they have read the QAPP and agree to implement the QAPP as written by signing it.*

Specific Comment 4. Section 5.0, Worksheet #6, Communication Pathways, Page 10, and Attachment B, Field Documentation Forms: The procedure for changes to the QAPP indicates that significant changes to the QAPP must be documented in a Field Change Request; however, the Field Change

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[2] In its comments on the Draft Final QAPP, EPA provided evaluations of the Army responses to EPA comments on the Draft QAPP (Attachment G). For clarity, the EPA comments on the Draft QAPP and the Army responses are reproduced here.

Request form is not provided in Attachment B. Please revise the Draft QAPP to ensure all field forms that may be used during the project are provided in Attachment B.

Response to Specific Comment 4: *There is no Field Change Request form per se. The PFAS SI Work Plan/QAPP Worksheet #6 was revised to clarify that significant changes to the QAPP must be documented and approved by the Ahtna Project Manager, USACE Technical Lead, and USACE Project Chemist via email correspondence that includes "Field Change Request" in the subject line prior to implementation.*

Evaluation of the Response to Specific Comment 4: The response partially addresses the comment as text was added to clarify that significant changes to the QAPP must be documented and approved by the Ahtna Project Manager, USACE Technical lead and USACE Project chemist via email with the phrase "Field Change Request" in the subject of the email; however, the revised text in Worksheet #6 does not include the phrase "Field Change Request." Please add the phase "Field Change Request" to Worksheet #6 in the appropriate areas.

Response to Evaluation of the Response to Specific Comment 4: *Worksheet #6 was revised per the evaluation of the response.*

Specific Comment 7. Section 7.3.6, Worksheet #10, Conceptual Site Model, Fritzsche Army Airfield Fire Drill Area, Page 20: Groundwater remediation by pump and treat was conducted but it is unclear where the treated water discharged or whether PFAS could have been removed (e.g., by granular activated carbon [GAC]). PFAS contamination could be associated with the area where treated groundwater was discharged. Please revise the text to discuss the treatment method, where the treated groundwater was discharged, and consider whether additional groundwater sampling is necessary near the discharge area.

Response to Specific Comment 7: *Groundwater remediation using pump and treat systems with GAC was conducted from 1988 through 2014 at the former Operable Unit 1 (OU1), which included the Fritzsche Army Airfield (FAAF) Fire Drill Area (FDA). Treated water from OU1 was discharged at different locations within OU1 depending on the specific treatment system that was in operation at the time. Treated water discharge facilities included two infiltration trench areas in the Fort Ord Natural Reserve (FONR), one infiltration basin in the OU1 Off-Post Area (Armstrong Ranch to the northwest of the FONR), two injection wells in the FONR, and a spray irrigation system in the former FAAF FDA. Treatment facilities at OU1 utilized GAC to remove several chemicals of concern (COC), though PFAS were not COCs and were not monitored during OU1 operations. However, sampling and analysis for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) at the Operable Unit 2 (OU2) groundwater treatment plant in 2019 demonstrated that GAC was effective at removing PFAS (see Administrative Record No. BW-2904A). In 2015, samples were collected at OU1 for PFOA and PFOS analysis and the results did not indicate the discharge facilities were a source of PFAS in groundwater (see Administrative Record No. OU1-631A). Based on site history and the results of the sampling for PFOA and PFOS at OU1 in 2015 and at OU2 in 2019, the three proposed groundwater sampling points downgradient of the FAAF FDA are sufficient to determine if PFAS releases occurred at the former FAAF FDA and no additional groundwater sampling is necessary near the discharge areas for the purposes of the SI. The PFAS SI Workplan/QAPP was revised to include this information.*

Evaluation of the Response to Specific Comment 7: The response partially addresses the comment by stating the 2019 effluent sampling at one Operable Unit 2 (OU2) treatment system demonstrated that the granular activated carbon (GAC) is successful in removing perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS); however, it is unclear if the 2019 detection limits for PFOA and PFOS were below current Regional Screening Levels (RSLs), dated May 2022, or if the former OU1 treatment plants were configured similar to the OU2 treatment plant; additionally, the 2019 OU2 treatment plant effluent sampling did not include all of the target PFAS compounds that are included in the Draft Final QAPP. Please confirm that the 2019 PFOA/PFOS detection limits were below current RSLs, if the 2019 results included the complete list of target PFAS compounds and if the OU1 and OU2 treatment systems are/were similar in construction or consider evaluating soil and groundwater at representative locations associated within the former OU1 treatment system effluent infiltration areas.

Response to Evaluation of the Response to Specific Comment 7: *The PFOA and PFOS detection limits (0.002 micrograms per liter [µg/L]) reported in the* Technical Summary Report — Perfluorooctanoic Acid and Perfluorooctane Sulfonate, Basewide Review of Historical Activities and Groundwater Monitoring at Operable Unit 2, Former Fort Ord, California *(Administrative Record No. OU2-722B) were below their current Regional Screening Levels (0.06 µg/L and 0.04 µg/L, respectively). The samples collected from the OU2 groundwater treatment plant were only analyzed for PFOA and PFOS because these were the only two PFAS compounds of concern at the time of sampling. The list of PFAS in the Draft Final SI QAPP was added as Draft EPA Method 1633 was only recently promulgated.*

GAC has been demonstrated to be 99% effective in the removal of PFOA and PFOS. For other PFAS, the effectiveness can range anywhere from 77% – 99%. The GAC generally works better for the longer change PFAS (https://www.awwa.org/Portals/0/AWWA/ETS/Resources/Per-andPolyfluoroalkylSubstances(PFAS)-Treatment.pdf).

Based on the above information, evaluating soil and groundwater within the former OU1 treatment system effluent infiltration areas will be considered in a future phase of the CERLCA process based on the results of the SI.

Specific Comment 8. Section 7.5.1, Worksheet #10, Conceptual Site Model, Contaminant Transport Model, Page 21: The text states that the PFAS in aqueous film-forming foam (AFFF) are not volatile, but that may not be true, depending on the specific constituents in AFFF, including fluorotelomer precursors discussed later in this section. While perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are not volatile, fluorotelomer alcohols (FTOHs) and some shorter chain (C4) compounds have been demonstrated to be volatile. Also, based on the Status of EPA Research and Development on PFAS website (https://www.epa.gov/chemical-research/status-epa-research-and-development-pfas), a United States Environmental Protection Agency (USEPA) report on subsurface migration potential of PFAS into buildings and residences is expected in 2022. Please revise the text to discuss the potential that volatile PFAS compounds are present in AFFF.

Response to Specific Comment 8: *The text does not state that PFAS in AFFF are not volatile, but that most of the major PFAS releases of concern at U.S. Department of the Army (Army) installations are likely to contain a variety of PFAS that do not volatilize. Regardless, discussion about potentially volatile PFAS in AFFF is not relevant to the SI because Fort Ord closed in 1994 and any PFAS releases to the air due to Army operations while Fort Ord was an active installation would have dispersed and no longer pose an* *unacceptable threat to human health or the environment via the air pathway (Administrative Record No. BW-2904A). The PFAS SI Workplan/QAPP was not revised per the comment.*

Evaluation of the Response to Specific Comment 8: The response does not address the comment. The response states that the QAPP does not indicate that aqueous film forming foam (AFFF) are not volatile and since no AFFF is currently located at Ford Ord, PFAS volatilization to air no longer pose an unacceptable threat to human health and the environment; however, it appears the original comment was misinterpreted as the comment stated that PFAS migration to indoor air may be a potential exposure pathway. Please include a discussion regarding the potential for PFAS to migrate from the subsurface into indoor air.

Response to Evaluation of the Response to Specific Comment 8: *The original comment asked that the text be revised to discuss the potential that volatile PFAS compounds are present in AFFF and the Army responded accordingly. There was no statement in the original comment about PFAS migration to indoor air as a potential exposure pathway. It is acknowledged that FTOHs and sulfonamide ethanols are volatile forms of PFAS; however, these are not typically associated with AFFF, use of which is the primary mechanism for PFAS releases at military installations. Accordingly, as stated in Section 7.5.1, soil vapor is not a primary media of concern for receptor exposure. Further, the sites being evaluated in the Site Inspection (SI) are undeveloped and will remain so for the foreseeable future (i.e., there is no pathway to indoor air). There is currently little information available regarding migration of PFAS from the subsurface to indoor air (e.g., as noted in the original comment, USEPA is working on a report on subsurface migration potential of PFAS into buildings and residences, but it has not been released yet), and the conventional wisdom remains that the majority of PFAS exhibit low volatility. The body of knowledge regarding PFAS continues to grow and evolve, so should this understanding change, evaluation of the vapor intrusion pathway for PFAS may occur in future phases of PFAS investigation at the former Fort Ord in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The QAPP was not revised per the comment.*

Specific Comment 16. Section 8.5, Step 5: Develop the Analytic Approach, Proposed Study Question 1, bullet point two, Page 40: If the soil is coarse grained sand, it is possible that all of the PFAS has been flushed from soil; therefore, this decision rule may lead to a misleading conclusion. Please consider revising this decision rule to include the possibility of evaluating groundwater regardless if PFAS are detracted in soil, or provide a new decision rule for this case.

Response to Specific Comment 16: *Recent data regarding PFAS transport through the vadose zone indicates that the vertical mobility of PFAS compounds actually decreases with decreasing clay content. Additionally, sites with low levels of flushing (i.e., low precipitation), such as the former Fort Ord, exhibit higher than expected PFAS concentrations in the vadose zone soil relative to groundwater.*[3] *Based on the low clay content of the soils present at the former Fort Ord and the low flushing levels observed regionally, it is unlikely complete flushing of PFAS from site soil has occurred. The PFAS SI Workplan/QAPP was not revised per the comment.*

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[3] Arcadis, 2019. Final PFAS Fate and Transport White Paper, Active Army Installations, Nationwide. July 7.

Evaluation of the Response to Specific Comment 16: The response appears to address the comment by referring to a PFAS fate and transport white paper prepared by Arcadis; however this white paper was not found or provided. Please include the white paper so the response can be assessed fully.

Response to Evaluation of the Response to Specific Comment 16: *The Army has determined that the Arcadis white papers referenced in the QAPP cannot be made available at this time; therefore, the QAPP was reviewed and revised to replace the references to the Arcadis white papers with references that are publicly available and accessible, where feasible.*

ATTACHMENT L

Responses to Comments on the Draft Final QAPP submitted by the Central Coast Regional Water Quality Control Board

Responses to Comments on the Draft Final QAPP submitted by the California Regional Water Quality Control Board – Central Coast Region (CCRWQCB)[1]

Comment 1: Section 6.0, Worksheet #9: Project Planning Session Summary, Date of Planning Session No. 4, Notes/Comments – This section indicates that the Central Coast Regional Water Quality Control Board will be providing a study performed by the state of California to the Army and other stakeholders that indicates increased PFAS concentrations in groundwater are associated with low-flow wastewater treatment plants (WWTPs).

Please revise this statement to indicate that once the data analysis is finalized by the State Water Resources Control Board (State Water Board) and presented at a regularly scheduled State Water Board meeting, Central Coast Water Board staff will share the State Water Board's staff report with the Army and other stakeholders. It is our understanding that the State Water Board's staff report will include PFAS results for groundwater samples collected at WWTPs throughout California, and preliminary results indicate an apparent increase in PFAS concentrations in groundwater associated with WWTPs with low-flow discharges to land.

Additionally, this section indicates that the regulatory agencies supported a "piecewise" investigation where data are collected starting this year. Please revise the word "piecewise" to either stepwise or phased investigation approach.

Response to Comment 1: *Worksheet #9 was revised per the comment.*

Comment 2: Section 6.0, Worksheet #9: Project Planning Session Summary, Date of Planning Session No. 5, Notes/Comments – This section indicates that the Central Coast Water Board may compile its own data and have more information about low-flow WWTPs. Please revised this to indicate that the State Water Board may compile its own data and have more information about PFAS discharges to groundwater from low-flow WWTPs.

Additionally, Sheila Soderberg with the Central Coast Water Board is listed as a participant in the meeting on May 13, 2022, however, she was not in attendance at this meeting.

Response to Comment 2: *Worksheet #9 was revised per the comment. Sheila Soderberg was removed from the attendance list per the comment.*

Comment 3: Section 7.2, Known or Suspected Contaminants or Classes of Contaminants – Please consider adding USEPA's June 15, 2022, updated interim drinking water health advisories for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) and final drinking water health advisories for perfluorobutane sulfonic acid and its potassium salt (PFBS) and hexafluoropropylene oxide (HFPO) dimer acid and its ammonium salt ("GenX chemicals") to this section.

Response to Comment 3: *The June 2022 U.S. Environmental Protection Agency (USEPA) interim health advisory (HA) levels for PFOA and PFOS are significantly below the current laboratory detection limits. Health advisories serve as technical information to assist Federal, state and local officials, as well as managers of public or community water systems in protecting public health. They are not regulations*

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[1] In a letter dated August 10, 2022 (see Administrative Record No. BW-2912A.3). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

and should not be construed as legally enforceable Federal standards. Conversely, Regional Screening Levels (RSLs) are specifically used to identify contaminated media (i.e., air, tap water, and soil) at a site that may need further investigation and are therefore appropriate for the purposes of the Site Inspection (SI). Since it is currently not analytically feasible to detect PFOA and PFOS at these levels, and these levels are at this time non-regulatory, the HA levels cannot reasonably be used for decision-making and were not included in the Quality Assurance Project Plan (QAPP).

Comment 4: Section 7.5.8, OU2: Fort Ord Landfills Potential Receptors and Exposure Pathways – Please update this section to include a comparison of the low concentrations of PFBS detected in Marina Coast Water District water supply well 29 to the USEPA Regional Screening Levels (RSLs) and DOD Screening Levels.

Response to Comment 4: *The text was revised per the comment.*

Comment 5: Section 9.2, Worksheet #12b – The measurement of performance criteria of detection limits less than or equal to the Project Screening Level (PSL) was removed from the table. Please confirm whether this should still be a measurement of performance criteria and add it back to the table, if appropriate.

Response to Comment 5: *The PSL was added back to Worksheet #12b per the comment.*

Comment 6: Section 11.2.1, Investigation Derived Waste – Liquid – This section indicates that purge water and decontamination rinse water from the assessment activities will be treated at the OU2 Groundwater Treatment Plant (GWTP) using granulated active carbon. Please include PFAS sampling of the GWTP effluent to confirm following treatment and prior to injection, PFAS concentrations are below the USEPA RSLs and drinking water health advisory levels.

Response to Comment 6: *Sampling the OU2 GWTP effluent for PFAS analysis is not warranted. The OU2 GWTP was previously analyzed for PFAS compounds at the GWTP influent and effluent and found to be effective at removing PFAS (Administrative Record No. OU2-722B). Influent concentrations were very low and effluent concentrations were non-detect (with a detection limit of 0.002 µg/L). The OU2 GWTP treats approximately 1,000 gallons of water per minute and the SI fieldwork is scheduled to take 11 weeks. During this time the OU2 GWTP will treat approximately 111 million gallons of extracted groundwater and the SI is conservatively estimated to generate approximately 9,000 gallons of liquid IDW, or 0.008 percent of the total volume treated at the OU2 GWTP. Additionally, concentrations of PFAS historically detected at the former Fort Ord are less than current screening levels (Administrative Record No. BW-2904A). Metering the low volumes of liquid IDW with low concentrations of PFAS into the influent flow will have negligible impact on the post-treatment effluent PFAS concentrations.*

Comment 7: Attachment I, Responses to CCRWQCB Comments on the Draft QAPP, Response to Specific Comments 1, 2, and 3 – If the Final PFAS Sampling and Analysis White Paper, Final PFAS Fate and Transport White Paper, and Final PFAS-Containing Investigation Derived Waste Management and Treatment Options White Paper by Arcadis become available to the public, please provide a copy for reference.

Response to Comment 7: *The Army has determined that the Arcadis white papers referenced in the QAPP cannot be made available at this time; therefore, the QAPP was reviewed and revised to replace* *the references to the Arcadis white papers with references that are publicly available and accessible, where feasible.*

Comment 8: Attachment I, Response to Specific Comment 4b – It is understood that the proposed new well location downgradient of the Main Garrison Fire Station and Site 10, Former Burn Pit is based on groundwater modeling and PFAS groundwater sampling results from the OU2 area. As discussed during the BCT meeting on July 22, 2022, based on the results from soil and groundwater samples collected as part of the SI scope of work, the Central Coast Water Board may require additional groundwater investigation in closer proximity to these sites to evaluate whether there has been a localized release of PFAS to groundwater.

Response to Comment 8: *The U.S. Department of the Army will determine the need for additional groundwater investigation based on the results of the SI and in consultation with the USEPA, the California Department of Toxic Substances Control, and the CCRWQCB.*

ATTACHMENT M

Responses to Comments on the Draft Final QAPP submitted by the Fort Ord Community Advisory Group

Responses to Comments submitted by the Fort Ord Community Advisory Group (FOCAG)[1]

COMMENT 1: The FOCAG had the opportunity to review this and the responses to the questions and comments submitted on the Draft document. There were submittals by the U.S. EPA, The California Department of Toxic Substances Control the California Regional Water Quality Control Board-Central Coast Region, and the FOCAG.

It was apparent our Regulatory Agencies spent considerable time on this as evidenced by the thoughtful questions. comments, concerns, and suggestions expressed to Ahtna Global, LLC, on behalf of the U.S. Army Corps of Engineers. The FOCAG didn't think much of many of the responses provided to them. The Regulatory Agencies can draw their own conclusions.

However, regarding the responses provided to the FOCAG's questions, comments, concerns, and suggestions, we wish to respectfully say we are disappointed. We think this document is minimizing and marginalizing the seriousness of the Issues. The title of the document is a "Quality Assurance Project Plan" involving a "Site Inspection" for "Former Fort Ord, California". The title is misleading. The Title should be changed to; "A Partial Site Inspection", or perhaps "A Preliminary Site Inspection for some of the Substances".

You won't find it if you don't look. The Per- and Polyfluoroalkyl Substances are too big a threat and will have serious long-term consequences.

RESPONSE TO COMMENT 1*: The U.S. Department of the Army (Army) considers per- and polyfluoroalkyl substances to be of serious concern and has therefore initiated the process for investigating PFAS at the former Fort Ord in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The proposed Site Inspection (SI) is in line with current regulatory requirements and the QAPP was prepared in close consultation with the regulatory agencies. Additionally, the SI is only one of the first steps in the CERCLA process and, as described in Section 1.0 of the SI Quality Assurance Project Plan (QAPP), the purpose of the SI is to determine if there is evidence of a PFAS release that would warrant further investigation under CERCLA (i.e., the Army would determine the full extent of PFAS contamination in a future phase of the CERCLA process). Accordingly, the term "Site Inspection" is correct per the CERCLA process and consistent with U.S. Environmental Protection Agency (USEPA) guidance: https://www.epa.gov/enforcement/comprehensive-environmental-response-compensation-and-liability-act-cercla-and-federal*

PFAS are emerging contaminants and, according to the USEPA, an emerging contaminant is a chemical or material characterized by a perceived, potential, or real threat to human health or the environment or by a lack of published health standards. A contaminant also may be "emerging" because of the discovery of a new source or a new pathway to humans. For more information on emerging contaminants, see https://www.epa.gov/fedfac/emerging-contaminants-and-federal-facility-contaminants-concern

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[1] In a letter dated August 11, 2022 (see Administrative Record No. BW-2912A.2). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.