Final
Stewart ANGB Uniform Federal Policy Quality Assurance Project Plan Addendum

PFAS Fingerprinting and Background Study
Multiple Air Force Bases

October 2024

Prepared for:

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814

Under Contract No./ Task Order No.
W91238-23-D-0023 / W91238-23-F0086

Prepared by:

Sustainment and Restoration Services, LLC
209 E. Victoria Street
Santa Barbara, California 93101

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Final
Stewart ANGB Uniform Federal Policy Quality Assurance Project Plan Addendum

Project Title:	Per- and Polyfluoroalkyl Substances (PFAS) Fingerprinting and Background Study at Multiple Air Force Bases
Contractor:	Sustainment and Restoration Services, LLC (SRS)
Submitted to:	U.S. Army Corps of Engineers, Sacramento District
Contract Number:	W91238-23-D-0023
Task Order:	W91238-23-F-0086
Contract Name:	PFAS Fingerprinting and Background Study
Prepared for:	U.S. Army Corps of Engineers Sacramento District
Period of Performance:	26 September 2023 to 25 September 2026
Date of Award:	26 September 2023

October 2024

TABLE OF CONTENTS

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
#	number
%	percent
AF	Air Force
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFFF	aqueous film forming foam
amsl	above mean sea level
ANG	Air National Guard
ANGB	Air National Guard Base
AW	Airlift Wing
bgs	below ground surface
B.S.	Bachelor of Science
CEG	Certified Engineering Geologist
CHG	Certified Hydrogeologist
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
COR	Contracting Officer’s Representative
CPR	cardiopulmonary resuscitation
CSM	conceptual site model
CSP	Certified Safety Professional
CZTE	Environmental Restoration Technical Support Branch
DAF	Department of the Air Force
DBF	Demolition and Burn Facility
DoD	Department of Defense
EPA	United States Environmental Protection Agency
FD	field duplicate
ft	feet or foot
FTL	Field Team Lead
GIS	geographical information systems
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEF	high expansion foam
ID	identification
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-derived waste
IRP	Installation Restoration Program

MMYY	month and year of sample collection
M.S.	Master of Science
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
No.	number
OASD	Office of the Assistant Secretary of Defense
OESC	Oneida Engineering, Science, and Construction Group
Oneida	Refers to SRS and OTIE in this UFP-QAPP
OPSEC	Operations Security
OSHA	Occupational Safety and Health Administration
OTIE	Oneida Total Integrated Enterprises, LLC
OWS	oil/water separator
PE	Professional Engineer
PFAS	per- and polyfluoroalkyl substances
PG	Professional Geologist
PgM	Program Manager
PM	Project Manager
PMP	Project Management Professional
POC	Point of Contact
PRL	Potential Release Location
QA	quality assurance
QC	quality control
RI	Remedial Investigation
RPM	Restoration Program Manager
SHM	Safety and Health Manager
SI	Site Inspection
SOP	standard operating procedure
SRS	Sustainment and Restoration Services, LLC
SSHO	Site Safety and Health Officer
TBD	to be determined
TOC	total organic carbon
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
U.S.	United States
USACE	United States Army Corps of Engineers
VAP	vertical aquifer profile

INTRODUCTION

This installation-specific Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Addendum was prepared to support per- and polyfluoroalkyl substances (PFAS) fingerprinting and background studies at Stewart Air National Guard Base (ANGB) to discriminate among potential aqueous film forming foam (AFFF) and other PFAS sources and evaluate the anthropogenic background PFAS concentrations.

This UFP-QAPP Addendum will be used in tandem with the Final Programmatic UFP-QAPP (Attachment A) to execute the performance objectives by Sustainment and Restoration Services, LLC (SRS) with support provided by sister company Oneida Total Integrated Enterprises (OTIE). Both OTIE and SRS are wholly owned subsidiaries of the Oneida Engineering, Science and Construction (OESC) Group and are referred to herein as Oneida. Oneida will be supported by subcontractor Battelle, together referred to herein as the Oneida Team.

This installation-specific UFP-QAPP Addendum has been prepared to provide installation-specific details including background information, conceptual site models (CSMs), data quality objectives, sampling locations, and installation-specific requirements.

SCOPE OF WORK

The overall scope of this project is to provide the United States Army Corps of Engineers (USACE) and the Department of the Air Force (DAF) support in conducting PFAS fingerprinting analyses and background studies at the following DAF installations:

- Des Moines ANGB, Iowa
- Dover Air Force Base (AFB), Delaware
- Eielson AFB, Alaska
- Stewart ANGB, New York
- Travis AFB, California
- Wright Patterson AFB, Ohio
- Tucson Area, including Morris ANGB, Air Force Plant 44, and Tucson International Airport.

DAF installations may contain several different types of PFAS sources. PFAS fingerprinting studies are being conducted to discriminate between multiple potential PFAS sources including but not limited to various AFFF formulations; various municipal/industrial wastes; and PFAS originating from commercial products and metal plating facilities. Both target and non-target analytes will be analyzed using Battelle's PFAS Signature® analysis. Background studies are being conducted to evaluate the anthropogenic background concentrations at each installation. The fingerprint studies will include sampling and evaluation of soil, surface water, and groundwater. The background studies will include sampling of soil both within and outside of installation boundaries to evaluate the anthropogenic PFAS background concentrations detected at each installation. These studies are intended to support CSM understanding and provide information to assess preliminary background (anthropogenic) PFAS soil concentrations at each installation.

Installation-specific investigation strategy, field methodology, screening criteria, and other detailed information outlining the approach for completion of the fingerprinting analyses and background studies at Stewart ANGB will be provided in this installation-specific UFP-QAPP Addendum, the Final

Programmatic UFP-QAPP (Attachment A), and other planning documents. One combined fingerprinting and Background Study Report will be prepared for Stewart ANGB.

PLAN ORGANIZATION

This UFP-QAPP Addendum is organized with the original 37 worksheets consolidated into optimized UFP-QAPP worksheets (Intergovernmental Data Quality Task Force [IDQTF] 2012). For ease of reference, the revised worksheets are named to reflect the original worksheets on which they are based (IDQTF 2012). The UFP-QAPP Addendum is intended to provide, in an orderly fashion, the problem definition; approach to resolving the problem; and quality assurance (QA)/quality control (QC) activities, such that the data collected are useable. The table of contents of this document presents a listing of all the UFP-QAPP worksheets. Several worksheets from the Programmatic UFP-QAPP are not included in this UFP-QAPP Addendum. A crosswalk for worksheets included in the UFP-QAPP Addendum vs the Programmatic UFP-QAPP is included below.

Attachments to this UFP-QAPP Addendum, provided as separate tabs, are as follows:

Attachment A	Final Programmatic UFP-QAPP
Attachment B	Kickoff and Scoping Meeting Minutes
Attachment C	Installation-specific Site Safety and Health Plan
Attachment D	Responses to Regulatory Comments

Crosswalk of Worksheets included in Programmatic UFP-QAPP vs. Installation-Specific UFP-QAPP Addendum

Worksheet	Included in Programmatic UFP-QAPP	Included in Installation-Specific UFP-QAPP Addenda
UFP-QAPP Worksheet #1 & 2 – Title and Approval Page	X	X
UFP-QAPP Worksheet #3 & 5 – Project Organization and QAPP Distribution	X	X
UFP-QAPP Worksheet #4, 7 & 8 – Personnel Qualifications and Sign-off Sheet	X	X
UFP-QAPP Worksheet #6 – Communication Pathways	X	X
UFP-QAPP Worksheet #9 – Project Planning Session Summary	X	X
UFP-QAPP Worksheet #10 – Conceptual Site Model	X	X
UFP-QAPP Worksheet #11 – Project/Data Quality Objectives	X	
UFP-QAPP Worksheet #12 – Measurement Performance Criteria	X	
UFP-QAPP Worksheet #13 – Secondary Data Uses and Limitations	X	X
UFP-QAPP Worksheet #14 & #16 – Project Tasks & Schedule	X	X
UFP-QAPP Worksheet #15 – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits	X	
UFP-QAPP Worksheet #17 – Sampling Design and Rationale	X	X
UFP-QAPP Worksheet #18 – Sampling Locations and Methods	X	X
UFP-QAPP Worksheet #19 & 30 – Sample Containers, Preservation, and Hold Times	X	

Worksheet	Included in Programmatic UFP-QAPP	Included in Installation-Specific UFP-QAPP Addenda
UFP-QAPP Worksheet #20 – Field Quality Control Summary	X	X
UFP-QAPP Worksheet #21 – Field Standard Operating Procedures	X	
UFP-QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing and Inspection	X	
UFP-QAPP Worksheet #23 – Analytical Standard Operating Procedures	X	
UFP-QAPP Worksheet #24 – Analytical Instrument Calibration	X	
UFP-QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection	X	
UFP-QAPP Worksheet #26 & 27 – Sample Handling System, Custody, and Disposal	X	
UFP-QAPP Worksheet #28 – Analytical Quality Control and Corrective Action	X	
UFP-QAPP Worksheet #29 – Project Documents and Records	X	
UFP-QAPP Worksheet #31, 32 & 33 – Assessments and Corrective Action	X	
UFP-QAPP Worksheet #34 – Data Verification and Validation Inputs	X	
UFP-QAPP Worksheet #35 – Data Verification Procedures	X	
UFP-QAPP Worksheet #36 – Data Validation Procedures	X	
UFP-QAPP Worksheet #37 – Data Usability Assessment	X	

UFP-QAPP Worksheet #1 & #2 – Title and Approval Page

(UFP-QAPP Manual Section 2.1) (EPA 2106-G-05 Section 2.2.1)

Project Identifying Information

a. Project Name: Per- and Polyfluoroalkyl Substances (PFAS) Fingerprinting and Background Study at Multiple Air Force Bases

b. Site Location Stewart ANGB, Newburgh, New York

c. Contract / Task Order: W91238-23-D-0023 / W91238-23-F-0086

Review Signatures:

Sustainment and Restoration Services, LLC (SRS)

Megan Duley

Megan Duley – Project Manager

Matt Van Beek

Matthew Van Beek – Corporate QC Manager

Jacques Marcillac – Program Manager

United States Army Corps of Engineers (USACE) – Sacramento District

ESTEY.AMY.LOW.1550425030 Digitally signed by ESTEY.AMY.LOW.1550425030 Date: 2024.10.16 14:53:14 -04'00'

Amy Estey – Project Manager/ Task Order Contracting Officer's Representative

Air Force Civil Engineer Center (AFCEC)

CASH.CYNTHIA.JOYCE.1520412197 Digitally signed by CASH.CYNTHIA.JOYCE.1520412197 Date: 2024.10.11 12:14:33 -05'00'

Cynthia Cash – Program Manager (PgM)

Air National Guard (ANG)

FREIHOFER.KEITH.EDWIN.1394572949 Digitally signed by FREIHOFER.KEITH.EDWIN.1394572949 Date: 2024.10.22 17:35:51 -04'00'

Keith Freihofer – PgM ANG Installations

1. This UFP-QAPP Addendum was prepared in accordance with the following guidance and additional applicable guidance listed in the Programmatic UFP-QAPP (Attachment A):

    - Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets. (IDQTF, 2012).

- Intergovernmental Data Quality Task Force, Uniform Federal Policy for Implementing Environmental Quality Systems. Evaluating, Assessing, and Documenting Environmental Data Collection/Use and Technology Programs, Parts 1 and 2A: UFP-QAPP Manual and UFP-QAPP Workbook (IDQTF, 2005).

2. This UFP-QAPP Addendum complies with the Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories Version 5.4 (DoD, 2021).

3. This is a project-specific UFP-QAPP Addendum.

4. A programmatic project kick-off meeting was held on 19 October 2023 to review project tasks, lines of communication, and roles and responsibilities (summarized in the programmatic UFP-QAPP; Attachment A). Installation-specific kickoff meetings were held for each installation included on this contract. The installation-specific kickoff meeting for Stewart ANGB was held on 20 November 2023 and an in-person scoping session was held on 7 March 2024. Meeting information is summarized in Worksheet #9 and meeting minutes are provided in Attachment B.

5. The organizational partners (stakeholders) and their connection with the lead organization are the USACE Sacramento District, and the DAF, which includes AFCEC and the Air National Guard (ANG). The agency representatives have been provided a copy of this UFP-QAPP Addendum for review and comment. USACE is the lead agency responsible for the work described in this UFP-QAPP Addendum.

6. The data users for this UFP-QAPP Addendum include the USACE Sacramento District, DAF, regulatory stakeholders, and the Oneida Team.

7. All required elements under the UFP-QAPP template are applicable to this installation-specific UFP-QAPP Addendum and each element is included. None of the required UFP-QAPP elements has been omitted from this document.

UFP-QAPP Worksheet #3 & #5 – Project Organization and UFP-QAPP Distribution

(UFP-QAPP Manual Sections 2.3 – 2.4) (EPA 2106-G-05 Section 2.2.3 and 2.2.4)

The programmatic project organizational chart and distribution list are provided in the programmatic UFP-QAPP (Attachment A). The Stewart ANGB project organizational chart and UFP-QAPP distribution list are provided below. This UFP-QAPP Addendum will be provided to those listed on both the programmatic and installation-specific distribution lists.

Stewart ANGB Project Organization

USACE/AFCEC	Regulatory Oversight	Stewart ANGB Team	Oneida Team
PM/Task Order COR - Jessica Faragalli (USACE) **PgM Active ANG Installations** - Keith Freihofer **PgM Active AF Installations** - Cynthia Cash (AFCEC)	**EPA Region 2** **New York State Department of Environmental Conservation**	**Restoration Program Manager (RPM)** - William Myer **Environmental Manager** - Michael Oettinger **Environmental Specialist** - Alekzander Obry	**Project Manager** - Megan Duley **Deputy Project Manager** - Lauren Idleman **Corporate Health and Safety Manager (SHM)** - Bradley Kuntz **SSHO/ FTL** - Mark Wanek **Field Geologists** - Richard Klamm - John Kelley - Kevin Engle (Alternate SSHO/FTL) - Brandon Womack

NOTES

AF	Air Force	PgM	Program Manager
COR	Contracting Officer's Representative	PM	Project Manager
EPA	U.S. Environmental Protection Agency	SSHO	Site Safety and Health Officer
FTL	Field Team Lead		

Stewart ANGB UFP-QAPP Addendum Distribution ListUFP- QAPP

Recipient	Title/Role	Organization	Email
Jessica Faragalli	PM/Task Order COR	USACE	jessica.w.faragalli@usace.army.mil
Daniel Czech	Contracting Officer	USACE	daniel.e.czech@usace.army.mil
Mike Riggle	Contract COR	USACE	michael.A.riggle@usace.army.mil
Nicholas Montgomery	Technical Lead	USACE	nicholas.d.montgomery@usace.army.mil
Cynthia Cash	PgM Active AF Installations	AFCEC	cynthia.cash.1@us.af.mil
Alecia George	Deputy PgM AF Installations	AFCEC	alecia.george.1@us.af.mil
Anne (Kathleen) Bradley	Technical Support (hydrogeologist)	AFCEC/CZTE	anne.bradley.1@us.af.mil

Recipient	Title/Role	Organization	Email
Richard (Hunter) Anderson	Technical Support (subject matter expert – PFAS)	AFCEC/CZTE	richard.anderson.55@us.af.mil
John (Seb) Gillette	Technical Support (Chemist)	AFCEC/CZTE	john.gillette.1@us.af.mil
Keith Freihofer	PgM ANG Installations	ANG	keith.freihofer.1@us.af.mil
William Myer	Stewart ANGB RPM	ANG	william.myer.2@us.af.mil
Michael Oettinger	Stewart ANGB Environmental Manager	ANG	michael.oettinger.2@us.af.mil
Jacques Marcillac, PG, CHG, CEG	PgM	Oneida	jmarcillac@oescgroup.com
Matthew Van Beek	Corporate QC Manager	Oneida	mvanbeek@oescgroup.com
Megan Duley, PE	PM	Oneida	mduley@oescgroup.com
Kevin Engle, PG	Deputy PM (AF Installations)	Oneida	kengle@oescgroup.com
Lauren Idleman, PG	Deputy PM (ANG Installations)	Oneida	lIdleman@oescgroup.com
Bob Mallisee, PG	Senior Hydrogeologist	Oneida	rmallisee@oescgroup.com
Kristen Carylon Peyton, CHMM	Senior Project Chemist	Oneida	kcarlyonpeyton@oescgroup.com
Bradley Kuntz, CIH, CSP, CHMM, SMS	Corporate Health and Safety Manager	Oneida	bkuntz@oescgroup.com
Pamela Chang, PMP	PM	Battelle	changp@battelle.org
Kavitha Dasu, PhD	Senior Chemist	Battelle	dasu@battelle.org
Rick Wice, PG	Senior Geologist	Battelle	wice@battelle.org
Franco Pala, PhD	Laboratory Director	Battelle Analytical Chemistry Services	palaf@battelle.org
Nicole Brown	Laboratory PM	Eurofins Lancaster Laboratories Environmental	nicole.brown@et.eurofinsus.com
Evin McKinney	Data Validator	Environmental Synectics, Inc. (Synectics)	evin.mckinney@synectics.net

NOTES

CEG	Certified Engineering Geologist	CZTE	Environmental Restoration Technical Support Branch
CHG	Certified Hydrogeologist	PE	Professional Engineer
CHMM	Certified Hazardous Materials Manager	PMP	Project Management Professional
CIH	Certified Industrial Hygienist	PG	Professional Geologist
CSP	Certified Safety Professional		

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UFP-QAPP Worksheet #4, #7 & #8 – Personnel Qualifications and Sign-off Sheet

(UFP-QAPP Manual Sections 2.3.2 – 2.3.4) (EPA 2106-G-05 Section 2.2.1 and 2.2.7)

Organization: SRS

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Megan Duley, PE	PM	B.S. Chemical Engineering / 23 years	Minnesota PE, Naval Facilities Engineering Systems Command Geographical Information Systems (GIS) Certification, 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response training (HAZWOPER), Antiterrorism Level I Training, Operations Security (OPSEC) training	Refer to signature on Worksheet #1&2
Jacques Marcillac, PG, CHG, CEG	PgM	B.S. Geological Sciences / 27 years	40-hour OSHA HAZWOPER, USACE Construction Quality Management for Contractors, Antiterrorism Level I Training, OPSEC training	Refer to signature on Worksheet #1&2
Matthew Van Beek, PE	Corporate QC Manager	M.S., Engineering Management / 20 years	OSHA 10-Hour Construction Safety and Health, USACE Construction Quality Management for Contractors, Antiterrorism Level I Training, OPSEC training	Refer to signature on Worksheet #1&2
Kevin Engle, PG	Deputy PM (AF)/Alternate SSHO/FTL	M.S. Geology/ 10 years	Wyoming PG, 40-hour OSHA HAZWOPER, USACE Construction Quality Management for Contractors, 30-hour OSHA Construction Supervisor, Antiterrorism Level I Training, OPSEC training	
Lauren Idleman, PG	Deputy PM (ANG)	M.S. Geology/ 10 years	Minnesota PG, 40-hour OSHA HAZWOPER, USACE Construction Quality Management for Contractors, Antiterrorism Level I Training, OPSEC training	
Bob Mallisee, PG	Sr. Hydrogeologist	B.S. Geology / 32 years	40-hour OSHA HAZWOPER, OSHA 8-Hour HAZWOPER Supervisor, Antiterrorism Level I Training, OPSEC training	
Mark Wanek, PG	SSHO/ Project Geologist/ FTL	B.S. Environmental Geology/Geohydrology / 22 years	California PG No. 9271, 40-hour HAZWOPER, 8-hour HAZWOPER Supervisor, 30-hour OSHA Construction Supervisor, USACE Construction Quality Management for Contractors, Excavation Competent Person Training, Antiterrorism Level I Training, First Aid/ Cardiopulmonary Resuscitation (CPR) training, OPSEC training	
Kristen Carlyon Peyton, CHMM	Senior Project Chemist	B.S. Chemistry / 28 years	Certified Hazardous Materials Manager (CHMM) #18310, 40-hour HAZWOPER, Antiterrorism Level I Training, OPSEC training	

Organization: Battelle

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Pamela Chang, PMP	PM	B.S. Chemical Engineering / 25 years	PMP, 40-hr HAZWOPER, 8-hr Annual HAZWOPER, 30-hr OSHA Construction, 8-hr OSHA Supervisor, First Aid/CPR, OPSEC training	
Kavitha Dasu, PhD	Senior Chemist	PhD Environmental Chemistry/12 years	OPSEC training	
Rick Wice, PG	Senior Geologist	M.S. Geology / 37 years	PG (Pennsylvania, Texas, Indiana, Delaware), 40-hours OSHA HAZWOPER, OSHA 8- Hour Site Supervisor Training, 30-Hour OSHA Construction Supervisor, OSHA 8-Hour refresher, OPSEC training, First Aid/CPR	
Franco Pala, PhD	Laboratory Director	PhD Environmental Chemistry/25 years	--	

Organization: Eurofins Lancaster

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Nicole Brown	Laboratory PM/Senior PM	B.S. Biological Sciences / 16 years	--	

Organization: Synectics

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Evin McKinney	Data Validator / Senior Scientist	B.S. Chemistry / 15 years laboratory experience/20 years validation experience	--	

NOTES

B.S.	Bachelor of Science
M.S.	Master of Science

UFP-QAPP Worksheet #6 – Communication Pathways

(UFP-QAPP Manual Sections 2.4.2) (EPA 2106-G-05 Section 2.2.4)

In addition to the communications pathways found in Worksheet #6 in the Programmatic UFP-QAPP (Attachment A), the following communication pathways are applicable to Stewart ANGB.

Communication Drivers	Organization	Name	Phone Number	Email Address	Procedure
Stop work due to safety issues	Oneida Team – FTL/ SSHO/Project Geologist	Mark Wanek	805-705-8017	mwanek@oescgroup.com	Oneida PM informs USACE/AFCEC PM via phone or e-mail (dependent on cause of stop work) within 24 hours of stop work event.
	Oneida Team – PM	Megan Duley	651-775-7870	mduley@oescgroup.com	
	Oneida Team – PgM	Jacques Marcillac	805-797-0021	jmarcillac@oescgroup.com	
	Oneida Team- SHM	Bradley Kuntz	704-907-5115	bkuntz@oescgroup.com	
	USACE – PM	Jessica Faragalli	916-710-1889	jessica.w.faragalli@usace.army.mil	
	USACE – COR	Daniel Czech	916-557-7012	daniel.e.czech@usace.army.mil	
	USACE Field Oversight	TBD	TBD	TBD	
	AFCEC – PM	Cynthia Cash	210-367-1511	cynthia.cash.1@us.af.mil	
	ANG – PM	Keith Freihofer	240-612-8762	keith.freihofer.1@us.af.mil	
	Installation POCs	(see below)			
	NYSDEC	Justin Starr	518 402-9543	justin.starr@dec.ny.gov	
Installation POCs	Stewart ANGB RPM	William Myer	240-612-8473	william.myer.2@us.af.mil	E-mail/phone communication with POC at Stewart ANGB (as needed).
	Stewart ANGB Environmental Manager	Michael Oettinger	845-563-2383	michael.oettinger.2@us.af.mil	
Daily Field Progress Reports	Oneida – FTL	Mark Wanek	805-705-8017	mwanek@oescgroup.com	Oneida FTL will receive e-mail field progress from field staff (daily).
	Oneida – Field Geologists	Richard Klamm	210-394-0744	rklamm@oescgroup.com	
		John Kelley	925-239-0865	jkelley@oescgroup.com	
		Kevin Engle	720-390-9747	kengle@oescgroup.com	
		Brandon Womack	801-200-4561	bwomack@oescgroup.com	

NOTES

NYSDEC	New York State Department of Environmental Conservation
POC	point of contact
TBD	to-be-determined

UFP-QAPP Worksheet #9 – Project Planning Session Summary

(UFP-QAPP Manual Section 2.5.1 and Figures 9-12) (EPA 2106-G-05 Section 2.2.5)

A kickoff meeting teleconference was held on 11 November 2023 to introduce the project team, discuss roles and responsibilities, establish project communication, discuss project objectives and schedule, and identify next steps for successful project execution at Stewart ANGB. Following the kickoff meeting, an in-person scoping session was held on 7 March 2024 to meet the project team, present and discuss the preliminary sampling plan, tour Stewart ANGB, and identify next steps for successful project execution.

Meeting minutes and attendees for the kickoff and scoping meetings are included in Attachment B.

UFP-QAPP Worksheet #10.1 – Conceptual Site Model

(UFP-QAPP Manual Sections 2.5.2) (EPA 2106-G-05 Section 2.2.5)

Facility Profile	Physical Profile	Release Profile	Fate and Transport
Installation Description: • Stewart Municipal Airport was established in 1930, transferred to the Air Force in 1947, and operated as Stewart AFB until 1969. • Stewart AFB was deactivated in 1970 and the aviation facilities were transferred to the State of New York. • The Stewart ANG 105th Air Support Group relocated from Westchester County Airport to the current 267-acre facility at Stewart International Airport in 1983. • The Stewart ANG 105th Air Support Group was renamed to the 105th Airlift Wing (AW) in 1995. The primary mission of the 105th AW is to provide peacetime and wartime inter-theater airlift operations.	**Site Characteristics:** • Stewart ANGB encompasses approximately 280 acres 2.5 miles west of the city of Newburgh in Orange County, New York. **Topography**: • The topography of Stewart ANGB is relatively flat, with significant slopes on the southern and eastern sides. Throughout most of the installation, surface elevations range from 440 to 450 feet (ft) above mean sea level (amsl), with lows of 340 ft amsl on the eastern property line and 400 ft amsl on the southern property line. **Surface Water:** • Recreation Pond • Lake Washington • Silver Stream • Patton Brook **Soils**: • Unconsolidated deposits in the area are well-graded glacial tills consisting of sand, silty sand, gravels, cobbles and boulders. The soils are primarily gravelly, sandy loam. **Geology:** See Worksheet #10.2 below. **Hydrogeology:** See Worksheet #10.2 below. **Meteorology/Climate**: • Average annual precipitation is 44.6 inches, generally evenly distributed throughout the year (Weatherbase, April 2024). • Average temperature is 49.2 degrees Fahrenheit (°F). The coldest month is January (average temperature of 25.3° F) and the warmest month is July (average temperature of 71.8° F) (Weatherbase, April 2024). **Sensitive cultural/ecological resources; other features of note** • Historic (Revolutionary War-era) homesteads • Wetlands	**Media of Potential Concern**: • Soil, groundwater, and surface water **Confirmed AFFF Releases:** (Site Inspection [SI] Report and Summary of Findings): • PRL 1: Building 104, Current Fire Station • PRL 2: Nozzle Testing Area • PRL 3: Building 105, Former Fire Station • PRL 4: Hangar 100 • PRL 5: Hangar 101 • PRL 6: Hangar 102 • PRL 7: Hangar 300 • PRL 8: Hangar 301 • PRL 9: Building 108, Pump House • PRL 10: Building 200 • PRL 11: Apron • PRL 15: Retention Basin • PRL 16: Former Nozzle Testing Area PRLs 12, 13, and 14 (Outfalls 002, 003 and 006, respectively) were included in the SI and SI Addendum. The outfall and drainage ditch are not primary source areas and are not investigated as separate PRLs. **Other Potential PFAS Sources:** • Landfills • Vehicle and equipment wash areas • Oil/water separators (OWS) • Former Demolition and Burn Facility (DBF)	**Migration Pathways**: • Infiltration into groundwater (unconsolidated material, fracture flow, etc.) • Soil (surface and subsurface) and sediment • Stormwater sewer collection systems • Adsorption to soil matrix near source • Surface water • Topographically controlled migration **Primary Transport Mechanisms:** • Groundwater and surface water at the base generally flow towards Lake Washington via Silver Stream and other tributaries • The stormwater sewer system generally directs surface water to the south. Cracks/leaks in piping may allow groundwater infiltration into sewer and/or stormwater infiltration out of sewer to soil/groundwater

NOTE

PRL	Potential Release Location

UFP-QAPP Worksheet #10.2 – Expanded Conceptual Site Model and Site Profiles

10.1 BACKGROUND

Stewart ANGB (Figure 1) encompasses approximately 280 acres adjacent to Stewart International Airport about 2.5 miles west of Newburgh in Orange County, New York (AECOM, 2022). Since 1983, Stewart ANGB has been home to the 105th Airlift Wing, whose primary mission is to provide peacetime and wartime inter-theater airlift operations using the Boeing C-17 Globemaster III (AECOM, July 2015). The base is bound to the north, east and south by industrial and interchange business zones and to the west by Stewart International Airport (AECOM, 2022).

10.2 GEOLOGY

The bedrock underlying Stewart ANGB is the Martinsburg Shale, which is a member of the Normanskill Formation (Wood, 2020a). The shale is thinly bedded, highly fractured, and highly weathered in the upper portions. Bedrock is generally found at depths of approximately 45 to 50 ft below ground surface (bgs) at the base. The bedrock east of Stewart ANGB and underlying Lake Washington is the Wappinger Group and is composed of carbonate rocks including limestone and/or dolostone. The deposits overlying the weathered bedrock at the base are glacial till which is composed of sand, silty sand, pebble, gravel, cobbles, and boulders (AECOM, 2022).

10.3 HYDROGEOLOGY

There are two primary water-bearing units in the Stewart ANGB area. The first is the coarse-grained sediments within the unconsolidated glacial tills, through which groundwater can move both vertically and horizontally at a rate of approximately 13 ft per year. The second is horizontal groundwater flow along the top of consolidated bedrock, primarily through the weathered bedrock zone at a rate of approximately 1.6 ft per year (Wood, 2020a).

10.4 HYDROLOGY

Groundwater in the Stewart ANGB area generally flows to the south-southeast and is generally encountered at depths ranging between 15 to 40 ft bgs on average. However, groundwater was encountered at 3.49 ft bgs in the northeastern section of the base during a synoptic water level event in 2019 (AECOM, 2022).

Surface water in the vicinity of Stewart ANGB generally flows in the direction of Lake Washington, located 0.5 miles southeast of the base. Surface water at the base includes Recreation Pond, located just south of the base’s southern border. Recreation Pond is the catchment for Stewart ANGB stormwater outfall discharges; Recreation pond discharges to Silver Stream, which flows into Lake Washington. Surface water along the eastern boundary of Stewart ANGB flows into a ditch known as Murphy’s Gulch, which flows east under Interstate 87 to wetlands that discharge to Patton Brook and eventually into Quassaick Creek.

10.5 ECOLOGY

Stewart ANGB may host several threatened or endangered species:

- Indiana bat – Mammal, state, and federally endangered
- Northern long-eared bat – Mammal, federally threatened
- Bog turtle – Reptiles, state endangered and federally threatened
- Small whorled pogonia – Plant, state endangered and federally threatened

These species may be present at Stewart ANGB. Rare animal habitats also occur in the areas around Stewart ANGB, including the red-headed woodpecker, northern harrier, northern long-eared bat, little brown bat, and the wood turtle. Wetlands were identified in the vicinity of Stewart ANGB, but not within the base boundaries (AECOM, 2022).

10.6 POTENTIAL RELEASE LOCATIONS (PRLS) AND OTHER POTENTIAL PFAS SOURCES

There are a total of 16 AFFF Areas at Stewart ANGB, most of which are currently subject to further investigation for PFAS. Descriptions for these areas are provided below. PRL Areas 12, 13, and 14, which encompass Outfall 002, 003, and 006, respectively, were included in the SI and SI Addendum. The outfall and drainage ditch are not considered primary sources areas and are not investigated as separate PRLs. Recent PFAS results for groundwater, surface water, and soil are shown on Figures 3a, 3b, and 3c respectively.

PRL 1: Building 104- Current Fire Station

Building 104 was constructed in 2007. AFFF is stored on site in totes and drums, and is also present in the fire department vehicles, including a foam trailer. Floor drains in the building are connected to an OWS which discharges through Outfall 002 into Recreation Pond. There is no record of a release of AFFF at Building 104. (BB&E, 2016; Wood, 2020a).

PRL 2: Nozzle Testing Area

The concrete pad to the west of Building 104 has been used annually for vehicle nozzle testing since 2007. This is the only known location of current nozzle testing and no records of the testing are available. Cracks have been observed in the concrete at the site, indicating a potential for infiltration into the soil below the pad (BB&E, 2016).

PRL 3: Building 105- Former Fire Station

Prior to 2007, Building 105 was the base fire department occupied Building 105, which was built in 1988. There are no documented releases of AFFF. Historical practices are unknown but are assumed to be similar to those conducted at the current fire station. It is also unknown whether nozzle testing was conducted. Floor drains are located on both ends of the building and discharge into the industrial waste line, which would capture accidental discharges or spills (BB&E, 2016).

PRL 4: Hangar 100

Hangar 100 contained an AFFF fire suppression system from 1987 to 2006, after which the system was retrofitted for use of high expansion foam (HEF). Prior to retrofitting, three AFFF supply tanks of unknown capacity were located in the boiler room of the building. There is no official record of an accidental AFFF release at Hangar 100. A newspaper article reportedly described an AFFF spill from Hangar 100 which discharged directly into New Windsor’s sanitary sewer system (BB&E, 2016).

PRL 5: Hangar 101

Hangar 101 contained an AFFF fire suppression system from 1987 to 2009, after which the system was retrofitted for use of HEF. The AFFF storage tanks were kept on the floor of the main hangar when in use. There is no record of accidental AFFF release, and it is not known whether the fire suppression system was tested. Hangar 101 contains trench drains that discharge to an OWS through the industrial waste system and into the Retention Basin. Base personnel indicated that several accidental AFFF fire suppression system releases had occurred; however, no accidental full-system releases occurred (BB&E, 2016).

PRL 6: Hangar 102

Hangar 102 contained an AFFF fire suppression system from 1988 to 2006, after which the system was retrofitted for use of HEF. The two AFFF supply tanks were located in the Electrical and Fire Protection Equipment Room, where staining was observed on the floor and wall. There are no floor drains in that room, but trench drains in the hangar bay discharge to an OWS through the industrial waste system and then to the Retention Basin (BB&E, 2016).

PRL 7: Hangar 300

Hangar 300 contained an AFFF fire suppression system from 1989/1990 to 2004, when the system was retrofitted for use of HEF. An 1,800-gallon AFFF supply tank was located in the Sprinkler/Mechanical Room in the hangar. The hangar has trench drains, which discharge through an OWS through the industrial waste system and into the Retention Basin. It is unknown if the fire suppression systems were tested. There is no record of accidental AFFF release (BB&E, 2016).

PRL 8: Hangar 301

Hangar 301 is a maintenance facility and is used for maintenance of aircraft fuel cells and washing and corrosion control of aircraft. The hangar contained an AFFF fire suppression system from 1992 to 2004, when the system was retrofitted for use of HEF. Two 1,300 gallon AFFF supply tanks were located in the Mechanical Room of the hangar to supply the system. It is unknown whether the fire suppression system at Hangar 301 was tested. There is no official record of accidental AFFF release; however, base personnel identified at least one accidental release (BB&E, 2016). The hangar contains trench drains, which discharge to an OWS through the industrial waste system and flow to the Retention Basin (BB&E, 2016).

PRL 9: Building 109- Pump House

Building 109 was built in 1988 and historically stored AFFF for the base. Dates and amounts of AFFF stored at the building are unknown, and there is no record of accidental AFFF release. The building contains floor drains that discharge to Outfall 006 via the storm sewer system (BB&E, 2016).

PRL 11: Apron

The Stewart ANGB apron is a paved area that covers approximately 75 acres on the west side of the flight line. The apron is used for parking, fueling, de-icing, and minor aircraft maintenance. Drain inlets installed on the apron discharge through the storm sewer system to Outfall 002. Drainage normally flows through the Diversion Valve Chamber, which includes a large filtration system and control system. However, if needed, the storm sewer system can be redirected at the Diversion Valve Chamber and diverted to the Retention Basin (BB&E, 2016).

PRL 15: Retention Basin

The retention basin is composed of two lined lagoons, east and west, built in 1986 and 1992, respectively. Both of the lagoons were relined in 2011. Releases from the base buildings ultimately discharge into the lagoons via the industrial waste system. Similarly, discharge from the apron can be rerouted to the Retention Basin if a spill occurs (BB&E, 2016).

PRL 16: Former Nozzle Testing Area

The former nozzle testing area was identified after the conclusion of the SI. The area is located to the northeast of the apron, on the airport side of the northern base boundary. In the past, fire suppression equipment would park at the end of the taxiway and discharge into the grassy area. The dates of use and amount of AFFF discharged in the area are unknown (Wood, 2019).

Former Demolition and Burn Facility

The former Demolition and Burn Facility (DBF) is a former fire training area/rifle range northwest of Stewart ANGB. This area was used by Stewart ANGB and other entities until some time between 1978 and 1980, when its utilization reportedly ceased. PFAS have been detected in groundwater at the DBF (HDR, 2016).

UFP-QAPP Worksheet #11 – Project/Data Quality Objectives

(UFP-QAPP Manual Section 2.6.1) (EPA 2106-G-05 Section 2.2.6)

Refer to Worksheet #11 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #12 – Measurement Performance Criteria

(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

Refer to Worksheet #12 in the Programmatic UFP-QAPP (Attachment A)

UFP-QAPP Worksheet #13 – Secondary Data Uses and Limitations

(UFP-QAPP Manual Section 2.7) (EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

The following worksheet identifies data used in the generation of this installation-specific UFP-QAPP Addendum.

Data Type	Data Source (Originating Organization, Report Title, and Date)	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Historical AFFF release locations	Final Perfluorinated Compounds Preliminary Assessment Site Visit Report, New York Air National Guard, Stewart Air National Guard Base, Newburgh, New York (BB&E, 2016)	Identification of AFFF release sites.	Some locations are based on eyewitness accounts; written documentation is not available to verify information for all sites. No limitations to final, validated data.
Historical AFFF release locations	Revised Final Report FY16 Phase I Regional Site Inspections Per- and Polyfluoroalkyl Substances, New York Air National Guard – 105th Airlift Wing, Stewart Air National Guard Base, Newburgh, New York (Wood, 2020a)	Identification of AFFF release sites.	Some locations are based on eyewitness accounts; written documentation is not available to verify information for all sites. No limitations to final, validated data.
Historical AFFF release locations and sampling off site	Final Expanded Site Inspection Report for Per- and Polyfluoroalkyl Substances, 105th Airlift Wing, New York Air National Guard, Stewart Air National Guard Base, Newburgh, NY (Wood, 2020b)	Identification of AFFF release sites and transport off-site	Some locations are based on eyewitness accounts; written documentation is not available to verify information for all sites. No limitations to final, validated data.
Validated data, GIS files	Environmental Resources Program Info Management System, installation GIS and geodatabase files	Updating the CSM	Some data have yet to undergo final approval.
Preliminary Remedial Investigation (RI) Data	Phase I Remedial Investigation Report, New York Air National Guard, Stewart Air National Guard Base, Newburgh, New York (AECOM, in progress)	Updating the CSM	Still in development.

UFP-QAPP Worksheet #14 & #16 – Project Tasks & Schedule

UFP-QAPP Manual Section 2.8.2) (EPA 2106-G-05 Section 2.2.4)

A general schedule for the primary project tasks is included in the programmatic UFP-QAPP (Attachment A). An installation-specific schedule for Stewart ANGB is presented below.

Task	Start	Finish
Project Planning and Scoping	September 26, 2023	May 2024
Draft UFP-QAPP Addendum	April 2024	May 2024
Draft Final UFP-QAPP Addendum	June 2024	August 2024
Final UFP-QAPP Addendum	August 2024	September 2024
Fieldwork	October 2024	October 2024
Data Analysis and Reporting	October 2024	May 2025
Draft Fingerprinting and Background Study Report	May 2025	July 2025
Draft Final Fingerprinting and Background Study Report	July 2025	October 2025
Final Fingerprinting and Background Study Report	October 2025	February 2026

14.1 PROJECT PLANNING

Initial planning included preparation of project planning documents and a programmatic kickoff meeting with the USACE and DAF project team members to discuss the overall project scope, schedule, and planning required for the sites investigated as part of this Task Order. The notes from the kickoff meeting are presented in Worksheet #9 of the Programmatic UFP-QAPP (Attachment A).

Installation-specific kickoff meetings were held for each installation under this contract. Participants and notes from the Stewart ANGB kickoff and scoping meeting are provided in Attachment B.

14.1.1 Permits and Notifications

The necessary installation-specific permits and notifications will be obtained prior to initiating field activities. For sites located within airfield areas, this will include coordination with Stewart ANGB personnel prior to necessary field activities to facilitate required reviews, approvals, and escort. Minimizing the effect on mission operations may require adjusting normal working hours to capitalize on limited closure time frames. Oneida will coordinate with the Stewart AGB RPM to confirm all safety requirements are complied with. Oneida will also work with the subcontracted drillers to coordinate the necessary permitting required for drilling.

Utility Locating and Permitting

Prior to drilling or digging activities Oneida will mark boring locations in the field in accordance with Standard Operating Procedure (SOP) OESC001A (refer to the Programmatic UFP-QAPP in Attachment A), and notify Utility Notification Center, a communication center that provides notice to utility owners that may potentially have underground utilities traversing the proposed drilling locations. Off-base utilities will be located and USA Dig Safe practices will be completed. Oneida will submit appropriate dig permitting forms and contact appropriate departments within Stewart ANGB for on-base utility location and marking. Soil boring and temporary well locations will be cleared using a private utility line locator before beginning drilling activities.

14.1.2 Pre-Field Activities

Oneida will coordinate all on-site activities sufficiently in advance with the Stewart ANGB RPM to determine that all installation and access requirements are identified and completed prior to mobilization of personnel and equipment. All activities will be conducted in accordance with the Programmatic Accident Prevention Plan and the Installation-Specific Site Safety and Health Plan (Attachment C).

Oneida will coordinate with the USACE, Stewart ANGB POCs, and the Stewart ANGB security section in order to obtain access to project work sites. The Oneida Team will work with installation personnel to determine and comply with right of entry requirements for off-installation property access if necessary.

A pre-planning meeting will be held on-site at each installation with the SSHO, FTL, and installation RPM. The on-site meeting will identify drilling locations for the utility location survey and coordinate permitting /update installation planning as needed. The Oneida Team and drilling subcontractors will also participate in an orientation for field activities prior to initiating work at Stewart ANGB, either in person or via telephone.

A PFAS- free water source will be provided by the installation for use during drilling and initial equipment decontamination. This type of water is typically obtained from a tap or spigot on the installation, and the location will be selected in consultation with the RPM. If necessary, a sample from the water source will be tested to document that it is not impacted with PFAS (PFAS-free is defined below). Preference will be given to a source that has previously been tested for PFAS and/or utilized in prior investigations at the installation. If this source is still available, analytical results will be obtained and verified by the Oneida Team for acceptability. If water testing results are not available, a local water sample will be collected prior to investigation activities for evaluation of suitability as a decontamination water source. Laboratory certified PFAS-free water will be brought onsite to perform final rinse decontamination procedures on sampling equipment.

For this project, PFAS-free is defined as follows:

- Water used for decontamination must be less than or equal to the project screening levels for all PFAS chemicals (see Worksheet #15 of the Programmatic UFP-QAPP) and laboratory-verified PFAS-free water must be used for the final rinse.
- Water introduced into a borehole during drilling must be less than or equal to one half the project screening levels for all PFAS chemicals (see Worksheet #15).

If PFAS-free source water cannot be identified, the decision for how to meet the above PFAS-free criteria will be made based on logistics and cost. The options for meeting the PFAS-free criteria will be presented to the stakeholders prior to making a final decision.

14.2 FIELD ACTIVITIES

Soil, groundwater, and surface water samples will be collected at Stewart ANGB and submitted for the analyses listed in Worksheet #15 of the Programmatic UFP-QAPP (Attachment A). Groundwater samples will be collected from existing monitoring and vertical aquifer profiling (VAP) wells. Samples will be collected at Stewart ANGB in accordance with the procedures and rationale described in Worksheet #17 and general types and quantities specified in Worksheet #18. Sample methodologies will follow the Oneida field SOPs listed in Worksheet #21 of the Programmatic UFP-QAPP (provided in Attachment A) which include methods that address the potential for false positive detections of PFAS.

14.3 INVESTIGATION-DERIVED WASTE SAMPLING

Investigation-derived waste (IDW) sampling will be completed at the conclusion of sampling activities at Stewart ANGB. All solid and liquid IDW will be containerized in Department of Transportation-approved 55-gallon steel drums and staged in an area designated by Stewart ANGB personnel. Following data and waste profile evaluation, the IDW drums will be removed from the site and transported to an off-site disposal facility. Alternate disposal methods may be considered if available at the time of sampling. All IDW will be disposed of in compliance with Air Force and DoD guidance and policies, specifically DoD Interim Guidance on Destruction or Disposal of Materials Containing Per- and Polyfluoroalkyl Substances in the United States (OASD, 2023a). An IDW management plan is included with the Programmatic UFP-QAPP (Attachment A).

14.4 LABORATORY ANALYSIS

All samples will be submitted for laboratory analysis of the constituents and following the methods listed in Worksheet #15 of the programmatic UFP-QAPP (Attachment A).

14.5 DATA MANAGEMENT AND DATA VALIDATION

Data management and data validation will be conducted in accordance with procedures outlined in Worksheets #14 & #16 of the programmatic UFP-QAPP (Attachment A).

14.6 DATA ANALYSIS AND EVALUATION

Data analysis and evaluation will be conducted in accordance with procedures outlined in Worksheets #14 & #16 and Worksheet #36 of the programmatic UFP-QAPP (Attachment A).

14.7 REPORTING

Reporting will be conducted in accordance with procedures outlined in Worksheets #14 & #16 of the programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #15 – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

(UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Refer to Worksheet #15 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #17 – Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1) (EPA 2106-G-05 Section 2.3.1)

A summary of the general sampling design and rationale for the collection of environmental samples to support the PFAS fingerprinting and background study investigations is presented in the Programmatic UFP-QAPP (Attachment A). The specific sampling design and rationale for Stewart ANGB is presented below and in Worksheet #18. Field methodologies will follow the Oneida field SOPs referenced herein and provided as Attachment A of the Programmatic UFP-QAPP (provided in Attachment A of this UFP-QAPP Addendum).

To satisfy the overall project objectives (Step 2, Worksheet #11 of the Programmatic UFP-QAPP in Attachment A), field activities will be conducted in accordance with Step 4 of the Project Quality Objectives established in Worksheet #11 of the Programmatic UFP-QAPP and project tasks outlined in Worksheet #14 of both this and the Programmatic UFP-QAPP. Field activities include collection of groundwater, soil, and surface water samples at Stewart ANGB. If feasible, an AFFF sample (approximately 5 milliliters) will also be collected from the AFFF currently stored at Stewart ANGB to support the machine learning analysis involved in the PFAS fingerprinting method. The collection of this sample will be coordinated with Stewart ANGB personnel.

Data generated from the PFAS background and fingerprinting studies will be used to clarify understanding of existing site CSMs and will be evaluated to determine if it provides clarification on types, strengths, and potential co-mingling of various PFAS sources at Stewart ANGB. Results from the PFAS background study will provide preliminary information to assess background (anthropogenic) PFAS soil concentrations at and surrounding the installation. The data generated during these studies may be used to support remedial investigations efforts that are underway at Stewart ANGB.

A list of sampling locations and detailed rationale is provided in Worksheet #18. The design and rationale for groundwater, surface water, and soil sample collection is described in the following sections.

17.1 GROUNDWATER

Forty-four groundwater samples will be collected to support the PFAS fingerprinting study at Stewart ANGB. Proposed groundwater sampling locations include existing monitoring wells as well as monitoring wells and VAP wells that will be installed to support the PFAS RI currently underway at Stewart ANGB. In the event that RI wells are not available, alternate sampling locations have been identified. Alternate locations that satisfy project technical objectives were identified for eight of the eleven PFAS RI wells (refer to Table 18.2a). One groundwater sample may be collected from a former DBF located to the northwest of Stewart ANGB and historically used by Stewart ANGB as well as other entities. This sample will be collected from an existing permanent monitoring well, dependent on well condition and accessibility as noted on Table 18.2a. Groundwater sampling will be performed using low-flow purging techniques in accordance with SOP OESC008F.

Sampling sites were selected within each PRL to determine concentrations/PFAS fingerprints specific to each area, and to conduct groundwater monitoring at base perimeters and at off-base sites in close proximity to the base, particularly those identified in earlier studies with elevated PFAS concentrations (Figure 3a). Total organic carbon (TOC) and total metals data will be collected at half of the groundwater sampling locations (Worksheet #18); these locations were selected to provide good spatial coverage with preference given to areas where these data would be particularly useful (i.e., suspected non-AFFF

PFAS source areas, locations with loamy or high organic soils, and locations suspected to have multiple PFAS sources). Rationales for each sampling location are provided in Worksheet #18.

17.2 SURFACE WATER

Forty-seven surface water samples are proposed to be collected to support the PFAS fingerprinting study at Stewart ANGB (Figure 5). Sampling locations were chosen at on- and off-base locations upgradient, cross gradient, and/or downgradient of AFFF areas, as well as at locations with known PFAS impacts (Figure 3b). Sample locations were also selected along base boundaries. TOC and total metals data will be collected at half of the surface water sampling locations (Worksheet #18); these locations were selected to achieve good spatial coverage with preference given to areas where these data would be particularly useful (i.e., suspected non-AFFF PFAS source areas, locations with loamy or high organic soils, and locations suspected to have multiple PFAS sources). Rationales for each sampling location are provided in Worksheet #18. Surface water samples will be collected following guidance in SOP OESC006D.

17.3 SOIL

A total of 54 soil samples are proposed to be collected at Stewart ANGB (Figure 6). Of these, 18 will be used to support the PFAS background study, and the remaining 36 will be used to support the PFAS fingerprinting study (refer to Worksheet #18). Background study soil samples will be collected from the 0.0-0.5 ft bgs interval to evaluate background anthropogenic PFAS concentrations (deposited via precipitation, aeolian transport, etc.). The 36 samples allocated for the fingerprinting study are distributed between multiple PRLs, with an intent to collect fingerprinting data from multiple potential PFAS source types (Figure 3c). In general, a surface soil sample collected from the 0-0.5 ft bgs interval was chosen for the PFAS fingerprinting study. However, in some cases (e.g. areas with higher PFAS concentrations observed at depth) a deeper sample is also proposed to determine if relative strength of different PFAS sources changes with depth. These subsurface samples are limited to the 4-6 ft bgs interval. All soil samples will be collected from the unsaturated zone. TOC and total metals data will be collected at half of the soil sampling locations included in the fingerprinting study (Worksheet #18); these locations were selected to achieve good spatial coverage with preference given to areas where these data would be particularly useful (i.e., suspected non-AFFF PFAS source areas, locations with loamy or high organic soils, and locations suspected to have multiple PFAS sources). All soil samples will be collected via hand auger following guidance in SOP OESC007C.

UFP-QAPP Worksheet #18 – Sampling Locations and Methods

(UFP-QAPP Manual Sections 3.1.1 and 3.1.2) (EPA 2106-G-05 Sections 2.3.1 and 2.3.2)

Table 18.1: Sampling Methods

Analytical Tool	Analytical Methods Included	PFAS Analytes
PFAS Fingerprinting Study/PFAS Signature®	EPA 1633 Targeted analysis – Quantitative Analysis	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis - Qualitative	520 Suspect screening analytes
	Machine Learning Analysis using Suspect screening data	520 Suspect screening analytes
	TOC and Total Metals*	N/A
PFAS Background Study	EPA 1633 Targeted analysis – Quantitative Analysis	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis – Semi-quantitative	520 Suspect screening analytes

NOTES:

* Samples will be analyzed for geochemical parameters (TOC and Total Metals) at a rate of 50 percent (%).

N/A not applicable

Table 18.2a: Groundwater Sample Rationale (Page 1 of 4)

Study Area	Sample Location	Sample ID	Sample Depth/Screen Interval	Analytical Tool	Rationale
Off-Base	SFHGW02	ST-SFHGW02-MMYY	TBD	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in groundwater adjacent to former Building 142, a satellite fire house and nozzle training area.
PRLs 1, 2, and 11	MW-101BR*	ST-MW-101BR-MMYY	TBD	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in groundwater in bedrock between PRLs 1, 2, and 11.
Off-Base	OBGW08	ST-OBGW08-MMYY	TBD	PFAS Signature	Evaluate PFAS signature in groundwater upgradient from northern base boundary.
PRL 16	OBGW06*	ST-OBGW06-MMYY	TBD	PFAS Signature	Evaluate PFAS signature in groundwater adjacent to PRL 16 and upgradient from northern base boundary.
Off-Base	OBGW11*	ST-OBGW11-MMYY	TBD	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in off-base groundwater side gradient from western base boundary.
N/A	MW-116BR*	ST-MW-116BR-MMYY	TBD	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in groundwater along western base boundary.
N/A	MW-21BR	ST-MW-21BR-MMYY	14-24	PFAS Signature	Evaluate PFAS signature in groundwater in bedrock along eastern base boundary.
N/A	MW-20BR	ST-MW-20BR-MMYY	30-40	PFAS Signature	Evaluate PFAS Signature in the groundwater in bedrock upgradient from IRP Site 3.
IRP Site 3	MW-18	ST-MW-18-MMYY	17.1-22.1	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in the groundwater downgradient of IRP Site 3.
N/A	MW-22BR	ST-MW-22BR-MMYY	17-27	PFAS Signature	Evaluate PFAS Signature in groundwater along eastern base boundary, downgradient of IRP Site 3.
Off-Base	MW-115BR*	ST-MW-115BR-MMYY	N/A	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater in bedrock upgradient of Recreation Pond.
Recreation Pond	RPMW-01BR	ST-RPMW-01BR-MMYY	40-50	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater in bedrock adjacent to Recreation Pond.
N/A	LF20CGW	ST-LF20CGW-MMYY	TBD	PFAS Signature	Evaluate PFAS Signature in groundwater on eastern side of base, downgradient from PRLs 7 and 10.
Off-Base	15GW13*	ST-15GW13-MMYY	TBD	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater downgradient from Retention Basins and upgradient from Recreation Pond.

Table 18.2a: Groundwater Sample Rationale (Page 2 of 4)

Study Area	Sample Location	Sample ID	Sample Depth/Screen Interval	Analytical Tool	Rationale
IRP Site 3	MW-10	ST-MW-10-MMYY	4-9	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater at IRP Site 3.
PRL 15	MW-113	ST-MW-113-MMYY	4-14	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater at PRL 15.
Recreation Pond	RPMW-01	ST-RPMW-01-MMYY	5-10, 14-19	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater adjacent to Recreation Pond.
Off-Base	SLMW-21S(wt)	ST-SLMW-21S(wt)-MMYY	5-15	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater along Silver Stream, downstream from Recreation Pond.
N/A	MW-107	ST-MW-107-MMYY	5.3-15.3	PFAS Signature	Evaluate PFAS Signature in groundwater along eastern base boundary.
Off-Base	SSMW-01	ST-SSMW-01-MMYY	6-16	PFAS Signature	Evaluate PFAS Signature in groundwater side-gradient from base.
Off-base	LWMW-03	ST-LWMW-03-MMYY	6-16	PFAS Signature	Evaluate PFAS Signature in groundwater south of Lake Washington.
IRP Site 3	MW-08	ST-MW-08-MMYY	17.89-17.9	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater east of IRP Site 3 and along southern base boundary.
PRLs 1, 2, and 11	MW-101	ST-MW-101-MMYY	7-17	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater between PRLs 1, 2, and 11.
N/A	MW-106	ST-MW-106-MMYY	8.35-18.35	PFAS Signature	Evaluate PFAS Signature in groundwater along eastern boundary of base.
Recreation Pond	MW-112	ST-MW-112-MMYY	4-19	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater on northern side of Recreation Pond.
PRL 2	MW-102	ST-MW-102-MMYY	10-20	PFAS Signature	Evaluate PFAS Signature in groundwater at PRL 2.
N/A	LWMW-02	ST-LWMW-02-MMYY	10-20	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater on western side of Lake Washington.
IRP Site 3	MW-09	ST-MW-09-MMYY	17.5-22.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater at IRP Site 3.

Table 18.2a: Groundwater Sample Rationale (Page 3 of 4)

Study Area	Sample Location	Sample ID	Sample Depth/Screen Interval	Analytical Tool	Rationale
Lake Washington	LWMW-01	ST-LWMW-01-MMYY	14-24	PFAS Signature	Evaluate PFAS Signature in groundwater on northwestern side of Lake Washington.
PRL 8	MW-103	ST-MW-103-MMYY	14-24	PFAS Signature	Evaluate PFAS Signature in groundwater adjacent to PRL 8.
PRL 7	MW-104	ST-MW-104-MMYY	16-26	PFAS Signature	Evaluate PFAS Signature in groundwater downgradient of PRL 7.
IRP Site 3	MW-07	ST-MW-07-MMYY	24.62-24.63	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater east of IRP Site 3 and along southern base boundary.
PRL 11	04GW01	ST-04GW01-MMYY	19-24, 30-35	PFAS Signature	Evaluate PFAS Signature in groundwater downgradient of PRL 11 and side-gradient of PRL 4.
PRL 3	MW-111	ST-MW-11-MMYY	30-40	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater downgradient of PRLs 3, 4, 5, and 6.
PRL 3	MW-111BR	ST-MW-111BR-MMYY	53-63	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater in bedrock downgradient of PRLs 3, 4, 5, and 6.
Off-Base	SLMW-20D	ST-SLMW-20D-MMYY	18.54-18.55	PFAS Signature	Evaluate PFAS Signature in groundwater along Silver Stream, downstream from Recreation Pond.
PRL 11	SDPGW03	ST-SDPGW03-MMYY	8-13, 23-28, 38-43	PFAS Signature	Evaluate PFAS Signature in groundwater downgradient of PRL 11.
PRLs 2 and 11	11GW04	ST-11GW04-MMYY	25-30, 42-47	PFAS Signature	Evaluate PFAS Signature in groundwater downgradient and side-gradient from PRLs 2 and 11.
PRL 10	10GW01	ST-10GW01-MMYY	13-18, 33-38, 47-52	PFAS Signature	Evaluate PFAS Signature in groundwater downgradient from PRL 10.
PRL 4	PFC-MW03	ST-PFC-MW03-MMYY	46.29-46.3	PFAS Signature	Evaluate PFAS Signature in groundwater downgradient from PRL 4.
N/A	MW-04	ST-MW-04-MMYY	51-56	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater upgradient from IRP Site 3.
DBF**	DBF-MW-03	ST-DBF-MW-03-MMYY	Unknown	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in groundwater at the former DBF.

Table 18.2a: Groundwater Sample Rationale (Page 4 of 4)

Study Area	Sample Location	Sample ID	Sample Depth/Screen Interval	Analytical Tool	Rationale
Alternate Groundwater Sample Locations*					
PRLs 1, 2, and 11	SDPGW01	ST- SDPGW01-MMYY	57-62	PFAS Signature/ TOC/ Total Metals	Alternate sample location for well MW-101BR.
PRL 16	11GW01	ST-11GW01-MMYY	42-47	PFAS Signature	Alternate sample location for well OBGW06.
Off-Base	WBBGW01	ST-WBBGW01-MMYY	25-30	PFAS Signature/ TOC/ Total Metals	Alternate sample location for well OBGW11.
N/A	WBBGW02	ST-WBBGW02-MMYY	32-37	PFAS Signature/ TOC/ Total Metals	Alternate sample location for well MW-116BR.
Off-Base	SDPGW05	ST-SDPGW05-MMYY	48-53	PFAS Signature/ TOC/ Total Metals	Alternate sample location for well MW-115BR.
Off-Base	MW-10D	ST-MW-10D-MMYY	51-60	PFAS Signature	Alternate sample location for well MW-23BR.
Off-Base	MW-6D	ST-MW-6D-MMYY	83-93	PFAS Signature	Alternate sample location for well MW-117BR.
Off-Base	15GW06	ST-15GW06-MMYY	15-20	PFAS Signature/ TOC/ Total Metals	Alternate sample location for well 15GW13.

NOTES:

[1] Sampling IDs have been assigned only to the primary samples. Field QC samples (field duplicate [FD], matrix spike/matrix spike duplicate [MS/MSD], and equipment blank) will be taken at random at the frequency specified on Worksheet #20 and identified using the nomenclature provided on Worksheet #27 of the Programmatic UFP-QAPP.

IRP	Installation Restoration Program
MMYY	Month and year of sample collection
N/A	not applicable

* Sample locations have an alternate location assigned (as noted in “Alternate Groundwater Sample Locations” section of table) in the event that these monitoring wells have not yet been installed at the time of sampling.

** Sample will be collected dependent on monitoring well condition and accessibility.

Table 18.2b: Surface Water Sample Rationales (page 1 of 3)

Study Area	Sample ID	Sample Location	Analytical Tool	Rationale
N/A	ST-SW01-MMYY	ST-SW01	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in OWS.
Outfalls 003 and 17K	ST-SW02-MMYY	ST-SW02	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in northern area of Recreation Pond, where Outfalls 003 and 17K enter the pond.
Outfalls 002 and A	ST-SW03-MMYY	ST-SW03	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in northern area of Recreation Pond, where Outfalls 002 and A enter the pond.
PRL 15	ST-SW04-MMYY	ST-SW04	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in eastern Retention Basin.
PRL 15	ST-SW05-MMYY	ST-SW05	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in western Retention Basin.
N/A	ST-SW06-MMYY	ST-SW06	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in water flowing out of Recreation Pond in Silver Stream.
Recreation Pond	ST-SW07-MMYY	ST-SW07	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in water of main portion of Recreation Pond.
N/A	ST-SW08-MMYY	ST-SW08	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in surface water flowing off northwest corner of Stewart ANGB.
N/A	ST-SW09-MMYY	ST-SW09	PFAS Signature	Evaluate PFAS Signature in surface water to the north of base.
N/A	ST-SW10-MMYY	ST-SW10	PFAS Signature	Evaluate PFAS Signature in storm water outfall at base entrance.
N/A	ST-SW11-MMYY	ST-SW11	PFAS Signature	Evaluate PFAS Signature in storm water outfall along entrance road.
PRL 11	ST-SW12-MMYY	ST-SW12	PFAS Signature	Evaluate PFAS Signature in storm water culvert northeast of PRL 11.
PRL 7 and 8	ST-SW13-MMYY	ST-SW13	PFAS Signature	Evaluate PFAS Signature in culvert northeast of parking lot adjacent to PRLs 7 and 8.
PRL 7	ST-SW14-MMYY	ST-SW14	PFAS Signature	Evaluate PFAS Signature in culvert southeast of PRL 7.
PRL 4 and 11	ST-SW15-MMYY	ST-SW15	PFAS Signature	Evaluate PFAS Signature in swale between PRLs 4 and 11.
PRL 3 and 6	ST-SW16-MMYY	ST-SW16	PFAS Signature	Evaluate PFAS Signature in culvert southeast of parking lot southeast of PRL 6 and northeast of PRL 3.
PRL 3 and 6	ST-SW17-MMYY	ST-SW17	PFAS Signature	Evaluate PFAS Signature in culvert south of PRL 3.
N/A	ST-SW18-MMYY	ST-SW18	PFAS Signature	Evaluate PFAS Signature in culvert to the west of the western base boundary.

Table 18.2b: Surface Water Sample Rationales (page 2 of 3)

Study Area	Sample ID	Sample Location	Analytical Tool	Rationale
N/A	ST-SW19-MMYY	ST-SW19	PFAS Signature	Evaluate PFAS Signature in culvert to the west of old Southeastern Landfill Area 7, located on current Stewart International Airport property.
N/A	ST-SW20-MMYY	ST-SW20	PFAS Signature	Evaluate PFAS Signature in Silver Stream, downstream from Stewart ANGB and Recreation Pond, just upstream from convergence with second Silver Stream branch.
N/A	ST-SW21-MMYY	ST-SW21	PFAS Signature	Evaluate PFAS Signature in Silver Stream branch coming from Silver Stream reservoir. Just upstream from where it converges with Silver Stream branch flowing from the base.
N/A	ST-SW22-MMYY	ST-SW22	PFAS Signature	Evaluate PFAS Signature in Silver Stream, downstream from Stewart ANGB and Recreation Pond and where the branches converge.
N/A	ST-SW23-MMYY	ST-SW23	PFAS Signature	Evaluate PFAS Signature in Silver Stream, just upstream from convergence with Lake Washington.
N/A	ST-SW24-MMYY	ST-SW24	PFAS Signature	Evaluate PFAS Signature in Lake Washington at Silver Stream outlet.
N/A	ST-SW25-MMYY	ST-SW25	PFAS Signature	Evaluate PFAS Signature in marsh southeast of base across Interstate 87.
N/A	ST-SW26-MMYY	ST-SW26	PFAS Signature	Evaluate PFAS Signature in marsh east of the base, across interstate 87.
N/A	ST-SW27-MMYY	ST-SW27	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in stream running along eastern edge of base, at base of slope.
N/A	ST-SW28-MMYY	ST-SW28	PFAS Signature	Evaluate PFAS Signature in stream flowing off base and downstream from marsh off east side of base.
N/A	ST-SW29-MMYY	ST-SW29	PFAS Signature	Evaluate PFAS Signature downstream from Browns Pond.
N/A	ST-SW30-MMYY	ST-SW30	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature upstream, to the north of the base.
N/A	ST-SW31-MMYY	ST-SW31	PFAS Signature	Evaluate PFAS Signature in stream downstream from discharge area from under airport.
N/A	ST-SW32-MMYY	ST-SW32	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in stream northwest of the airport.
N/A	ST-SW33-MMYY	ST-SW33	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in discharge pipe south of the retention pond.
N/A	ST-SW34-MMYY	ST-SW34	PFAS Signature	Evaluate PFAS Signature along southeast edge of the base.

Table 18.2b: Surface Water Sample Rationales (page 3 of 3)

Study Area	Sample ID	Sample Location	Analytical Tool	Rationale
N/A	ST-SW35-MMYY	ST-SW35	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature on northern end of Lake Washington.
Outfall 002	ST-SW36-MMYY	ST-SW36	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in Outfall 002.
Outfall 003	ST-SW37-MMYY	ST-SW37	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in Outfall 003.
Outfall 17K	ST-SW38-MMYY	ST-SW38	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in Outfall 17K.
Outfall A	ST-SW39-MMYY	ST-SW39	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in Outfall A.
N/A	ST-SW40-MMYY	ST-SW40	PFAS Signature	Evaluate PFAS Signature on eastern end of Lake Washington.
N/A	ST-SW41-MMYY	ST-SW41	PFAS Signature	Evaluate PFAS Signature in river prior to flowing onto base.
Site 3 Landfill	ST-SW42-MMYY	ST-SW42	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in leachate sample for Site 3 Landfill.
N/A	ST-SW43-MMYY	ST-SW43	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in marsh south of the base, east of the retention pond.
N/A	ST-SW44-MMYY	ST-SW44	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS in stream adjacent to Vails Gate Firehouse.
N/A	ST-SW45-MMYY	ST-SW45	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in stream flowing south onto airport.
N/A	ST-SW46-MMYY	ST-SW46	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in stream discharging from under airport.
N/A	ST-SW47-MMYY	ST-SW47	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in stream just prior to flowing under the airport on the north side.

NOTES:

MMYY	Month and year of sample collection
N/A	not applicable

Table 18.2c: Soil Sample Rationales (page 1 of 3)

Study Area	Sample ID	Sample Location	Sample Depth/Screen Interval	Analytical Tool	Rationale
PRL 2, Nozzle Testing Area	ST-SB01-FP-MMYY	ST-SB01-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature at Nozzle Testing Area.
PRL 16, Former Nozzle Testing Area	ST-SB02-FP-MMYY	ST-SB02-FP	0-0.5	PFAS Signature	Evaluate PFAS signature at Former Nozzle Testing Area.
PRL 11, Apron	ST-SB03-FP-MMYY	ST-SB03-FP	0-0.5	PFAS Signature	Evaluate PFAS Signature on north side of the Apron.
PRL 4, Hangar 100	ST-SB04-FP(0-.5)-MMYY	ST-SB04-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil southwest of Hangar 100 and southeast of the Apron.
PRL 4, Hangar 100	ST-SB04-FP(4-6)-MMYY		4-6	PFAS Signature	
PRL 15, Retention Basin	ST-SB05-FP(0-.5)-MMYY	ST-SB05-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in soil on the south side of the Retention Basins.
PRL 15, Retention Basin	ST-SB05-FP(4-6)-MMYY		4-6	PFAS Signature/ TOC/ Total Metals	
PRL 7, Hangar 300 and PRL 11, Apron	ST-SB06-FP-MMYY	ST-SB06-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil northwest of Hangar 300 and southeast of the Apron.
PRL 7, Hangar 300	ST-SB07-FP-MMYY	ST-SB07-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in soil northeast of Hangar 300.
Oil/ Water Separator	ST-SB08-FP(0-.5)-MMYY	ST-SB08-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in soil at oil/water separator on west side of base.
Oil/ Water Separator	ST-SB08-FP(4-6)-MMYY		4-6	PFAS Signature/ TOC/ Total Metals	
PRL 11, Apron	ST-SB09-FP-MMYY	ST-SB09-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil southwest of the Apron.
PRL 5, Hangar 101	ST-SB10-FP-MMYY	ST-SB10-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil northeast of Hangar 5.
PRL 6, Hangar 102	ST-SB11-FP-MMYY	ST-SB11-FP	0-0.5	PFAS Signature	Evaluate PFAS Signature in soil on the westside of Hangar 102.
Outfall 17K	ST-SB12-FP-MMYY	ST-SB12-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in soil adjacent to Outfall 17K.
PRL 3, Building 105, Former Fire Station	ST-SB13-FP(0-.5)-MMYY	ST-SB13-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in soil at the former fire station.
PRL 3, Building 105, Former Fire Station	ST-SB13-FP(4-6)-MMYY		4-6	PFAS Signature/ TOC/ Total Metals	

Table 18.2c: Soil Sample Rationales (page 2 of 3)

Study Area	Sample ID	Sample Location	Sample Depth/Screen Interval	Analytical Tool	Rationale
PRL 5, Hangar 101	ST-SB14-FP(0-.5)-MMYY	ST-SB14-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in soil at Hangar 101.
PRL 5, Hangar 101	ST-SB14-FP(4-6)-MMYY		4-6	PFAS Signature/ TOC/ Total Metals	
PRL 4, Hangar 100, and PRL 11, Apron	ST-SB15-FP-MMYY	ST-SB15-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in soil between the Apron and Hangar 100.
Old Pesticide Burial Pit	ST-SB16-FP(0-.5)-MMYY	ST-SB16-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in soil at Old Pesticide Burial Pit.
Old Pesticide Burial Pit	ST-SB16(4-6)-FP-MMYY		4-6	PFAS Signature/ TOC/ Total Metals	
PRL 1, Current Fire Station, and PRL 2, Nozzle Testing Area	ST-SB17-FP(0-.5)-MMYY	ST-SB17-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil At the current fire station and the nozzle testing area.
PRL 1, Current Fire Station, and PRL 2, Nozzle Testing Area	ST-SB17-FP(4-6)-MMYY		4-6	PFAS Signature	
PRL 11, Apron	ST-SB18-FP(0-.5)-MMYY	ST-SB18-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil northeast of the Apron.
PRL 11, Apron	ST-SB18-FP(4-6)-MMYY		4-6	PFAS Signature	
Recreation Pond	ST-SB19-FP-MMYY	ST-SB19-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in soil at AFFF Area 8, Hangar 715 AFFF Release. southeast of the Recreation Pond.
Storm Sewer	ST-SB20-FP-MMYY	ST-SB20-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS signature in soil adjacent to stormwater inspection in RI.
N/A	ST-SB21-FP(0-.5)-MMYY	ST-SB21-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil south of base border, above Outfall 002 and Outfall A.
N/A	ST-SB21-FP(4-6)-MMYY		4-6	PFAS Signature	
PRL 15, Retention Basin	ST-SB22-FP(0-.5)-MMYY	ST-SB22-FP	0-0.5	PFAS Signature/ TOC/ Total Metals	Evaluate PFAS Signature in soil on the north side of the Retention Basins.
PRL 15, Retention Basin	ST-SB22-FP(4-6)-MMYY		4-6	PFAS Signature/ TOC/ Total Metals	
N/A	ST-SB23-FP-MMYY	ST-SB23-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil southeast of the base.

Table 18.2c: Soil Sample Rationales (page 3 of 3)

Study Area	Sample ID	Sample Location	Sample Depth/Screen Interval	Analytical Tool	Rationale
N/A	ST-SB24-FP-MMYY	ST-SB24-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil northeast edge of the base.
N/A	ST-SB25-FP-MMYY	ST-SB25-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil at potential spray area for Building 142.
N/A	ST-SB26-FP-MMYY	ST-SB26-FP	0-0.5	PFAS Signature	Evaluate PFAS signature in soil for Building 142.
N/A	ST-SB27-BG-MMYY	ST-SB27-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB28-BG-MMYY	ST-SB28-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB29-BG-MMYY	ST-SB29-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB30-BG-MMYY	ST-SB30-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB31-BG-MMYY	ST-SB31-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB32-BG-MMYY	ST-SB32-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB33-BG-MMYY	ST-SB27-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB34-BG-MMYY	ST-SB28-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB35-BG-MMYY	ST-SB29-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB36-BG-MMYY	ST-SB30-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB37-BG-MMYY	ST-SB31-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB38-BG-MMYY	ST-SB32-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB39-BG-MMYY	ST-SB27-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB40-BG-MMYY	ST-SB28-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB41-BG-MMYY	ST-SB29-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB42-BG-MMYY	ST-SB30-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB43-BG-MMYY	ST-SB31-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.
N/A	ST-SB44-BG-MMYY	ST-SB32-BG	0-0.5	Background	Support determination of background soil PFAS concentrations.

NOTES:

MMYY	Month and year of sample collection
N/A	not applicable

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UFP-QAPP Worksheet #19 & #30 – Sample Containers, Preservation, and Hold Times

(UFP-QAPP Manual Section 3.1.2.2) (EPA 2106-G-05 Section 2.3.2)

Refer to Worksheets #19 & 30 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #20 – Field Quality Control Summary

(UFP-QAPP Manual Section 3.1.1 and 3.1.2) (EPA 2106-G-05 Section 2.3.5)

Matrix	Analytical Group	Number of Samples	Number of FD [1]	Number of MS[2]	Number of MSDs[2]	Number of Equipment Blanks[3,4]	Number of Field Blanks[3,4]	Total Number of Samples
Groundwater	PFAS	44	5	3	3	One per Day	N/A	55
	TOC	22	3	2	2			29
	Total Metals	22	3	2	2			29
Surface Water	PFAS	47	5	3	3	N/A	One per Day	58
	TOC	23	3	2	2			30
	Total Metals	23	3	2	2			30
Soil	PFAS	54	6	3	3	One per Day	N/A	66
	TOC	18	2	1	1			22
	Total Metals	18	2	1	1			22

NOTES:

*Samples analyzed for TOC and Total Metals at a rate of 50% (soil samples collected in support of the background study are not analyzed for TOC and Total Metals)

1. FDs will be collected at a frequency of 1 for every 10 primary samples collected.
2. MS/MSD samples will be collected at a frequency of 1 for every 20 primary samples collected.
3. Equipment blanks will be collected by each sampling team at a minimum frequency of 1 per day and for each equipment type. When disposable or dedicated sampling equipment is used, equipment blank samples will not be collected (i.e. surface water sampling). Field blanks will be collected by each sampling team at a minimum frequency of one per day for surface water sampling only. Since equipment blanks are not needed during surface water sampling, field blanks will serve as QC for demonstrating proper sample handling. Equipment blanks and field blanks are not included in sample totals.
4. Equipment blanks will be analyzed for the following analytical groups: PFAS, TOC, and Total Metals. Field blanks will be analyzed for PFAS only.

UFP-QAPP Worksheet #21 – Field Standard Operating Procedures

(UFP-QAPP Manual Section 3.1.2) (EPA 2106-G-05 Section 2.3.2)

Refer to Worksheet #21 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.1.2.4) (EPA 2106-G-05 Section 2.3.6)

Refer to Worksheet #22 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #23 – Analytical Standard Operating Procedures

(UFP-QAPP Manual Section 3.2.1) (EPA 2106-G-05 Section 2.3.4)

Refer to Worksheet #23 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #24 – Analytical Instrument Calibration

(UFP-QAPP Manual Section 3.2.2) (EPA 2106-G-05 Section 2.3.6)

Refer to Worksheet #24 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection

(UFP-QAPP Manual Section 3.2.3) (EPA 2106-G-05 Section 2.3.6)

Refer to Worksheet #25 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #26 & #27 – Sample Handling System, Custody, and Disposal

(UFP-QAPP Manual Section 3.3) (EPA 2106-G-05 Section 2.3.3)

Refer to Worksheets #26 and #27 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Refer to Worksheet #28 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #29 – Project Documents and Records

(UFP-QAPP Manual Section 3.5.1) (EPA 2106-G-05 Section 2.2.8)

Refer to Worksheet #29 in the Programmatic UFP-QAPP (Attachment A)

UFP-QAPP Worksheet #31, #32 & #33 – Assessments and Corrective Action

UFP-QAPP Manual Sections 4.1.1 and 4.1.2) (EPA 2106-G-05 Sections 2.4 and 2.5.5)

Refer to Worksheets #31, 32, & 33 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #34 – Data Verification and Validation Inputs

UFP-QAPP Manual Section 5.2.1 and Table 9) (EPA 2106-G-05 Section 2.5.1)

Refer to Worksheet #34 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #35 – Data Verification Procedures

(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Refer to Worksheet #35 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #36 – Data Validation Procedures

(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Refer to Worksheet #36 in the Programmatic UFP-QAPP (Attachment A).

UFP-QAPP Worksheet #37 – Data Usability Assessment

(UFP-QAPP Manual Section 5.2.3 including Table 12) (EPA 2106-G-05 Sections 2.5.2, 2.5.3, and 2.5.4)

Refer to Worksheet #37 in the Programmatic UFP-QAPP (Attachment A).

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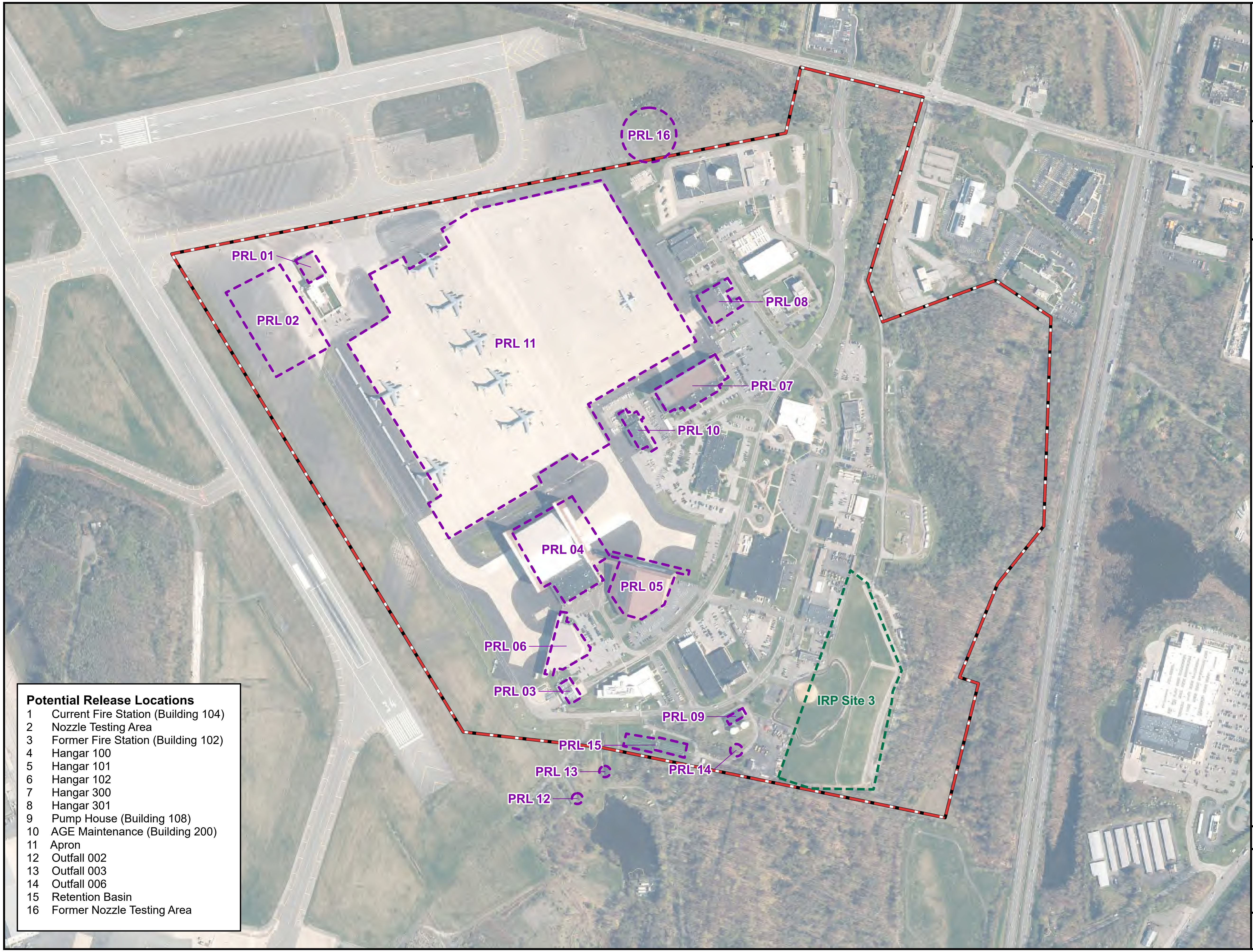
FIGURES

Figure 1
PFAS Potential Release Locations at Stewart ANGB

Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center



Potential Release Locations

1	Current Fire Station (Building 104)
2	Nozzle Testing Area
3	Former Fire Station (Building 102)
4	Hangar 100
5	Hangar 101
6	Hangar 102
7	Hangar 300
8	Hangar 301
9	Pump House (Building 108)
10	AGE Maintenance (Building 200)
11	Apron
12	Outfall 002
13	Outfall 003
14	Outfall 006
15	Retention Basin
16	Former Nozzle Testing Area

Legend

▭	Potential Release Locations
▭	IRP Site 3
▭	Stewart ANGB Installation Boundary

ABBREVIATIONS:
ANGB - Air National Guard Base
IRP - Installation Restoration Program
PFAS - per-and polyfluoroalkyl substances

By: NMS	4/30/2024

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0 250 500 1,000
Feet

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Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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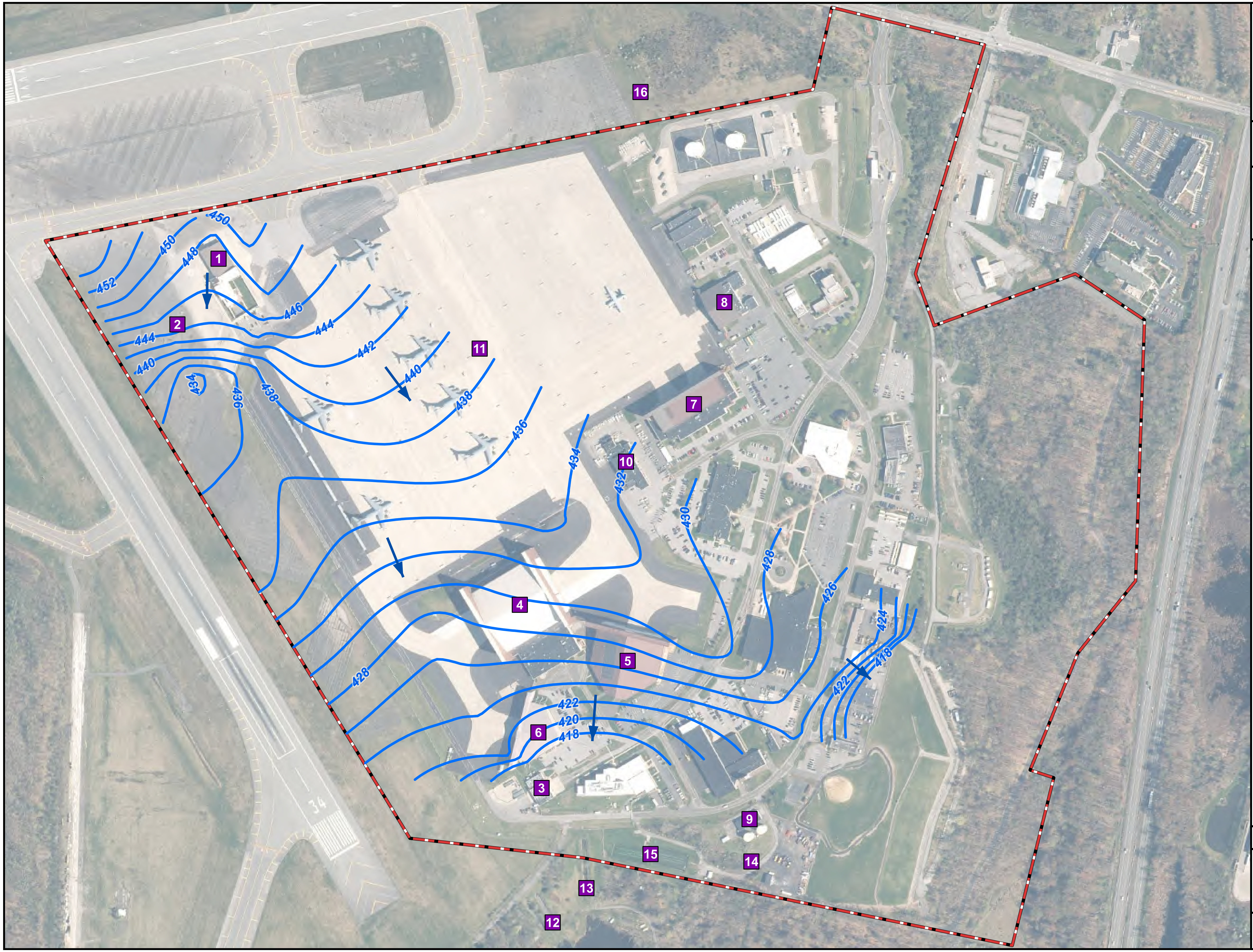

Figure 2
Groundwater Potentiometric Surface
Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

- 1 PRL
- ➔ Groundwater Flow Direction
- — Groundwater Contours (ft amsl) (AECOM)
- ▭ Stewart ANGB Installation Boundary

ABBREVIATIONS:
ANGB - Air National Guard Base
ft amsl - feet above mean sea level
PFAS - per-and polyfluoroalkyl substances
PRL - Potential Release Location

By: NMS	**4/29/2024**

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Sustainment and Restoration Services

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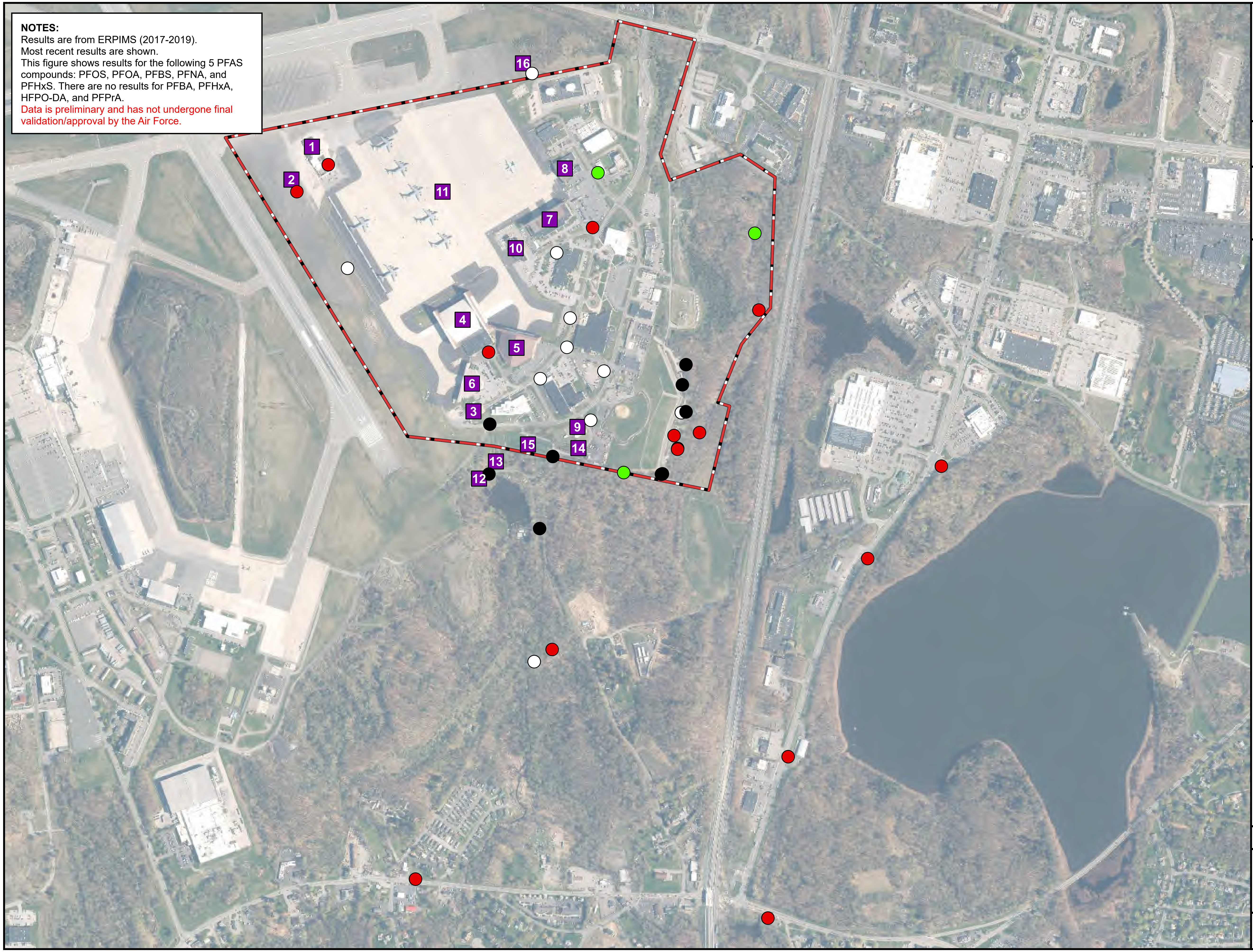
Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



NOTES:
Results are from ERPIMS (2017-2019).
Most recent results are shown.
This figure shows results for the following 5 PFAS compounds: PFOS, PFOA, PFBS, PFNA, and PFHxS. There are no results for PFBA, PFHxA, HFPO-DA, and PFPrA.
Data is preliminary and has not undergone final validation/approval by the Air Force.

Figure 3a
PFAS Groundwater Results
Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

- **1** PRL
- Stewart ANGB Installation Boundary

PFAS Results in Groundwater (See Notes)

- ○ No PFAS detected
- 🟢 One or more PFAS detected at concentrations less than respective RSLs
- 🔴 One or more PFAS detected at concentrations exceeding respective RSLs
- ● One or more PFAS detected at concentrations exceeding 100x respective RSLs

PROJECT SCREENING LEVELS:
PFOS - 4.0 ng/L
PFOA - 6.0 ng/L
PFBS - 600 ng/L
PFNA - 5.9 ng/L
PFHxS - 39 ng/L
PFBA - 1800 ng/L
PFHxA - 990 ng/L
HFPO-DA - 1.5 ng/L
PFPrA - 980 ng/L
Screening Levels from: Selected PFAS in GW USEPA RSL for Tap Water (THQ 0.1) per OASD 2023 and DoD 2024.

ABBREVIATIONS:
ANGB - Air National Guard Base
DoD - Department of Defense
EPA - U.S. Environmental Protection Agency
ERPIMS - Environmental Resources Program Information Management System
GW - Groundwater
HFPO-DA - Hexafluoropropylene oxide dimer acid
OASD - Office of the Assistant Secretary of Defense
PFAS - per-and polyfluoroalkyl substances
PFOA - Perfluorooctanoic acid
PFOS - Perfluorooctanesulfonic acid
PFBA - Perfluorobutanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHxA - Perfluorohexanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
PFPrA - Perfluoropropanoic acid
RSL - EPA Regional Screening Level
THQ – target hazard quotient
ng/L - nanograms per liter

By: NMS	9/13/2024

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ONEIDA Sustainment and Restoration Services

0 400 800 1,600
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Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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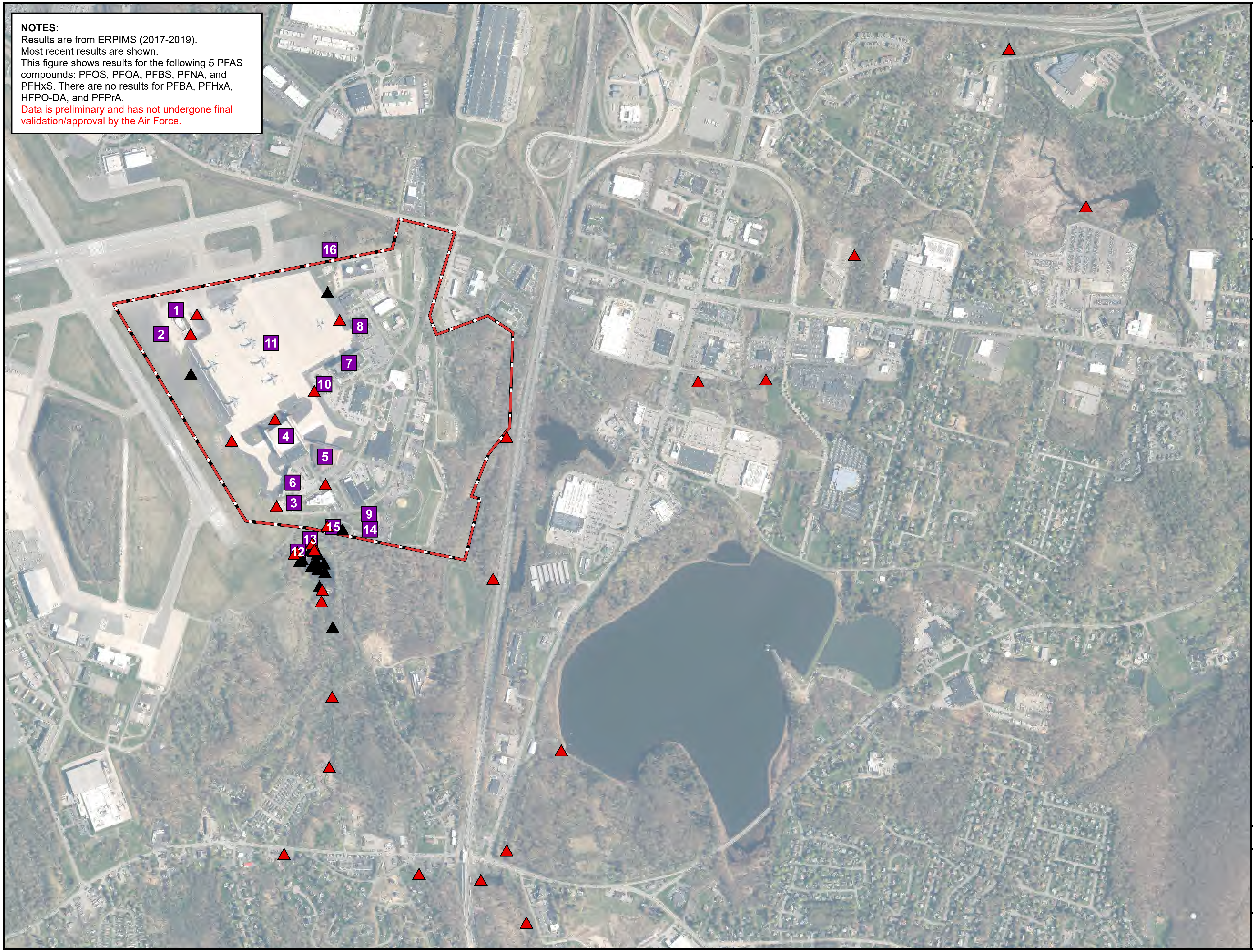

NOTES:
Results are from ERPIMS (2017-2019).
Most recent results are shown.
This figure shows results for the following 5 PFAS compounds: PFOS, PFOA, PFBS, PFNA, and PFHxS. There are no results for PFBA, PFHxA, HFPO-DA, and PFPrA.
Data is preliminary and has not undergone final validation/approval by the Air Force.

Figure 3b
PFAS Surface Water Results
Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

1	PRL
▭	Stewart ANGB Installation Boundary

PFAS Results in Surface Water (See Notes)

△	No PFAS detected
▲	One or more PFAS detected at concentrations less than respective RSLs
🔺	One or more PFAS detected at concentrations exceeding respective RSLs
▲	One or more PFAS detected at concentrations exceeding 100x respective RSLs

PROJECT SCREENING LEVELS:
PFOS - 4.0 ng/L
PFOA - 6.0 ng/L
PFBS - 600 ng/L
PFNA - 5.9 ng/L
PFHxS - 39 ng/L
PFBA - 1800 ng/L
PFHxA - 990 ng/L
HFPO-DA - 1.5 ng/L
PFPrA - 980 ng/L
Screening Levels from: Selected PFAS in GW USEPA RSL for Tap Water (THQ 0.1) per OASD 2023 and DoD 2024.

ABBREVIATIONS:
ANGB - Air National Guard Base
DoD - Department of Defense
EPA - U.S. Environmental Protection Agency
ERPIMS - Environmental Resources Program Information Management System
HFPO-DA - Hexafluoropropylene oxide dimer acid
OASD - Office of the Assistant Secretary of Defense
PFAS - per-and polyfluoroalkyl substances
PFOA - Perfluorooctanoic acid
PFOS - Perfluorooctanesulfonic acid
PFBA - Perfluorobutanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHxA - Perfluorohexanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
PFPrA - Perfluoropropanoic acid
RSL - EPA Regional Screening Level
SW - Surface Water
THQ – target hazard quotient
ng/L - nanograms per liter

By: NMS	9/13/2024

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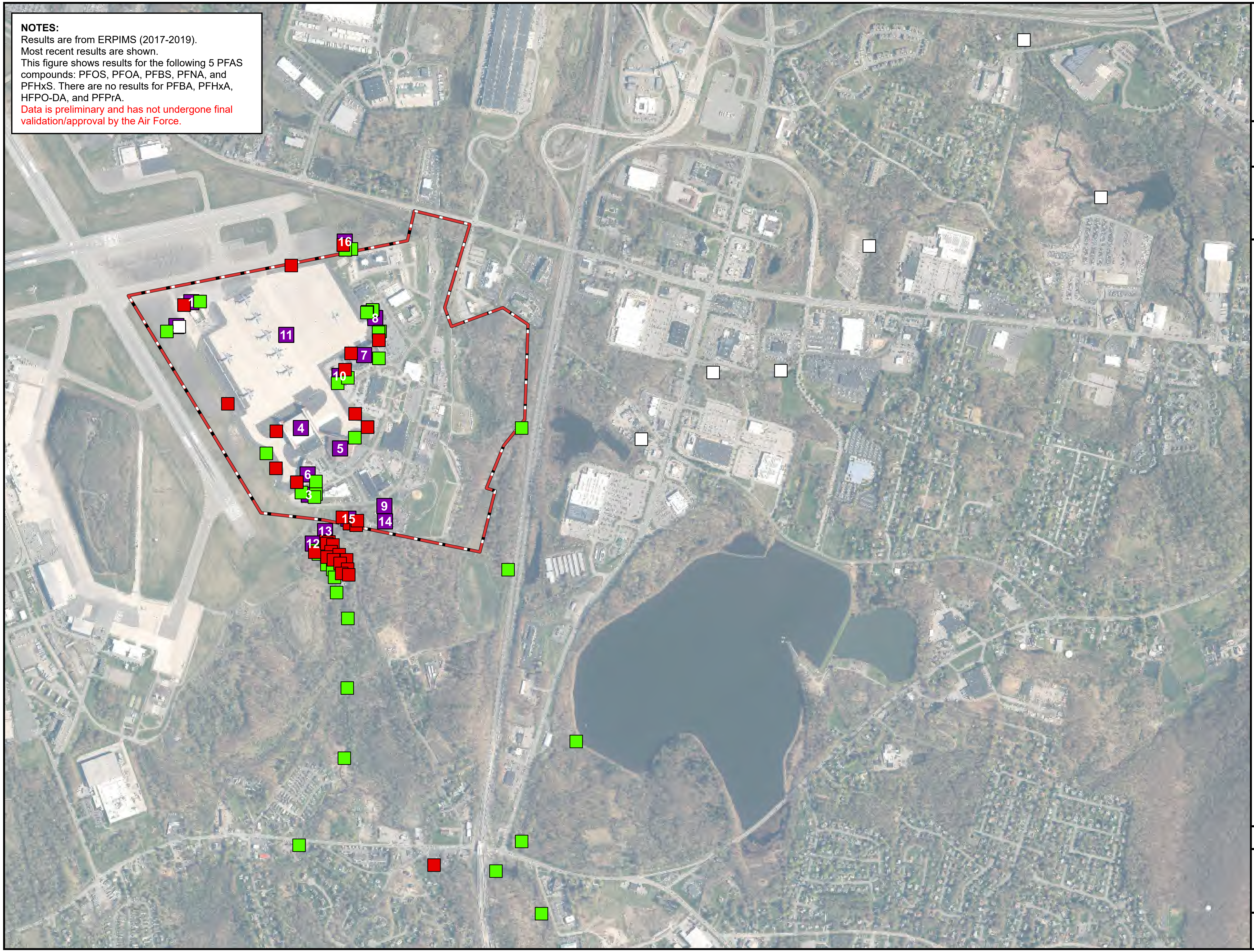
Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 3c
PFAS Soil and Sediment Results
Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

NOTES:
Results are from ERPIMS (2017-2019).
Most recent results are shown.
This figure shows results for the following 5 PFAS compounds: PFOS, PFOA, PFBS, PFNA, and PFHxS. There are no results for PFBA, PFHxA, HFPO-DA, and PFPrA.
Data is preliminary and has not undergone final validation/approval by the Air Force.



Legend

- **1** PRL
- Stewart ANGB Installation Boundary

PFAS Results in Soil (See Notes)

- ☐ No PFAS detected
- 🟩 One or more PFAS detected at concentrations less than respective RSLs
- 🟥 One or more PFAS detected at concentrations exceeding respective RSLs
- ■ One or more PFAS detected at concentrations exceeding 100x respective RSLs

PROJECT SCREENING LEVELS:
PFOS - 0.013 mg/kg
PFOA - 0.019 mg/kg
PFBS - 1.9 mg/kg
PFNA - 0.019 mg/kg
PFHxS - 0.13 mg/kg
PFBA - 7.8 mg/kg
PFHxA - 3.2 mg/kg
HFPO-DA - 0.023 mg/kg
PFPrA - 3.9 mg/kg
Screening Levels from: Selected PFAS in SO USEPA RSL for Soil (THQ 0.1) per OASD 2023 and DoD 2024.

ABBREVIATIONS:
ANGB - Air National Guard Base
DoD - Department of Defense
EPA - U.S. Environmental Protection Agency
ERPIMS - Environmental Resources Program Information Management System
HFPO-DA - Hexafluoropropylene oxide dimer acid
OASD - Office of the Assistant Secretary of Defense
PFAS - per-and polyfluoroalkyl substances
PFOA - Perfluorooctanoic acid
PFOS - Perfluorooctanesulfonic acid
PFBA - Perfluorobutanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHxA - Perfluorohexanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
PFPrA - Perfluoropropanoic acid
RSL - EPA Regional Screening Level
SO - Soil
THQ – target hazard quotient
mg/kg - milligrams per kilogram

By: NMS	4/29/2024

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Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

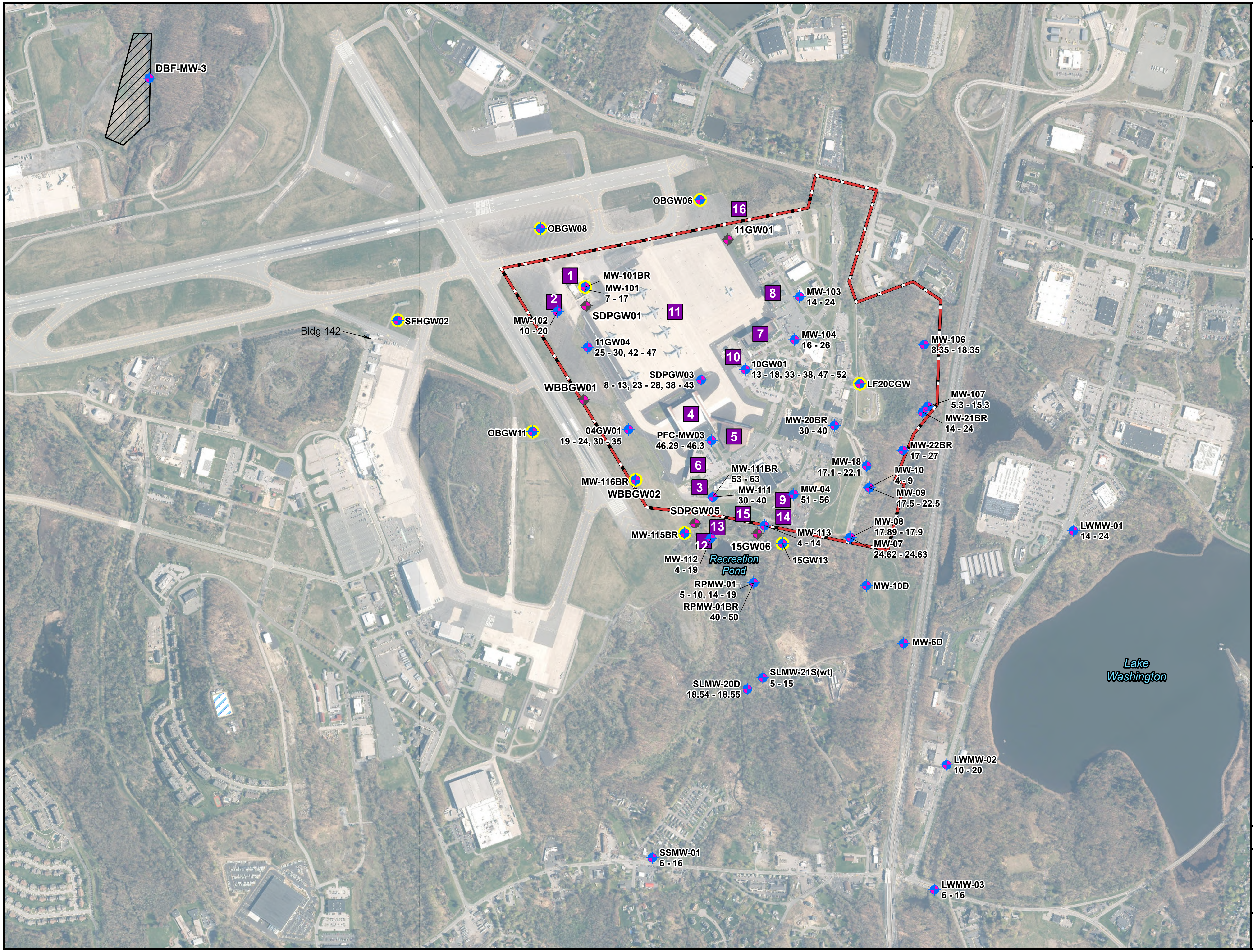

Figure 4
Proposed Groundwater Sampling Locations

Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

1	PRL
⊕	Proposed Groundwater Sample - Existing Monitoring Well
⊕	Proposed Groundwater Sample - RI MOB 2 Installation (Not Yet Installed)
⊕	Proposed Groundwater Sample - Alternate Monitoring Well Sample Locations
▨	Demolition and Burn Facility Area
▭	Stewart ANGB Installation Boundary

NOTES:
Well labeled with Well ID and Screen Interval (if available).

ABBREVIATIONS:
ANGB - Air National Guard Base
ID - Identification
MOB - Mobilization
PFAS - per-and polyfluoroalkyl substances
PRL - Potential Release Location
RI - Remedial Investigation

By: NMS	10/9/2024

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Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

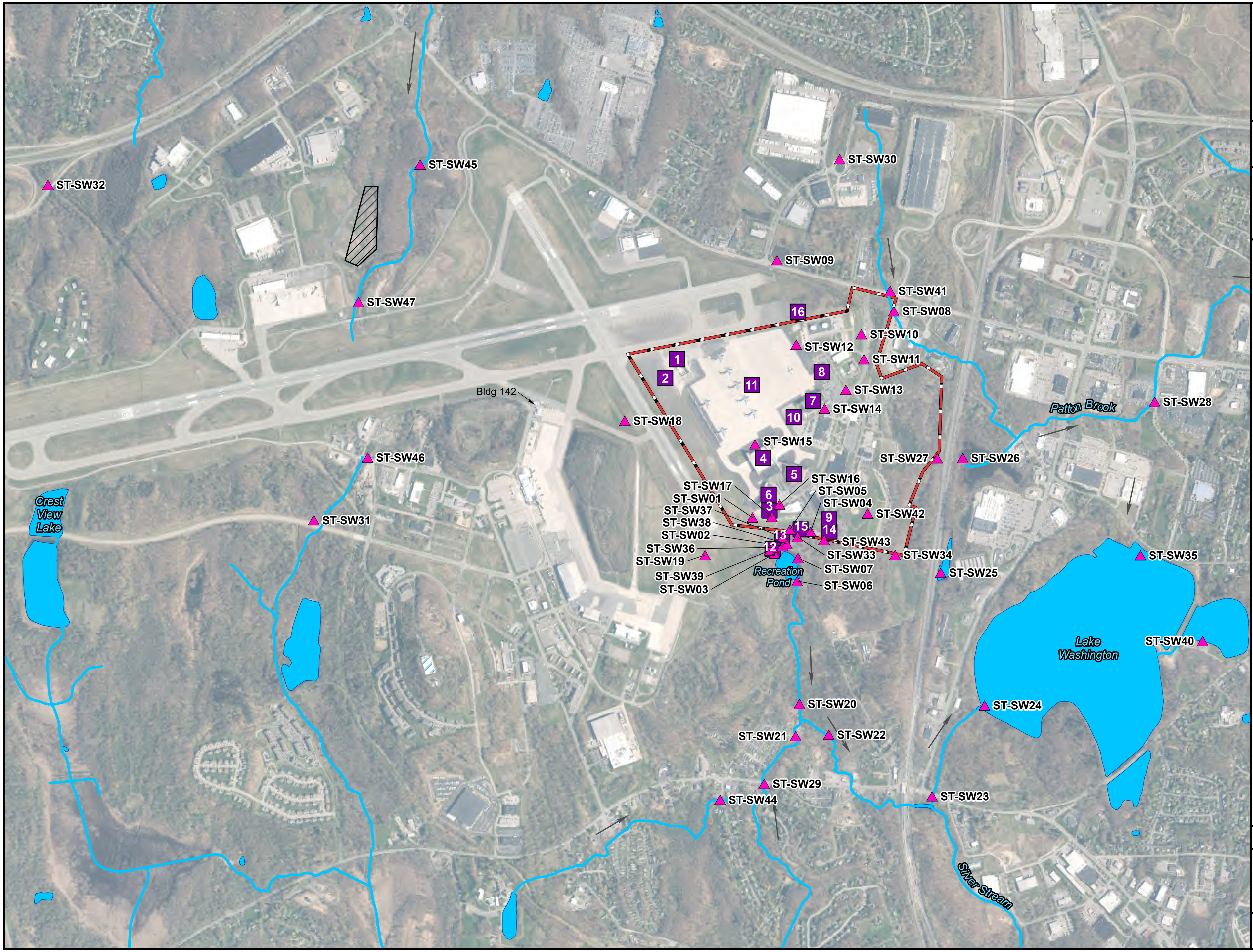

Figure 5
Proposed Surface Water Sampling Locations

Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

- 1 PRL
- ▲ Proposed Surface Water Sample Location
- → Surface Flow Direction
- — Stream/River
- 🟦 Lake/Pond
- ▨ Reservoir
- ▨ Demolition and Burn Facility Area
- ▭ Stewart ANGB Installation Boundary

NOTES:
Hydrology layers are from the USGS National Hydrography Dataset.

ABBREVIATIONS:
ANGB - Air National Guard Base
PFAS - per-and polyfluoroalkyl substances
PRL - Potential Release Location

By: NMS	9/16/2024

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Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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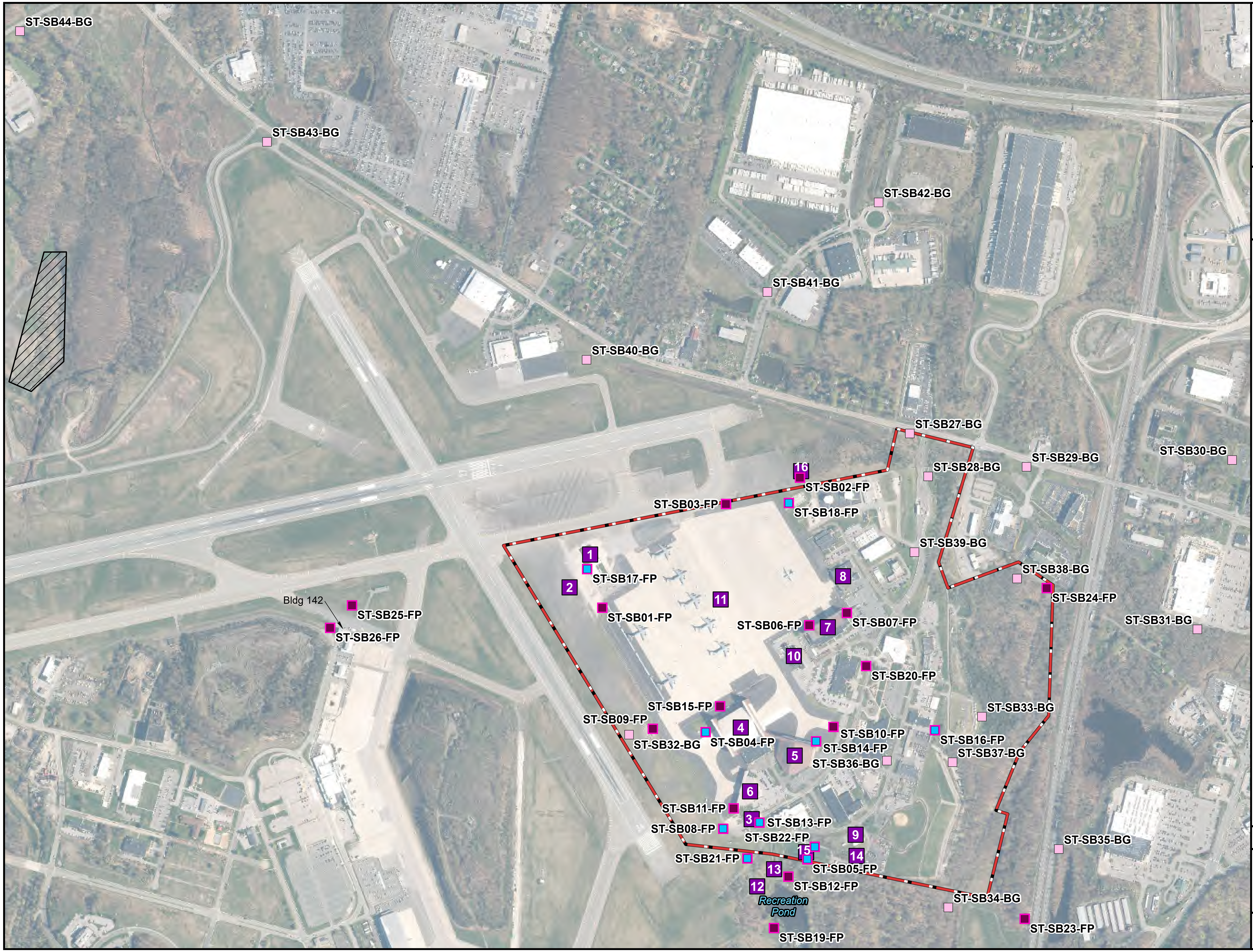

Figure 6
Proposed Soil Sampling Locations

Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

1	PRL
■	Proposed Fingerprinting Soil Sample Location
■	Proposed Fingerprinting Soil Sample Location (Multiple Depths)
■	Proposed Background Soil Sample Location
▨	Demolition and Burn Facility Area
▭	Stewart ANGB Installation Boundary

ABBREVIATIONS:
ANGB - Air National Guard Base
PFAS - per-and polyfluoroalkyl substances
PRL - Potential Release Location

By: NMS	9/16/2024

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ONEIDA Sustainment and Restoration Services

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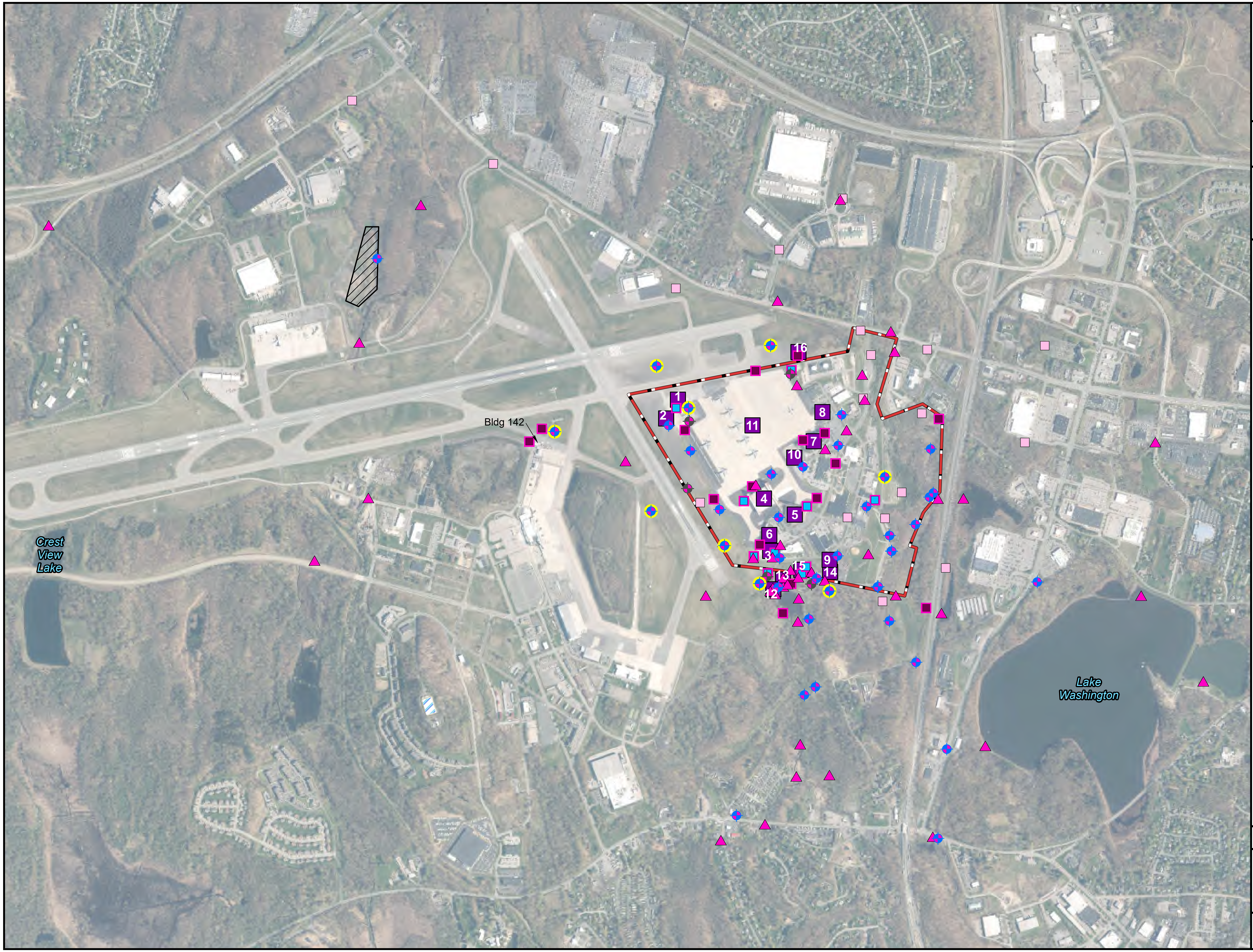
Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 7
Sampling Summary
Stewart ANGB
UFP-QAPP Addendum

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center



Legend

1	PRL
▲	Proposed Surface Water Sample Location
■	Proposed Fingerprinting Soil Sample Location
■	Proposed Fingerprinting Soil Sample Location (Multiple Depths)
■	Proposed Background Soil Sample Location
●	Proposed Groundwater Sample - Existing Monitoring Well
●	Proposed Groundwater Sample - RI MOB 2 Installation (Not Yet Installed)
●	Proposed Groundwater Sample - Alternate Monitoring Well Sample Locations
▨	Demolition and Burn Facility Area
▭	Stewart ANGB Installation Boundary

ABBREVIATIONS:
ANGB - Air National Guard Base
MOB - Mobilization
PFAS - per-and polyfluoroalkyl substances
PRL - Potential Release Location
RI - Remedial Investigation

By: NMS	9/16/2024

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Service Layer Credits: World Imagery (Firefly): Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Attachment A

Final Programmatic UFP-QAPP

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Final
Programmatic Uniform Federal Policy Quality Assurance Project Plan

PFAS Fingerprinting and Background Study
Multiple Air Force Bases

April 2024

Prepared for:

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814

Under Contract No./ Task Order No.
W91238-23-D-0023 / W91238-23-F0086

Prepared by:
Sustainment and Restoration Services, LLC
209 E. Victoria Street
Santa Barbara, California 93101

Final
Programmatic Uniform Federal Policy Quality Assurance Project Plan

Project Title:	Per- and Polyfluoroalkyl Substances (PFAS) Fingerprinting and Background Study at Multiple Air Force Bases
Contractor:	Sustainment and Restoration Services, LLC (SRS)
Submitted to:	U.S. Army Corps of Engineers, Sacramento District
Contract Number:	W91238-23-D-0023
Task Order	W91238-23-F-0086
Contract Name:	PFAS Fingerprinting and Background Study
Prepared for:	U.S. Army Corps of Engineers Sacramento District
Delivery Order Period:	26 September 2023 to 25 September 2026
Date of Award:	26 September 2023

April 2024

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TABLE OF CONTENTS

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

<	less than
>	greater than
≤	less than or equal to
±	plus or minus
#	number
%	percent
µg/L	micrograms per liter
˚C	degrees Celsius
AF	Air Force
AFB	Air Force Base
AFP	Air Force Plant
AFCEC	Air Force Civil Engineer Center
AFCEC/CZTE	AFCEC Environmental Restoration Technical Support Branch
AFFF	aqueous film forming foam
ANG	Air National Guard
ANGB	Air National Guard Base
B.S.	Bachelor of Science
bgs	below ground surface
ºA	corrective action
CAS	Chemical Abstract Service
CCV	continuing calibration verification
CVAA	cold vapor atomic absorption
CEG	Certified Engineering Geologist
CHG	Certified Hydrogeologist
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CL	confidence level
COR	Contracting Officer’s Representative
CPR	cardiopulmonary resuscitation
CQCS	Contractor Quality Control Supervisor
CSM	conceptual site model
CSP	Certified Safety Professional
DAF	Department of the Air Force
DL	detection limit
DoD	Department of Defense

DQI	data quality indicator
DQO	data quality objective
DUA	data usability assessment
EDD	electronic data deliverables
EIS	extracted internal standard
ELAP	Environmental Laboratory Accreditation Program
ELLE	Eurofins Lancaster Laboratories Environmental
EPA	United States Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
FTL	Field Team Lead
FTS	fluorotelomer sulfonate
GIS	geographical information systems
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	high density polyethylene
HFPO-DA	hexafluoropropylene oxide dimer acid
HSP	Health and Safety Plan
ICAL	initial calibration
ICC	initial calibration check
ICP	inductively coupled plasma
ICP/MS	inductively coupled plasma-mass spectrometry
ICV	initial calibration verification
ISC	instrument sensitivity check
ID	identification
IDQTF	Intergovernmental Data Quality Task Force
IDW	investigation derived waste
LC/MS/MS	liquid chromatography-tandem mass spectroscopy
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MAD	Median Absolute Deviation
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MPC	measurement performance criteria
M.S.	Master of Science
MS	matrix spike

MSD	matrix spike duplicate
NA	not applicable
ng/L	nanogram per liter
NIS	non-extracted internal standards
No.	number
OASD	Office of the Assistant Secretary of Defense
OESC	Oneida Engineering, Science, and Construction Group
Oneida	Refers to SRS and OTIE in this UFP-QAPP
OSHA	Occupational Safety and Health Administration
OTIE	Oneida Total Integrated Enterprises, LLC
PA	Preliminary Assessment
PDS	post digestion spike
PE	Professional Engineer
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFHxS	perfluorohexane sulfonate
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PG	Professional Geologist
PgM	Program Manager
PM	Project Manager
PSL	project screening limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QMP	Quality Management Plan
QSM	quality systems manual
r^2	coefficient of determination
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RPD	relative percent difference
RPM	Remedial Project Manager
SI	Site Inspection
SOP	standard operating procedure
SRS	Sustainment and Restoration Services, LLC
SSHO	Site Safety and Health Officer

SVOC	semi-volatile organic compound
SVS	system verification standard
TAL	Target analyte list
TCLP	toxicity characteristic leaching procedure
TIA	Tucson International Airport
TDCA	taurodeoxycholic acid
TO	task order
TOC	total organic carbon
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
µg/kg	microgram per kilogram
U.S.	United States
USAF	United States Air Force
USACE	United States Army Corps of Engineers
VOC	volatile organic compound
WRS	Wilcoxon Rank Sum

INTRODUCTION

This Programmatic Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) was prepared to support per- and polyfluoroalkyl substances (PFAS) fingerprinting and background studies at multiple Department of Air Force (DAF) installations to discriminate among potential aqueous film forming foam (AFFF) and other PFAS sources and evaluate anthropogenic background PFAS concentrations at each installation.

This UFP-QAPP will be used to execute the performance objectives by Sustainment and Restoration Services, LLC (SRS) with support provided by sister company Oneida Total Integrated Enterprises (OTIE). Both OTIE and SRS are wholly owned subsidiaries of the Oneida Engineering, Science and Construction (OESC) Group and are referred to herein as Oneida. Oneida will be supported by subcontractor Battelle, together referred to herein as the Oneida Team.

An installation-specific addendum to this Programmatic UFP-QAPP will be prepared for each installation included on this contract to provide site-specific details including background information, conceptual site models (CSMs), data quality objectives (DQOs), sampling locations, and site-specific requirements.

SCOPE OF WORK

The scope of this project is to provide the United States Army Corps of Engineers (USACE) and DAF support in conducting PFAS fingerprint analyses and background studies at the following DAF installations:

- Des Moines Air National Guard Base (ANGB), Iowa
- Dover Air Force Base (AFB), Delaware
- Eielson AFB, Alaska
- Stewart ANGB, New York
- Travis AFB, California
- Wright Patterson AFB, Ohio
- Tucson Area, including Morris ANGB, Air Force Plant (AFP) 44, and Tucson International Airport (TIA).

The scope of this project is to provide the USACE and DAF support in conducting PFAS fingerprinting analyses and background studies at multiple DAF installations. The goal of the PFAS fingerprinting studies is to potentially discriminate among PFAS sources, including but not limited to various AFFF formulations; various municipal/industrial wastes (e.g., landfill leachates, municipal wastewater, paper mill wastewater, waste water treatment facilities, and compost); a wide variety of commercial products; and metal plating. Both target and non-target analytes will be analyzed using Battelle’s PFAS Signature® analysis, and background studies are being conducted to evaluate the anthropogenic background concentrations at each installation. The fingerprinting studies will include sampling and evaluation of soil, surface water, and groundwater; porewater may also be collected at installations with lysimeters available for sampling. The background studies will include sampling of soil both within and outside of installation boundaries to evaluate the anthropogenic PFAS background concentrations detected at each installation. These studies are intended to support CSM understanding and provide preliminary background (anthropogenic) PFAS soil concentrations at each installation.

Under the task order (TO), the Oneida Team will conduct one PFAS fingerprinting and background study at each of the installations listed above. Installation-specific investigation strategy, field methodology, screening criteria, and other detailed information outlining the approach for completion of the fingerprinting analyses and background studies are provided in this UFP-QAPP, with additional details to be provided in the installation-specific UFP-QAPP addenda, and other planning documents. One combined Fingerprinting and Background Study Report will be prepared for each installation. The Tucson Area properties will be addressed collectively.

PLAN ORGANIZATION

This UFP-QAPP is organized with the original 37 worksheets consolidated into optimized UFP-QAPP worksheets (Intergovernmental Data Quality Task Force [IDQTF] 2012). For ease of reference, the revised worksheets are named to reflect the original worksheets on which they are based (IDQTF 2012). The UFP-QAPP is intended to provide, in an orderly fashion, the problem definition; approach to resolving the problem; and quality assurance (QA)/quality control (QC) activities, such that the data collected are usable. The table of contents of this document presents a listing of all the UFP-QAPP worksheets.

Appendices to this UFP-QAPP, provided as separate tabs, are as follows:

- Appendix A Oneida Standard Operating Procedures (SOPs)
- Appendix B Laboratory Accreditation
- Appendix C Quality Management Plan (QMP)
    - Attachment A-1 Authorization Letter to Project Quality Control Manager
    - Attachment A-2 Resumes and Certifications
    - Attachment B Checklists for Preparatory and Initial Phases
    - Attachment C Contractor Quality Control Forms (Daily Contractor Production and Quality Control Report, and Deficiency Reporting)
    - Attachment D Test Report Form
    - Attachment E Materials Tracking Log
    - Attachment F Amendments to the Quality Management Plan
- Appendix D Field Forms
- Appendix E Waste Management Plan
- Appendix F PFAS Signature ® Brochure

UFP-QAPP Worksheet #1 & 2 – Title and Approval Page

(UFP-QAPP Manual Sections 2.1) (EPA 2106-G-05 Section 2.2.1)

Project Identifying Information

a. Project Name:	Per- and Polyfluoroalkyl Substances (PFAS) Fingerprinting and Background Study at Multiple Air Force Bases
b. Site Location:	Multiple Air Force Bases
c. Contract/Task Order:	W9123823D0023 / W91238-23-F-0086

Review Signatures:

Sustainment and Restoration Services, LLC (SRS)

Megan Duley

Megan Duley – Project Manager

Matt Van Beek

Matthew Van Beek – Contractor Quality Control Supervisor

Jacques Marcillac – Program Manager

United States Army Corps of Engineers (USACE) – Sacramento District

HIGGINS.JOLIE.LOGAN.1173440720
Digitally signed by HIGGINS.JOLIE.LOGAN.1173440720
Date: 2024.05.28 15:34:59 -07'00'
on behalf of Jessica Faragalli

Jessica Faragalli – Project Manager/ Task Order Contracting Officer Representative

Air Force Civil Engineer Center (AFCEC)

CASH.CYNTHIA.JOYCE.1520412197
Digitally signed by CASH.CYNTHIA.JOYCE.1520412197
Date: 2024.05.28 16:35:14 -05'00'

Cynthia Cash – Project Manager

1. This UFP-QAPP was prepared in accordance with the following guidance:

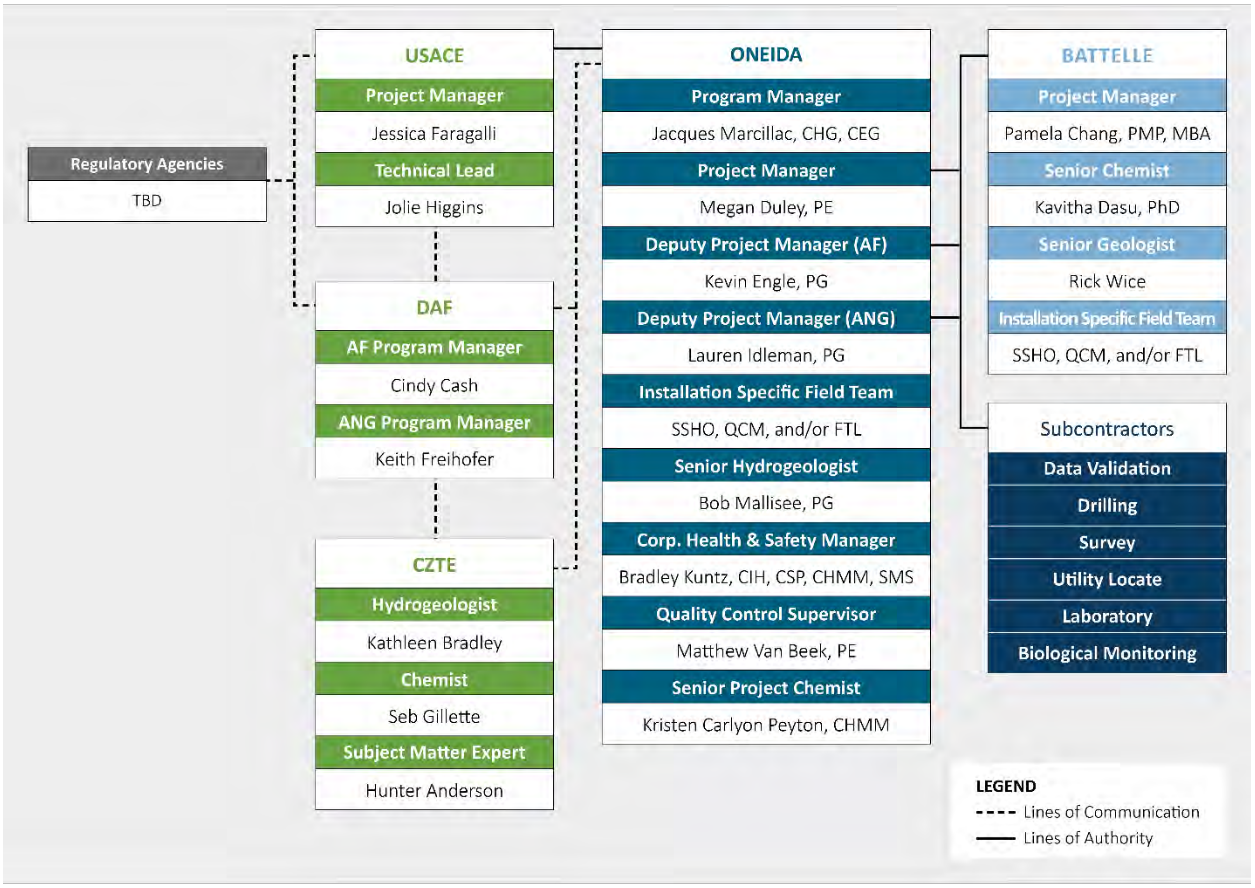
   - Uniform Federal Policy for Quality Assurance Project Plans (United States Environmental Protection Agency [EPA], 2012a).
   - Office of The Assistant Secretary of Defense (OASD). 2023. Investigating Per- And Polyfluoroalkyl Substances within the Department of Defense Cleanup Program (OASD, 2023).
   - Department of Defense (DOD) Update to Assistant Secretary of Defense for Energy, Installations, and Environment Memorandum, “Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program,” August 24, 2023 (DoD, 2024)

- Intergovernmental Data Quality Task Force, Uniform Federal Policy for Implementing Environmental Quality Systems. Evaluating, Assessing, and Documenting Environmental Data Collection/Use and Technology Programs, Part 2A: UFP-QAPP Workbook (EPA, 2012b).

2. This UFP-QAPP complies with the DoD Quality Systems Manual (QSM) for Environmental Laboratories Version 5.4 (DoD, 2021).
3. This is a project-specific UFP-QAPP.
4. A programmatic project kickoff meeting was held on 19 October 2023 to review project tasks, lines of communication, and roles and responsibilities. Installation-specific kickoff meetings were held for each installation included on this contract and will be documented in installation-specific UFP-QAPP Addenda (provided under separate cover).
5. The organizational partners (stakeholders) and their connection with lead organization are the USACE Sacramento District, and the DAF, which includes the AFCEC and Air National Guard (ANG). The agency representatives have been provided a copy of this UFP-QAPP for review and comment. USACE is the lead agency responsible for the work described in this UFP-QAPP.
6. The data users for this UFP-QAPP include the USACE Sacramento District, DAF, SRS, sister company OTIE, and Battelle.
7. All required elements under the UFP-QAPP template are applicable to the project-specific UFP-QAPP and each element is included. None of the required UFP-QAPP elements has been omitted from this document.
8. Plans and reports from previous investigations relevant to this project will be listed in installation-specific UFP-QAPP addenda.

UFP-QAPP Worksheet #3 & 5 – Project Organization and QAPP Distribution

(UFP-QAPP Manual Sections 2.3 – 2.4)3-10 (EPA 2106-G-05 Section 2.2.3 and 2.2.4)



USACE PFAS Fingerprinting and Background Study Org Chart

QAPP Recipient	Title/Role	Organization	Email
Jessica Faragalli	PM/Task Order COR	USACE	jessica.w.faragalli@usace.army.mil
Daniel Czech	Contracting Officer	USACE	daniel.e.czech@usace.army.mil
Mike Riggle	Contract COR	USACE	michael.A.riggle@usace.army.mil
Jolie Higgins	Technical Lead	USACE	jolie.l.higgins@usace.army.mil
Cynthia Cash	PgM Active AF Installations	AFCEC	cynthia.cash.1@us.af.mil
Alecia George	Deputy PgM AF Installations	AFCEC	alecia.george.1@us.af.mil
Anne (Kathleen) Bradley	Technical Support (hydrogeologist)	AFCEC/CZTE	anne.bradley.1@us.af.mil
Richard (Hunter) Anderson	Technical Support (Subject matter expert)	AFCEC/CZTE	richard.anderson.55@us.af.mil

QAPP Recipient	Title/Role	Organization	Email
John (Seb) Gillette	Technical Support (Chemist)	AFCEC/CZTE	john.gillette.1@us.af.mil
Keith Freihofer	PgM ANG Installations	ANG	keith.freihofer.1@us.af.mil
Jacques Marcillac, PG, CHG, CEG	PgM	Oneida	jmarcillac@oescgroup.com
Matthew Van Beek	Corporate QC Manager	Oneida	mvanbeek@oescgroup.com
Megan Duley, PE	PM	Oneida	mduley@oescgroup.com
Kevin Engle, PG	Deputy PM (AF Installations)	Oneida	kengle@oescgroup.com
Lauren Idleman, PG	Deputy PM (ANG Installations)	Oneida	lIdleman@oescgroup.com
Bob Mallisee, PG	Senior Hydrogeologist	Oneida	rmallisee@oescgroup.com
Kristen Carylon Peyton, CHMM	Senior Project Chemist	Oneida	kcarlyonpeyton@oescgroup.com
Bradley Kuntz, CIH, CSP, CHMM, SMS	Corporate Health and Safety Manager	Oneida	bkuntz@oescgroup.com
Pamela Chang, PMP	PM	Battelle	changp@battelle.org
Kavitha Dasu, PhD	Senior Chemist	Battelle	dasu@battelle.org
Rick Wice, PG	Senior Geologist	Battelle	wice@battelle.org
Franco Pala, PhD	Laboratory Director	Battelle Analytical Chemistry Services	palaf@battelle.org
Nicole Brown	Laboratory PM	ELLE	nicole.brown@et.eurofinsus.com
Evin McKinney	Data Validator	Environmental Synectics, Inc. (Synectics)	evin.mckinney@synectics.net

NOTES

AF	Air Force
CEG	Certified Engineering Geologist
CHG	Certified Hydrogeologist
CHMM	Certified Hazardous Materials Manager
COR	Contracting Officer Representative
CZTE	Environmental Restoration Technical Support Branch
ELLE	Eurofins Lancaster Laboratories Environmental
PE	Professional Engineer
PG	Professional Geologist
PgM	Program Manager
PM	Project Manager

UFP-QAPP Worksheet #4, 7 & 8 – Personnel Qualifications and Sign-off Sheet

(UFP-QAPP Manual Sections 2.3.2 – 2.3.4) (EPA 2106-G-05 Section 2.2.1 and 2.2.7)

Organization: SRS

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Megan Duley, PE	PM	B.S. Chemical Engineering / 22 years	Minnesota PE, Naval Facilities Engineering Systems Command Geographical Information Systems (GIS) Certification, 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response training (HAZWOPER), Antiterrorism Level I Training	
Jacques Marcillac, PG, CHG, CEG	PgM	B.S. Geological Sciences / 25 years	40-hour OSHA HAZWOPER, USACE Construction Quality Management for Contractors, Antiterrorism Level I Training	
Kevin Engle, PG	Deputy PM (AF)/Alternate Site Safety and Health Officer (SSHO)/ Field Team Lead (FTL)	M.S. Geology/ 9 years	Wyoming PG, 40-hour OSHA HAZWOPER, USACE Construction Quality Management for Contractors, 30-hour OSHA Construction Supervisor, Antiterrorism Level I Training	
Lauren Idleman, PG	Deputy PM (ANG)	M.S. Geology/ 10 years	Minnesota PG, 40-hour OSHA HAZWOPER, USACE Construction Quality Management for Contractors, Antiterrorism Level I Training	
Bob Mallisee, PG	Sr. Hydrogeologist	B.S. Geology / 32 years	40-hour OSHA HAZWOPER, OSHA 8-Hour HAZWOPER Supervisor, Antiterrorism Level I Training	
Mark Wanek, PG	SSHO/ Project Geologist/ FTL	B.S. Environmental Geology/Geohydrology / 22 years	California PG No. 9271, 40-hour HAZWOPER, 8-hour HAZWOPER Supervisor, 30-hour OSHA Construction Supervisor, USACE Construction Quality Management for Contractors, Excavation Competent Person Training, Antiterrorism Level I Training, First Aid/ Cardiopulmonary Resuscitation (CPR) training	
Kristen Carlyon Peyton, CHMM	Senior Project Chemist	B.S. Chemistry / 28 years	Certified Hazardous Materials Manager (CHMM) #18310, 40-hour HAZWOPER, Antiterrorism Level I Training	

Organization: Battelle

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Pamela Chang, PMP	PM	B.S. Chemical Engineering / 25 years	--	
Kavita Dasu, PhD	Senior Chemist	PhD Environmental Chemistry/12 years	--	
Rick Wice, PG	Senior Geologist	M.S. Geology / 37 years	--	
Franco Pala, PhD	Laboratory Director	PhD Environmental Chemistry/25 years	--	

Organization: Eurofins Lancaster

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Nicole Brown	Laboratory PM/Senior PM	B.S. Biological Sciences / 16 years	--	

Organization: Synectics

Name	Project Role/Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Evin McKinney	Data Validator / Senior Scientist	B.S. Chemistry / 15 years laboratory experience/20 years validation experience	--	

UFP-QAPP Worksheet #6 – Communication Pathways

(UFP-QAPP Manual Sections 2.4.2) (EPA 2106-G-05 Section 2.2.4)

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure
Contractual modification and/or program performance	Oneida PgM	Jacques Marcillac	805-797-0021	Communicates with USACE Contracting Officer and other USACE personnel at the programmatic level regarding overall performance.
Manage all project phases/overall technical lead	Oneida PM	Megan Duley	651-775-7870	Overall contractor management and execution of the project. Maintains lines of communication with USACE and DAF. Communicates field changes to the USACE and DAF PMs and discusses options prior to implementation. Receives direction from the USACE and DAF regarding communications with stakeholders. Deputy PMs serve as secondary points of contact.
Project Safety	Oneida	Bradley Kuntz	704-907-5115	Communicates with Battelle and other subcontractors regarding safety issues. Reviews and approves safety plans, conducts audits, and exercises stop-work authority, if needed.
Project QA/QC and Cas	Oneida Contractor Quality Control Supervisor (CQCS)	Matthew Van Beek	414-67-6790	Communicates with Battelle PM regarding QC/QA issues. Reviews and approves corrective action plans.
Modifications to Analytical corrective actions (Cas)	Oneida Senior Program Chemist	Kristen Carlyon Peyton	510-517-8113	Report on the adequacy, status and effectiveness of the QA program by phone or emails during weekly progress calls and as needed.
Modifications to analytical responsibilities	Eurofins Lab PM Battelle Lab PM	Nicole Brown Franco Pala	717-471-3265 718-681-5400	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email.
Modifications to data validation responsibilities	Data Validator	Evin McKinney	916-737-4016	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email.

UFP-QAPP Worksheet #9 – Project Planning Session Summary

(UFP-QAPP Manual Sections 2.5.1 and Figures 9-12) (EPA 2106-G-05 Section 2.2.5)

Title: Kickoff Meeting

Meeting Location: Teleconference

Date of Session: 19 October 2023

Scoping Session Purpose: Introduce the project team, discuss roles and responsibilities, establish project communication, discuss project objectives and schedule, and identify next steps for successful project execution.

Name	Organization	Project Role
Jessica Faragalli	USACE	PM
Harvey Jones	USACE	PgM
Jolie Higgins	USACE	Technical Lead
Johnnie Terry	USACE	Contracting
Amy Estey	USACE	USACE Support
Monique Osterman	USACE	USACE Support
Cynthia Cash	AFCEC	AF PgM
Chin Zen Plotner	AFCEC	DAF Litigation Center Support
Alecia George	AFCEC	Deputy PM – AF Installations
Brian Howard	Secretary of the Air Force for Environment, Safety, and Infrastructure	Tucson Area Support
Keith Freihofer	ANG	ANG PgM
Wendell Williams	ANG	Des Moines ANGB Restoration Project Manager (RPM)
Jose Hurtado	ANG	Morris ANGB RPM
Bill Myer	ANG	Stewart ANGB RPM
Jacques Marcillac	Oneida	PgM
Megan Duley	Oneida	PM
Kevin Engle	Oneida	Deputy PM – Air Force (AF) Installations
Lauren Idleman	Oneida	Deputy PM – ANG Installations
Kristen Carlyon Peyton	Oneida	Senior Program Chemist
Mark Wanek	Oneida	Project Geologist
Nicole Cook	Oneida	Project Geologist
Rachel Ofili	Oneida	Project Geologist
Sam Santoso	Oneida	Project Geologist

Name	Organization	Project Role
Pamela Chang	Battelle	Battelle PM
Kavitha Dasu	Battelle	Battelle Lead Chemist
Amy Dindal	Battelle	Technical Support
Rick Wice	Battelle	Battelle Geologist
Steve Verdibello	Battelle	Battelle Hydrogeologist
Allen Davis	Battelle	Technical Support

Meeting Summary and Key Points:

Introduced the project team, organization, and scope of the TO. Discussion also included project planning, project coordination, and generalized schedule, including installation priorities and timing of in-person scoping meetings to avoid winter accessibility issues.

The team discussed project documents. Installation-specific UFP-QAPP addenda will undergo regulatory review, and the fingerprinting and background studies will be submitted as a single report for each installation.

The project schedule will be refined as kickoff and scoping meetings are scheduled; the team will identify schedule options for these meetings. Project website access will be coordinated for key users.

UFP-QAPP Worksheet #10 – Conceptual Site Model

(UFP-QAPP Manual Sections 2.5.2) (EPA 2106-G-05 Section 2.2.5)

Brief descriptions of each installation included in this contract are provided below. Detailed site background, descriptions, and CSMs for each installation will be provided in installation-specific UFP-QAPP addenda provided under separate cover. Figures 1 through 7 show the locations of the installations/areas where the work will be performed.

Des Moines ANGB is located in Polk County, Iowa, approximately 5 miles south of downtown Des Moines. The ANGB is located on the west side of the Des Moines International Airport. It comprises approximately 165 acres and is the home of the 132nd Wing. A PFAS Preliminary Assessment (PA) performed in 2016 evaluated 15 potential release areas as well as potential PFAS impacts along the installation boundary. Fourteen potential release areas were investigated in a 2019 Site Inspection (SI) and all were recommended for further evaluation in an expanded SI or Remedial Investigation (RI) (Leidos, 2019).

Dover AFB is located in Kent County, Delaware, about 4 miles southeast of the city of Dover. It is bounded to the southwest by the St. Jones River. Dover AFB comprises approximately 4,000 acres and is the home of the 436th Airlift Wing. PFAS SIs were completed at Dover AFB in 2014 and 2017 (SES 2014; Aerostar SES, 2017). AFFF releases were confirmed at two areas located near installation boundaries and an expanded SI was completed at these locations in 2022 (AECOM, 2022). An RI is under way to investigate PFAS impacts to off-base drinking water sources.

Eielson AFB is located 6 miles southeast of the community of Moose Creek, Alaska. Eielson AFB comprises approximately 19,790 acres and is bounded to the north by Moose Creek and on all other sides by undeveloped military reservation lands. 3,651 acres of the installation are improved or partially improved and the remainder are undeveloped. PFAS were initially detected in groundwater and surface water at Eielson AFB in 2014 (AFCEC, 2015); quarterly groundwater monitoring was conducted from 2015-2020. Granular activated carbon treatment was added to the installation water treatment plant in 2016 (United States Air Force [USAF], 2017). SIs were completed at 15 AFFF release areas in 2015-16 as well as at other installation monitoring wells; PFAS were detected at all 15 release areas (AFCEC, 2017a; AFCEC, 2017b; AFCEC, 2018). An expanded SI was conducted in 2022 (Sundance-EA II, 2022) and recommended further investigation in an RI, which started in 2020 and is currently underway.

Stewart ANGB is located at Stewart International Airport, 2.5 miles west of the city of Newburgh, New York. It comprises 280 acres and is the home of the 105th Airlift Wing. Lake Washington is located to the southeast of the Stewart ANGB and forms part of the reservoir system used by the City of Newburgh Water Department. Brown's Pond, located to the south-southwest of the Stewart ANGB, has been used as a backup source of water supply. A PFAS PA was conducted in 2016 (BB&E, 2016), an SI in 2018 (Wood, 2018), and an expanded SI in 2020 (Wood, 2020). The SI investigations found PFAS impacts in on- and off-base groundwater and off-base surface water and recommended further investigation in an RI, which is currently underway.

Travis AFB is located in Solano County, California, approximately 3 miles east of downtown Fairfield and 8 miles south of downtown Vacaville. It comprises approximately 6,383 acres. A limited SI conducted in 2014 (SES, 2015) evaluated seven locations. A PA was completed in 2015 that identified and assessed 26 potential source areas; it recommended 20 for further investigation (CH2M, 2015a). Following additional site visits and scoping, SIs were completed at 17 areas in 2017 (OTIE, 2018a), seven of which were recommended for further evaluation. Following the SI, an expanded SI was conducted to assess potential off-base drinking water impacts at 10 off-base wells. Three wells had PFAS impacts at concentrations exceeding the EPA Lifetime Health Advisories (EPA, 2016a and 2016b) and were outfitted with point of entry treatment systems (OTIE, 2018b). A PFAS Phase I RI was initiated in July 2020 and is currently underway at Travis AFB.

Wright Patterson AFB is located in Greene and Montgomery Counties, Ohio, in between the cities of Dayton and Fairborn. It comprises 7,630 acres that make up two areas: Area A (Patterson Field) and Area B (Wright Field). The city of Dayton drinking water well field is immediately downgradient of Wright Patterson AFB. A PFAS PA was conducted in 2015 (CH2M Hill, 2015b) and an SI in 2016 (Aerostar SES LLC, 2018). The SI recommended 15 areas for additional investigation. Groundwater PFAS monitoring has been conducted since 2016 to fill data gaps identified in the PFAS SI and evaluate if PFAS are moving off-base towards the city of Dayton's Huffman Dam well field. An expanded SI was conducted at four AFFF areas previously investigated in the SI as well as three additional investigation areas (Aerostar SES LLC, 2020). The expanded SI recommended that two areas undergo groundwater evaluation, and five areas undergo further investigation in an RI, which is currently underway.

Tucson Area Installations (Morris ANGB, AFP 44, and TIA) are located in Tucson, Arizona. The three properties are located adjacent to each other immediately south of Tucson. Morris ANGB/TIA is the northernmost property. The ANGB comprises 94 acres on the northwestern portion of the TIA and is home to the 162nd Wing. AFP 44, a government-owned, contractor-operated defense industrial plant, adjoins Morris ANGB/TIA. Historical industrial processes conducted at AFP 44 in conjunction with the production, maintenance, and modification of weapons systems included cleaning and degreasing, plating, anodizing, chemical milling, chemical etching, printed circuit board production, heat treating, and painting. PFAS investigations are underway at these and other nearby facilities. The DAF oversees investigations at Morris ANGB and AFP 44; EPA is overseeing investigations at the TIA (Ayuda Companies, 2021; AECOM, 2019; USACE, 2023).

UFP-QAPP Worksheet #11 – Project/Data Quality Objectives

(UFP-QAPP Manual Sections 2.6.1) (EPA 2106-G-05 Section 2.2.6)

The DQOs for the project are outlined below. Specific DQOs will be established for each site and will be described in the UFP-QAPP Addendum for each installation. All DQOs will follow EPA's seven-step iterative process for DQO development (EPA, 2006). DQOs are influenced by the ongoing project planning discussions with stakeholders and will be updated if new consensus decisions materialize.

DQO Step	Description	
Step 1 State the Problem	PFAS constitute a large family exceeding several thousand fluorinated chemicals that may be in commercial use or the environment, that vary widely in their chemical and physical properties. The persistence and mobility of some PFAS, combined with decades of widespread use in industrial processes, certain types of firefighting foams, and consumer products, have resulted in their presence in environmental media such as soil, groundwater, and surface water at trace levels across the globe (ITRC, 2023), including in and around USAF and ANGB installations. In many instances, the types and compositions of PFAS impacts both in the vicinity of and originating from USAF and ANGB installations are not yet fully understood, leading to a potential data gap that may affect completion of future risk assessments and feasibility studies.	
Step 2 Identify the Goals of the Study	The goal of the fingerprinting study is to potentially discriminate among potential PFAS sources. The goal of the background study is to establish preliminary anthropogenic background concentrations at each installation. Samples for the fingerprinting and background study will be analyzed by Draft Method 1633 and also using the PFAS Signature® analysis, which can identify up to 520 distinct PFAS compounds. The data generated using PFAS Signature® will be evaluated alongside data generated by Method 1633 and additional lines of evidence (such as geochemical parameters and current site CSMs) to evaluate if/how they may be used to inform site understanding. Installation-specific UFP-QAPP addenda will be prepared for each installation or study area. The UFP-QAPP addenda will detail installation-specific sampling and analysis plans, data quality objectives, procedures, and documentation necessary to achieve the study goals	
Step 3 Identify Information Inputs	The following data and informational needs for each study (fingerprinting and background) are required to achieve project goals using a multiple line of evidence approach:	
	Background Study	**Fingerprinting Study**
	• Analytical results from surface soil samples collected and analyzed for PFAS, and geochemical parameters for selected samples, in accordance with this Programmatic UFP-QAPP and installation-specific addenda.	• Analytical results from surface soil, subsurface soil, groundwater, surface water, and potentially porewater samples collected and analyzed for PFAS, and geochemical parameters for selected samples, in accordance with this Programmatic UFP-QAPP and installation-specific addenda.
	• Results from a chemical forensic technique, PFAS Signature®, which uses a combination of high-resolution mass spectrometry and statistical analysis for PFAS source differentiation and tracking (refer to table in Worksheets #14 & 16, Section 14.4 for additional information on the analytical methods that comprise PFAS Signature®).	• Results from a chemical forensic technique, PFAS Signature®, which uses a combination of high-resolution mass spectrometry and statistical analysis for PFAS source differentiation and tracking (refer to table in Worksheets #14 & 16, Section 14.4 for additional information on the analytical methods that comprise PFAS Signature®).

DQO Step	Description	
	• Installation-specific information obtained through historical document reviews, site visits, record reviews, public GIS databases, and conference calls. • Off-installation information obtained through historical document reviews, site visits, record reviews, public GIS databases, and conference calls with installation personnel who live locally. • Data analysis and evaluation as described on Worksheet #14	• Installation-specific information obtained through historical document reviews, site visits, record reviews, public GIS databases, and conference calls. • Off-installation information obtained through historical document reviews, site visits, record reviews, public GIS databases, and conference calls with installation personnel who live locally. • Data analysis and evaluation as described on Worksheet #14
Step 4 Define the Boundaries of the Study	Specific sampling locations at each installation will be determined based on site visits and site-specific conditions such as topography, groundwater flow and surface water runoff direction, the results of previous investigations, and consultation with USACE and DAF. Specific sampling locations will be included in the installation-specific addenda, but in general samples will be collected within installation borders with samples collected off-installation as needed to meet project objectives. The locations and quantities of off-base fingerprinting samples will be developed on an installation-specific basis. Samples will be collected on- and off-installation to support the background studies and the fingerprinting studies. The locations of off-base fingerprinting samples will be selected to provide information regarding potential PFAS migrating onto an installation (upgradient) as well as migrating off of an installation (downgradient), and potentially comingling with off-base sources. The goal of off-base fingerprinting sampling is not to search for other potential contributors to identified PFAS impacts, but rather to achieve acceptable lateral distribution of sample locations. Off-base background study sample locations will be selected as appropriate in consideration of suitability for use in the background study (as removed from known/suspected PFAS sources and other environmental contaminants to the extent practicable) while also considering location safety, access, and sensitive natural resources. Temporal boundaries are described in the schedule presented in Worksheets #14 & 16.	
Step 5 Develop the Analytic Approach	Background Study If PFAS are detected at concentrations greater than their respective limits of quantitation (LOQs), then installation-specific background levels will be statistically developed. Statistical analysis will include data collected from both the concentrations of targeted analytes measured using Draft Method 1633 and the semi-quantitative concentrations calculated from the Suspect Screening Responses. The background samples will be assessed for outliers, i.e. samples with high PFAS concentrations such that they are likely not actual background samples. The Median Absolute Deviation (MAD) approach will be used to identify potential outliers, selecting the median ± 2.5 times the MAD as the criterion. This approach is applicable when the data are not normally distributed, as is likely to be the case for the background samples in the presence of non-detects. Outlier detection will be performed for each site. The Wilcoxon Rank Sum (WRS) test will be used to compare background sample PFAS concentrations to test site samples (EPA Guidance EPA 540-R-01-003). The WRS test is non-parametric, robust to outliers, and robust in the presence of up to 40% non-detects in either set of samples. The WRS test will be used to test the null hypothesis H0: $\Delta \le S$ vs. HA: $\Delta > S$, where Δ is the difference in distribution of PFAS concentrations between the test site and the background, and S is an a priori specified substantial difference. This test assumes that the difference is	

DQO Step	Description
	≤ S and rejects that assumption if there is statistically significant evidence that the difference is > S. The test for each site will be performed with a significance level of 0.05. If more than 40% non-detects are observed in either set of samples, then alternative statistical methods will be considered. Proportionality tests will be used to compare PFAS detection rates across land use categories, if the data are amenable. Each sample will be classified as either PFAS detected (at any concentration) or PFAS not detected. A chi-squared test will be performed to test the null hypothesis of equal PFAS detection rates across land use categories. If the semiquantitative suspect screening analysis detects the presence of PFAS compounds, then further evaluation or future investigation may be warranted to understand the presence/absence of and determine the semi-quantitative concentrations of the suspect screening analytes. This approach will be informative for future investigations. This study provides the development and proof of concept data to understand the background levels of the suspect analytes. The USACE and AFCEC may consider further investigations after reviewing the study results. Results may be used to clarify the installation-specific CSMs. <u>Fingerprinting Study</u> If suspect screening results achieve a confidence level of 1, 2, or 3, then the results are suitable for use in fingerprinting analysis via machine learning. Following machine learning analysis, AFFF/non-AFFF source classification confidence levels will be reported. Confidence levels for machine learning analysis results will be assessed as follows: • A confidence level greater than 0.5 (> 0.5) means that PFAS contamination is likely due to an AFFF source. Determination will be supported by evaluation of additional lines of evidence. • A confidence level less than 0.5 (< 0.5) means that PFAS contamination may be due to a mixture of AFFF and non-AFFF sources or may be non-AFFF in origin. Determination will be supported by evaluation of additional lines of evidence. • In both instances, further lines of evidence will be evaluated and may include: o *Target analysis data, which provides quantitative data for 40 PFAS analytes.* o *Evaluation of PFAS precursors and metabolites in the suspect screening data at known AFFF* source *areas and downgradient locations*. If the comparison of the data from the source and downgradient shows the data to be similar, then the concentrations can be considered to originate from the same source (AFFF). If the comparison shows that the data are different, then an AFFF source is unlikely. o *Evaluation of total organic carbon (TOC) and total metals concentrations at known AFFF source areas and downgradient locations.* If concentrations of TOC and/or total metals provide evidence that source area AFFF has migrated downgradient or is from another source, then the information will be used as an additional line of evidence.
Step 6 Specify Performance or Acceptance Criteria	To limit uncertainty in obtained environmental data, project-specific measurement performance criteria (MPC) have been developed and are presented in Worksheet #12. Measurement errors will be controlled by using appropriate sampling and analytical methods, adhering to the DoD/Department of Energy Consolidated QSM (version 5.4), having independent data validation to verify laboratory processes for definitive data, and by following established SOPs. The field team will review the UFP-QAPP and site-specific addenda before sample collection to limit sample collection errors. The subcontract laboratories will be provided with a copy of the UFP-QAPP for review and will adhere to the guidance herein to limit measurement errors.

DQO Step	Description
Step 7 Develop the Plan for Obtaining Data	As described in Worksheet #17, sampling locations at each installation may include shallow and deep soil borings, temporary monitoring wells, surface water locations, lysimeters, and existing on-base monitoring wells. A field QC sample summary is provided in Worksheet #20; field SOPs are identified in Worksheet #21 and provided in Appendix A; and field equipment calibration, maintenance, testing, and inspection procedures are provided in Worksheet #22. Worksheets #23, #24, and #25 provide analytical SOPs, instrument calibration, and analytical equipment maintenance, testing and inspection. Worksheets #26 and #27 provide sample handling, custody, and disposal procedures. Worksheet #28 provides the analytical QC and corrective action.

UFP-QAPP Worksheet #12A – Measurement Performance Criteria, Aqueous Samples

(UFP-QAPP Manual Sections 2.6.2) (EPA 2106-G-05 Section 2.2.6)

This worksheet documents the project specific MPC in terms of data quality indicators (DQI) (i.e., precision, accuracy, sensitivity, representativeness, completeness, and comparability).

Analyte/Method	PFAS by Third Draft Method 1633 compliant with QSM 5.4 Table B-24/SOP 5-381	
Matrix	Groundwater/Surface Water	
Concentration Level	Low	
Sampling procedure	Groundwater/Surface Water Sampling; Oneida SOP OESC008F/OESC006D	
Data Quality Indicators	**Quality Control Sample**	**Measurement Performance Criteria**
Bias Contamination	Field Blank/Equipment Blank	<1/2 Limit of Quantitation (LOQ)
Overall Precision	Field Duplicate	Relative Percent Difference (RPD) ≤ 35 percent (%)
Accuracy/Bias Contamination	Method blank	<1/2 LOQ or <1/10 the amount measured in field samples, or <1/10 the regulatory limit, whichever is greater
Accuracy/Method bias in ideal matrix	Laboratory Control Sample (LCS), spiked at mid-to-low range	Laboratory-derived statistical limits (Table 28-1a)
Precision and Accuracy in ideal matrix	Laboratory Control Sample Duplicate (LCSD)	RPD <30%
Accuracy in project matrix	Matrix Spike (MS)	Laboratory-derived statistical limits (Table 28-1a)
Precision and Accuracy in project matrix	Matrix Spike Duplicate (MSD)	RPD <30%
Accuracy in individual samples	Extracted Internal Standards (EIS)	Laboratory-derived statistical limits (Table 28-1a)
Accuracy in individual samples	Non-extracted Internal Standards (NIS)	Peak area ≥ 30% of average peak area from the initial calibration (ICAL)
Sensitivity	Instrument Sensitivity Check (ISC)	All analyte concentrations must be within ±30% of their true values. Analyte concentrations must be at LOQ.
Representativeness	Temperature blanks, Laboratory sample receipt checklists	Samples met preservation requirements discussed in Worksheets #19 & #30
Comparability	Standardized field and laboratory SOPs	Based on accuracy and media comparison
Completeness	See Worksheet #34 and #37	90%

UFP-QAPP Worksheet #12B – Measurement Performance Criteria, Soil Samples

Analyte/Method	PFAS by Third Draft Method 1633 compliant with QSM 5.4 Table B-24/SOP 5-381	
Matrix	Soil	
Concentration Level	Low	
Sampling procedure	Soil Sampling; Oneida SOP OESC006B and OESC007D	
Data Quality Indicators	**Quality Control Sample**	**Measurement Performance Criteria**
Bias Contamination	Field Blank/Equipment Blank	<1/2 LOQ
Overall Precision	Field Duplicate	RPD ≤ 50 %
Accuracy/Bias Contamination	Method blank	<1/2 LOQ or <1/10 the amount measured in field samples, or <1/10 the regulatory limit, whichever is greater
Accuracy/Method bias in ideal matrix	LCS spiked at mid-to-low range	Laboratory-derived statistical limits (Table 28-1b)
Precision and Accuracy in ideal matrix	LCSD	RPD <30%
Accuracy in project matrix	MS	Laboratory-derived statistical limits (Table 28-1b)
Precision and Accuracy in project matrix	MSD	RPD <30%
Accuracy in individual samples	EIS	Laboratory-derived statistical limits (Table 28-1b)
Accuracy in individual samples	NIS	Peak area ≥ 30% of average peak area from the ICAL
Sensitivity	ISC	All analyte concentrations must be within ±30% of their true values. Analyte concentrations must be at LOQ.
Representativeness	Temperature blanks, Laboratory sample receipt checklists	Samples met preservation requirements discussed in Worksheets #19 & #30
Comparability	Standardized field and laboratory SOPs	Based on accuracy and media comparison
Completeness	See Worksheet #34 and #37	90%

UFP-QAPP Worksheet #12C – Measurement Performance Criteria, Aqueous Samples

Analyte/Method	Total Metals by EPA Methods 6020B/7470A	
Matrix	Groundwater/Surface Water	
Concentration Level	Low	
Sampling procedure	Groundwater/Surface Water Sampling; Oneida SOP OESC008F/OESC006D	
Data Quality Indicators	**Quality Control Sample**	**Measurement Performance Criteria**
Bias Contamination	Field Blank/Equipment Blank	<1/2 LOQ
Overall Precision	Field Duplicate	RPD ≤ 35%
Accuracy/Bias Contamination	Method blank	<1/2 LOQ or <1/10 the amount measured in field samples
Accuracy/Method bias in ideal matrix	LCS	QSM 5.4 Table C-6 and C-12
Precision and Accuracy in ideal matrix	LCSD	RPD <20%
Accuracy in project matrix	MS	QSM 5.4 Table C-6 and C-12
Precision and Accuracy in project matrix	MSD	RPD <20%
Accuracy in individual samples	Internal Standards (ICP/MS only)	Must be 30%-120% of the calibration blank
Sensitivity	Low Level Check (ICP/MS only)	± 20% True Value
Representativeness	Temperature blanks, Laboratory sample receipt checklists	Samples met preservation requirements discussed in Worksheets #19 & #30
Comparability	Standardized field and laboratory SOPs	Based on accuracy and media comparison
Completeness	See Worksheet #34 and #37	90%

NOTE

ICP/MS = inductively coupled plasma / mass spectrophotometer

UFP-QAPP Worksheet #12D – Measurement Performance Criteria, Soil Samples

Analyte/Method	Total Metals by EPA Methods 6020B/7471B	
Matrix	Soil	
Concentration Level	Low	
Sampling procedure	Soil Sampling; Oneida SOP OESC006B and OESC007D	
Data Quality Indicators	**Quality Control Sample**	**Measurement Performance Criteria**
Bias Contamination	Field Blank/Equipment Blank	<1/2 LOQ
Overall Precision	Field Duplicate	RPD ≤ 50 %
Accuracy/Bias Contamination	Method blank	<1/2 LOQ or <1/10 the amount measured in field samples
Accuracy/Method bias in ideal matrix	LCS	QSM 5.4 Table C-5 and C-11
Precision and Accuracy in ideal matrix	LCSD	RPD <20%
Accuracy in project matrix	MS	QSM 5.4 Table C-5 and C-11
Precision and Accuracy in project matrix	MSD	RPD <20%
Accuracy in individual samples	Internal Standards (ICP/MS only)	Must be 30%-120% of the calibration blank
Sensitivity	Low Level Check (ICP/MS only)	± 20% True Value
Representativeness	Temperature blanks, Laboratory sample receipt checklists	Samples met preservation requirements discussed in Worksheets #19 & #30
Comparability	Standardized field and laboratory SOPs	Based on accuracy and media comparison
Completeness	See Worksheet #34 and #37	90%

UFP-QAPP Worksheet #12E – Measurement Performance Criteria, Aqueous Samples

Analyte/Method	Total Organic Carbon by EPA Method 9060A	
Matrix	Groundwater/Surface Water	
Concentration Level	Low	
Sampling procedure	Groundwater/Surface Water Sampling; Oneida SOP OESC008F/OESC006D	
Data Quality Indicators	**Quality Control Sample**	**Measurement Performance Criteria**
Bias Contamination	Field Blank/Equipment Blank	<1/2 LOQ
Overall Precision	Field Duplicate	RPD ≤ 35 %
Accuracy/Bias Contamination	Method blank	<1/2 LOQ or <1/10 the amount measured in field samples
Accuracy/Method bias in ideal matrix	LCS	80-120 %R
Precision and Accuracy in ideal matrix	LCSD	RPD <20%
Accuracy in project matrix	MS	75-125 %R
Precision and Accuracy in project matrix	MSD	RPD <20%
Representativeness	Temperature blanks, Laboratory sample receipt checklists	Samples met preservation requirements discussed in Worksheets #19 & #30
Comparability	Standardized field and laboratory SOPs	Based on accuracy and media comparison
Completeness	See Worksheet #34 and #37	90%

NOTES:

1. EPA Method 9060A does not have QSM limits. Limits provided are in accordance with the precision and accuracy guidance provided in EPA Method 9060A for aqueous matrices.

UFP-QAPP Worksheet #12F – Measurement Performance Criteria, Soil Samples

Analyte/Method	Total Organic Carbon by EPA Method 9060A
Matrix	Soil
Concentration Level	Low
Sampling procedure	Soil Sampling; Oneida SOP OESC006B and OESC007D

Data Quality Indicators	Quality Control Sample	Measurement Performance Criteria
Bias Contamination	Field Blank/Equipment Blank	<1/2 LOQ
Overall Precision	Field Duplicate	RPD ≤ 50 %
Accuracy/Bias Contamination	Method blank	<1/2 LOQ or <1/10 the amount measured in field samples
Accuracy/Method bias in ideal matrix	LCS	36-163%R
Precision and Accuracy in ideal matrix	LCSD	RPD <20%
Accuracy in project matrix	MS	36-163%R
Precision and Accuracy in project matrix	MSD	RPD <20%
Representativeness	Temperature blanks, Laboratory sample receipt checklists	Samples met preservation requirements discussed in Worksheets #19 & #30
Comparability	Standardized field and laboratory SOPs	Based on accuracy and media comparison
Completeness	See Worksheet #34 and #37	90%

NOTES:

1. EPA Method 9060A does not have QSM limits; therefore, statistically-derived laboratory control limits will be used for soil.

UFP-QAPP Worksheet #12G – Measurement Performance Criteria, Soil Samples

Analyte/Method	PFAS by Liquid Chromatography – Quadrupole Time-of-Flight Mass Spectrometry (LC-QTOF MS) (PFAS Signature® analysis)/SOP 5-382	
Matrix	Soil	
Concentration Level	Low	
Sampling procedure	Soil Sampling; Oneida SOP OESC006B and OESC007D	
Data Quality Indicators	**Quality Control Sample**	**Measurement Performance Criteria**
Accuracy/Bias Contamination (Sample)	Method blank	< 5x the response of the response measures in the field samples for any analyte detected in method blank
Bias Contamination (Instrument)	Instrument Blank analyzed prior to the batch sequence run to assess an instrument's cleanliness	< 5x the response of the response measures in the field samples for any analyte detected in the instrument blank.
Bias Contamination (Instrument)	System Blank analyzed during the batch sequence run to assess an instrument's cleanliness	None of the system verification standard (SVS), calibration curve, or positive control analytes should be detected at greater than 3:1 signal-to-noise ratio in the instrument blanks.
Accuracy in project samples	Internal/Surrogate Standard Spikes	In negative mode analysis, at least 70% spiked internal and surrogate standards are expected to be detected. If that criterion fails, samples need to be reanalyzed. There are no labeled positive mode analytes commercially available. Therefore, this criterion is not applicable for positive mode detections.
Confidence Level Assignment	Confidence Level 1 (CL 1)	The retention time has previously been determined from the analysis of authentic reference material. The mass error of the detection is ≤ 3 mDa. The detection contains at least one logical high-energy product ion.
Confidence Level Assignment	Confidence Level 2a (CL 2a) Confidence Level 2b (CL 2b) Confidence Level 3 (CL 3) Confidence Level 4 (CL 4)	Each peak will be given a confidence level which are modified from Schymanski et al (2014)[1]

NOTES:

1. Laboratory SOPs available for review upon request.

UFP-QAPP Worksheet #12H – Measurement Performance Criteria, Aqueous Samples

Analyte/Method	PFAS by Liquid Chromatography – Quadrupole Time-of-Flight Mass Spectrometry (LC-QTOF MS) (PFAS Signature® analysis)/SOP 5-382	
Matrix	Groundwater/Surface Water	
Concentration Level	Low	
Sampling procedure	Groundwater/Surface Water Sampling; Oneida SOP OESC008F/OESC006D	
Data Quality Indicators	**Quality Control Sample**	**Measurement Performance Criteria**
Accuracy/Bias Contamination (Sample)	Method blank	Analytes detected in method blank must be < 3x the response measured in the field samples for any analyte
Bias Contamination (Instrument)	Instrument Blank analyzed prior to the batch sequence run to assess an instrument's cleanliness	< 3x the response of the response measures in the field samples for any analyte detected in the instrument blank.
Bias Contamination (Instrument)	System Blank analyzed during the batch sequence run to assess an instrument's cleanliness	None of the SVS, calibration curve, or positive control analytes should be detected at greater than 3:1 signal-to-noise in the instrument blanks.
Accuracy in project samples	Internal/Surrogate Standard Spikes	In negative mode analysis, at least 70% spiked internal and surrogate standards are expected to be detected. If that criterion fails, samples need to be reanalyzed. There are no labeled positive mode analytes commercially available. Therefore, this criterion is not applicable for positive mode detections.
Confidence Level Assignment	Confidence Level 1 (CL 1)	The retention time has previously been determined from the analysis of authentic reference material. The mass error of the detection is ≤ 3 mDa. The detection contains at least one logical high-energy product ion.
Confidence Level Assignment	Confidence Level 2a (CL 2a) Confidence Level 2b (CL 2b) Confidence Level 3 (CL 3) Confidence Level 4 (CL 4)	Each peak will be given a confidence level which are modified from Schymanski et al (2014)[1]

NOTES

1. Laboratory SOPs available for review upon request.

UFP-QAPP Worksheet #13 – Secondary Data Uses and Limitations

(UFP-QAPP Manual Sections 2.7) (EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

The following worksheet will be included in the installation-specific UFP-QAPP addenda and will identify data used in the generation of the installation-specific UFP-QAPP addenda.

Data Type	Data Source (Originating Organization, Report Title, and Date)	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use

UFP-QAPP Worksheet #14 & #16 – Project Tasks & Schedule

UFP-QAPP Manual Sections 2.8.2) (EPA 2106-G-05 Section 2.2.4)

A general schedule for the primary project tasks is presented below and represents the anticipated schedule for programmatic activities to be completed at the installations. The specific procedures to be completed at each installation and schedule will be provided in installation-specific UFP-QAPP addenda.

Task	Start	Finish
Project Planning and Scoping	September 26, 2023	October 2024
Fieldwork and Laboratory Analysis	June 2024	February 2025
Data Analysis and Reporting	October 2024	March 2026

14.1 PROJECT PLANNING

Initial planning included preparation of project planning documents (including this programmatic UFP-QAPP) and a programmatic kickoff meeting with the USACE and DAF project team members to discuss the overall project scope, schedule, and planning required for the sites investigated as part of this TO. The notes from the kickoff meeting are presented in Worksheet #9.

Installation-specific kickoff meetings were also held for each installation under this contract. Meeting participants were identified and meeting notes provided under separate cover; these will also be summarized in the installation-specific UFP-QAPP addenda. In-person scoping sessions also will be conducted for each installation. A Programmatic Accident Prevention Plan is provided under separate cover and site-specific safety and health plans will be prepared for each installation.

14.1.1 Permits and Notifications

The necessary installation-specific permits and notifications will be identified in the UFP-QAPP addenda. The Oneida Team and drilling subcontractors (where utilized) will participate in an orientation for field activities prior to initiating work at an installation, either in person or via telephone. All fieldwork will be coordinated with the RPM for each installation. The Oneida Team will work with installation personnel to determine and comply with right of entry requirements for off-installation property access if necessary.

Utility clearance will be conducted for soil boring and temporary well locations (if installed) following installation-specific procedures. Oneida will ensure that a thorough mark-out at each site is completed to locate electrical, gas, telephone, water, sewer, low voltage electric lines, product delivery pipelines, fiber optic, and other subsurface utilities/services. The subcontracted drillers will coordinate the necessary permitting required for drilling.

14.1.2 Pre-Field Activities

A pre-planning meeting will be held onsite at each installation with the SSHO, field team lead, and installation RPM. The onsite meeting will identify drilling locations for the utility location survey and coordinate permitting /update installation planning as needed.

The site preparation activities for the PFAS fingerprinting and background study field investigations include mobilization of field team personnel and equipment to each installation. Installation-specific access and fieldwork requirements will be coordinated with installation RPMs prior to initiating field activities.

A water source will be provided by each installation for use during drilling and initial equipment decontamination. This type of water is typically obtained from a tap or spigot on the installation, and the location will be selected in consultation with the RPM. If necessary, a sample from the water source will be tested to ensure that it is not impacted with PFAS (does not contain PFAS concentrations equal to or greater than the project screening levels (PSLs) listed in Worksheet #15). Preference will be given to a source that has previously been tested for PFAS and/or utilized in prior investigations at the installation. If this source is available, analytical results will be obtained from the RPM and results verified by the Oneida Team for acceptability. If water testing results are not available, a local water sample will be collected during investigation activities for subsequent evaluation of decontamination water during the data usability assessment. Laboratory certified PFAS-free water will be brought onsite to perform final rinse decontamination procedures on sampling equipment.

14.2 FIELD ACTIVITIES

Soil, groundwater, and surface water samples will be collected at each installation and submitted for the analyses listed in Worksheet #15. Groundwater samples may be collected from existing monitoring wells; temporary monitoring wells may also be installed and sampled as needed. Lysimeter samples may be collected on an installation-specific basis from installations with existing lysimeters. Samples will be collected at each installation in accordance with the general types and quantities specified in Worksheet #18; specific sampling plans will be presented in the installation-specific UFP-QAPP addenda. Sample methodologies will follow the Oneida field SOPs listed in Worksheet 21 and provided in Appendix A, which include methods that address the potential for false positive detections of PFAS. Proposed sample locations and fieldwork schedules will be presented in the installation-specific UFP-QAPP addenda.

14.3 INVESTIGATION-DERIVED WASTE SAMPLING

Investigation-derived waste (IDW) sampling will be completed at the conclusion of sampling activities at each installation, following procedures outlined in the Waste Management Plan (Appendix E) and as required by each installation. Specific IDW handling procedures will be documented in the installation-specific UFP-QAPP addenda. All IDW will be disposed of in accordance with Federal, State, and local regulations.

14.4 LABORATORY ANALYSIS

All samples will be submitted for laboratory analysis of the constituents and following the methods listed in Worksheet #15. Samples are analyzed for TOC and TAL metals to support PFAS fingerprinting analysis; as noted on Worksheet #15, results for these analyses will not be compared to screening criteria and will be used to support PFAS fingerprinting only. Installation-specific sampling plans will be described in the UFP-QAPP addenda.

Battelle will analyze samples for PFAS using Draft Method 1633, liquid chromatography with tandem mass spectrometry (LC/MS/MS) in accordance with DoD QSM version 5.4, Table B-24. Battelle will also analyze samples for PFAS fingerprinting using high resolution fingerprinting analysis (PFAS Signature®). Eurofins Lancaster will analyze samples for non-PFAS analytes.

Analytical Tool	Analytical Methods Included	PFAS Analytes
PFAS Signature® (Fingerprinting Study)	EPA 1633 Targeted analysis – Quantitative Analysis	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis -Qualitative	520 suspect screening analytes
	Machine Learning Analysis using Suspect screening data	520 suspect screening analytes

Analytical Tool	Analytical Methods Included	PFAS Analytes
PFAS Background Study	EPA 1633 Targeted analysis – Quantitative Analysis	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis – Semi-quantitative	520 suspect screening analytes

14.5 DATA MANAGEMENT AND DATA VALIDATION

Data management and data validation services will be provided by Synectics of Sacramento, California. Data generated by the analytical laboratory will be recorded in electronic copies and in electronic data deliverables (EDDs) after completion of sample analysis. With the exception of the IDW data, the laboratory will upload both to the Oneida database where they will undergo automated data validation. PFAS data will be validated by Synectics at 100% Stage 2B and at least 10% Stage 4, by sample delivery group. Results for at least one sample in each sample delivery group will receive Stage 4 validation. Non-PFAS data (geotechnical/geochemical) will be validated at 100% Stage 2A. Data verification and validation details are in Worksheets #34 through Worksheet #36. Data validation results will be provided 15 business days from receipt of analytical data.

Data generated during field activities will be recorded using field forms provided in Appendix D. These forms will be reviewed for completeness and accuracy by the Oneida FTL. The Oneida database contains data for (1) summarizing observations on PFAS constituents and site conditions, (2) preparing reports and graphics, and (3) transmitting data in an electronic format. Synectics will export approved data for upload to the Environmental Resources Program Information Management System (ERPIMS). PFAS Signature® data will not be uploaded to ERPIMS.

14.6 DATA ANALYSIS AND EVALUATION

Results of the PFAS Signature® analysis will be processed based on high-resolution mass spectrometric data. Suspect screening analysis and machine learning analysis are complementary analyses providing different lines of evidence. Application of a high-resolution, mass spectral suspect screening method reveals non-target PFAS precursor information, which facilitates comparison of similarities and differences among AFFF source samples and groundwater samples.

All of the samples in the source library will be processed to extract distinct analytes. The labeled samples will be further processed using supervised machine learning techniques to generate a predictive model that processes an unknown sample and predicts the source classification, based on the sample signature matches to the source library. Model predictions are supported with additional evidence from diagnostic measures, which include: (i) a confusion matrix that diagnoses predicted model classes versus known model classes, (ii) confidence levels in individual predictions, (iii) similarity metrics between different samples, (iv) hierarchical clustering, and (v) the importance of analytes in the model's decision-making process (refer to Appendix F for additional details). Site-specific information used to verify model predictions includes site history, sample locations/distance from the known source, and groundwater flow /potential PFAS migration pathways.

The data also will be evaluated considering TOC and metals results obtained for a subset of samples to understand the partitioning and transport of different PFAS analytes and potential co-mingling with non-AFFF related sources. TOC and metals data provide another line of evidence in understanding potential PFAS sources. For example, the presence of high concentrations of chromium in a sample in addition to PFOS/ 6:2 fluorotelomer sulfonate (FTS) potentially indicates a metal plating source, while the presence of high TOC may suggest a low likelihood of downgradient migration (potentially indicating that any observed downgradient PFAS impacts may be attributable to a different source or source area).

14.7 REPORTING

A PFAS Fingerprinting and Background Study Report will be generated for each installation included under this TO. The report will describe the completed field sampling, laboratory analysis, and data validation, and include figures and tables that present the findings. It will describe potential PFAS sources identified at each installation (such as AFFF releases, contributions from municipal/industrial wastes, and PFAS impacts from commercial products and metal plating operations). It will also present the preliminary upper limits of the anthropogenic background concentration for PFAS in soils at each installation. The background study will be prepared in general accordance with the EPA Guidance on conducting background studies (EPA, 2002).

UFP-QAPP Worksheet #15A – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

(UFP-QAPP Manual Sections 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Matrix: Water
Analytical Group: PFAS
Laboratory: Battelle
Method: PFAS by Third Draft Method 1633 compliant with QSM 5.4 Table B-24/SOP 5-381

Analyte	CAS	Project Screening Limit) (ng/L)[1]	Project Screening Limit Reference[2]	Practical Quantitation Limit Goal (ng/L)	Battelle Laboratory Limits		
					LOQ (ng/L)	LOD (ng/L)	DL (ng/L)
Perfluorobutanoic acid (PFBA)	375-22-4	1,800	DoD, 2024	600	6.40	1.25	0.597
Perfluoropentanoic acid (PFPeA)	2706-90-3	---	---	3.2	3.20	1.25	0.563
Perfluorohexanoic acid (PFHxA)	307-24-4	990	DoD, 2024	330	1.60	1.00	0.412
Perfluoroheptanoic acid (PFHpA)	375-85-9	---	---	1.6	1.60	0.50	0.173
Perfluorooctanoic acid (PFOA)	335-67-1	6.0	DoD, 2024	2.0	1.60	0.75	0.290
Perfluorononanoic acid (PFNA)	375-95-1	5.9	DoD, 2024	2.0	1.60	0.50	0.250
Perfluorodecanoic acid (PFDA)	335-76-2	---	---	1.6	1.60	0.50	0.223
Perfluoroundecanoic acid (PFUnA)	2058-94-8	---	---	1.6	1.60	0.50	0.203
Perfluorododecanoic acid (PFDoA)	307-55-1	---	---	1.6	1.60	0.75	0.301
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	---	---	1.6	1.60	0.75	0.363
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	---	---	1.6	1.60	1.00	0.429
Perfluorobutanesulfonic acid (PFBS)	375-73-5	600	DoD, 2024	200	1.60	0.50	0.177
Perfluoropentanesulfonic acid (PFPeS)	375-22-4	---	---	1.6	1.60	0.50	0.129
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	39	DoD, 2024	13	1.60	0.75	0.291
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	---	---	1.6	1.60	0.50	0.204
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	4.0	DoD, 2024	1.6	1.60	0.50	0.248
Perfluorornonanesulfonic acid (PFNS)	68259-12-1	---	---	1.6	1.60	0.50	0.249
Perfluorordecaanesulfonic acid (PFDS)	335-77-3	---	---	1.6	1.60	0.50	0.162

Analyte	CAS	Project Screening Limit) (ng/L)[1]	Project Screening Limit Reference[2]	Practical Quantitation Limit Goal (ng/L)	Battelle Laboratory Limits		
					LOQ (ng/L)	LOD (ng/L)	DL (ng/L)
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	---	---	1.6	1.60	0.50	0.180
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2FTS)	757124-72-4	---	---	6.4	6.40	2.75	1.32
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2FTS)	27619-97-2	---	---	6.4	6.40	3.00	1.48
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2FTS)	39108-34-4	---	---	6.4	6.40	2.00	0.916
Perfluorooctanesulfonamide (PFOSA)	754-91-6	---	---	1.6	1.60	0.50	0.188
N-methylperfluorooctanesulfonamide (NMeFOSA)	31506-32-8	---	---	1.6	1.60	0.50	0.199
N-ethylperfluorooctanesulfonamide (NEtFOSA)	4151-50-2	---	---	1.6	1.60	0.25	0.0998
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	---	---	1.6	1.60	1.50	0.655
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	---	---	1.6	1.60	1.25	0.571
N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)	24448-09-7	---	---	16	16.0	3.50	1.65
N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)	1691-99-2	---	---	16	16.0	3.00	1.45
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	1.5[3]	DoD, 2024	6.4	6.40	1.50	0.748
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	---	---	6.4	6.40	1.50	0.694
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	---	---	3.2	3.20	1.50	0.628
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	---	---	3.2	3.20	1.25	0.600
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	---	---	3.2	3.20	1.75	0.760
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	---	---	6.4	6.40	1.50	0.699
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	---	---	6.4	6.40	2.25	1.09
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	---	---	3.2	3.20	0.50	0.212
3-perfluoropropyl propanoic acid (3:3 FTCA)	356-02-5	---	---	8	8.00	3.50	1.67
2H,2H,3H,3H-perfluorooctanoic acid (5:3 FTCA)	914637-49-3	---	---	40	40.0	9.00	4.46
3-perfluoroheptyl propanoic acid (7:3 FTCA)	812-70-4	---	---	40	40.0	10.50	5.22

NOTES:

1. Project screening levels (PSLs) are provided for reference. Data will be screened against PSLs for informational purposes only.

2. Screening levels are based on residential scenario and calculated using the EPA Regional Screening Level calculator (hazard quotient = 0.1), as presented by Office of the Assistant Secretary of Defense (OASD, 2024) and updated by the DoD (DoD, 2024).

3. The LOQ does not meet the comparison criterion; however, the DL and the LOD are sufficient to meet the comparison criterion. Non-detects will be reported to the LOD.

CAS	Chemical Abstracts Service Registry Number
DL	detection limit
ng/L	nanograms per liter
LOD	limit of detection

UFP-QAPP Worksheet #15B – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: PFAS
Laboratory: Battelle
Method: PFAS by Third Draft Method 1633 compliant with QSM 5.4 Table B-24/SOP 5-381

Analyte	CAS	Project Screening Limit (µg/kg)	Project Screening Limit Reference[1]	Practical Quantitation Limit Goal (µg/kg)	Battelle Laboratory Limits		
					LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
Perfluorobutanoic acid (PFBA)	375-22-4	7,800	DoD, 2024	2,600	0.640	0.250	0.0872
Perfluoropentanoic acid (PFPeA)	2706-90-3	---	---	0.32	0.320	0.250	0.0842
Perfluorohexanoic acid (PFHxA)	307-24-4	3,200	DoD, 2024	1,100	0.160	0.150	0.0375
Perfluoroheptanoic acid (PFHpA)	375-85-9	---	---	0.16	0.160	0.150	0.0675
Perfluorooctanoic acid (PFOA)	335-67-1	19	DoD, 2024	6.3	0.160	0.100	0.0315
Perfluorononanoic acid (PFNA)	375-95-1	19	DoD, 2024	6.3	0.160	0.100	0.0459
Perfluorodecanoic acid (PFDA)	335-76-2	---	---	0.16	0.160	0.150	0.0618
Perfluoroundecanoic acid (PFUnA)	2058-94-8	---	---	0.16	0.160	0.050	0.0240
Perfluorododecanoic acid (PFDoA)	307-55-1	---	---	0.16	0.160	0.150	0.0648
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	---	---	0.16	0.160	0.100	0.0339
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	---	---	0.16	0.160	0.100	0.0408
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,900	DoD, 2024	630	0.160	0.150	0.0624
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	---	---	0.16	0.160	0.150	0.0690
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	130	DoD, 2024	43	0.160	0.0800	0.0363
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	---	---	0.16	0.160	0.100	0.0483
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	13	DoD, 2024	4.3	0.160	0.100	0.0426
Perfluorornonanesulfonic acid (PFNS)	68259-12-1	---	---	0.16	0.160	0.100	0.0495
Perfluorordecaanesulfonic acid (PFDS)	335-77-3	---	---	0.16	0.160	0.125	0.0597
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	---	---	0.16	0.160	0.100	0.0309
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2FTS)	757124-72-4	---	---	0.64	0.640	0.500	0.238

Analyte	CAS	Project Screening Limit (µg/kg)	Project Screening Limit Reference[1]	Practical Quantitation Limit Goal (µg/kg)	Battelle Laboratory Limits LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2FTS)	27619-97-2	---	---	0.64	0.640	0.500	0.193
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2FTS)	39108-34-4	---	---	0.64	0.640	0.250	0.102
Perfluorooctanesulfonamide (PFOSA)	754-91-6	---	---	0.16	0.160	0.100	0.0273
N-methylperfluorooctanesulfonamide (NMeFOSA)	31506-32-8	---	---	0.16	0.160	0.100	0.0468
N-ethylperfluorooctanesulfonamide (NEtFOSA)	4151-50-2	---	---	0.16	0.160	0.100	0.0417
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	---	---	0.16	0.160	0.100	0.0318
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	---	---	0.16	0.160	0.150	0.0510
N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)	24448-09-7	---	---	0.16	1.60	0.750	0.290
N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)	1691-99-2	---	---	0.16	1.60	0.750	0.309
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	23	DoD, 2024	7.6	0.640	0.250	0.125
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	---	---	0.64	0.640	0.250	0.110
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	---	---	0.32	0.320	0.250	0.103
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	---	---	0.32	0.320	0.250	0.0788
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	---	---	0.32	0.320	0.250	0.0911
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	---	---	0.64	0.640	0.250	0.0986
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	---	---	0.64	0.640	0.250	0.118
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	---	---	0.32	0.320	0.150	0.0378
3-perfluoropropyl propanoic acid (3:3 FTCA)	356-02-5	---	---	0.80	0.800	0.500	0.165
2H,2H,3H,3H-perfluorooctanoic acid (5:3 FTCA)	914637-49-3	---	---	4.0	4.00	1.500	0.645
3-perfluoroheptyl propanoic acid (7:3 FTCA)	812-70-4	---	---	4.0	4.00	1.500	0.741

NOTES:

1. Project screening levels are based on residential scenario and calculated using the EPA Regional Screening Level calculator (hazard quotient = 0.1), consistent with OASD, 2023 and DoD, 2024

ng/g nanograms per gram

UFP-QAPP Worksheet #15C – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Water
Analytical Group: Total Metals
Laboratory: Eurofins Lancaster Laboratories Environmental
Method: EPA Methods 6020B/7470A

Analyte	CAS	Project Screening Limit (µg/L)	Project Screening Limit Reference	Practical Quantitation Limit (µg/L)	Eurofins Lancaster Laboratory Limits		
					LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Aluminum	7429-90-5	NE	NA[1]	30	30.0	24.0	12.0
Antimony	7440-36-0	NE	NA	1	1.00	0.500	0.200
Arsenic	7440-38-2	NE	NA	2	2.00	1.70	0.680
Barium	7440-39-3	NE	NA	2	2.00	1.60	0.746
Beryllium	7440-41-7	NE	NA	0.5	0.500	0.300	0.119
Cadmium	7440-43-9	NE	NA	0.5	0.500	0.400	0.151
Calcium	7440-70-2	NE	NA	120	120	100	50.0
Chromium	7440-47-3	NE	NA	2	2.00	1.10	0.550
Cobalt	7440-48-4	NE	NA	0.5	0.500	0.400	0.156
Copper	7440-50-8	NE	NA	1.0	1.00	0.900	0.362
Iron	7439-89-6	NE	NA	50	50.0	40.0	20.0
Lead	7439-92-1	NE	NA	0.5	0.500	0.240	0.120
Magnesium	7439-95-4	NE	NA	50	50.0	32.0	16.0
Manganese	7439-96-5	NE	NA	2.0	2.00	1.90	0.950
Nickel	7440-02-0	NE	NA	1.5	1.50	0.800	0.400
Potassium	7440-09-7	NE	NA	200	200	180	65.0
Selenium	7782-49-2	NE	NA	1.0	1.00	0.600	0.278
Silver	7440-22-4	NE	NA	0.5	0.500	0.300	0.100
Sodium	7440-23-5	NE	NA	200	200	180	90.0

Analyte	CAS	Project Screening Limit (µg/L)	Project Screening Limit Reference	Practical Quantitation Limit (µg/L)	Eurofins Lancaster Laboratory Limits		
					LOQ (µg/L)	LOD (µg/L)	DL (µg/L)
Thallium	7440-28-0	NE	NA	0.5	0.500	0.300	0.130
Zinc	7440-66-6	NE	NA	15	15.0	8.00	4.00
Vanadium	7440-62-2	NE	NA	4.0	4.00	2.00	0.794
Mercury	7439-97-6	NE	NA	0.2	0.200	0.160	0.0790

NOTES:

1. Total Metals are being collected as part of the geophysical/geochemical suite to be used in the background analysis. No project screening criteria are applicable.

µg/L	micrograms per liter
NA	not applicable
NE	not established

UFP-QAPP Worksheet #15D – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: Total Metals
Laboratory: Eurofins Lancaster Laboratories Environmental
Method: EPA Methods 6020B/7471B

Analyte	CAS	Project Screening Limit (mg/kg)	Project Screening Limit Reference	Practical Quantitation Limit Goal (mg/kg)	Eurofins Lancaster Laboratory Limits		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Aluminum	7429-90-5	NA	NA[1]	10	10.0	9.90	4.95
Antimony	7440-36-0	NE	NA	0.1	0.100	0.0800	0.0400
Arsenic	7440-38-2	NE	NA	0.2	0.200	0.160	0.0670
Barium	7440-39-3	NE	NA	0.2	0.200	0.184	0.0920
Beryllium	7440-41-7	NE	NA	0.05	0.0500	0.0250	0.0120
Cadmium	7440-43-9	NE	NA	0.05	0.0500	0.0400	0.0200
Calcium	7440-70-2	NE	NA	20	20.0	19.6	9.80
Chromium	7440-47-3	NE	NA	0.2	0.200	0.190	0.0950
Cobalt	7440-48-4	NE	NA	0.1	0.100	0.0800	0.0400
Copper	7440-50-8	NE	NA	0.2	0.200	0.180	0.0900
Iron	7439-89-6	NE	NA	10	10.0	9.22	4.61
Lead	7439-92-1	NE	NA	0.1	0.100	0.0800	0.0380
Magnesium	7439-95-4	NE	NA	5	5.00	4.90	2.45
Manganese	7439-96-5	NE	NA	0.25	0.250	0.200	0.100
Nickel	7440-02-0	NE	NA	0.2	0.200	0.190	0.0950
Potassium	7440-09-7	NE	NA	20	20.0	16.0	8.00
Selenium	7782-49-2	NE	NA	0.2	0.200	0.100	0.0500
Silver	7440-22-4	NE	NA	0.05	0.0500	0.0400	0.0200
Sodium	7440-23-5	NE	NA	25	25.0	24.0	12.0

Analyte	CAS	Project Screening Limit (mg/kg)	Project Screening Limit Reference	Practical Quantitation Limit Goal (mg/kg)	Eurofins Lancaster Laboratory Limits		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Thallium	7440-28-0	NE	NA	0.05	0.0500	0.0400	0.0200
Zinc	7440-66-6	NE	NA	15	15.0	4.00	2.00
Vanadium	7440-62-2	NE	NA	0.4	0.400	0.200	0.100
Mercury	7439-97-6	NE	NA	0.06	0.0600	0.0400	0.0200

NOTES:

1. Total Metals are being collected as part of the geophysical/geochemical suite to be used in the background analysis. No project screening criteria are applicable.

mg/kg	milligram per kilogram

UFP-QAPP Worksheet #15E – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Water
Analytical Group: Total Organic Carbon
Laboratory: Eurofins Lancaster Laboratories Environmental
Method: EPA Methods 9060A

Analyte	CAS	Project Screening Limit (mg/L)	Project Screening Limit Reference	Practical Quantitation Limit Goal (mg/L)	Eurofins Lancaster Laboratory Limits		
					LOQ (mg/L)	LOD (mg/L)	DL (mg/L)
Total Organic Carbon	7440-44-0	NE	NA[1]	2.0	2.00	1.00	0.500

NOTES:

1. Total organic carbon is being collected as part of the geophysical/geochemical suite to be used in the background analysis. No project screening criteria are applicable.

mg/L	milligrams per liter

UFP-QAPP Worksheet #15F – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: Total Organic Carbon
Laboratory: Eurofins Lancaster Laboratories Environmental
Method: EPA Methods 9060A

Analyte	CAS	Project Screening Limit (mg/kg)	Project Screening Limit Reference	Practical Quantitation Limit Goal (mg/kg)	Eurofins Lancaster Laboratory Limits		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Total Organic Carbon	7440-44-0	NE	Not Applicable[1]	300	300	200	100

NOTES:

1. Total organic carbon is being collected as part of the geophysical/geochemical suite to be used in the background analysis. No project screening criteria are applicable.

UFP-QAPP Worksheet #15G – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: PFAS Signature Analysis (LC-QTOF MS)
Laboratory: Battelle
Method: LC/QTOF-MS)/SOP 5-382

Analyte	CAS	Project Screening Limit (µg/kg)	Project Screening Limit Reference	Practical Quantitation Limit Goal (µg/kg)	Battelle Laboratory Limits[2]		
					LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)
Up to 520 PFAS Compounds (SOP 5-382)[3]	Various	NE	Not Applicable[1]	N/A	N/A	N/A	N/A

NOTES:

1. LC/TOF-MS will provide qualitative and semiquantitative values. No project screening criteria are applicable.
2. Quantitation limits are not applicable to the LC/TOF-MS method. The results will be evaluated with confidence levels as described in Worksheet 12 in lieu of traditional quantitation limits.
3. Additional detail provided in Appendix F.

UFP-QAPP Worksheet #15H – Project Screening Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater/Surface Water
Analytical Group: PFAS Signature Analysis (LC/QTOF-MS)
Laboratory: Battelle
Method: LC/QTOF-MS)/SOP 5-382

Analyte	CAS	Project Screening Limit (ng/L)	Project Screening Limit Reference	Practical Quantitation Limit Goal (ng/L)	Battelle Laboratory Limits[2]		
					LOQ (ng/L)	LOD (ng/L)	DL (ng/L)
Up to 520 PFAS Compounds (SOP 5-382)[3]	Various	NE	Not Applicable[1]	N/A	N/A	N/A	N/A

NOTES:

1. LC/TOF-MS will provide qualitative and semiquantitative values. No project screening criteria are applicable.
2. Quantitation limits are not applicable to the LC/TOF-MS method. The results will be evaluated with confidence levels as described in Worksheet 12 in lieu of traditional quantitation limits.
3. Additional detail provided in Appendix F.

UFP-QAPP Worksheet #17 – Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1) (EPA 2106-G-05 Section 2.3.1)

This worksheet summarizes the general sampling design and rationale for the collection of environmental samples to support the PFAS fingerprinting and background study investigations. Installation-specific UFP-QAPP addenda will be completed prior to sampling and will provide a detailed presentation of the proposed sampling locations for each site. Surface and subsurface soil, groundwater, and surface water samples will be collected at each installation to support PFAS fingerprinting; surface soil samples will be collected at each installation to support PFAS background determination. Lysimeter samples may be collected to support PFAS fingerprinting; this determination will be made on an installation-by-installation basis and will be documented in installation-specific UFP-QAPP addenda as appropriate.

Sampling tasks are described in Worksheets #14 & 16 and will be conducted in accordance with the SOPs identified in Worksheet #21. Wherever possible, existing groundwater monitoring wells will be utilized for sampling. Temporary monitoring wells will be installed if needed to ensure adequate sampling to support the PFAS fingerprinting investigation.

The general approach to sampling design development will be as follows:

Step 1: Understand the current CSM. Review available information such as existing site/installation CSMs (including lithology, groundwater flow, etc.); historical documents; and analytical data for PFAS and supporting geochemical data. Review available environmental data for non-PFAS contaminants that might impact PFAS fate and transport. Assess if mixing of surface water and groundwater may be occurring by evaluating factors such as stream type (gaining vs. losing), recharge sources, and seasonal impacts/episodic events (at installations in arid climates, surface water features may be ephemeral).

Step 2: Evaluate AFFF and non-AFFF PFAS source areas. Work with each installation team to evaluate potential AFFF- and non-AFFF PFAS sources on-installation as well as those nearby. Common PFAS contributors include metal plating, landfills, fire training areas, crash sites, burn pits, water treatment facilities, and fire stations.

Step 3: Develop the sampling plan for the PFAS Background Study. The PFAS background studies will focus on soils only. The PFAS background studies are limited in scope and are intended to establish preliminary PFAS soil background concentrations. Data generated from the background studies will be evaluated to assess if/how they may be used to inform site understanding and may be used to begin developing a wider-scale (multi-installation) understanding of background PFAS concentrations at DoD installations.

Sample locations will be chosen in coordination with USACE/DAF and installation personnel as applicable. Soil samples will be collected from within installation boundaries in areas where no previous PFAS releases have been identified and may also be collected from along installation boundaries or off-installation. Sample locations will be selected to ensure good spatial coverage and, to the extent possible, a representative distribution of land use types. If possible, samples will not be collected from current or former environmental investigation sites. These sites have a higher likelihood of fill materials, re-worked soils, known or unknown PFAS constituents or other contaminants, and land use that is incompatible with background sampling (for instance, current or historical industrial use). Samples will be collected from 0.0-0.5 foot below ground surface (bgs) or from the depth interval that matches the surface soil interval identified in the RI sampling plans, if plans are available. If the planned number of sample locations cannot be identified, then samples may be collected from additional depth intervals at fewer locations instead (i.e., from 0.0-0.5 foot bgs and 0.5-1.0 foot bgs at a given location) to provide adequate data for the background study.

Step 4: Develop the sampling plan for the PFAS Fingerprinting study. The approach for each media is as follows:

> *Soil:* Sample locations will be targeted at known source areas within each installation and along installation boundaries. Areas with potential comingling of PFAS sources may also be targeted. Source areas will be chosen to ensure that a representative spread of different potential sources is selected for sampling. Soil samples may be collected from multiple depth intervals based on information gathered from the installation CSMs, site personnel, or other pertinent sources. Sample locations and depths (if necessary) will be chosen in coordination with the USACE/DAF and installation personnel.
>
> *Groundwater:* Inputs to the groundwater sampling plans will include locations, screen intervals, and lithology (if available) of the existing monitoring well network. The uppermost aquifer will generally be targeted for sampling. Groundwater samples will be primarily focused on the installation. Off-installation groundwater samples may be collected upgradient, side-gradient, and downgradient from installation boundaries. Drinking water wells may also be sampled on an installation-specific basis. Wherever possible, existing monitoring wells will be sampled. If these do not provide adequate vertical or horizontal coverage, then temporary monitoring wells will be installed, sampled, and abandoned in accordance with state regulations. Temporary well locations and sampling depths will be chosen in coordination with the project team and installation personnel in accordance with the scope of work. Groundwater samples will be collected using low-flow purging.
>
> *Surface Water:* Surface water samples will be collected from surface water bodies present at each installation. When sampling flowing surface water, samples will be collected in sequence from downstream to upstream to avoid introducing sediment into the samples. To the extent practicable, field events will be scheduled to coincide with times when surface water is present and flow is considered average. Surface water samples may be collected upgradient and downgradient of installation boundaries; however, it is anticipated that the bulk of surface water samples will be collected within installation boundaries. Sample locations will be chosen in coordination with the USACE/DAF and installation personnel.
>
> *Porewater:* Porewater samples may be collected at installations with existing lysimeters. Lysimeter sampling will be evaluated on an installation-by-installation basis; lysimeters located outside of PFAS soil source areas or those with limited porewater may not be candidates for sampling. All lysimeter sampling will be coordinated with the project team, installation personnel and contractors.

UFP-QAPP Worksheet #18 – Sampling Locations and Methods

(UFP-QAPP Manual Sections 3.1.1 and 3.1.2) (EPA 2106-G-05 Sections 2.3.1 and 2.3.2)

Sampling locations, sample types (PFAS background vs. fingerprinting) and sample identifying nomenclature will be presented in the installation-specific UFP-QAPP addenda. All samples will be analyzed for PFAS Signature® and PFAS using EPA Method 1633; half of all samples will also be analyzed for TOC using EPA methods 9060A and total metals using EPA methods 6020B/7471B.Sample methodologies will follow Oneida SOPs (Appendix A). Unique sample identifiers for each sample will be assigned and used for sample labels, chain of custody forms, field logbooks, and sampling field forms (Appendix D).

Required QC samples will be collected at the same time as the original samples. Samples will be placed in sample coolers with wet ice that is double bagged to maintain the samples at or less than 6 degrees Celsius (°C) and shipped overnight to Battelle Analytical Chemistry Services or Eurofins Lancaster Laboratories Environmental. If samples are not shipped the same day they are collected, the samples will be placed on ice or refrigerated in a secure area to maintain temperature and custody until shipment. QC sample quantities and types will be presented in the installation-specific UFP-QAPP addenda.

UFP-QAPP Worksheet #19 & 30 – Sample Containers, Preservation, and Hold Times

PFAS Laboratory:	Battelle Analytical Chemistry Services, 141 Longwater Drive, Suite 202, Norwell, MA 02061
Phone	781-681-5565
Contact	Franco Pala, palaf@battelle.org
Accreditations/Expiration Date:	DoD Environmental Laboratory Accreditation Program (ELAP) # 91667 Exp: 30 Apr 2025
Sample Delivery Method:	Overnight Courier Service
Non-PFAS Laboratory:	Eurofins Lancaster Laboratories Environmental
Phone	718-681-5400
Contact	Nicole Brown, Nicole.Brown@et.eurofinsus.com
Accreditations/Expiration Date:	DoD ELAP # 1.01 Exp 30 Nov 2024
Sample Delivery Method:	Overnight Courier Service

Analytical Group	Matrix	Method	Container(s) (number, size, & type per sample)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Data Package Turnaround
PFAS/Signature Analysis	Water	Draft EPA 1633 PFAS by LC/MS/MS Compliant with QSM 5.4 Table B-24 / 5-381-03	2 x 500 milliliter (mL) high density polyethylene (HDPE) bottle 1 x 125 mL HDPE bottle	Temperature must be above freezing and less than or equal to 6 °C when received at the laboratory. Samples stored in the lab at 0-6 °C or at less than or equal to 20 °C (≤ -20 °C) and protected from light until sample preparation	28 days[1] from sampling to extraction stored 0-6 °C, 90 days if stored ≤ -20 °C/ Up to 90 days from extraction to analysis if stored in the dark ≤ 0 ºC [2]	15 business days
PFAS/Signature Analysis	Soil	Draft EPA 1633 PFAS by LC/MS/MS Compliant with QSM 5.4 Table B-24 / 5-381-03	1 x 8 oz HDPE jar	Temperature must be above freezing and less than or equal to 6 °C when received at the laboratory. Samples stored in the lab at 0-6 °C or at ≤ -20 °C and protected from light until sample preparation.	Up to 90 days from sampling to extraction[3]/ Up to 90 from extraction to analysis if stored in the dark at ≤ 0 ºC [2]	15 business days

Analytical Group	Matrix	Method	Container(s) (number, size, & type per sample)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Data Package Turnaround
TOC	Solid/ Water	EPA 9060A	Glass for Solids: One 4-oz jar For Water: Five 40-mL amber VOA vials	Stored at ≤ 6ºC Stored at ≤ 6ºC, H_3PO_4 to pH < 2	28 days to analysis	15 business days
Target Analyte List (TAL) and/or RCRA Metals	Soil/ Water	6020B/7471B/ 7470A	Polyethylene, glass for Solids: One 4-oz jar For Water: Polyethylene, One 250-mL bottle	Stored at ≤ 6ºC Stored at ≤ 6ºC, HNO_3 to pH < 2	180 days (28 days for mercury)	15 business days
Volatile Organic Compounds (VOCs)	Solid/ Waters	EPA 8260D	Glass for Soils: One 4-oz. jar For Water: Three 40-mL VOA vials	Stored at ≤ 6ºC Stored at ≤ 6ºC, HCl to pH < 2	For Soil: 14 days to analysis For Water: 14 days to analysis preserved; 7 days to analysis unpreserved	15 business days
Semi-volatile Organics (SVOCs)	Solid/ Water	EPA 8270E	Glass for Solids: One 8-oz jar For Water: One 1,000-mL bottle	Stored at ≤ 6ºC	For Solids: 14 days to extraction, 40 days to analysis For Water: 7 days to extraction 40 days to analysis	15 business days
Pesticides	Solid/ Water	EPA 8081B	Glass for Solids: One 8-oz jar For Water: One 1,000-mL bottle	Stored at ≤ 6ºC	For Solids: 14 days to extraction, 40 days to analysis For Water: 7 days to extraction 40 days to analysis	15 business days
Herbicides	Solid/ Water	EPA 8151A	Glass for Solids: One 8-oz jar For Water: One 1,000-mL bottle	Stored at ≤ 6ºC	For Solids: 14 days to extraction, 40 days to analysis For Water: 7 days to extraction 40 days to analysis	15 business days

Analytical Group	Matrix	Method	Container(s) (number, size, & type per sample)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)	Data Package Turnaround
Toxicity Characteristic Leaching Procedure (TCLP) Metals	Solid	EPA 1311/ 6020B/7470A	Polyethylene or glass: One 8-oz. jar	Stored at ≤ 6ºC	180 days (28 days for mercury)	15 business days
pH	Solid/ Water	EPA 9045D/ 9040C	Polyethylene, Glass for Solids: One 2-oz. jar For Water: One 250-mL bottle	None	As soon as possible	15 business days
Ignitability	Solid	40 Code of Federal Regulations 261.21	Glass For Solids: One 4-oz jar	None	Not specified	15 business days
Ignitability	Water	EPA 1010B	Polyethylene, Glass For Water: One 250-mL bottle	<28°C, not frozen	Not specified	15 business days
Reactivity/ Cyanide	Solid/ Water	SW-846 Chapter 7, EPA 9012B	Polyethylene, Glass for Solids: One 4-oz jar For Water: One 500-mL bottle	Cool to 0-6°C For water, NaOH to pH>12	Solid: 28 days Water: 14 days	15 business days
Reactivity/ Sulfide	Solid/ Water	SW-846 Chapter 7, EPA 9034/SM 4500 S2F	Polyethylene, Glass for Solids: One 4-oz jar For Water: One 500-mL bottle	Cool to 0-6°C	Solid: 28 days Water: 7 days	15 business days

NOTES:

1- Issues were observed with certain perfluorooctane sulfonamide ethanols and perfluorooctane sulfonamidoacetic acids after 7 days if stored 0-6 °C.

2 - Stored at 0-4 °C, issues were observed for some ether sulfonates after 28 days.

3 - Samples may need to be extracted as soon as possible if NFDHA is an important analyte, preferred storage method is ≤ -20 °C.

4 – DoD ELAP certificates are found in Appendix B.

RCRA	Resource Conservation and Recovery Act
TAL	Target analyte list

UFP-QAPP Worksheet #20 – Field Quality Control Summary

(UFP-QAPP Manual Section 3.1.1 and 3.1.2) (EPA 2106-G-05 Section 2.3.5)

Matrix	Analytical Group	Concentration Level	Field Samples	Field Duplicates	MS/ MSD	Equipment Blank[2]	Total Number of Samples to Lab[1]
Groundwater	PFAS	Low/Medium	Installation specific	10%	5%	One per day per piece of equipment	Installation specific
	TOC	Unknown	Installation specific	10%	5%		Installation specific
	Total Metals	Unknown	Installation specific	10%	5%		Installation specific
Surface Water	PFAS	Low/Medium	Installation specific	10%	5%		Installation specific
	TOC	Unknown	Installation specific	10%	5%		Installation specific
	Total Metals	Unknown	Installation specific	10%	5%		Installation specific
Soil	PFAS	Low/Medium	Installation specific	10%	5%		Installation specific
	TOC	Unknown	Installation specific	10%	5%		Installation specific
	Total Metals	Unknown	Installation specific	10%	5%		Installation specific

NOTES:

1-Number of samples collected will vary by installation.

2-Equipment blanks are anticipated to be collected from rinse water for non-dedicated sampling equipment. One equipment blank per day will be collected from each piece of non-dedicated (reusable) sampling equipment.

UFP-QAPP Worksheet #21 – Field Standard Operating Procedures

(UFP-QAPP Manual Section 3.1.2) (EPA 2106-G-05 Section 2.3.2)

SOP Reference Number	SOP Owner	Title, Revision Date and/or Number	Equipment Type	Comments
OESC001A	OESC	Site Access, Dig Permits, and Utility Clearance Procedures	NA	See Note 1
OESC002A	OESC	Field Records and Documentation	NA	See Note 1
OESC005A	OESC	Field Parameter Measurements in Water	Horiba	See Note 1
OESC006B	OESC	Sampling of Surface Soils and Other Surficial Materials	NA	See Note 1
OESC006D	OESC	Surface Water Sampling	NA	See Note 1
OESC007A	OESC	Drilling Methods and Procedures	NA	See Note 1
OESC007B	OESC	Soil and Rock Geologic Logging and Classification	NA	See Note 1
OESC007C	OESC	Hand Auger Borings	NA	See Note 1
OESC007D	OESC	Subsurface Soil Sampling	NA	See Note 1
OESC007E	OESC	Direct Push Technologies	NA	See Note 1
OESC007I	OESC	Lysimeter Sampling	NA	See Note 1
OESC008D	OESC	Monitoring and Extraction Well Installation and Development	NA	See Note 1
OESC008E	OESC	Fluid Level Measurement in Wells	Manual Water Level Indicator	See Note 1
OESC008F	OESC	Monitoring Well Sampling	QED MicroPurge® bladder pump	See Note 1
OESC008I	OESC	Borehole Abandonment and Well Destruction	NA	See Note 1
OESC010C	OESC	Sampling Labeling, Control and Shipping	NA	See Note 1
OESC011A	OESC	Sampling Equipment Decontamination Procedures	NA	See Note 1
OESC011B	OESC	Calibration Procedures for Field Equipment	NA	See Note 1
OESC012A	OESC	Investigative Derived Materials Management Procedures	NA	See Note 1
Addendum No. 1 for PFAS Sampling	OESC	PFAS Sampling Instructions	NA	See Note 1

NOTES:

1. The procedures in the referenced SOP are modified by the requirements for PFAS sampling described in SOP Addendum No. 1 where applicable.

UFP-QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing and Inspection

(UFP-QAPP Manual Section 3.1.2.4) (EPA 2106-G-05 Section 2.3.6)

This worksheet provides procedures for performing testing, inspections, and QC for all field equipment. References to the applicable activity and SOPs are included. Where appropriate, the failure response will prescribe a corrective action (described in Appendix C).

Measurement Quality Objective	Activity/ SOP Reference	Frequency	Responsible Person/ Report Method Verified By	Acceptance Criteria	Failure Response
Depth to Water Probe	OESC008E	Prior to use and at the end of each day	Oneida FTL	Manufacturer's specifications	Recalibrate or replace
MicroPurge® Pump	Manufacturer's instruction manual	Prior to pump installation or if pump not functioning properly	Oneida FTL	Manufacturer's specifications	Replace rubber parts and fittings
Pump Control Box	Manufacturer's instruction manual	Prior to use	Oneida FTL	Manufacturer's specifications	Replace
Photoionization Detector	OESC011B	Prior to use, change in field conditions, and as needed	Oneida FTL	Manufacturer's specifications	Repair or replace
YSI DSS Pro1 (or equivalent)	OESC011B	Prior to use, change in field conditions, and as needed	Oneida FTL	Manufacturer's specifications	Repair or replace
Hand-held Global Positioning System Unit	Manufacturer's instruction manual	Prior to use and at the end of each day	Oneida FTL	Positional error for the Global Positioning System less than ±1 meter	Reposition, replace battery

UFP-QAPP Worksheet #23 – Analytical Standard Operating Procedures

(UFP-QAPP Manual Section 3.2.1) (EPA 2106-G-05 Section 2.3.4)

Lab SOP Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	SOP Option or Equipment Type	Modified for Project Work?
Battelle 5-381-03	Analysis of Poly and Perfluoroalkyl Substances in Aqueous, Solid, Biosolid, and Tissue Samples by Liquid Chromatography and Tandem Mass Spectrometry (LC-MS/MS) Following EPA Draft Method 1633, 5/2023, Version 3	Definitive	Extraction, non-potable water / solid PFAS	LC/MS/MS	N
Battelle 5-382	PFAS by Liquid Chromatography – Quadrupole Time-of-Flight Mass Spectrometry (LC-QTOF MS)	Screening	non-potable water / solid	LC-QTOF MS	N
Battelle 6-010-20	Sample Receipt, Custody, and Handling, 10/2018, revision 20, 6/2/2023	NA	Sample Receipt	NA	N
Battelle 5-114-11	The Storage and Disposal of Regulated and Non-Regulated Waste, 2/2021, Revision 11 (last reviewed 7/2022)	NA	Sample Disposal	NA	N
Battelle 5-291-18	Determination of Method Detection Limits in the Analytical Laboratory, 10/2021, revision 18 (last reviewed 11/2022)	NA	DL/LOD/LOQ	NA	N
ELLE WI11933	Metals by ICP/MS by Methods SW-846 6020/6020A/6020B (waters, solid, tissue) and EPA 200.8 (waters)and EPA 200.8 (aqueous), Version 13, effective 07/27/2022 (last reviewed 07.19.2023)	Definitive	Solid, liquid, tissues Metals	ICP/MS	N
ELLE WI8639	Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP/MS, Version 28, effective 07/11/2023	NA	Liquid Inorganic Preparation SW-846 3005A	NA	N
ELLE WI21590	Instrument Maintenance for Agilent 7900, Version 2, effective 02/21/2021 (Last reviewed 04.20.2023)	NA	Maintenance	NA	N

Lab SOP Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	SOP Option or Equipment Type	Modified for Project Work?
ELLE WI7965	Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA, Version 21, effective 4/30/2023	Definitive	Solid, liquid, tissues Metals	CVAA	N
ELLE WI11924	Digestion of Aqueous Samples by SW-846 Method 7470A, Version 23, effective 05/20/2022	NA	Liquid Inorganic Preparation	NA	N
ELLE WI11948	Preparation of Solids by EPA 7471A or B for Mercury Analysis, Version 23, effective 07/26/2023	NA	Solid, tissue, and oil Inorganic Preparation	NA	N
ELLE WI10038	Total Organic Carbon in Water by SW-846 9060/9060A (Quadruplicate Studies), Version 14, effective 07/13/2023	Definitive	Water	TOC Analyzer	N
ELLE WI11627	TOC and TC in Solids and Sludges by Combustion by SM 5310B, EPA 415.1, SW-846 9060/9060A, Lloyd Kahn, Version 18, effective 11/04/2022	Definitive	Solid, Instrumental Wet Chemistry	TOC Analyzer	N
ELLE SOP11880	Laboratory Support Equipment - Calibrations, Verifications, and Maintenance, Version 15, effective 08/04/2023	NA	Maintenance	Balance	N

NOTES:

1 - Laboratory SOPs contain proprietary information and are provided for review upon request.

ELLE	Eurofins Lancaster Laboratories Environmental
CVAA	cold vapor atomic absorption
ICP	inductively coupled plasma

UFP-QAPP Worksheet #24 – Analytical Instrument Calibration

(UFP-QAPP Manual Section 3.2.2) (EPA 2106-G-05 Section 2.3.6)

The calibration procedures, criteria, and corrective actions specified in this worksheet are in compliance with Table B-24 of the DoD QSM Version 5.4. The analytical SOPs referenced below are available for review upon request. Methods represent those currently certified by the laboratory and may undergo revision during periodic UFP-QAPP review. UFP-QAPP revisions will be submitted for approval.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
LC/MS/MS	Mass Calibration	Instrument must have a valid mass calibration before any sample analysis, performed annually at a minimum.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer.	Consult manufacturer instructions on corrective maintenance. Analysis may not proceed without passing Mass Calibration. Flagging is not appropriate.	Analyst/ Laboratory PM	SOP 5-381
LC/MS/MS	Mass Calibration Verification	Mass calibration is verified after each mass calibration, before ICAL.	Check the instrument mass resolution to ensure that it is at least unit resolution. Check the mass calibration by measuring the amount of peak drift from the expected masses. If the peak apex has shifted more than approximately 0.2 Da, then the instrument will need to be recalibrated following the manufacturer's instructions.	If the peak apex has shifted more than approximately 0.2 Da, then the instrument will need to be recalibrated following the manufacturer's instructions.	Analyst/ Laboratory PM	SOP 5-381
LC/MS/MS	ICAL	At instrument set-up, whenever laboratory takes action that changes the chromatographic conditions, if either the calibration verification, ICV, or ISC acceptance criteria have not been met.	Performed with a minimum of six calibration points, including native PFAS, EIS, and NIS compounds. Peak S/N ratio ≥ 3:1, S/N ≥ 10:1 for analytes that do not have a suitable confirmatory transition ion. The RSD of the response factors for each native PFAS and EIS compound must be ≤ 20%.	Correct problem, then repeat ICAL	Analyst/ Laboratory PM	SOP 5-381

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
LC/MS/MS	Ion Transitions (Precursor -> Product)	Every field sample, standard, blank, and QC sample	In addition to the requirements of EPA Draft 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 EPA Draft Method 1633 unless interferences render the product ion unusable as the quantification ion. 2) In cases where interferences render the product ion unusable as the quantification ion, project approval is required before using the alternative product ion.	NA	Analyst/ Laboratory PM	SOP 5-381
LC/MS/MS	Instrument sensitivity check (ISC)	Daily. At the beginning of each analytical sequence, prior to sample analysis.	All analyte concentrations must be within ±30% of their true values. Analyte concentrations must be at LOQ.	Correct problem, rerun Instrument Sensitivity Check. If problem persists, repeat ICAL.	Analyst/ Laboratory PM	SOP 5-381
LC/MS/MS	Initial Calibration Verification (ICV or ICC)	After each ICAL, prior to sample analysis.	Analyte concentrations must be within ±30% of their true value. Must be made from a second source standard.	Correct problem, rerun ICV. If problem persists, repeat ICAL.	Analyst/ Laboratory PM	SOP 5-381

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
LC/MS/MS	Calibration Verification (CV or CCV)	Analysis of mid-level calibration solution. After a passing ISC, at the beginning of each analytical sequence, after every 10 samples, and at the end of the analytical sequence.	Recovery of native compounds must be within ±30 % of their true value. If the analyte failed high and was not detected in the bracketed samples, reanalysis is not needed.	Run a new CCV, if the CCV passes, reanalyze the sample extracts bracketed by the CCV with exceedances and report the data. If the CCV continues to fail, recalibrate, then reanalyze all associated samples since the last acceptable CCV.	Analyst/ Laboratory PM	SOP 5-381
LC/MS/MS	Retention Time Window	Every field sample, standard, blank, and QC sample for each analyte and EIS.	Retention time of each analyte and EIS analyte must fall within 0.4 minute of the predicted retention times from the daily calibration verification or, on days when ICAL is performed, from the midpoint standard of the ICAL or initial daily CCV. All branched isomer peaks identified in either the calibration standard or the qualitative (technical grade) standard must fall within the retention time window for that analyte.	NA	Analyst/ Laboratory PM	SOP 5-381
LC/MS/MS	Retention Time Window (EIS RRT)	Each analyte that has a labeled EIS analog.	Analytes must elute within 0.1 minute of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples	Analyst/ Laboratory PM	SOP 5-381

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
LC/MS/MS	Bile Salt Interference Check	Daily, prior to the analysis of all matrix types (aqueous, solid, tissue, and AFFF)	Retention time of bile salt (TDCA) must fall at least one minute outside the RT window of the branched and linear isomers of PFOS	If this requirement is not met, the chromatographic conditions must be adjusted to meet the requirement and the initial calibration must be repeated before any field sample are analyzed.	Analyst/Laboratory PM	SOP 5-381
LC-QTOF MS	Mass Calibration	Instrument must have a valid mass calibration before any sample analysis, performed annually at a minimum.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer.	Consult manufacturer instructions on corrective maintenance. Analysis may not proceed without passing Mass Calibration. Flagging is not appropriate.	Analyst/ Laboratory PM	SOP 5-382

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
LC-QTOF MS	SVS	Before and after samples, and during the run sequence with no more than 15 injections separating SVSs	Target analytes detected with precursor ion mass accuracy ≤ 5 millidaltons (mDa) and at least one expected/ theoretical product ion. Additional Negative Polarity Criteria i.The chromatographic peak width at half height for PFOS is less than 0.1 min. ii.The mass resolution of PFOS is greater than 20,000. iii. The following pairs of analytes demonstrate at least partial chromatographic resolution: 4:2 FTS from PFHxA, 6:2 FTS from PFOA, L-PFDS from N-EtFOSAA. iv. Detection of PFBA indicates acceptable system sensitivity. Additional Positive Polarity Criteria. i.The chromatographic peak width at half height for n-2 FtSaB C6 is less than 0.1 min ii.The mass resolution of n-2 FtSaB C6 is greater than 20,000. iii. N-TAmP FASA C6 and PFASAAm C6 demonstrate at least partial chromatographic separation. iv. Detection of N-TAmP FASA C6 indicates acceptable system sensitivity.	Criteria not met, notified appropriate project lead and results assessed for potential impact. Appropriate corrective action will be determined in consultation with the project lead.	Analyst/ Laboratory PM	SOP 5-382
ICP/MS	Tuning	Daily	No AMU difference of >0.1 AMU. Peak Width < 0.9 AMU at 10% height. %RSD < 5 for masses used for tuning.	Perform mass calibration for AMU. Adjust mass calibration for peak width	ELLE Analyst	WI11933

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
ICP/MS	Initial Calibration consists of Blank and 1 point	Each new run	Passing ICV and ICB	Recalibrate, perform instrument maintenance if calibration cannot conform to criteria, recalibrate	ELLE Analyst	WI11933
ICP/MS	ICV	After each calibration	±10% of true value	Reanalyze	ELLE Analyst	WI11933
ICP/MS	ICB	Immediately after the ICV	No analytes > LOD	Reanalyze	ELLE Analyst	WI11933
ICP/MS	CCV	Immediately after the ICSAB and every 10 samples	±10% of true value	Reanalyze	ELLE Analyst	WI11933
ICP/MS	CCB	Immediately after the CCV and every 10 samples	No analytes > LOD	Reanalyze	ELLE Analyst	WI11933
ICP/MS	Interference Check Sample-A	At the beginning of each run immediately following the LLC	Absolute value of concentration for all non-spiked project analytes <1/2 LOQ	Recalibrate	ELLE Analyst	WI11933
ICP/MS	Interference Check Sample-AB	At the beginning of each run immediately following the LLC	± 20% of the true value for each analyte	Recalibrate	ELLE Analyst	WI11933
ICP/MS	Low Level Check (LLC)	Beginning of each sequence and before the interference check samples	± 20% True Value	Reanalyze the sample	ELLE Analyst	WI11933
ICP/MS	Linear Dynamic Range (LDR) Check	Quarterly	±10% of true value	Samples > 90% of the linear range must be reanalyzed as a dilution	ELLE Analyst	WI11933
CVAA	Initial Calibration consists of a Blank and 5 points ranging from 0.2 ppb to 5 ppb	Each new run	Correlation coefficient (r) >0.995	Recalibrate, perform instrument maintenance if calibration cannot conform to criteria, recalibrate	ELLE Analyst	WI7965

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
CVAA	ICV	After each calibration	±10% of true value	Reanalyze	ELLE Analyst	WI7965
CVAA	ICB	Immediately after the ICV	No analytes > LOD	Reanalyze	ELLE Analyst	WI7965
CVAA	CCV	Immediately after the CRA and every 10 samples	±10% of true value	Reanalyze	ELLE Analyst	WI7965
CVAA	CCB	Immediately after the CCV and at a frequency of every 10 samples	No analytes > LOD	Reanalyze	ELLE Analyst	WI7965
CVAA	Low level Check (CRA)	Immediately after the ICB	± 20% True Value	Reanalyze	ELLE Analyst	WI7965
TOC Analyzer - Soil	Initial calibration with a minimum 4 points	Monthly or after continuing calibration fails	r^2 ≥0.995. %Relative Error for low and mid-point calibration standards must meet lab criteria	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI11627
TOC Analyzer - Water	Initial calibration with a minimum 6 points	Monthly or after continuing calibration fails	r^2 ≥0.995.	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI10038
TOC Analyzer	ICB Standard	After each initial calibration	No analytes detected > 1/2 RL	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI11627 WI10038
TOC Analyzer	ICV Standard	After each initial calibration	Laboratory Acceptance Criteria	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.	ELLE Analyst	WI11627 WI10038
TOC Analyzer - Water	Total Inorganic Check Standard	Daily	Laboratory Acceptance Criteria	All affected samples are reanalyzed	ELLE Analyst	WI10038

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Personnel Responsible	SOP Reference
TOC Analyzer	CCV Standard	After every 10 analyses, and at the end of the sequence	Manufacturer acceptance limits	All affected samples are reanalyzed	ELLE Analyst	WI11627 WI10038
TOC Analyzer	CCB Standard	After every 10 analyses, and at the end of the sequence	No analytes detected > RL	All affected samples are reanalyzed	ELLE Analyst	WI11627 WI10038

NOTES:

ICC	initial calibration check
ICSAB	interference check standard AB
r^2	coefficient of determination
TDCA	Taurodeoxycholic Acid

UFP-QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing and Inspection

(UFP-QAPP Manual Section 3.2.3) (EPA 2106-G-05 Section 2.3.6)

The analytical SOPs referenced below are available for review upon request. Methods represent those currently certified by the laboratory and may undergo revision during periodic UFP-QAPP review. QAPP revisions will be submitted for approval.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LC/MS/MS	Preventative Maintenance	PFAS	NA	6 Months	NA	NA	Analyst / supervisor	3-200-03
LC/MS/MS	Clean Curtain Plate	PFAS	Visual inspection of curtain plate for residue.	As needed when curtain plate has visible residue present	No visible residue on curtain plate	NA	Analyst / supervisor	3-200-03
LC/MS/MS	Replace analytical column	PFAS	Review peak shape, retention times, and peak separation on ICAL, ICC, and CCV samples.	Performed when chromatography deteriorates	Acceptable initial calibration	NA	Analyst / supervisor	3-200-03
LC-QTOF	Preventative Maintenance (seal/gasket from LC pump, needle from autosampler)	PFAS	NA	As needed, minimally annually	NA	Refer to manufacturer's instruction manual	Analyst / supervisor	KAC-DCAL.IV-057-00
LC-QTOF	Replace analytical column	PFAS	Review peak shape, retention times, and peak separation	Performed when chromatography deteriorates	Acceptable initial SVS	Refer to manufacturer's instruction manual	Analyst / supervisor	5-382-02

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Mass Spectrometer (MS)	Preventative Maintenance (cleaning of source, changing pump oil,	PFAS	NA	As needed, minimally annually	NA	Refer to manufacturer's instruction manual	Analyst / supervisor	5-382-02 / KAC.I-011-04
LC-QTOF MS	Clean/replace probes/tips or other ion source/optic parts	PFAS	Reduced sensitivity	When sensitivity decreases to unacceptable levels.	Improved sensitivity	Refer to manufacturer's instruction manual	Analyst / supervisor	5-382-02
Agilent 7900 ICP/MS	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/ calibration checks every 10 injections	90-110% for the calibration checks	Recalibration	ELLE Analyst	WI21590
Leeman Labs Hydra II Mercury Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/ calibration checks every 10 injections	90-110% for the calibration checks	Recalibration	ELLE Analyst	WI7965
TOC Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	Manufacturer acceptance limits	Recalibration	ELLE Analyst	WI11627

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Analytical balance	Assure the balance is in a vibration-free area, is level, and the interior housing is clean.	Verification with ASTM certified weights	Visual inspection and weight verification	Each day of use	The reading must be ±0.1% or ±0.5mg, whichever is greater.	1) verify cleanliness of weights 2) remove balance from service and place a call to service firm 3) management must evaluate data generated since last acceptable reading to determine any potential impacts to data quality	ELLE analyst	SOP11880
Balance	Verification	Weight	NA	Daily	+/- 0.02 gram or +/- 0.1% of calibration weight used (whichever is greater)	Refer to manufacturer's instruction manual	Analyst / supervisor	3-160-09
Balance	Calibration	Weight	NA	Annually	Per manufacturer	Remove from service, repair, replace	Analyst / supervisor	3-160-09
Pipette	Verification	Volume	NA	Daily	+/- 2% difference from true value, ≤ 1% relative standard deviation (n=3)	Remove from service, repair, replace	Analyst / supervisor	3-181-09
Pipette	Calibration	Volume	NA	Quarterly	Per manufacturer	Remove from service, repair, replace	Analyst / supervisor	3-181-09

UFP-QAPP Worksheet #26 & 27 – Sample Handling System, Custody, and Disposal

(UFP-QAPP Manual Section 3.3) (EPA 2106-G-05 Section 2.3.3)

Sampling Organization	Oneida Team
Laboratory	Battelle Analytical; Eurofins Lancaster
Method of sample delivery (shipper/carrier)	Overnight/FedEx or UPS
Number of days from reporting until sample disposal:	60 days

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	Oneida Team - FTL	OESC010C
Chain-of-custody form completion	Oneida Team - FTL	OESC010C
Sample packing and packaging	Oneida Team - FTL	OESC010C
Shipping coordination	Oneida Team - FTL	OESC010C
Sample receipt, inspection, and log-in	Eurofins, Battelle Analytical – Laboratory Sample Custodians	Battelle: 6-010-19 Eurofins: 10725, 10723
Sample custody and storage	Eurofins, Battelle Analytical – Laboratory Sample Custodians	Battelle: 6-010-19 Eurofins: 12042, 10725
Sample disposal	Eurofins, Battelle Analytical – Laboratory Sample Custodians	Battelle: 5-114-11 Eurofins: 12042

Sample Number

All samples submitted to an analytical laboratory will be uniquely numbered. The sample number will be recorded on the field forms, labels, and chain-of-custody form when the sample is collected. Specific sample nomenclature will be presented in Worksheet #18 of each installation-specific Addendum and will adhere to the formats described below.

Parent Samples

Unless otherwise required by the individual installation, soil sample designation will adhere to the following format: *XX-SBYY-ZZ-MMYY,* where *XX* indicates the abbreviation for the installation name, *SB* indicates soil boring, *YY* represents the next sequential number, *ZZ* represents either BG (background) or FP (fingerprint) sample, and *MMYY* indicates the date of sample collection.

Unless otherwise required by the individual installation, groundwater samples from existing monitoring wells will generally adhere to the following format: *XX-WWWW-MMYY,* where *XX* indicates the abbreviation for the installation name, *WWWW* is the name of the well, and *MMYY* is the date of sample collection. Lysimeter samples, if collected, will follow a similar format. This nomenclature may change slightly based on pre-existing naming conventions at individual installations; any such changes will be documented in the installation-specific UFP-QAPP addenda.

Unless otherwise required by the individual installation, groundwater boring and grab sample designations will adhere to the following format: *XX-TMWYY-MMYY*, where *XX* indicates the abbreviation for the installation name, *TMW* indicates temporary monitoring well, *YY* represents the next sequential number, and *MMYY* represents the date of sample collection.

Unless otherwise required by the individual installation surface water sample designations will adhere to the following format: *XX*-SW*YY-MMYY*, where *XX* represents indicates the abbreviation for the installation name, SW indicates surface water, *YY* represents the next sequential number, and *MMYY* represents the date of sample collection.

Field QC Samples

Field QC samples will be named using the following convention: *XX(QC type)YY-MMYY*, where *XX* indicates the site name, *QC* type will indicate either TB, FB, or EB, and *YY* represents the next sequential number. Field duplicates will be identified with the site name, "FD" and sequential number. The original sample corresponding to each field duplicate will be noted on the field forms or in a field logbook.

UFP-QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix	Soil/Water
Analytical Group	PFAS
Analytical Method / SOP	PFAS by Third Draft Method 1633 compliant with Table B-24/SOP 5-381

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
Ion Ratio	All Samples	Recalculated for each calibration. Expected Ion Ratio set for all analytes with two transitions, using the weighted average of the calibration curve or the L4 of the calibration curve[1]. Ion ratio for peak not to exceed 50% of expected ratio.	If acceptance criteria are not met, reanalyze a fresh aliquot of extract. If reanalysis passes, report reanalysis. If reanalysis confirms original result, report original result and "I" qualify the result. Document exceedance in the case narrative.	Analyst/ Laboratory PM	Laboratory Accuracy	Ion ratio for peak not to exceed 50% of expected ratio.

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[1] Sciex MultiQuant uses the average of the calibration curve's ion ratios; Sciex-OS programmed to use the ion ratio of the L4 of the calibration curve.

Matrix	Soil/Water
Analytical Group	PFAS
Analytical Method / SOP	PFAS by Third Draft Method 1633 compliant with Table B-24/SOP 5-381

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
Instrument Blanks	Immediately following the highest standard analyzed; daily before sample analysis; and immediately following samples with PFAS concentrations exceeding the quantification range.	Each analyte <1/2 LOQ Instrument Blank must contain EIS and NIS.	If acceptance criteria not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed. Flag results only if samples cannot be reanalyzed.	Analyst, Supervisor, QA Manager	Bias/ contamination	No analytes detected > 1/2 LOQ
Method Blank	1 per extraction batch of no more than 20 samples.	Each analyte <1/2 LOQ or <1/10th the amount measured in field samples or < 1/10 the amount measured in any sample, or < 1/10 the regulatory limit whichever is greater.	Correct problem. If required, re-extract and reanalyze method blank and all QC samples and field samples processed with the contamination blank. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective actions associated with QC samples. If continued retesting results in repeated blank contamination, the laboratory must document and report the failures. Contact the client for additional measures that need to be taken.	Analyst, Supervisor, QA Manager	Absence of interference/ contamination	< 1/2 LOQ or <1/10 the amount measured in field samples, or <1/10 the regulatory limit, whichever is greater

Matrix	Soil/Water
Analytical Group	PFAS
Analytical Method / SOP	PFAS by Third Draft Method 1633 compliant with Table B-24/SOP 5-381

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
LCS	2 per extraction batch of no more than 20 samples	Within statistically derived laboratory limits (Table 28-1)	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: Biased high, samples ND – report with qualifications. Biased low –re-extracted and reanalyzed. Insufficient volume – qualify and document.	Analyst, Supervisor, QA Manager	Laboratory Accuracy/ Method bias in ideal matrix	Meet laboratory derived limits (Table 28-1)
MS/MSD	1 per 20 samples or one for each extraction batch	Within LCS criteria, RSD ≤ 30	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to LCS as measure of method performance in clean matrix. The Project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or to re-extract and re-analyze the sample.	Analyst, Supervisor, QA Manager	Precision and Accuracy in field samples	Within LCS criteria, RSD ≤ 30
NIS	All Samples	Peak area ≥ 30% of average peak area from the ICAL	If peak areas are unacceptable, analyze a second aliquot. If second analysis meets criteria, report it. Insufficient volume – qualify and document.	Analyst, Supervisor, QA Manager	Laboratory Accuracy	Area ≥ 30% of average peak area from the ICAL

Matrix	Soil/Water
Analytical Group	PFAS
Analytical Method / SOP	PFAS by Third Draft Method 1633 compliant with Table B-24/SOP 5-381

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
EIS	All Samples	Within statistically derived laboratory limits (Table 28-1)	If failure is due to instrument performance issues, the problem must be identified, corrected, and the sample must be re-analyzed. If no instrument problem is found and if matrix interference is suspected or if the data is not impacted by the variance the data is qualified and reported. Sample may be re-analyzed depending on the severity of issue and backup availability.	Analyst/ Laboratory PM	Laboratory Accuracy in field samples	Within statistically derived laboratory limits (Table 28-1)

Table 28-1a. Laboratory Derived QC Acceptance Limits for PFAS in Non-Potable Water (per 1633 Draft Method 4, Tables 5 and 6)

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
Perfluorobutanoic acid (PFBA)	375-22-4	Target	70	140	30
Perfluoropentanoic acid (PFPeA)	2706-90-3	Target	65	135	30
Perfluorohexanoic acid (PFHxA)	307-24-4	Target	70	145	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	Target	70	150	30
Perfluorooctanoic acid (PFOA)	335-67-1	Target	70	150	30
Perfluorononanoic acid (PFNA)	375-95-1	Target	70	150	30
Perfluorodecanoic acid (PFDA)	335-76-2	Target	70	140	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	Target	70	145	30
Perfluorododecanoic acid (PFDoA)	307-55-1	Target	70	140	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	Target	65	140	30

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	Target	60	140	30
Perfluorobutanesulfonic acid (PFBS)	375-73-5	Target	65	145	30
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	Target	65	140	30
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	Target	65	145	30
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	Target	70	150	30
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	Target	55	150	30
Perfluorornonanesulfonic acid (PFNS)	68259-12-1	Target	65	145	30
Perfluorordecaanesulfonic acid (PFDS)	335-77-3	Target	60	145	30
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	Target	50	145	30
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2FTS)	757124-72-4	Target	70	145	30
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2FTS)	27619-97-2	Target	65	155	30
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2FTS)	39108-34-4	Target	60	150	30
Perfluorooctanesulfonamide (PFOSA)	754-91-6	Target	70	145	30
N-methylperfluorooctanesulfonamide (NMeFOSA)	31506-32-8	Target	60	150	30
N-ethylperfluorooctanesulfonamide (NEtFOSA)	4151-50-2	Target	65	145	30
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	Target	50	140	30
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	Target	70	145	30
N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)	24448-09-7	Target	70	145	30
N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)	1691-99-2	Target	70	135	30
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	Target	70	140	30
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	Target	65	145	30
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	Target	55	140	30
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	Target	60	150	30
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	Target	50	150	30

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	Target	70	155	30
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	Target	55	160	30
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	Target	70	140	30
3-perfluoropropyl propanoic acid (3:3 FTCA)	356-02-5	Target	65	135	30
2H,2H,3H,3H-perfluorooctanoic acid (5:3 FTCA)	914637-49-3	Target	70	135	30
3-perfluoroheptyl propanoic acid (7:3 FTCA)	812-70-4	Target	50	145	30
13C4-PFBA	NA	EIS	5 (10)[1]	130	NA
13C5-PFPeA	NA	EIS	40	130	NA
13C5-PFHxA	NA	EIS	40	130	NA
13C4-PFHpA	NA	EIS	40	130	NA
13C8-PFOA	NA	EIS	40	130	NA
13C9-PFNA	NA	EIS	40	130	NA
13C6-PFDA	NA	EIS	40	130	NA
13C7-PFUnA	NA	EIS	30	13	NA
13C2-PFDoA	NA	EIS	10	130	NA
13C2-PFTeDA	NA	EIS	10	130	NA
13C3-PFBS	NA	EIS	40	135	NA
13C3-PFHxS	NA	EIS	40	130	NA
13C8-PFOS	NA	EIS	40	130	NA
13C2-4:2FTS	NA	EIS	40	200	NA
13C2-6:2FTS	NA	EIS	40	200	NA
13C2-8:2FTS	NA	EIS	40	300	NA
13C8-PFOSA	NA	EIS	40	130	NA
d3-MeFOSA	NA	EIS	10	130	NA

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
d5-EtFOSA	NA	EIS	10	130	NA
d3-MeFOSAA	NA	EIS	40	170	NA
d5-EtFOSAA	NA	EIS	25	135	NA
d7-MeFOSE	NA	EIS	10	130	NA
d9-EtFOSE	NA	EIS	10	130	NA
13C3-HFPO-DA	NA	EIS	40	130	NA

NOTES:

1 - Recovery of 13C4-PFBA can be problematic in some field samples. Although the lower limit for recovery is set below 10%, laboratories should routinely track recovery and take reasonable steps to ensure recovery is at least 10% in the majority of samples.

Table 28-1b. Laboratory Derived QC Acceptance Limits for PFAS in Solids

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
Perfluorobutanoic acid (PFBA)	375-22-4	Target	70	140	30
Perfluoropentanoic acid (PFPeA)	2706-90-3	Target	60	50	30
Perfluorohexanoic acid (PFHxA)	307-24-4	Target	65	140	30
Perfluoroheptanoic acid (PFHpA)	375-85-9	Target	70	150	30
Perfluorooctanoic acid (PFOA)	335-67-1	Target	70	150	30
Perfluorononanoic acid (PFNA)	375-95-1	Target	70	155	30
Perfluorodecanoic acid (PFDA)	335-76-2	Target	70	155	30
Perfluoroundecanoic acid (PFUnA)	2058-94-8	Target	70	155	30
Perfluorododecanoic acid (PFDoA)	307-55-1	Target	70	150	30
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	Target	65	150	30
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	Target	65	150	30

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
Perfluorobutanesulfonic acid (PFBS)	375-73-5	Target	65	145	30
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	Target	55	160	30
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	Target	60	150	30
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	Target	656	155	30
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	Target	65	160	30
Perfluorornonanesulfonic acid (PFNS)	68259-12-1	Target	55	140	30
Perfluorordecaanesulfonic acid (PFDS)	335-77-3	Target	40	155	30
Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	Target	25	160	30
1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2FTS)	757124-72-4	Target	60	150	30
1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2FTS)	27619-97-2	Target	55	200	30
1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2FTS)	39108-34-4	Target	70	150	30
Perfluorooctanesulfonamide (PFOSA)	754-91-6	Target	70	140	30
N-methylperfluorooctanesulfonamide (NMeFOSA)	31506-32-8	Target	70	155	30
N-ethylperfluorooctanesulfonamide (NEtFOSA)	4151-50-2	Target	70	140	30
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	Target	65	155	30
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	Target	65	165	30
N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)	24448-09-7	Target	70	140	30
N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)	1691-99-2	Target	70	135	30
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	Target	70	145	30
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	Target	70	160	30
Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	Target	30	140	30
Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	Target	60	150	30
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	Target	60	155	30
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1	Target	70	150	30

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	763051-92-9	Target	45	160	30
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	Target	70	140	30
3-perfluoropropyl propanoic acid (3:3 FTCA)	356-02-5	Target	45	130	30
2H,2H,3H,3H-perfluorooctanoic acid (5:3 FTCA)	914637-49-3	Target	60	130	30
3-perfluoroheptyl propanoic acid (7:3 FTCA)	812-70-4	Target	60	150	30
13C4-PFBA	NA	EIS	8 (10)[1]	130	NA
13C5-PFPeA	NA	EIS	35	130	NA
13C5-PFHxA	NA	EIS	40	130	NA
13C4-PFHpA	NA	EIS	40	130	NA
13C8-PFOA	NA	EIS	40	130	NA
13C9-PFNA	NA	EIS	40	130	NA
13C6-PFDA	NA	EIS	40	130	NA
13C7-PFUnA	NA	EIS	40	130	NA
13C2-PFDoA	NA	EIS	40	130	NA
13C2-PFTeDA	NA	EIS	20	130	NA
13C3-PFBS	NA	EIS	40	135	NA
13C3-PFHxS	NA	EIS	40	130	NA
13C8-PFOS	NA	EIS	40	130	NA
13C2-4:2FTS	NA	EIS	40	165	NA
13C2-6:2FTS	NA	EIS	40	215	NA
13C2-8:2FTS	NA	EIS	40	275	NA
13C8-PFOSA	NA	EIS	40	130	NA
d3-MeFOSA	NA	EIS	40	135	NA
d5-EtFOSA	NA	EIS	40	150	NA

Analyte	CAS Number	Type	Lower Control Limit (%)	Upper Control Limit (%)	RPD
d3-MeFOSAA	NA	EIS	40	135	NA
d5-EtFOSAA	NA	EIS	40	150	NA
d7-MeFOSE	NA	EIS	20	130	NA
d9-EtFOSE	NA	EIS	15	130	NA
13C3-HFPO-DA	NA	EIS	40	130	NA

1 - Recovery of 13C4-PFBA can be problematic in some field samples. Although the lower limit for recovery is set below 10%, laboratories should routinely track recovery and take reasonable steps to ensure recovery is at least 10% in the majority of samples.

Matrix	Soil/Water
Analytical Group	Total Organic Carbon
Analytical Method / SOP	EPA 9060A / WI10038

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected > 1/2 LOQ or >1/10th the amount measured in any sample	Reanalyze the blank to confirm detections. If detects confirm, reprep samples that are not ND or not >10x the blank value.	ELLE Analyst	Accuracy/ Laboratory Contamination	No analytes detected > 1/2 LOQ or >1/10th the amount measured in any sample
MS/MSD	1 per 10 samples (batch not to exceed 20 samples)	Laboratory statistical limits for compounds and RPD	Flag outliers	ELLE Analyst	Accuracy/ Bias/Precision	Results within acceptance limits
LCS/LCSD	1 per prep batch of up to 20 samples	Laboratory statistical limits for compounds and RPD	Correct problem, reprepare and reanalyze the LCS and all sample associated	ELLE Analyst	Accuracy/ Bias/Precision	Results within acceptance limits
Quadruplicate	1 per 20 samples	Laboratory statistical limits for RPD	Flag data	ELLE Analyst	Precision	Results within acceptance limits

Matrix	Solid/Water
Analytical Group	Total Metals
Analytical Method / SOP	EPA 6020B and 7471B / ELLE WI11933 and WI7965

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
Method Blank	1 per extraction batch of no more than 20 samples.	Each analyte <1/2 LOQ or >1/10th the amount measured in field samples	Reanalyze the blank to confirm detections. If detects confirm, redigest samples that are not ND or not >10x the blank value.	ELLE Analyst	Absence of interference/ contamination	1/2 LOQ or >1/10th the amount measured in field samples
LCS/LCSD	1 per prep batch of up to 20 samples	Recovery limits per QSM 5.4. RPD ≤20%	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-digested and reanalyzed.	ELLE Analyst	Accuracy/Bias/Precision	Results within acceptance limits
MS/MSD	1 per prep batch of up to 20 samples	Recovery limits per QSM 5.4. RPD ≤20%	Flag outliers	ELLE Analyst	Accuracy/Bias/Precision	Results within acceptance limits
Matrix Duplicate	1 per prep batch of up to 20 samples	RPD must be ≤20%	Flag data	ELLE Analyst	Precision	Results within acceptance limits
Serial Dilutions (6020B only)	Must be prepared with each background sample, evaluated only when analyte concentrations are >50x the LOQ	The percent difference must be ≤10%	Flag data	ELLE Analyst	Precision	Results within acceptance limits
Post Digestion Spike (PDS)	One per prep batch if MS/MSD fails	± 20% of True Value	None, unless required by project	ELLE Analyst	Accuracy/Bias	Results within acceptance criteria. Report PDS in data package
Internal Standard (6020B only)	Every sample and QC	Must be 30%-120% of the calibration blank	Reanalyze at a dilution	ELLE Analyst	Precision	Results within acceptance criteria

Matrix	Solid/Water
Analytical Group	PFAS
Analytical Method / SOP	PFAS by LC-QTOF MS/SOP 5-382

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
Instrument Blanks (IB)	Analyzed prior to analysis of initial SVS or standards in the sequence	None of the SVS analytes should be detected at greater than 3:1 signal-to-noise	If acceptance criteria are not met maintenance should be performed to eliminate the contamination, including but not limited to replacing the column, acquiring a new instrument blank, replacing the mobile phase, and/or flushing the LC system.	Analyst/ Laboratory PM	Same as Method / SOP QC Acceptance Limits	< 3:1 signal to noise ratio
Method Blank (MB)	1 per extraction batch of no more than 20 samples	Analytes detected in the MB must be less than 5 times the response in samples	Correct problem. Examine the project-specific requirements for the analytes that fail. Reanalysis of MB and all QC samples and field samples will be assessed based on the level of contamination.	Analyst/ Laboratory PM	Same as Method / SOP QC Acceptance Limits	< 5x the response in associated samples
Solvent Blank (SB)	1 per extraction batch of no more than 20 samples	Analytes detected in the SB must be less than 5 times the response in samples	Correct problem. Examine the project-specific requirements for the analytes that fail. Reanalysis of SB and all QC samples and field samples will be assessed based on the level of contamination.	Analyst/ Laboratory PM	Same as Method / SOP QC Acceptance Limits	< 5x the response in associated samples
System Blank	Analyzed after SVS, calibration curve, or positive control samples and before field samples.	None of the SVS, calibration curve, or positive control analytes should be detected at greater than 3:1 signal-to-noise	Analyze a freshly prepared system blank and/or reduce the concentration of the calibration standard or positive control.	Analyst/ Laboratory PM	Same as Method / SOP QC Acceptance Limits	< 3:1 signal to noise in associated SVS, calibration curve, or positive control analytes

Matrix	Solid/Water
Analytical Group	PFAS
Analytical Method / SOP	PFAS by LC-QTOF MS/SOP 5-382

QC Sample	Number/ Frequency	Method/SOP Acceptance Criteria	Corrective Action	Person Responsible	Data Quality Indicators	Project-Specific MPC
Internal/ Surrogate Standards	All Samples	Negative mode: at least 70% spiked internal/surrogate standards are detected. Note: there are no positive mode analytes – criteria does not apply	Reanalyze samples	Analyst/ Laboratory PM	Same as Method / SOP QC Acceptance Limits	70 % of IS/surrogate standard in negative mode are detected. No criteria apply to positive mode.

UFP-QAPP Worksheet #29 – Project Documents and Records

(UFP-QAPP Manual Section 3.5.1) (EPA 2106-G-05 Section 2.2.8)

See additional information in the QMP provided in Appendix C to this QAPP.

Sample Collection and Field Records

Record	Generation	Verification	Storage location/archival[1]
Sample Collection and Field Records			
Field notes/logbook	Field personnel	Oneida Team FTL	Project file
Chain of custody forms	Field personnel	Oneida Team FTL and Project Chemist	Project file
Shipping Records	Field personnel	Oneida team FTL	Project file
Daily QC reports	Field personnel	Oneida Team QCM (Office)	Project file
Deviations/ Field Change Request forms	Field personnel	Oneida Team Deputy PM/QCM (Office)	Project file
Corrective Action (CA) Reports	Oneida Team PM	CQCS	Project file/reports
Correspondence	Field personnel	Oneida Team Deputy PM/PM	Project file
Laboratory Records			
Laboratory sample receipt logs	Laboratory check-in staff	Synectics Data Manager/ Oneida Team Project Chemist	Laboratory Files/Project files
Chain of custody forms	Laboratory check-in staff	Synectics Data Manager/ Oneida Team Project Chemist	Project file/reports
Instrument maintenance and calibration logs	Laboratory analyst	Laboratory QA Manager	Laboratory Files
Sample Preparation Analysis Worksheets/Logs	Laboratory analyst	Laboratory QA Manager	Laboratory Files
Chromatograms/Raw Data	Laboratory analyst	Laboratory QA Manager	Project file/reports
Sample and QC Sample Results	Laboratory analyst	Laboratory QA Manager/Oneida Team Project Chemist	Project file/reports
Correspondence	Laboratory PM	Oneida Team Project Chemist	Project file
Project Assessments			
Data validation report	Data Validator	Oneida Team Project Chemist/ data usability assessment (DUA) Team (Worksheet #37)	Project file/reports
CA documentation	Oneida Team Deputy PM/Project Chemist	Oneida Team PM/CQCS	Project file
Inspection checklists	Oneida Team Deputy PMs	Oneida Team QCM (Office)	Project file

Sample Collection and Field Records

Record	Generation	Verification	Storage location/archival[1]
Non-conformance Form	Oneida Team PM	Oneida Team PgM	Project file
Data usability report	Oneida Team Deputy PMs/Project Chemist	DUA Team (Worksheet #37)	Project file/reports

Laboratory Data Deliverable

Record	Analytical Data
Narrative	X
Chain-of-custody form	X
Summary results	X
Quality control results	X
Level IV data package	X
Synectics’ Fixed-Width Laboratory Electronic Data Deliverable	X

UFP-QAPP Worksheet #31, 32 & 33 – Assessments and Corrective Action

UFP-QAPP Manual Sections 4.1.1 and 4.1.2) (EPA 2106-G-05 Sections 2.4 and 2.5.5)

Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
Field Sampling Technical Systems Audit	1 / at sampling startup	Internal	Oneida Team	Megan Duley, PM, Oneida Team	Installation-specific FTL, Oneida Team	Installation-specific FTL, Oneida Team	Megan Duley, PM, Oneida Team
Data Review Technical Systems Audit	During field sampling and analysis through validation	Internal	Oneida Team	Installation-specific QCM, Oneida Team Kristen Carlyon Peyton, Senior Project Chemist, Oneida Team Evin McKinney, Data Validation PM, Synectics	Installation-specific QCM, Oneida Team Kristen Carlyon Peyton, Senior Project Chemist, Oneida Team Evin McKinney Data Validation PM, Synectics Franco Pala, Battelle PM Nicole Brown, ELLE PM	Installation-specific QCM, Oneida Team Kristen Carlyon Peyton, Senior Project Chemist, Oneida Team Evin McKinney, Data Validation PM, Synectics Franco Pala, Battelle PM Nicole Brown, ELLE PM	Installation-specific QCM, Oneida Team Kristen Carlyon Peyton, Senior Project Chemist, Oneida Team Evin McKinney, Data Validation PM, Synectics Franco Pala, Battelle PM Nicole Brown, ELLE PM

Assessment Response and Corrective Action

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Technical Systems Audit	Written Audit Report	Megan Duley, PM, Oneida Team	24 Hours after audit	Letter	Megan Duley, PM, Oneida Team	24 Hours after notification
Off-site Laboratory Technical Systems Audit - DoD ELAP	Per DoD ELAP	DoD ELAP Laboratory Evaluator	21 Days after audit	Letter	Franco Pala, Battelle PM Nicole Brown, ELLE PM	30 days
Laboratory Performance Evaluation	AFCEC Performance Evaluation Results Report	Oneida Team	7 Days	Report	Oneida Team/AFCEC	30 days
Laboratory Data Review	Data Validation Report	Evin McKinney, Data Validation PM, Synectics	15 days after submittal of data for validation	Report	Kristen Carlyon Peyton, Senior Project Chemist, Oneida Team Evin McKinney, Data Validation PM, Synectics Franco Pala, Battelle PM Nicole Brown, ELLE PM	48 hours after notification

UFP-QAPP Worksheet #34 – Data Verification and Validation Inputs

UFP-QAPP Manual Section 5.2.1 and Table 9) (EPA 2106-G-05 Section 2.5.1)

This worksheet is used to list the inputs that will be used during data verification, validation, and usability assessment. Inputs include all requirements documents (e.g. contracts, SOPs, planning documents), field records (both hard-copy and electronic), and interim and final reports. Data verification is a completeness check that all specified activities involved in data collection and processing have been completed and recorded and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements.

Item	Description	Verification (completeness)	Validation (conformance to specifications)	Usability (achievement of DQOs and MPCs)
Planning Documents/Records				
1	Approved QAPP	X		
2	Contract			
3	Field SOPs	X		
4	Laboratory SOPs	X		
Field Records				
5	Field logbooks/notes	X	X	
6	Daily and weekly QC reports	X	X	
7	Chain-of-custody records	X	X	
8	Calibration records	X	X	
9	Change orders/deviations	X	X	
10	Field CA reports	X	X	
Electronic Data				
11	Photographs	X		
12	Sampling surveys	X	X	
13	Analytical sampling data	X	X	
Final Report / Deliverables				
14	Communication Records	X		
15	QC sample results	X	X	X
16	Final CA reports	X	X	
17	LOD/LOQ Establishment and Verification	X	X	X
18	Sample receipt records	X	X	X

UFP-QAPP Worksheet #35 – Data Verification Procedures

(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

This worksheet documents procedures that will be used to verify project data. Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. The referenced Oneida SOPs are provided in Appendix A and the QMP is provided in Appendix C.

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field records	SOP OESC002A	• Verify that records are present and complete for each day of field activities. • Verify that all planned samples including field QC samples were collected and that sample collection locations are recorded. • Verify that meteorological data were provided for each day of field activities. Verify that required field monitoring was performed, and results are recorded. • Verify that changes/exceptions are recorded and were reported in accordance with requirements set forth in SOP.	Oneida Team FTLs Oneida Team Deputy PMs
Daily and Weekly QC Report	QMP, UFP-QAPP	• Verify that all QC reports are complete for each field day/week.	Oneida Team QCM (Office)
Chain-of-custody forms	SOP OESC002A	• Verify the completeness of chain-of-custody records. • Examine entries for consistency with the field records. • Check that appropriate methods and sample preservation have been recorded. • Verify that the required volume of sample has been collected. • Verify that all required signatures and dates are present. • Check against the laboratory sample receipt documentation for transcription errors.	Oneida Team Project Chemist Synectics Data Manager
Calibration records	SOP OESC011B	• Verify that all instrument/meter calibrations are recorded. • Verify that the form is complete and signed.	Oneida Team FTLs Oneida Team QCM (Office)
Change Orders/ Deviations	QMP	• Verify that changes/exceptions are recorded in and were reported in accordance with requirements.	Oneida Team PM

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field CA Reports	QMP	• Verify that CA was implemented according to procedures specified in the project plan.	Oneida Team Deputy PMs Oneida Team QCM (Office)
Electronic data	UFP-QAPP	• Verify that electronic laboratory data is consistent with expected data based on field records.	Synectics Data Manager
Analytical Sampling Data	UFP-QAPP	• Verify that the laboratory deliverable contains all records specified in the UFP-QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported. • Compare the data package with the chain of custody forms to verify that results were provided for all collected samples. • Review the narrative to ensure all QC exceptions are described. • Check for evidence that any required notifications were provided to project personnel as specified in the UFP-QAPP. • Verify that necessary signatures and dates are present.	Laboratory QA Manager Oneida Team Project Chemist
Audit reports, CA reports	UFP-QAPP, QMP	• Verify that all planned audits were conducted. • Examine audit reports. For any deficiencies noted, verify that CA was implemented according to plan.	Oneida CQCS

UFP-QAPP Worksheet #36 – Data Validation Procedures

(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

The PFAS sample data will be validated to a 100% Stage 2B and a 10% Stage 4 standard, including DoD QSM Version 5.4, Table B-24 requirements. Supporting geochemical data will be validated to 100% Stage 2A. Results from analyses conducted for characterization of IDW will not be validated.

There are no data validation criteria for liquid chromatography/time-of-flight mass spectrometry data. Once the data is processed by a primary experienced HRMS analyst, an independent second review of all the detections will be performed by a second HRMS analyst. Each analytical batch will receive at a minimum a 10% review of all data by a quality assurance officer, or designee. The review will consist of tracing samples from receipt through extraction, analysis, and final reporting. Any discrepancies found will be reported to the project manager and any that could affect the integrity or quality of the results will have the root cause determined and appropriate corrective action documented. All quality assurance reviews will be approved by management and stored as part of the project's records.

Data Validator:

Analytical Group/Method	PFAS (Draft EPA Method 1633); Geochemical (EPA Methods 9060A, 6020B, 7470A, 7471B)
Data deliverable requirements	Enhanced ERPIMS EDDs and Stage 4 Type Portable Document Format Data Package
Analytical specifications	Analytical Quality Control Worksheets #24 and #28
MPC	Worksheet #12
Percent of data packages to be validated	100%
Percent of raw data reviewed	10%
Percent of results to be recalculated	10%
Validation procedure	DoD General Data Validation Guidelines, Rev. 1 (DoD, 2019); DoD Validation Guidelines Module 6: Procedure for PFAS Analysis by QSM Table B-24 (DoD, 2022a); DoD Validation Guidelines Module 5: Data Validation Procedure for Metals by ICP/MS (DoD, 2022b)
Validation code	100% S2BVEM/10% S4VEM (PFAS - Draft EPA Method 1633); 100% S2A (Geochemical - EPA Methods 9060A, 6020B, 7470A, 7471B)
Electronic validation program/version	Synectics' EDMS ADR

The following qualifiers will be used to indicate QC deficiencies and will be defined in the data tables:

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.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the laboratory. 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 QC 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.

UFP-QAPP Worksheet #37 – Data Usability Assessment

(UFP-QAPP Manual Section 5.2.3 including Table 12) (EPA 2106-G-05 Sections 2.5.2, 2.5.3, and 2.5.4)

This worksheet documents procedures that will be used to perform the data usability assessment (DUA). The DUA is performed at the conclusion of data collection activities, using the outputs from data verification and data validation (Worksheets #35 and #36).

Identify personnel (organization and position/title) responsible for participating in the DUA:

Name	Position/Title	Organization
Megan Duley, PE	PM	Onieda
Kevin Engle, PG	Deputy PM (AF)	Oneida
Lauren Idleman, PG	Deputy PM (ANG)	Oneida
Robert Price, PG, CEG	Project QC Manager	Oneida
Kristen Carlyon Peyton, CHMM	Senior Project Chemist	Oneida
Pamela Chang, PMP	PM	Battelle
Kavitha Dasu, PhD	Senior Chemist	Battelle
Jessica Faragalli	PM	USACE
Cynthia Cash	Program Manager	DAF
Keith Freihofer	Program Manager	ANG
John (Seb) Gillette	Chemist	CZTE
Hunter Anderson	Subject matter expert	CZTE

A third-party data validation will be performed on the data set. The steps included in performing an assessment of the data usability will include the following:

Step 1	Review the project's objectives and sampling design: • Review the key outputs defined during systematic planning (i.e., DQOs and MPCs) and make sure they are still applicable. Review the sampling design for consistency with stated objectives. This provides the context for interpreting the data in subsequent steps.
Step 2	Review the data verification and data validation outputs: • Review available QA reports, including the data verification and data validation reports. Look for patterns, trends, and anomalies. • Review sample collection parameters to identify any possible sources of inconsistencies in reported PFAS concentrations. • Review deviations from planned activities (e.g., number and locations of samples, damaged samples, and SOP deviations) and determine their impacts on the data usability. • Identify those data that are not acceptable for use. Determine the cause, evaluate the effects on the project, and take appropriate corrective action (e.g., resample or limit the use of data). • Review any "X" qualifiers and determine whether the data are accepted or rejected and change to the appropriate final qualifier.
Step 3	Verify the assumptions of the selected statistical method. • Verify whether underlying assumptions for the selected statistical methods (i.e., PFAS Signature®) are valid. Common assumptions include the distributional form of the data, independence of the data, dispersion characteristics, homogeneity, etc. Depending on the robustness of the statistical method, minor deviations from assumptions usually are not critical

	to statistical analysis and data interpretation. If serious deviations from assumptions are discovered, the resulting uncertainty will be discussed in the final report. .
Step 4	Implement the statistical method. • Analyze the data using PFAS Signature® methodologies as described in the UFP-QAPP and review underlying assumptions. Consider the tolerance for uncertainty in measurements.
Step 5	Record data usability and draw conclusions. • Determine if the data can be used as intended, considering implications of deviations and corrective actions. Discuss DQIs. Assess the performance of the sampling design and identify limitations on data use. Update the CSM and record conclusions. Prepare the data usability summary report, which will be in the form of a checklist with supporting text and tables.

Project Completeness—The evaluation of planned versus actual data will determine project completeness. Consideration will be given to project changes and alterations during implementation. All data not rejected during the DUA will be considered valid in calculations of completeness. Overall, the project completeness will be assessed using primary samples relative to media, analyte, and area of inspection.

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FIGURES

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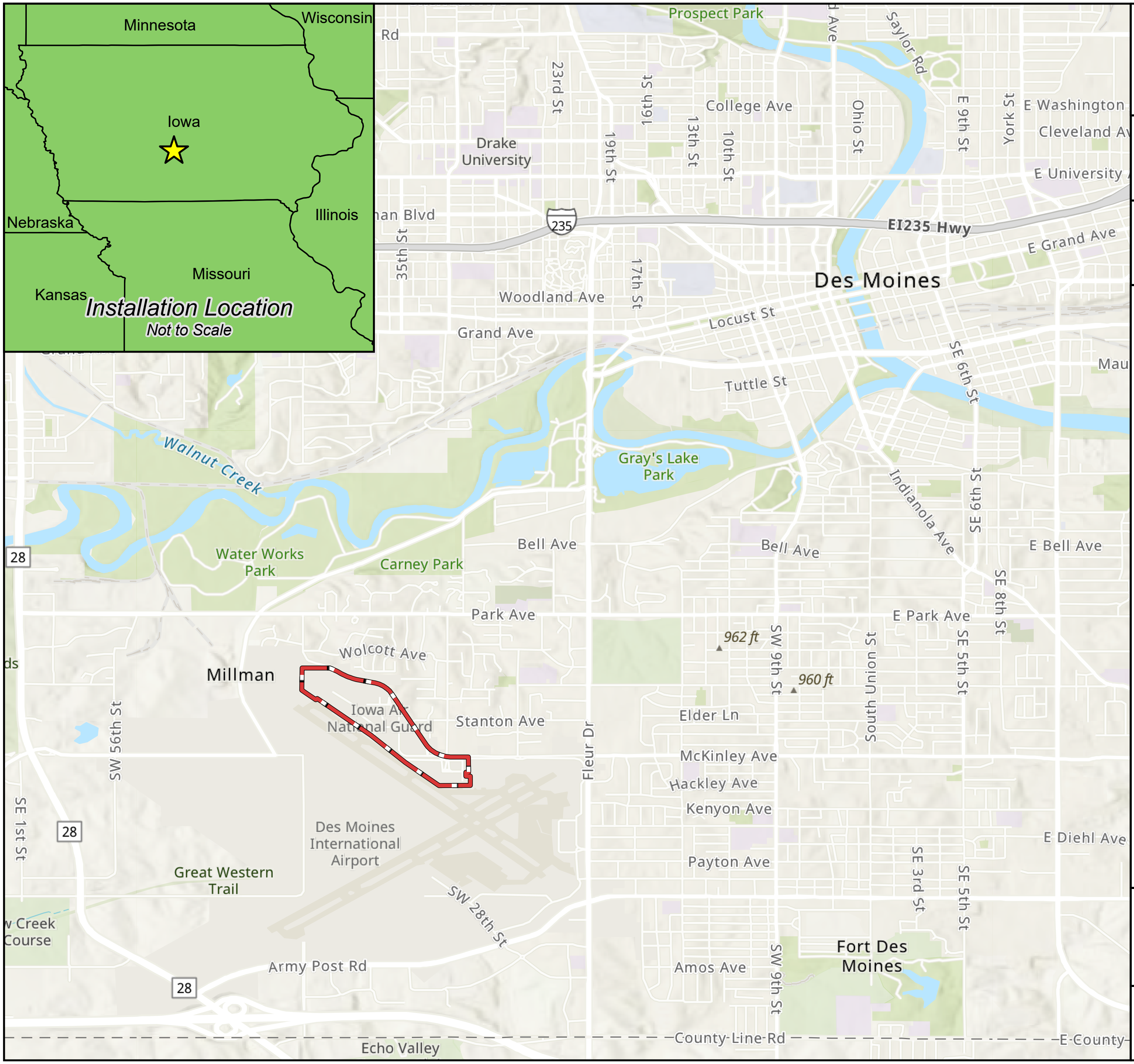

Figure 1
Des Moines ANGB Location Map

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

🟥 Des Moines ANGB Installation Boundary

★ Installation Location

Abbreviations
ANGB - Air Force National Guard Base
PFAS - Per- and polyfluoroalkyl substances

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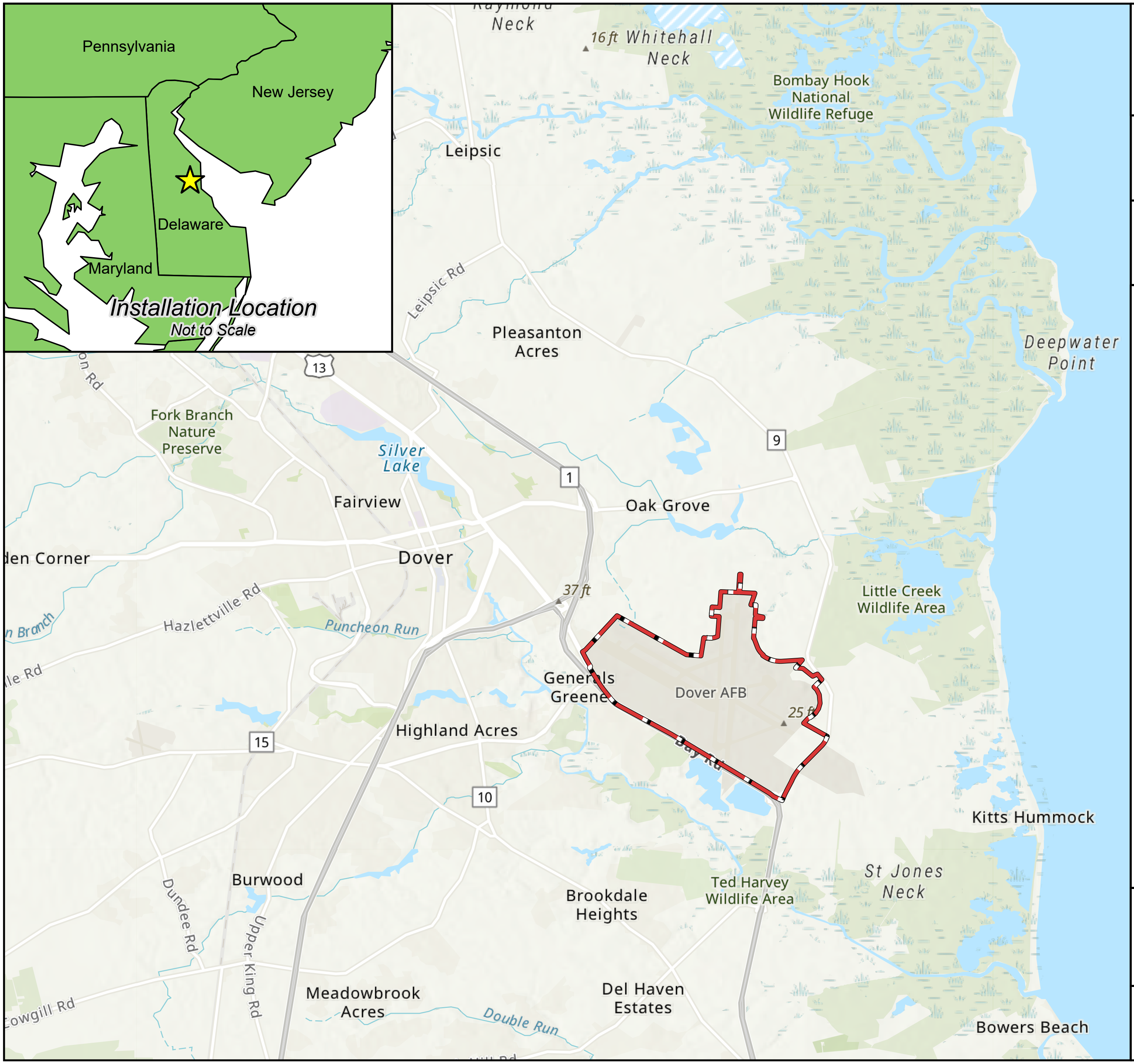


Figure 2
Dover AFB Location Map

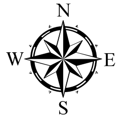
PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

🟥	Dover AFB Installation Boundary
☆	Installation Location

Abbreviations
AFB - Air Force Base
PFAS - Per- and polyfluoroalkyl substances



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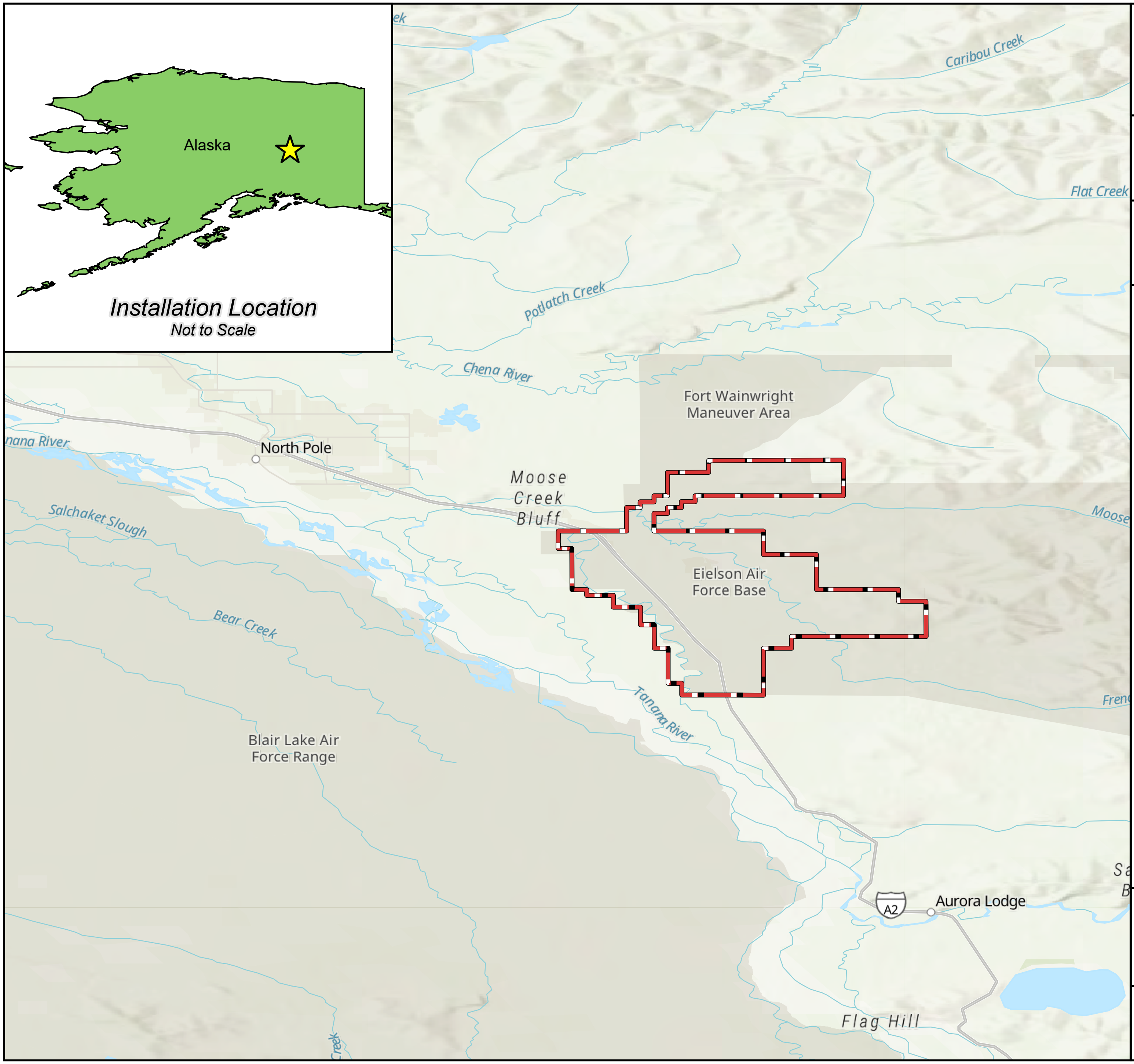

Figure 3 Eielson AFB Location Map

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

🟥	Eielson AFB Installation Boundary
★	Installation Location

Abbreviations
AFB - Air Force Base
PFAS - Per- and polyfluoroalkyl substances

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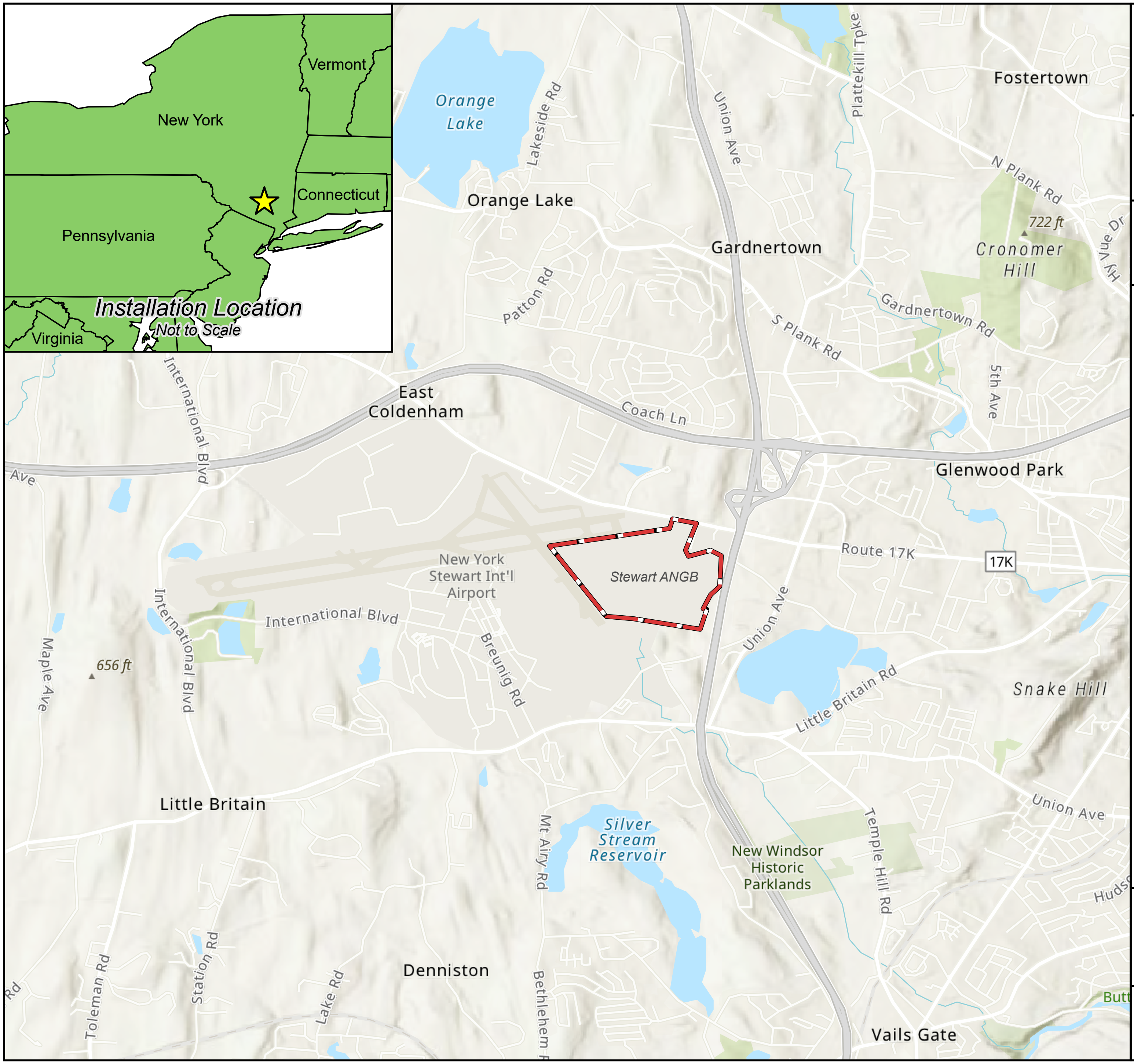

Figure 4
Stewart ANGB
Location Map

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

🟥 Stewart ANGB Installation Boundary

★ Installation Location

Abbreviations
ANGB - Air Force National Guard Base
PFAS - Per- and polyfluoroalkyl substances

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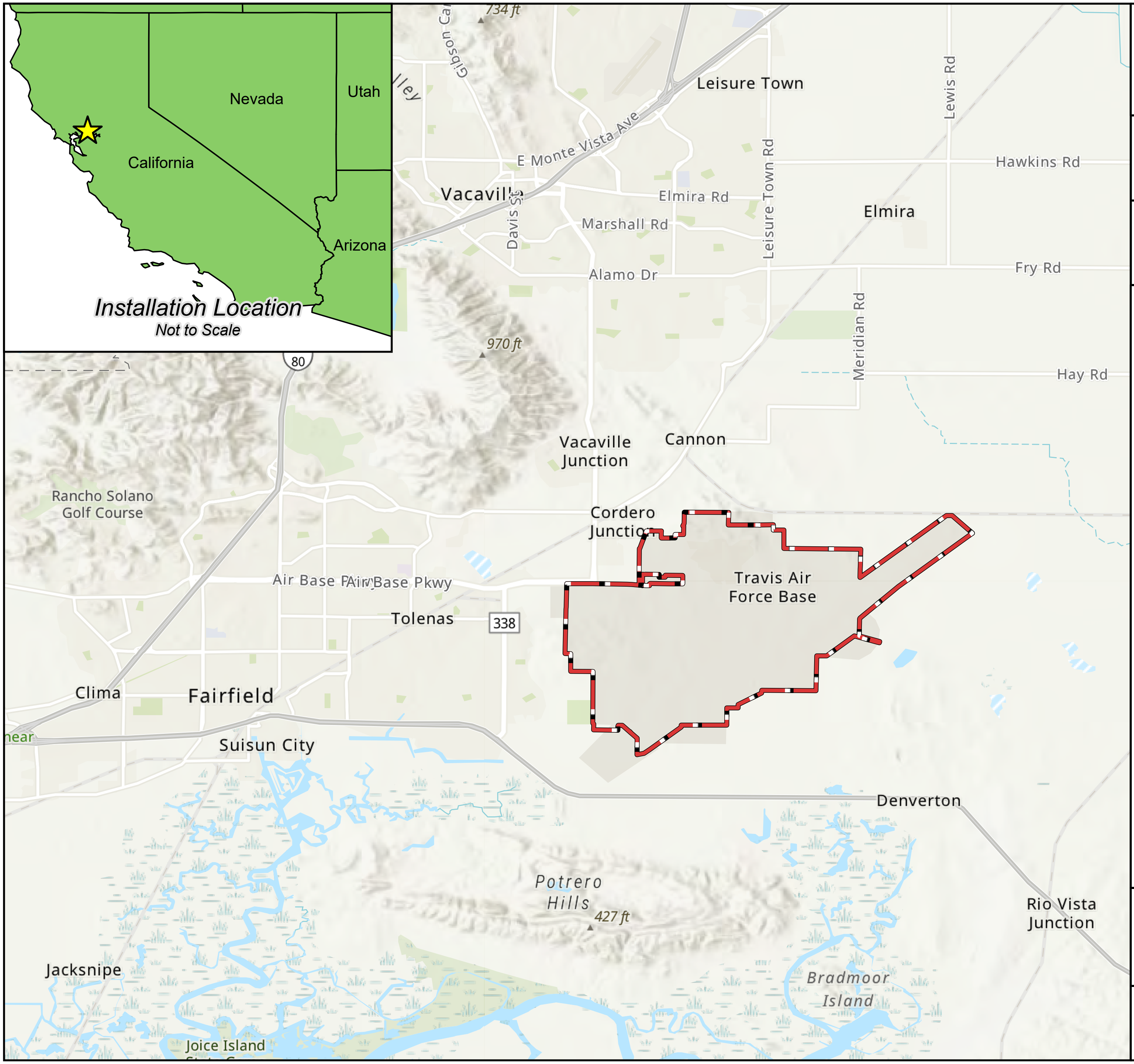

Figure 5
Travis AFB
Location Map

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

🟥 Travis AFB Installation Boundary

★ Installation Location

Abbreviations
AFB - Air Force Base
PFAS - Per- and polyfluoroalkyl substances

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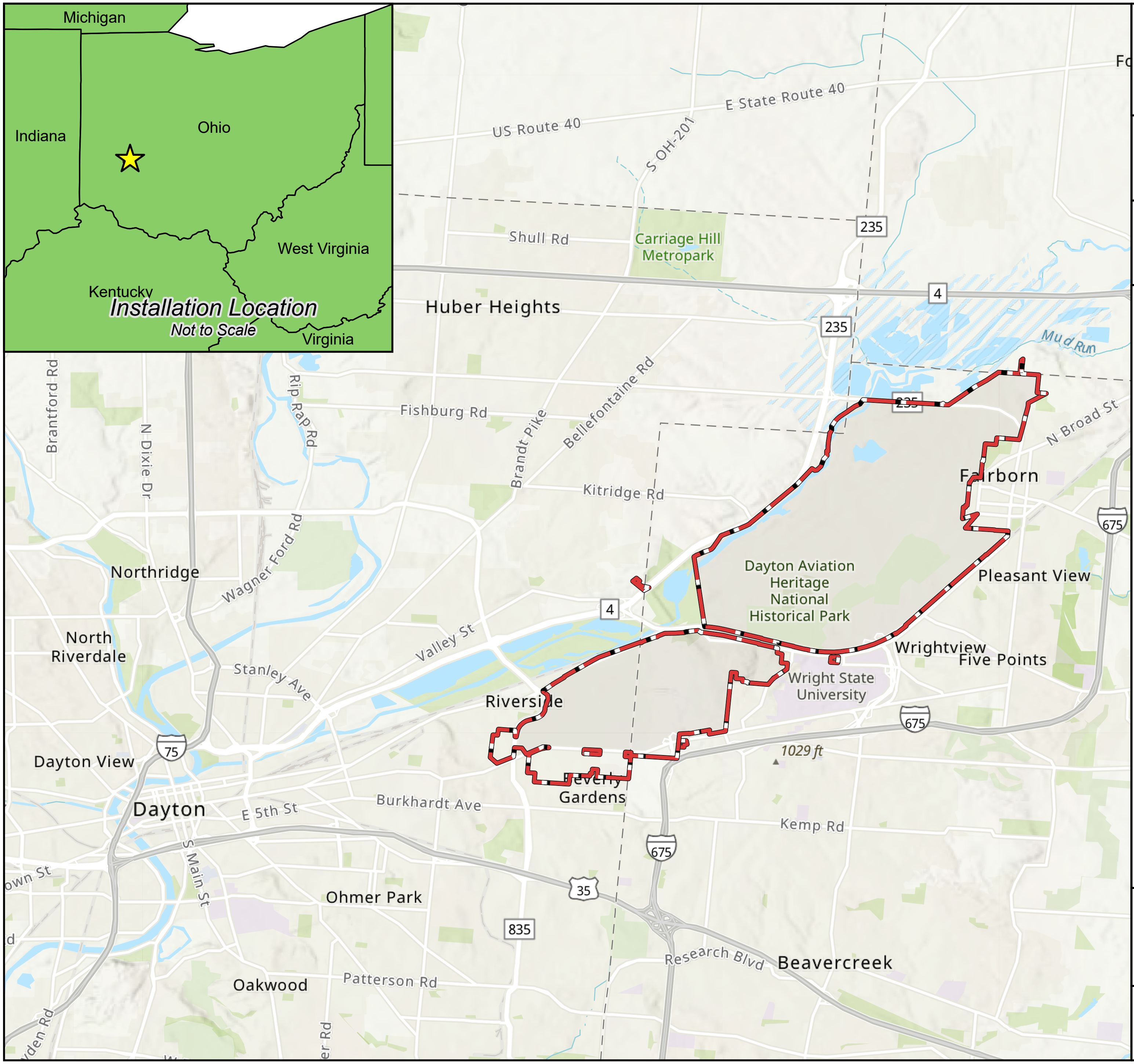
Figure 6
Wright Patterson AFB Location Map

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center



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🟥 Wright Patterson AFB Installation Boundary

☆ Installation Location

Abbreviations
AFB - Air Force Base
PFAS - Per- and polyfluoroalkyl substances

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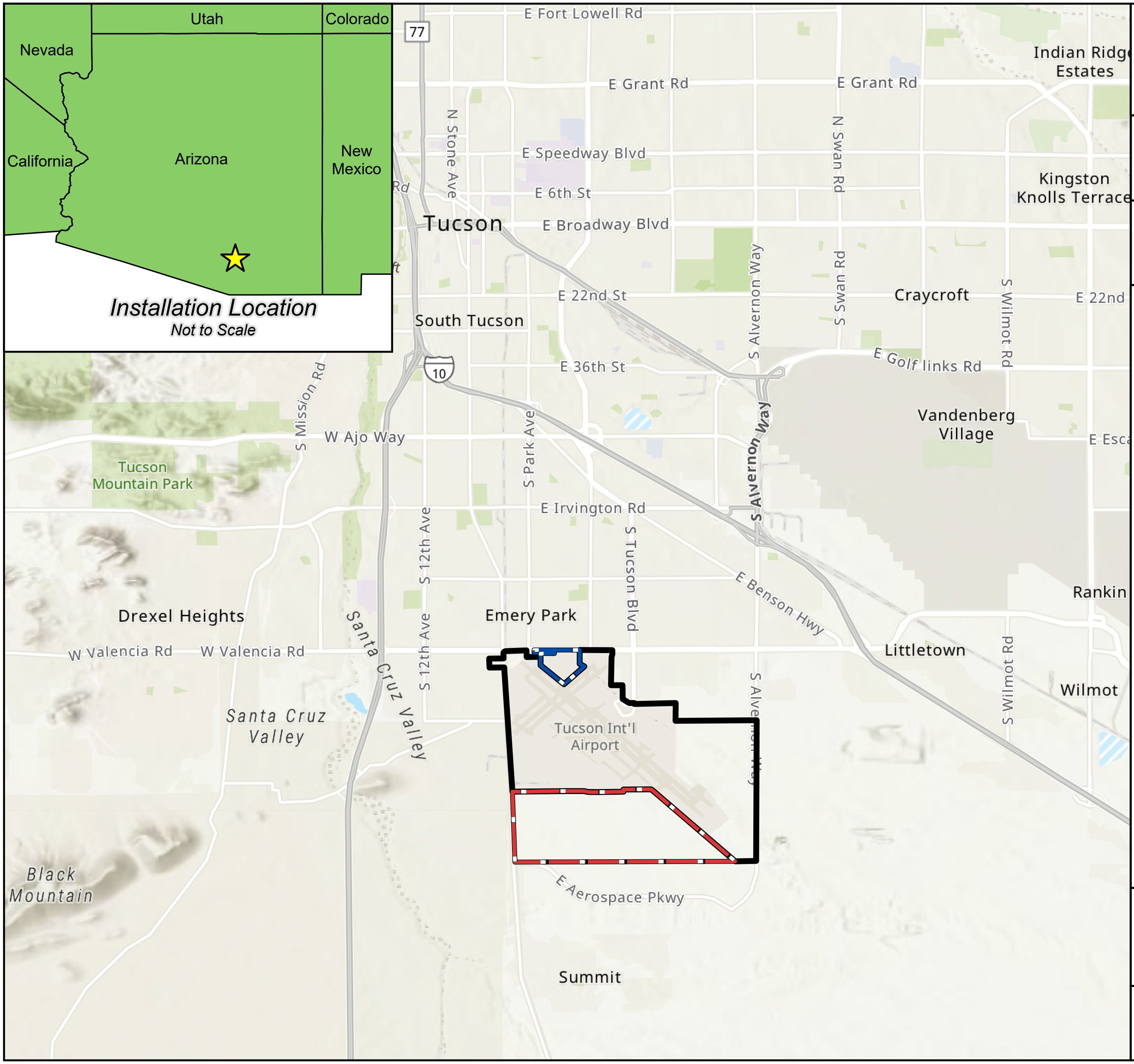

Figure 7
Tucson Area Installations Location Map

PFAS Fingerprinting and Background Studies at Multiple Air Force and Air National Guard Installations

U.S. Army Corps of Engineers
Sacramento District
for
Air Force Civil Engineer Center

Legend

- 🟥 AFP44 Installation Boundary
- 🟦 Morris ANGB Installation Boundary
- ⬛ Tucson Int'l Airport Boundary
- ★ Installation Location

Abbreviations
AFP - Air Force Plant
ANGB - Air National Guard Base
Int'l - International
PFAS - Per- and polyfluoroalkyl substances

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Appendix A

Oneida Standard Operating Procedures (SOPs)

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SOP Reference Number	Title, Revision Date and/or Number
OESC001A	Site Access, Dig Permits, and Utility Clearance Procedures
OESC002A	Field Records and Documentation
OESC005A	Field Parameter Measurements in Water
OESC006B	Sampling of Surface Soils and Other Surficial Materials
OESC006D	Surface Water Sampling
OESC007A	Drilling Methods and Procedures
OESC007B	Soil and Rock Geologic Logging and Classification
OESC007C	Hand Auger Borings
OESC007D	Subsurface Soil Sampling
OESC007E	Direct Push Technologies
OESC007I	Lysimeter Sampling
OESC008D	Monitoring and Extraction Well Installation and Development
OESC008E	Fluid Level Measurement in Wells
OESC008F	Monitoring Well Sampling
OESC008I	Borehole Abandonment and Well Destruction
OESC010C	Sampling Labeling, Control and Shipping
OESC011A	Sampling Equipment Decontamination Procedures
OESC011B	Calibration Procedures for Field Equipment
OESC012A	Investigative Derived Materials Management Procedures
Addendum No. 1 for PFAS Sampling	PFAS Sampling Instructions

February 2023
Revision 02

SOP Addendum No. 1 for PFAS Sampling

Brand names, suppliers, and model numbers are for illustration purposes only and no endorsement is implied. Equivalent performance may be achieved using apparatus and materials other than those specified here.

PFAS Sampling Limitations

Special sampling techniques for per- and polyfluoroalkyl substances (PFAS), formerly referred to as perfluorinated compounds (PFCs), were identified in the Department of the Navy (DON) Interim Guidance/Frequently Asked Questions (DON 2015) and Final (Revision 1) PFCs Release Determination at Multiple Base Realignment and Closure (BRAC) Bases Quality Program Plan (AMEC Environment & Infrastructure [AMEC] 2014), which helped shape guidance for sampling of PFAS constituents. Because PFAS constituents can be found in a number of consumer products, there are several precautions that will be taken during sample collection to avoid inadvertent sample contamination:

- No equipment containing PFAS, polytetrafluoroethylene (PTFE, aka Teflon®), low density polyethylene (LDPE), or polyvinylidene fluoride (PVDF) may be used.
- Well purging will be conducted using a PFAS-free, PTFE-free, PVDF-free and LDPE-free pump such as the Proactive SS pump™, a Geotech SS Geosub™ pump with polyvinyl chloride (PVC) leads, or a Besst Panacea P200 SS pump™, or equivalent.
- High density polyethylene (HDPE) or silicone tubing will be used. New disposable tubing will be used at each well that is sampled for PFAS constituents.
- When a flow-through cell is utilized for measure groundwater parameters, the cell will be disconnected from the sampling train prior to sample collection.
- No water level meters with PFAS, PFTE, LDPE, or PVDF materials (e.g., select Solinst and Heron) should be used. A Durham Geo Slope Indicator Water Level Indicator (or equivalent) may be used.
- Post-it® Notes and equivalent products will not be used at any time during the sample event.
- No markers other than Sharpie® will be used. Pens and pencils may be used.
- Samples will be collected in HDPE plastic bottles provided by the laboratory. The screw cap will be made of polypropylene or HDPE and may be lined or unlined. However, if lined, the liner may not contain PFTE or PFAS constituents.
- Personnel involved with sample collection and handling will avoid wearing clothing or boots that are new (e.g., at least 6 washings since purchase), synthetic, water resistant, stain-treated, or contain Gore-Tex™, PTFE, or other polyfluorinated materials. Field personnel will avoid wearing waterproof or water-resistant rain gear.

- Personnel involved with sample collection and handling will not use cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling.
- Sunscreens and insect repellants that are natural and contain no PFAS constituents may be used. These include:
  - Sunscreens - Alba Organics Natural Sunscreen™, Yes to Cucumbers™, Aubrey Organics™, Jason Natural Sun Block™, Kiss my face™;
  - Insect Repellents - Jason Natural Quit Bugging Me™, Repel Lemon Eucalyptus Insect Repellant™, Herbal Armor™, California Baby Natural Bug Spray™, BabyGanics™; and
  - Sunscreen and Insect Repellant - Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion™.
- Personnel involved with sample collection and handling will not touch Tyvek® suits or bring Tyvek® suits on-site during the PFAS sampling event.
- Personnel involved with sample collection and handling will wear new nitrile gloves at all times while collecting and handling samples. Latex gloves are not to be used for PFAS sampling.
- No food or drink will be present or consumed on-site with the exception of bottled water and hydration drinks (i.e., Gatorade® or Powerade®). Many food and snack products are packaged in wrappers treated with PFAS. Therefore, hands will be thoroughly washed before coming back on-site after handling fast food, carryout food, or snacks.
- Only ice made from frozen water will be used. Cooler ice pack, reusable or single-use cold packs, instant ice packs, or equivalent will not be used to preserve or store samples or be used in sample coolers.
- Products containing PFTE, PFAS, or LDPE will not be used during sample handling, or mobilization/demobilization. Aluminum foil will not be used on-site.
- Waterproof field notebooks will not be used as they are noted as a potential source of PFAS (AECOM 2015). Loose paper (non-waterproof) may be used.
- Aluminum or Masonite clipboards will be used. No plastic clipboards, or spiral bound notebooks will be used on-site.
- Decontamination will be conducted using several steps. The first step is to clean equipment using a mix of Liquinox® or Alconox® and potable water; the second and third steps are potable water rinse; the fourth step is laboratory-certified PFAS-free water rinse. All clean equipment will be placed on PFAS-free materials. If plastic is used, it must be HDPE or polyvinyl chloride. The detergent Decon 90™ shall not be used.

References

AECOM. 2015. Characterization and Treatment of Perfluorinated Compounds - The Next Big Emerging Class of Contaminants. Online Presentation by Dave Woodward. January 15.

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STANDARD OPERATING PROCEDURE OESC001A

SITE ACCESS, DIG PERMITS, AND UTILITY CLEARANCE PROCEDURES

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Brennan Johnson OESC Health and Safety	Brennan Johnson	09 January 2023
Reviewed By: Stacy Kowalski Project Geologist	Stacy Kowalski	09 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	09 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for project managers and field personnel to obtain site access and identify and mark (clear) underground utilities and potential underground infrastructure locations for proposed subsurface work. Underground utilities must be identified and marked prior to commencing site activities in the work area to prevent damage to underground utilities.

2.0 ACCESS, PERMISSION AND PERMITTING

The project manager is responsible for obtaining site access from the property owner and documenting that personnel are permitted to enter the site prior to performing work to identify and clear underground utilities.

The project manager will coordinate with the client to secure permission for access to all areas that will be impacted by subsurface activities, including adjoining or nearby properties, as necessary. Legal review of access agreements and insurance coverage documentation by corporate staff may be required. Signed access agreements and/or written approvals are required for all properties prior to conducting any work, including locating underground utilities. The project manager should obtain site access in a timely manner to prevent delays in scheduled field work. Arranging site access for field personnel may take four weeks or longer. The project manager is also responsible for complying with client/owner security requirements and personnel security clearance.

2.1 DIG PERMITS

Dig permits may be required by state law, the property owner/operator, or other site-specific requirements. A dig permit or work clearance request can provide intra- and inter-agency coordination and may be required for work that potentially disrupts or interferes with routine activities on the subject site, including but not limited to: aircraft or vehicular traffic flow; utility services; and fire and alarm systems. The project manager is responsible for procuring required site- specific dig permits prior to conducting subsurface work, including work performed by subcontractors. The dig permit will be kept in the field with the project files for the duration of the field work and will be included in the project report. The project manager is further responsible for tracking and keeping dig permits current for each phase of work.

3.0 UNDERGROUND UTILITY CLEARANCE AND LOCATING

Underground utilities in the vicinity of each work area must be identified, located, and marked prior to the start of invasive work. Clearing the work area for subsurface utilities must comply with state law, implement best practices, and minimize the potential for damage during invasive activities, which may include drilling, trenching, excavation, hand-augering, hand-digging, or other activities that disturb or break the ground surface. In addition to the procedures described in this section, each project may have site-specific requirements that are documented in the project planning documents.

3.1 UTILITY CLEARANCE PROCEDURE

3.1.1 Delineation

Areas proposed for subsurface activities must be marked in white prior to calling the regional notification center. White marking products, such as marking paint, chalk, flour (for areas of sensitive vegetation or landscaping), stakes, flags, or survey whiskers – or a combination of these – will clearly identify the area of concern prior to calling the regional notification center. This process reduces confusion for the utility companies clearing the area and ensures that all areas to be impacted are marked accurately. The following markings may be used to delineate the approximate extent of the work area:

- A full, continuous line.
- Dots or other markers to delineate the outer extent of subsurface activities.
- Dashes or markers to delineate corners of a subsurface work area.
- Dashes or other markers outlining an entire excavation area. Each dash should be approximately 6 inches to 1 foot in length, and one inch wide. Dashes can be spaced a distance of 4 feet, or for very large areas, up to 50 feet apart.
- A single stake with the radius noted can define the excavation within a 50-foot maximum radius.

A face-to-face meeting with the locator(s) is required when the work area cannot be clearly and adequately identified for projects that are too large or not conducive to pre-marking.

3.1.2 Notification of the One-Call Notification Center (811)

Notification of a request for utility identification is required between three working days and 14 calendar days prior to the start of subsurface activity (refer to state law). The date of the notification call is not included in the three working days. Confirmation of the request must be obtained from each underground utility that has been identified.

Provide and record the following information to the One Call center:

- Date and time of call
- Name of caller and notification center representative
- Work location (can include any of the following, as appropriate, to identify the work area):
    - Site City, county/parish/township, as appropriate, and State
    - Street address and/or street intersections, if applicable

  - Length and direction of the excavation and the nearest adjacent cross streets required to locate the excavation area
  - Subdivision and lot number (if a new development)
  - Coordinates of latitude and longitude
  - Global positioning system (GPS) coordinates, specified in either degrees/decimal minutes, or degrees/minutes/seconds
  - Highway mile marker(s)
  - Railroad milepost(s)
  - Map grid(s)
  - Distances to the nearest cross streets
  - Other pertinent references to establish and identify the location of the subsurface work site
- Description and depth of the ground disturbing activity (drilling, sampling, excavation, etc.)
- Planned start and end date of work
- Customer for whom the work is being done
- If a permit is required for the work, provide the permit number to the call operator
- Company name, address, phone number, and e-mail address of the company completing the subsurface activities
- Name of subcontractors, if applicable.
- Site contact information such as Project Field Team Leader or Site Safety & Health Officer
- Any additional information requested or provided by the notification center representative.

<u>Record and document the following information provided by the One-Call Center:</u>

- Valid Locate Ticket number (The ticket information can be retrieved via email from the One-Call-Center or online from the One-Call Center website.). The project manager must maintain the locate ticket in the project files.
- List of utility companies associated with the property. Public utility companies with potential underground utilities in the work area will be notified of the ticket and work area. Each affected utility company will send a locator to mark the approximate location of the underground utility line in the delineated work area. Coordination with the utility company may be required to allow access to the work area.
- Positive response from each underground utility. The project manager must ensure there is positive response for each underground utility on the ticket from the One-Call Center before invasive work is performed. A positive response may include one or more of the following: verification of no utilities present, markings or documentation left at the job site, callback, fax, or automated response system. A positive response is required to ensure that all affected utility companies have marked the requested area prior to the beginning of any soil invasive work.
- High priority subsurface installation. High priority subsurface installations, include but are not limited to: underground storage tanks, underground pipelines, conduits, ducts, wire, or other similar structures.

3.1.3 Review of Existing Information about Underground Utilities

In addition to contacting the One-Call Notification Center, available information about underground utilities in the area of the planned work shall be requested from the facility personnel or client and reviewed, when available. This information also may be available from local government agencies that have historical records of the work area. Pertinent information includes:

- Maps of existing, abandoned, and out-of-service subsurface features
- Cathodic protection and grounding systems
- As-builts of any underground non-public utilities/features in the area
- Review of the site for aboveground indicators of underground facilities, such as:
    - Permanent signs or markers
    - Manhole covers
    - Vent pipes
    - Pad-mounted devices
    - Riser poles
    - Power and communication pedestals
    - Valve covers
- Any information regarding high priority subsurface installation. The project manager must communicate with the site owner/operator to identify any high priority subsurface installations present in the area of work. Prior to conducting subsurface activities, the site owner/operator must verify the locations of subsurface installations. The methods and tools that will be used during the subsurface work must be reviewed with the site owner/operator prior to soil disturbance. See Section 3.1.4 for procedures to locate these structures if blueprints, files, or other specific documentation are unavailable.

This information should be used to confirm the location of known underground utilities in the work area and provided to field personnel before invasive work begins.

3.1.4 Private Utility Clearance

It is possible that underground private utilities are present in the work area, such as those belonging to a military facility or base. If the One-Call Notification Center and record review cannot confirm the presence of known utilities, a private utility locator may be used to conduct a geophysical survey at the site.

Private underground utilities can be identified by a geophysical survey using a combination of electromagnetic (EM) induction, magnetometry, and ground penetrating radar (GPR), radar tomography, metal detectors, and optical instruments to gather and record approximate horizontal and vertical positional data. Limitations to these technologies include but are not limited to; rebar-reinforced ground cover, abrupt changes in ground cover type, aboveground obstacles preventing full traverses or allowing traverses in one direction only, aboveground conductive objects interfering with instrument signal, nearby powerlines or electromagnetic transmitters, highly conductive background soil conditions, limited GPR penetration, non-metallic targets, shallower or larger objects shielding deeper or smaller targets, tracing signal jumping from one line to another, and inaccessible risers, cleanouts, valve boxes, and manholes.

Following a geophysical survey, the private utility locator should provide information on the presence, approximate location, size and shape of detected underground anomalies. This should include identification of the possible types of utilities or underground structures detected.

Abandoned underground utilities: Information regarding the presence or location of an abandoned utility may not be available because of updating or deletion of records. Abandonment of an existing utility, damage to an abandoned utility, or limited or non-existing access points may render an abandoned line non-locatable. Appropriate caution including hand digging to a minimum of 3 feet prior to use of mechanical equipment should be exercised in potential or suspect abandoned underground utility areas.

3.2 COLOR-CODED UTILITY MARKING

The American Public Works Association (APWA) has adopted a uniform color code (American National Standards Institute [ANSI] Z535.1) for marking underground utilities. The following markings may be indicated at the site as a result of the utility clearance procedures described above. The white markings will be made as described in this SOP. The other marking will be made by responding notified parties:

- White - Proposed excavation (See Section 3.1.1)
- Pink -Temporary survey markings
- Red - Electric power lines, cables, conduit and lighting cables
- Yellow - natural gas, oil, steam, petroleum, or gaseous materials
- Orange - Communication, alarm or signal lines, cables or conduit
- Blue - Potable water
- Purple - Reclaimed water, irrigation and slurry lines
- Green - Sewer and drain lines

4.0 EVALUATING THE NEED FOR MANUAL CLEARANCE

Depending on the underground utility information available for a site, manual clearance also may be used when initiating invasive work. The American Society of Civil Engineers establishes Subsurface Utility Engineering quality levels (QL) A, B, C, and D for obtaining utility location data (ASCE, 2002). These are described as follows by Common Ground Alliance (CGA, 2021):

- QL-D involves utility records research and interviews with knowledgeable utility personnel.
- QL-C involves surface survey and identifying and recording aboveground features of subsurface utilities, such as manholes, valves, and hydrants.
- QL-B involves application of “surface geophysical methods,” such as [electromagnetic] EM-based locating instruments, GPR, radar tomography, metal detectors, and optical instruments, to gather and record approximate horizontal (and, in some cases, vertical) positional data.
- QL-A involves physical exposure via “soft-digging” (vacuum excavation or hand-digging) and provides precise horizontal and vertical positional data.

QL-A, the most accurate level, denotes data in which the horizontal and vertical location of a utility is known by the actual exposure and surveying of the utility. Commonly, QL-A data may be obtained based on site conditions, client or property owner requirement, or when locating high priority subsurface installation(s). In those cases, the utility may be initially exposed by hand using vacuum extraction such as an air knife, or digging with an auger, shovel, or other manual technique. Manual exposure of utilities will help minimize the potential to cause damage.

5.0 REFERENCES

American National Standards Institute (ANSI). 2022. ANSI Z535.1-2022: Standard for Safety Colors.

American Society of Civil Engineers. 2002. Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data. CI/ASCE 38-02.

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STANDARD OPERATING PROCEDURE OESC002A

FIELD RECORDS AND DOCUMENTATION

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared by: OESC Operations	Lik-See Chung	15 December 2020
Reviewed by: Brennan Johnson, CIH CSP OESC Health & Safety Manager	Brennan Johnson	21 December 2022
Reviewed by: Nathan Mullens, PG, REM Geologist		21 December 2022
Approved by: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	21 December 2022

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to provide guidance, procedures, and formats by which field records of work activities will be recorded and managed. This SOP is limited to field records for typical environmental assessment and restoration field work.

1.1 Summary of Method

Field records are part of the legal record of project work and document critical original site data. They are legal documents that must be maintained as part of the project files. Entries are recorded in sufficient detail to allow for reconstruction of field activities conducted each day. Language should be objective, clear, factual, and accurate.

1.2 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

2.0 EQUIPMENT AND SUPPLIES

The following materials and supplies should be obtained and brought to the field in sufficient quantities to complete the assigned work:

- Field logbooks with weatherproof lined paper and numbered pages. For example, all-weather horizontal line No. 390 NF, or field forms that meet the general requirements for field logbooks.
- Indelible, waterproof, black ink pens.
- Plastic file box (field file) with hanging folders and lid with handle, and/or three-ring binders, for keeping field records easily accessible, clean, protected, and organized.

3.0 FIELD LOGBOOK

Logbooks are used for a field activity on the project until the specific activity is completed. The logbook for a specific field activity is used until the logbook is full. If the logbook for a specific activity is not filled completely, the logbook for that specific activity may be used for future work at that project site.

3.1 Parts of the Logbook

Book Cover: The center of the front cover is labeled with the company name, project or site name, company project number, and logbook number. Logbooks for each project will be sequentially numbered. Logbook numbers should reference the project number and the dates of field activity.

First Page: The front inside cover will be filled out with the company name, office address, and phone number. Write: "If found please return to:" above the identifying information.

Table of Contents Page: For ongoing projects or projects of significant duration, create a table of contents at the front of the logbook. Fill in the Table of Contents as log entries are entered. Keep the contents table up to date on a regular basis.

Each Page: Each page of the logbook will be numbered sequentially if not pre-printed. Each page will be dated at the top and initialed at the bottom without exception.

3.2 Entry Format

Use waterproof black ink for logbooks. Record sufficient information in logbooks and/or on field forms to allow for reconstruction of field activities conducted each day. Language should be objective, clear, factual, and accurate to support later written reports. If an error is made on any hard copy field documentation (e.g., logbook, form, or chain-of-custody) make a correction by crossing a single line through the error, entering the correct information, initialing, and dating the correction. The project manager will conduct periodic audits of field logbooks.

3.3 What to Record in the Field Logbook

The following types of information should be recorded in field logbooks (except where this information is recorded on equivalent field forms):

3.3.1 Basic and Project Information

- Name and title of the originator (first page of daily entry)
- Name, company name, and address of the site contact
- Site activities and personnel on site
- Modifications to planned work/schedule
- Date and time of client notification of major changes, pending change orders, et al.
- Conversations with client representatives, senior OESC personnel, landowners, regulatory agency representatives, or other associated parties.

3.3.2 Daily Entries

Daily entries include the following:

- Site name, project name, and purpose and type of activity (e.g., "ABC Facility, Site 1, Soil Sampling")

- The time of each written entry in a column on the left-hand side of each page, followed by the entry indented
- Entrance and exit times for personnel, subcontractors, site visitors, deliveries, and pickups.
- Site weather or conditions (e.g., Temp 15°F, 20 mph gusts, rain causing muddy conditions)
- Each performed field activity, with location, start and end times, and details (e.g., "groundwater sample collection at MW-1 for VOCs")
- Sample collection information (see below)
- Personnel: Names and roles/titles of people involved for each field activity, including employees, contractors, regulators, and visitors.
- Equipment: Identify the types and manufacturers of equipment and machinery used during field activities, and include:
    - Performance of initial inspections, and corrective actions for defects, when equipment arrives onsite
    - Decontamination procedures
    - Date and time of departure of equipment deliveries
- If field forms are used, notation of which forms were used (refer to Section 5.0, below).
- Site safety and health information (Section 4.0, below)
- Problems, corrective actions, down-time (beginning and end times, reason), requested field changes or variances, and approvals of requested field changes or variances
- The last entry of the day will document when personnel and contractors exit the site and the status of site exits, including access gates locked by whom, at what time. If the last page is not completely filled, draw a diagonal line through the remaining blank space. Sign the bottom of the page.

3.3.3 Sample Collection Information

Refer to applicable SOPs for field activities, and to the project Sampling and Analysis Plan (SAP) or Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) for task-specific guidance. The following general information is recorded in the logbook:

- Sample location, ID, collection method, and any variances from the SAP or UFP-QAPP.
- Photograph log
- Drilling conditions encountered, decisions (also recorded on the boring log; refer to SOP OESC007B)
- Details of the sampling location, including a sketch map illustrating the sampling location if not on the boring log
- Equipment and materials used for sample collection
- Field instruments (type, serial number), calibration methods and results
- Sample identification numbers, dates and times of collection to corroborate with chain-of-custody forms
- Information from containers, labels of reagents, deionized and organic-free water, et al.
- Field analyses, conducted by whom, using what instruments or test kits, results

- Calculations and results
- Changed site conditions affecting the ability to perform work on time or as specified in the approved work plans or planning documents

3.3.4 Investigation Derived Waste (IDW) Documentation

Investigation derived waste (IDW) documentation (refer to SOP OESC012A) in the logbook will include, but not limited to:

- Types and numbers of containers/drums
- Storage location, conditions (e.g., on pallets, in fenced area)
- Contents, type, and approximate volume of waste
- Contaminant types based on available information
- Documentation of properly labeled containers
- Shipping information (transportation and disposal companies), dates, times, manifests signed by whom

4.0 SITE SAFETY AND HEALTH DOCUMENTATION

Site Safety and Health (SSH) information may be recorded in a separate SSH logbook maintained by the Site Safety and Health Officer (SSHO), or in the field logbook. Additional documentation will include field forms provided in the site Accident Prevention Plan (APP), Site Safety and Health Plan (SSHP), or other applicable site safety plan. The SSHO will be responsible for obtaining and retaining the following documentation:

- When the daily health and safety meeting/briefing was conducted (use daily form to record meeting topics and attendees)
- Daily health and safety site inspections
- Daily inspection of field equipment
- Weather, including general weather conditions, temperature, and other conditions that may cause or contribute to hazards
- Review and signatures on site safety plan and associated activity hazard analyses (AHAs) by all affected employees
- Inventory of all hazardous chemicals on site and the associated Safety Data Sheet (SDS) for each
- Copies of any/all required training records specific to the hazards anticipated on site
- Calibration of and any problems associated with equipment utilized for the purposes of personnel exposure monitoring (i.e., air monitoring equipment, noise dosimeters, wet bulb globe temperature monitors, et al.)
- Detailed record of health and safety incidents at the site, including subcontractor incidents
- Medical problems with field team member, including those taking special medications

5.0 FIELD FORMS

Field forms are used to efficiently collect detailed and complete field data. The Field Team Leader (FTL) or designated team member is responsible for distribution, collection, and maintenance of field forms. Project-specific forms should be listed in project work plan or planning document(s). The FTL is responsible to verify that the forms are filled out correctly by the field team members. Examples of forms that may be used for field work include:

- Daily Site Safety Briefing Form
- Visitor Sign-In
- Site Safety Health Plan (SSHP) Forms
    - Contractor SSHP Acceptance Form
    - Employee SSHP Acceptance Form
- Air Monitoring Log
- Drilling Log
- Well Construction Log
- Well Development Log
- Well/Boring Abandonment Log
- Groundwater Sampling Log
- Groundwater Level Measurement Log
- Sampling Logs (by media or as designated in site-specific SAP)
- Decontamination Form
- Chain-of-Custody Form
- Field Equipment/Meter Calibration Form
- IDW Inventory

6.0 MANAGING FIELD RECORDS

Tracking field records, including logbooks and forms, is the responsibility of the FTL during field operations. The FTL compiles the original field forms and stores then in a location to prevent damage during field operations. At the end of the fieldwork or phases of fieldwork, the FTL delivers the field forms and logbook(s) to the project manager. The FTL maintains copies of the field forms throughout the duration of the project.

Non-bound hard copy field records such as field forms will be completed on the day the associated activity occurs, signed or initialed by the person completing the form, and turned in to the FTL by the end of the day. The unbound daily field forms should be sent to the project manager on at least a weekly basis, or on a fixed schedule that the project manager has approved; the project manager will determine a schedule for assuring that hard copies are periodically scanned for storage as electronic files with other project documentation as described below.

Field data collected and entered electronically will be downloaded to a secure storage device and/or to the electronic project file on an OESC server. Field data will be downloaded on a daily basis by the person collecting the data. The FTL will be responsible for verifying that electronic data collected are present in electronic media and in the project file. A hard copy of electronic records may be generated and filed in a project file, depending on project records retention requirements and in accordance with regulatory requirements for records retention, where applicable.

7.0 DAILY QUALITY CONTROL AND PRODUCTION REPORTS

The U.S. Army Corps of Engineers has developed a construction quality control and production reporting protocol that includes a number of forms commonly used on federal government projects (USACE, 1995). Forms for environmental and construction activities include forms for sampling, well installation, remedial system installation, removal actions, demolition, etc.

During development of work planning documents, it will be determined which forms are required and how they must be distributed. Use established templates for each form. Changes to official forms should be approved by the client representative prior to use. The FTL, construction manager, or designee is responsible for timely submittal of forms. Generally, the project manager reviews and maintains a file of the forms. The following are examples of commonly used forms.

- Contractor Quality Control (CQC) Daily Reports are completed by the FTL or site manager to provide a daily report of construction and/or field activities to the client representative, base representative, and OESC project manager. CQC Reports are completed and sent daily to the client representative and OESC project manager during field events or construction activities. Information on the CQC Report is in a concise, bulleted format, and includes, at minimum:
    - Project, contract, and delivery order/task order numbers
    - Date (on each page)
    - Project name and location
    - Temperature range, sun/wind conditions
    - Summary of site activities
    - Level of health and safety protection used
    - Field instruments used and calibrations performed
    - Problems encountered and corrective actions taken
    - Sampling or testing activities performed (sample IDs)
    - QC samples collected (QC sample IDs)
    - Additional remarks as applicable
    - Signature of person filling out CQC Report
- Daily Contractor Production Reports are also filled out and submitted on a daily basis along with the CQC Report. The Contractor Production Reports document work performed, health and safety actions and inspections, equipment and personnel on site, number of hours for equipment and personnel, equipment and material received, and remarks (generally, production achieved). The Daily Contractor Production Report references specific plan documents or work plan sections for each activity (USACE, 2004).

8.0 REFERENCES

U.S. Army Corps of Engineers Professional Development Support Center and U.S. Naval Facilities Engineering Command. 2004. Construction Quality Management for Contractors: Student Study Guide. Control #784. January.

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STANDARD OPERATING PROCEDURE OESC005A

FIELD PARAMETER MEASUREMENTS IN WATER

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signatures	Date
Prepared By: Moriah Mason Staff Environmental Scientist	Moriah B. Mason	16 December 2020
Reviewed By: Brandon Womack Geologist		20 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	20 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to establish a uniform procedure for collection of the field parameters associated with groundwater and surface water.

This SOP may also apply to the testing of wastewater; however, the general intent of this SOP is for environmental monitoring sampling of natural waters and is not intended for waste characterization or unknown waste categorization.

2.0 SUMMARY AND METHOD

Accurate measurement of field parameters is critical for the prediction and interpretation of the reactions and migration of dissolved species. Practices covered under this SOP include measurement of the following:

- Multiple parameters during purging of groundwater monitoring wells
- Multiple parameters in situ (in the well) by downhole deployment of measuring devices
- Surface water quality parameters
- Individual parameters (using single purpose meter)
- Ferrous iron in water samples using field test kits

Refer to SOP OESC008F for guidance regarding parameter stabilization criteria for groundwater sample collection.

2.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

3.0 EQUIPMENT AND SUPPLIES

The set-up and use of field meters will follow manufacturer's recommended procedures to assure consistency of use. In addition, all meters will be properly maintained, cleaned, calibrated, operated, and stored in accordance with the manufacturer's specifications. All field measurement equipment will be properly calibrated prior to use in the field in accordance with the manufacturer instructions.

- Refer to SOP OESC011B for guidance regarding instrument calibration.

4.0 FIELD MEASUREMENT USING MULTI-PARAMETER PROBE

4.1 Description

Field measurement of several water quality parameters at once is performed using a multi-parameter probe. Different manufactures offer different configurations; typical meters for groundwater and surface water applications include:

- Temperature
- Specific conductance
- Oxidation-reduction potential (ORP)
- pH
- Dissolved oxygen (DO)

Some multi-parameter probes may include a turbidity meter, but a separate meter for measurement of turbidity is recommended.

A list of the specific parameters that must be measured in the field will be identified in the project-specific Sampling and Analysis Plan (SAP) or Uniform Federal Policy – Quality Assurance Project Plan (QAPP).

Typical uses of a multi-parameter water probe include:

- Measuring water quality parameters downhole in a well
- Monitoring purged groundwater in a flow-through cell that is attached to the outflow tubing of a pump
- Directly measuring water in a surface water body
- Obtaining measurements using a grab sample of groundwater or surface water (turbidity and ferrous iron)

4.2 Procedure

The following are general procedures to be implemented before deploying multi-parameter water probe:

1. Inspect the exterior of equipment (probe and digital readout display) for damage (e.g., tears or cuts in cable, cracked probe housing, etc.). If there are cuts in the cable, calibration will indicate whether or not the cut cable affects connections from the probe to the data logger. If damage affects the operation of the probe and/or data logger, the equipment will be replaced with functional equipment and damaged equipment will be returned for repair.

Inspect the DO and pH probes for a silicon or rubber protective sleeve; if present, remove before calibration and purging. Save sleeves to reinstall before returning to rental company.

2. Prior to use, the probe will be calibrated for all of the parameters that will be measured in the field (with the exception of temperature, although instrument performance will be checked in ice water).

   Calibration for the instrument shall follow the instructions outlined in the manufacturer instructions which will be stored in the equipment box, field vehicle, or mobile laboratory for reference.

   To check temperature probe performance, place the probe in ice water and check the reading once it has stabilized. Ice water will measure between 0° and 4° Celsius (between 32° and 39.2° Fahrenheit).

3. Upon completing calibration, the probe and digital readout display are ready for use. Special care will be taken in deploying the probe in the various configurations. A discussion on using each configuration follows.

4.3 Deploying a Multiparameter Probe Downhole in a Monitoring Well (Transducer)

When possible, reference historical groundwater analytical data for each well where the instrument will be used. Highly contaminated groundwater and free-phase liquids could degrade instrument performance by damaging sensors. Communicate relevant field observations (e.g., strong odors, presence of product) with your Field Team Leader (FTL) or project manager. Check available well construction logs or project specific SAP or UFP-QAPP for specific well information before deploying instrument.

1. Measure water levels and total well depths with sufficient time before deployment of the probe to allow disturbed well bottom sediments to resettle (at least one hour).
2. If the screened interval and depth to the top-of-screen are known, measure sufficient cable length to place the probe within the middle of the screened interval of the well. If the water column is below the top of the screened interval, place probe within the middle of the difference between the water level and the bottom of the screen. If the water column height in the well is less than 2 feet, use of the probe downhole is not recommended (discuss alternative measurements with FTL or PM).
3. Do not deploy the probe in the stagnant water column above the screened interval or in the bottom well sump because stagnant groundwater in the well casing is not representative of groundwater in the formation.
4. Slowly lower the probe into the well to minimize splashing or disturbance of the water. To prevent the disturbance of sediment, be mindful to not drop the probe down the well or tag the bottom.
5. Secure the cable at the wellhead to ensure that the probe remains at the desired depth.
6. Set up the file name and logging parameters on the data logger following manufacturer’s instructions.
7. If possible, secure well cover to prevent tampering while deployed.

4.4 Deploying Multiparameter Probe in a Flow-Through Cell

1. Inspect flow through cell O-rings for any damage or tears. Ensure that the screw-on top of the flow-through cell is not cross-threaded when inserting the probes into flow-through cell.
2. Connect the inlet line of the flow-through cell with the pump discharge line.
3. Ensure the outlet line of the flow-through cell is secured to a proper discharge container (e.g., 5-gallon bucket or 55-gallon drum).
4. Once purging has begun, allow the flow-through cell to fill with water and begin flowing out of the outlet line into the discharge container. This ensures that all probes are fully submerged and will give accurate readings.
5. Determine the flow rate using a graduated cup and timer to ensure rate is in low-flow limits (refer to SOP OESC008F).
6. If needed, place the flow-through cell at a 45-degree angle with the outlet line facing upward to help remove trapped air bubbles during the collection of measurements.

4.5 Surface Water Measurements with a Multiparameter Probe

Follow manufacturer’s instructions for probe set-up. Since surface water conditions are highly variable, this SOP provides only general instructions for collection of the data. Generally, surface water measurements will be collected from the top 2 feet of the water column, unless otherwise specified in the site-specific SAP or UFP-QAPP.

1. Slowly lower the probe into the surface water sampling location, minimizing splashing and disturbance of the sediment. Completely submerse all probes.
2. Prevent submerging the bottom of the probes directly into the streambed by using the equipment’s attachable perforated housing.
3. If reading measurements while in moving water, work from downstream to upstream to avoid contamination of downstream samples with suspended sediments transported in the current.

4.6 Measurement Interval Guidelines

Field parameter measurement intervals will be dependent on the objectives of the project, equipment being used, and flow rate. The following are suggested time intervals for specific activities requiring field parameter measurements:

Activity	Criteria Determining Measurement Interval	Approximate Time Intervals for Readings (min.)
Development of a monitoring well	One well volume (OESC008D)	5-10
Purging of a monitoring well	“Turn over” of at least one flow-through cell volume (OESC008F)	5-10
Sampling Surface water	Equalized parameters	One time reading

5.0 FIELD MEASUREMENT OF SPECIFIC CONDUCTANCE

5.1 Description

Specific conductance is a measurement of water's ability to conduct or transmit an electrical current, which depends on the presence of ions, their total concentration, mobility, and temperature. For inorganic species, the electrical conductivity of water is directly proportional to the total dissolved salt content. Additionally, specific conductance is an indirect way of determining total dissolved solids (TDS). It can also be used as an indicator of change within a system and aid in evaluating whether a sample is representative of the water in the system. It is rapidly and easily measured in the field.

Briefly, the specific conductance is defined as the measure of the quantity of electricity transferred across a unit area, per unit potential gradient, per unit time. A cell constant is determined by measuring a solution of known conductivity. Solutions of known conductivity are usually provided with the field equipment rental but can also be purchased or made from reagent-grade KCl. Sampling personnel will consult operating instructions for the specific instrument used for the determination of the cell constant. This conductivity is expressed in various units, including micromhos per centimeter (µmhos/cm) and microsiemens per centimeter (µS/cm).

The following procedure describes the field measurement of the specific conductance of an aqueous sample using a conductance meter and a platinum or stainless-steel electrode. This method is applicable to groundwater and surface water. The specific conductance of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge type, or equivalent. Samples are preferably analyzed at 25°C. If not, temperature corrections are made and results reported at 25°C. The specific conductance meter will be calibrated on a daily basis prior to the procedures outlined below. The calibration procedures will conform to the manufacturer's specifications.

5.2 Procedure

Follow the instruction manual for the specific field conductivity meter used.

1. Collect the sample and record its temperature.
2. Set the instrument's temperature adjustment to the temperature of the sample, if required.
3. Immerse the probe in the sample, keeping it away from the sides and bottom of the container. Make sure the probe is entirely submerged.
4. Report the results to the nearest ten units for readings under 1,000 µmhos/cm and the nearest 100 units for readings over 1,000 µmhos/cm.

5.3 Documentation

Record the following information:

1. Date and time of calibration, solutions used, solution expiration dates.
2. Instrument manufacturer and model number.
3. Site name, sampling location, date, and time.
4. Person performing the measurement.
5. Sample specific conductance readings or download data logger as soon as practicable following data collection.

5.4 Precision and Accuracy

Most conductivity meters have an accuracy of ± 2% of the reading. With satisfactory equipment, results within 1% of the true value will be obtained.

6.0 FIELD MEASUREMENT OF PH

6.1 Description

The measurement of pH in an aqueous solution uses a reference electrode of known potential (pH meter). The pH of a solution is defined as the negative logarithm to the base 10 of the hydrogen ion activity in moles per liter or grams equivalent per liter (pH = -log[H+]). The pH expresses the relative acidity or alkalinity of a fluid on a scale from zero to 14. A pH of seven represents a neutral solution. Follow the site-specific safety plan when measuring pH in fluids that may be highly acidic (pH 4 or less) or highly alkaline (pH 9 or greater).

Natural waters generally have pH values in the range of four to nine. The primary control over pH in natural waters is the carbonate system, including gaseous and dissolved carbon dioxide, bicarbonate, and carbonate ions. Sample degassing may affect pH due to loss of carbon dioxide. Temperature and ionic strength of the fluid are factors that also may affect pH measurements.

The following procedure describes the field measurement of the pH of an aqueous sample using a pH meter attached to a multiparameter probe. This method is applicable to groundwater and surface water. The pH meter will be calibrated on a daily basis before the day's activities begin.

6.2 Procedure

1. Before the start of the day's activities, calibrate the pH meter using the provided calibration solution(s), following manufacturer's instructions.
2. At the job site, allow the pH meter to equilibrate to ambient temperature before use.
3. Thoroughly rinse the electrode with distilled water.
4. Insert the multiparameter probe into the flow-through cell or perforated housing.
5. Record the stabilized reading in the logbook.
6. Rinse the probe with deionized water after each sample. If exposed to oily solutions, thoroughly cleanse with laboratory-grade detergent and triple rinse before next sample.
7. Properly store meter according to manufacturer's instructions.

6.3 Documentation

For each field event, record the following information:

- Date and time of calibration, solutions used, solution expiration dates
- Instrument manufacturer and model number
- Site name, sample location, date, and time
- Person performing the measurement
- Sample pH readings or download data logger as soon as practicable following data collection

6.4 Precision and Accuracy

Under normal conditions the accuracy of a pH meter is to ± 0.01 pH units.

7.0 FIELD MEASUREMENT OF DISSOLVED OXYGEN

7.1 Description

The measurement of DO in an aqueous solution provides an estimate of the oxidation state of the water and indirectly measures the ability of the water to support aerobic metabolism or geochemical reactions. DO is commonly used as an indicator to evaluate groundwater remedial progress, particularly for enhanced in-situ bioremediation. Two different types of DO meters are now available: the optical DO sensor and the electrochemical cell. Of the two types, the optical DO sensor provides greater accuracy and precision as well as less interference from groundwater conditions or data collection methods.

7.2 Procedure – Optical Dissolved Oxygen Sensor

Follow the manufacturer's instruction manual for the specific DO sensor used. Generally, the optical DO sensor is used with a data logger (e.g., TROLL) or on a multiparameter probe (e.g., Horiba or YSI); follow manufacturer's instructions for set-up and connection of the data logger with the DO sensor (InSitu, 2009).

1. Follow manufacturer's instructions for DO sensor calibration, and record calibration results. (Note: For multiparameter probes such as a Horiba, which do not field-calibrate this sensor, record ambient air DO reading.)
2. Rinse the sensor and other probes thoroughly with distilled water following completion of all calibration steps. The optical DO sensor will be calibrated at least once every 3 months.
3. Select the oxygen concentration units (e.g., mg/L [ppm], µg/L [ppb], microMolar concentration [µmol/L], or oxygen saturation [%]). The desired units may be specified in the SAP or UFP-QAPP and generally will be consistent for all monitoring events to prevent data interpretation errors.
4. If you are measuring DO in a significantly saline environment (e.g., marine waters, salt-water intrusion areas, landfill leachate zones) a salinity compensation algorithm will be applied during DO sensor setup following manufacturer's instructions. Use the most recent salinity data from the site.
5. Deploy the calibrated optical DO sensor either downhole in a monitoring well, in a flow-through cell, or directly in a surface water body. DO changes rapidly in response to pressure and temperature changes; therefore, DO measurements collected in ways other than those listed may not be valid. For example, readings of DO in a bucket of purge water are unlikely to reflect subsurface aquifer conditions.
6. Record the results in the field logbook and applicable field form or, if using a data logger, download the data logger as soon as practicable following the field event.

7.3 Procedure – Electrochemical Cell DO Meter

Follow manufacturer's instruction manual for the specific DO meter used.

1. Prior to field use, inspect the membrane of the DO meter for air bubbles and/or holes. Replace the membrane if bubbles or holes exist.

2. Make sure the membrane is wet by soaking it in analyte-free water prior to calibration and during storage.
3. Calibrate the DO meter on a daily basis in accordance with to the manufacturer's instructions.
4. Use the DO probe either downhole in a monitoring well, in a flow-through cell, or directly in a surface water body. DO changes rapidly in response to pressure and temperature changes; therefore, DO measurements collected in ways other than those listed may not be valid. For example, readings of DO in a bucket of purge water are unlikely to reflect subsurface aquifer conditions.
5. When deployed downhole, it may be necessary to move the probe slowly up and down in the water column (unless the device is equipped to move water past the sensor). The sensor will deplete the oxygen around it and will yield artificially low DO readings if held steady in still water.
6. Record the results within the field logbook and applicable field form to the nearest 0.1 mg/L.

7.4 Documentation

Record the following information:

1. Date and time of calibration, solutions used, solution expiration dates.
2. Instrument manufacturer and model number.
3. Site name, sampling location, date, and time.
4. Person performing the measurement.
5. Sample DO readings or download data logger as soon as practicable following data collection.

8.0 FIELD MEASUREMENT OF OXIDATION REDUCTION POTENTIAL (ORP)

8.1 Description

ORP is a measurement, in mV, of the tendency of a chemical substance to oxidize or reduce another chemical substance. An ORP sensor consists of an ORP electrode and a reference electrode, similar to a pH meter.

The principle behind the ORP measurement is the use of an inert metal electrode (platinum, sometimes gold), which, due to its low resistance, will give up electrons to an oxidant or accept electrons from a reductant. The ORP electrode will continue to accept or give up electrons until it develops a potential, due to the built-up charge, which is equal to the ORP of the solution. (Emerson Process Management, 2008).

8.2 Influences on and Limitations of ORP Data:

ORP is a nonspecific measurement: An ORP measurement reflects the combined effects of all dissolved species in the fluid. Unless the dissolved species, and in particular, the predominant redox-active species, are known through geochemical testing, ORP data in relatively clean groundwater or surface water has only limited utility.

Temperature: The temperature of the water for which ORP is being determined will affect the voltage output of the sensor. While temperature must be taken into account for calibration and will be considered when reporting field ORP values, the variation is usually not definable since the temperature effect depends on the dissolved species responsible for the ORP reading, and these species are usually not known exactly for environmental water.

Contamination of the ORP Sensor: A slow equilibrium response or erratic response may indicate a fouled ORP sensor. Particularly for routine monitoring (versus long-term monitoring as in installation of the probe in a well), the ORP sensors must be properly maintained and stored to ensure quick equilibrium time and accurate readings.

Low Concentration of Redox-Active Species: Environmental waters can be naturally low in reduction/oxidation species; essentially these waters fall below the detection limit of the ORP meter.

Due to the listed limitations, ORP measurements are best applied when measuring changes in ORP due to completion of redox reactions (Emerson Process Management, 2008).

8.3 Procedure

1. Follow manufacturer's instructions for the ORP meter used; record calibration results (if calibration performed). Rinse the sensor thoroughly with distilled water following completion of all calibration steps.
2. Deploy the calibrated ORP meter either downhole in a monitoring well, in a flow-through cell, or directly in a surface water body.
3. Record the results in the field logbook and applicable field form or, if using a data logger, download the data logger as soon as practicable following the field event.
4. Clean and properly store the ORP Meter.

8.4 Documentation

Record the following information:

1. Instrument manufacturer and model number.
2. Date and time of calibration, solutions used, solution expiration dates.
3. Site name, sampling location, date, and time.
4. Person performing the measurement.
5. Sample ORP readings or download data logger as soon as practicable following data collection.

8.5 Precision and Accuracy

Under normal conditions the typical accuracy of an ORP measurement is ±5 mV. (Emerson Process Management, 2008).

9.0 FIELD MEASUREMENT OF TURBIDITY

9.1 Description

Elevated turbidity in a sample indicates it contains suspended matter that may affect the quality of analytical data.

The turbidity meter will be calibrated in accordance with the manufacturer's manual. The following procedures will be used to measure the turbidity of a sample using a handheld turbidity meter (e.g., Hach).

9.2 Procedure

1. Place reference container (cuvette) in light well of handheld meter. Take care in handling and storing the cuvette to prevent inaccurate results. Reference standards should be completely filled; do not uncap.
2. Use the provided sample cuvette for the sample – clean inside and outside surfaces with a lint-free, non-abrasive wipe or soft cloth before use. Take care to not scratch cuvette surfaces.
3. Fill cuvette approximately three quarters full of water to be sampled. Replace cap onto the cuvette.
4. Completely dry the outside of the cuvette before placing it into the light well. Moisture on the outside of the cuvette can cause false high readings.
5. Place sample in light well of handheld meter and close the light well lid. Select the appropriate range for best readability. Cuvettes will be handled in accordance with the manufacturer’s specifications.
6. Note and record sample turbidity.
7. Properly dispose of sample and clean cuvette thoroughly before filling with the next sample.

9.3 Documentation

Record the following information:

1. Date and time of calibration, solutions used, solution expiration dates.
2. Instrument manufacturer and model number.
3. Site name, sample location, date, and time.
4. Person performing the measurement.
5. Sample name and sample turbidity readings.

9.4 Precision and Accuracy

Under normal conditions:

Linear	±1% of full scale; and
Repeatability	±1% of full scale.

10.0 FIELD MEASUREMENT OF FERROUS IRON

10.1 Description

This section is for measurement of ferrous iron in groundwater using a field test kit. It is preferable to analyze ferrous iron immediately following sample collection to ensure accuracy and representativeness. Ferrous iron data are typically used as part of natural attenuation monitoring in groundwater to determine the predominant terminal electron accepting process.

Ferrous iron field test kits are generally colorimetric tests. The provided reagent reacts with ferrous iron in the sample to form an orange color in proportion to the ferrous iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

The following procedures describe the method to field test for ferrous iron in an aqueous sample. This method is applicable to natural waters (i.e., surface water and groundwater).

10.2 Procedure

1. Fill a test-kit provided viewing vial to the first (5-mL) line with distilled water. This will be the reference vial. Place this vial in the top left opening of the color comparator.
2. Fill the measuring vial to the 25-mL mark with sample water.
3. Add the contents of one Ferrous Iron Reagent Powder Pillow and recap the measuring vial.
4. Swirl/Shake to mix. An orange color will develop if ferrous iron is present. Allow three minutes for full color development.
5. Fill another viewing vial to the first (5-mL) mark with the prepared sample water.
6. Place the second viewing vial in the top right opening of the color comparator.
7. Hold comparator up to a light source such as the sky, a window, or a lamp.
8. Look through the front openings and rotate the color disc until the overlaid reference vial color matches in the sample vial color.
9. Read the mg/L ferrous iron in the scale window.

10.3 Documentation

Record the following information:

1. Site name, sampling location, source of sample, sample type.
2. Date and time of the sample collection
3. Person performing the measurement.
4. Results for ferrous iron.

11.0 REFERENCES

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STANDARD OPERATING PROCEDURE OESC006B

SAMPLING OF SURFACE SOILS AND OTHER SURFICIAL MATERIALS

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Mark Wanek Project Geologist	Mark Wanek	25 February 2021
Reviewed By: Robert Price Senior Geologist		22 February 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	28 February 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to define the techniques and requirements for collecting grab surface-soils and other surficial material samples for the purposes of site characterization and/or risk assessment.

2.0 SUMMARY OF METHOD

Surface soil is usually referred to as the soil extending from the ground surface to a depth of approximately 1 foot (ft) below land surface. For human health risk assessment purposes where physical contact with soil is part of the exposure route (e.g., analysis of potential soil ingestion and inhalation of particulates), surface soil samples are typically collected from the upper 6-inches of soil. In consultation with regulatory agencies, the site-specific project Sampling and Analysis Plan (SAP) or Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) or comparable document will specify the depth at which surface soil samples are to be collected.

Surface-soil samples are collected to determine the type(s) and level(s) of contamination, define the area affected by contaminants, and determine background concentrations. These samples may be collected as part of an investigative plan, site-specific sampling plan, and/or as a screening method for areas of potential contamination that may require more extensive sampling.

This SOP also applies to the collection of samples from other types of surface materials (fills, sediments, or other relatively dry, non-cemented media). This SOP does not cover radioactive materials.

2.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

3.0 SAMPLING EQUIPMENT

3.1 General Sampling Supplies

Equipment and supplies that are typically needed for sampling surface soils and other surficial materials include:

- Site-specific UFP-QAPP or SAP
- Field logbook and/or sampling forms and site map
- Global Positioning System (GPS) equipment
- Indelible (waterproof) ink pens, paint pens, and markers
- Sample tags/labels and the appropriate forms/documentation (including chain-of-custody forms) as described in OESC SOP OESC010C
- Appropriate sample containers, insulated cooler, ice for sample preservation (if required)
- Latex or nitrile gloves
- Plastic zip-top bags and waterproof sealing tape
- Plastic sheeting
- Decontamination equipment (e.g., rinse bottles and pressurized spray tanks) and supplies (e.g., ASTM Type II organic-free water, Alconox®). See OESC SOP OESC011A for decontamination procedures
- Protective clothing and gear
- Site-specific Safety and Health Plan (SSHP)

3.2 Soil Sampling Equipment

The following list provides general guidance to field personnel preparing for a field event including surface soil sampling:

- Appropriate equipment and field screening instruments (e.g., GPS, photoionization detector, x-ray fluorescence analyzer) for obtaining field measurements as specified in the UFP-QAPP or SAP.
- Distance measuring device (e.g., tape measure).
- Sampling device (e.g., soil auger, slide-hammer sampling assembly, stainless-steel trowel). If sampling for analysis of volatile organic compounds (VOCs), the sampling device can be Teflon®-lined or constructed of stainless steel, brass, or mild steel. When sampling for metals, the sampling device must be stainless steel or plastic. When sample for PFAS, the sampling devices must be PFAS-free. Always refer to the project-specific QAPP or SAP.
- See SOP OESC010B for VOC sample collection devices (e.g., En Core®, Terra Core™, etc.)
- Stainless steel, brass, Lexan® or Teflon® inserts for auger sampler (if used)
- Plastic end caps for the sleeves, aluminum foil, and Teflon® or silicon tape

- Stainless-steel and/or Teflon®-lined pans, trays, or bowls for compositing sample material (if required by SAP)
- Stainless-steel and/or disposable plastic scoops, shovels, trowels, spoons, or spatulas
- Appropriate certified-clean laboratory grade glassware for sample collection

4.0 PROCEDURES

4.1 Preparations for Sample Collection

When preparing for sample collection:

1. Personnel will first don appropriate protective clothing and equipment as required by the SSHP.
2. Create a clean work surface for sample collection using plastic sheeting on the ground or a portable table covered with clean plastic sheeting near the sampling area, and place decontaminated sampling equipment, sampling containers, and cooler on it. If equipment is to be decontaminated in the field, place a separate plastic sheet away from the sampling area on the ground for the decontamination equipment and supplies. This will serve as a decontamination area for sampling equipment after sampling is completed.
3. Record all information in the field logbook or on field forms (refer to SOP OESC007B). Document any deviations from procedure(s) and rationale(s) for changes in the field logbook and/or on field forms, as required by the UFP-QAPP or SAP.

4.2 Collection of Discrete Surface Soil Samples

When sampling for multiple contaminants, collect samples for VOC analysis first following procedures to minimize loss of volatiles.

4.2.1 Discrete Samples for Volatile Organic Compounds Analysis

1. Follow the sampling pattern outlined in the site-specific UFP-QAPP or SAP. When known or suspected contamination exists (e.g., spill area or dumping site), collect samples beginning at the anticipated least contaminated locations and progressing to the anticipated most contaminated locations.
2. Change gloves between each sample location and use decontaminated equipment at each location to minimize cross-contamination.
3. Label each certified-clean laboratory-provided container with the appropriate information (sample number, analysis, date, time, sampler initials, etc., as described in SOP OESC010C). Record the information into the Field Logbook.
4. Carefully remove or excavate vegetation, loose debris, and exposed material from the top 1 to 2 centimeters (cm) or to the desired sampling depth.
5. Use a stainless-steel spoon, trowel or hand auger or assemble a clean slide-hammer sampling assembly with a stainless steel, brass, or Teflon® liner. The type and material of the liner will be specified in the UFP-QAPP or SAP and noted on the field forms by the sampler.
6. Collect the sample by advancing the sampler into the soil to the desired depth of the sample.
7. Withdraw the sampler and extract the sleeve (if used).

8. If the sample is saturated with water, carefully decant the water from the sleeve with minimal disturbance to the sample.
9. If using sampler liner, carefully cut open the liner using the appropriate tools as specified in the SAP.
10. Collect VOC sample volume(s) immediately from the freshly-exposed portion of the soil sample. Refer to SOP OESC010B for use of samplers appropriate for VOC analysis. The sampling device is specified in the site-specific UFP-QAPP or SAP and will be noted on field forms by the sampler.
11. If not using a liner, immediately transfer VOC samples to the appropriate container as defined in the UFP-QAPP or SAP. Add field preservative, if required. Note: <u>Do not composite or homogenize</u> the VOC sample.
12. Place custody seals on each container, and insert the samples in the cooler with ice so that the cooler remains at a temperature of at 4 ± 2 degrees Celsius (˚C). Refer to SOP OESC010C and the UFP-QAPP or SAP for sample preservation, chain-of-custody, and shipping procedures.
13. Collect appropriate location, sample-depth, and/or field measurements and record data in the field logbook.
14. Mark the location with GPS coordinates and confirm the sample location with the field map.
15. Backfill the sample hole and flag or stake, as required. If used, mark the sample location identification (ID) on the flag or stake with a paint pen.

4.2.2 Discrete Samples for Semi-volatile Organic Compounds and Inorganic Analyses

1. Follow steps 1 through 9 from Section 4.2.1.
2. Homogenize the sample and place sufficient material into a certified-clean laboratory-provided container. Sample volume requirements are provided in the UFP-QAPP or SAP.
3. Remove stones, twigs, grass, etc., from the sample using the trowel or forceps.
4. Remove dirt and grit from the threads of sample container(s) with a gloved hand. Secure and seal the Teflon®-lined cap.
5. Follow steps 12 through 15 from Section 4.2.1.

4.3 Collection and Homogenization of Composite Samples

Composite samples (surface soil, sediment or other surficial material) consist of a series of discrete grab samples that are combined to characterize the average composition of a given material. The discrete samples used to create a composite sample are of equal depth and volume and are collected in an identical manner. The site-specific UFP-QAPP or SAP will specify the rationale (random grid, targeted, etc.) for the collection and number of discrete samples used in the composite sample.

Proper homogenization techniques should be followed to ensure the composite sample is well-mixed so that subsamples are representative of the whole. A laboratory may be responsible for performing the sample homogenization (ASTM D6323-12e1 and USEPA, 2002). Refer to the site-specific SAP or UFP-QAPP for composite sample homogenization and subsampling procedures.

Refer to SOP OESC010C and the UFP-QAPP or SAP for labeling, packaging, and shipping procedures.

4.4 Sieving Soil Samples

4.4.1 Objectives of Sieving Soil Samples

Sieving of soil samples may be performed in the field to segregate sample material by particle and/or determine grain-size distribution. Soil samples must be processed through multiple sieve sizes to determine grain-size distribution.

4.4.2 Equipment and Supplies

- Stainless-steel and/or Teflon®-lined pans, trays, or bowls for compositing and mixing sample material
- Stainless steel and/or disposable plastic scoops, shovels, trowels, spoons, or spatulas
- Sampling device (e.g., soil auger, slide-hammer sampling assembly, stainless-steel trowel). If sampling for metals, the sampling device must be stainless steel or plastic
- No. 10 mesh (2.0- millimeter) stainless-steel sieve, and other sieve sizes as required for project
- Digital scale
- Batteries

4.4.3 Field Procedures

1. Calibrate and "zero" the scale.
2. After collecting the sample as directed in Sections 4.1 through 4.3 above, weigh the total sample and record the information in the logbook or on field forms.
3. Place the sample into the sieve or sieve series and shake until the separated fraction has been produced from each sieve size. A shaker may be used.
4. Weigh each soil fraction; determine volume of each fraction if needed for determination of mass.
5. Collect desired samples from sieved fraction of the sample; place in sample container, record fraction size on label as well as sample ID. Manage samples following chain-of-custody procedures.
6. Record the weights, volumes, sample descriptions, sample processing methods and equipment in the field logbook or on field forms.

4.4.4 Field Quality Control Samples

The type and frequency of Quality Control (QC) samples will be identified in the site-specific SAP or UFP-QAPP. Field QC samples are designed to evaluate whether cross-contamination has occurred. QC samples may include trip blanks, equipment blanks, field duplicates, and field reagent blanks, per the project-specific SAP.

5.0 REFERENCES

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STANDARD OPERATING PROCEDURE OESC006D

SURFACE WATER SAMPLING

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Mark Wanek OTIE Project Geologist	Mark Wanek	25 February 2021
Reviewed By: Megan Duley, PE Senior Engineer	Megan Duley	13 April 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	20 April 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to establish a general procedure for obtaining representative samples from various types of surface water bodies including lakes and streams, springs or seeps, impoundments, and wastewater treatment plant access points, outfalls, pipes, and drains.

Data quality objectives (DQOs), contaminant types, and surface-water body configurations vary from project to project. Refer to the project-specific planning documents, such as a Sampling and Analysis Plan (SAP), to identify the project DQOs, samples to be collected, methods and procedures, and equipment. Refer to the Site-specific Safety and Health Plan (SSHP) to prepare for and mitigate potentials risks during surface water sample collection.

2.0 SUMMARY AND METHODS

Surface water is defined as water that flows over (lotic) or rests on (lentic) the land and is open to the atmosphere. For the purpose of this SOP, a surface water body is defined as a naturally occurring or man-made drainage, impoundment or other surface feature containing or discharging water.

2.1 Definitions

Lentic sites – All sizes and shapes of lakes, reservoirs, ponds, wetlands, or any other body of surface water where water generally does not move unidirectionally.

Lotic sites – Streams (fast or slow, ephemeral or perennial), canals, ditches, and flumes of all sizes and shapes or any other surface water feature in which water moves unidirectionally. Lotic sites are those with organisms or habitats in rapidly moving fresh water.

Grab samples – Discrete aliquots representing a single location at a given point in time. The sample is collected all at once and at only one particular point in the sample medium. Grab samples are not mixed or composited with other samples.

Composite samples – Water sample in one container that is composed of more than one aliquot (or subsample) collected at various locations and/or at different points in time. Analytical results from this type sample represent an average value for the locations or time periods incorporated into the sample. Samples collected for analysis of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) must not be composited.

Integrated samples – Continuously collected subsamples from a water column or across a cross-section of waterbody; these differ from composite samples, which are not collected continuously.

Intermediate sampling containers – Temporary sampling vessels used to directly sample water and transfer to a primary sample container. Temporary containers should be composed of material compatible with site water quality and be larger than the primary sample container(s) to preserve sample quality/integrity to meet DQOs.

Thalweg – A line connecting the lowest points of successive cross-sections through a river channel or valley. Thalweg profiles are longitudinal profiles of the streambed elevation measured along the deepest portion of the stream.

2.2 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses.

If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

3.0 EQUIPMENT

In addition to the personal protective equipment required by the site-specific SSHP, all or part of the following equipment may be required at a specific site, depending on the project-specific planning documents:

- Rubber boots and/or rubberized waders
- Sample collection devices and equipment
- Flow measurement equipment
- Depth sounding equipment
- Thermistor and/or clinometer to measure temperature and salinity changes with depth, respectively
- Water quality meters for field measurement of parameters such as temperature, electrical conductivity, pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), turbidity, et al
- Data logging equipment or field data sheets
- Sample containers, preservatives, coolers and ice
- Decontamination equipment and supplies

A wide range of surface water sampling equipment is available, depending on the site constraints, DQOs, and procedures to be employed; some possibilities include:

- Dipper with an extended handle (pond dipper or pond sampler); the portions in contact with water should be constructed of material compatible with site water quality
- Sampling extension pole
- Weighted bottle sampler (1-liter capacity) - Wheaton bottle or Kemmerer bottle

- DH-81 (or similar) integrated sampler
- Submersible or peristaltic pump – pump components and tubing should be constructed of materials compatible with site water quality
- Bailer with weighted end
- Intermediate non-preserved sample container (e.g., polypropylene) used to collect sample to transfer to preserved sample container
- Sample container (e.g., glass jar) used to collect the sample with a gloved hand

4.0 SAMPLING CONSIDERATIONS

4.1 Preparation

In preparation of the sampling effort, the project and field leaders will determine the sampling methods to be employed and the types and amounts of equipment and supplies needed as established in the SAP. All necessary equipment should be decontaminated or pre-cleaned and in working order.

Safety during sample collection is always the first concern; the second concern is obtaining a representative sample or set of samples. A site survey should be performed as part of the SSHP and to assess safety issues at each sampling location and/or access point. Follow the site-specific SSHP; do not sample alone, wear the proper gear, and carefully evaluate seen and unseen potential risks before collecting a sample from a water body.

4.2 General Considerations for Lentic Sites

To collect a representative surface sample from a lentic body, potential stratification needs to be assessed. This will help to determine the appropriate sampling location(s) and depth(s). Field measurements such as DO, pH, conductivity, ORP, temperature, turbidity, and thermistors/clinometers can identify possible stratification that would affect analytical results. Water quality measurements will assist in selecting sampling locations and depths.

- Collect field measurements at 3-feet intervals from the surface to the bottom using the appropriate instrument (e.g., Hydrolab or equivalent).
- Depth characterization should be performed prior to *each* sampling event.

Sampling Position

Follow site-specific SSHP outlining correct use and requirements of operation of a boat. To avoid gas/oil contamination for boat motor (if applicable), collect samples from near the bow and upwind. Avoid surface debris and the boat wake.

Collect onshore samples from within 2.5 feet of the shoreline by using an extending pole or from a wharf/pier. Collect samples upwind, taking care to avoid any surface debris.

Avoid areas with moored boats and utilities, unless it is part of the SAP.

Avoid wading into the water to collect a sample within a lentic site; substrate disturbance from walking may contaminate the sample.

4.3 General Considerations for Lotic Sites

The selection of the surface water sample locations at lotic sites will depend on the type of surface water body being sampled. The following considerations apply:

- Field conductivity measurements are recommended for determining the uniformity of the water composition across the width and depth of the water body. Field salinity measurements may be taken to determine sample locations in estuaries and lagoons.
- If an average composition is required, then avoid sampling locations where mixing is visibly incomplete. For example, color or turbidity differences immediately below the confluence of a tributary and the main river or at a wastewater discharge point may indicate incomplete mixing.
- Avoid back eddies and side channels that would not be representative of the water quality affecting downstream sites.
- Unless otherwise specified in the project-specific SAP, collect samples at the mid-section or deepest flow channel of the stream (i.e., the thalweg). A vertical composite sample consisting of subsamples collected just below the surface, at mid-depth, and just above the bottom will be collected from the thalweg. For large rivers, several vertical composites across the channel may be required to characterize the water quality.
- Generally, sample locations will be closer together towards the thalweg where most flow occurs as opposed to the edges where less flow occurs. Consult the project SAP for sampling requirements.
- Collect samples in order from the downstream sample location to the upstream location to prevent sediment disturbance and sample contamination.
- At locations where surface water and sediment samples may be collected, the surface water sample will be collected before the sediment sample to avoid disturbing the sediments and possibly affecting the surface water quality.
- Collection devices must be constructed of materials that will not react with contaminants of concern or cross-contaminate samples. Metals other than high-grade stainless steel should not be used if samples will be collected for metals analysis. Materials that will react with organic contaminants should not be used when collecting samples for organic and/or semi-organic contaminants.

Sampling Position

Surface water bodies deeper than two feet or with perceptible current may be hazardous to sample by the wading-in method. If possible, collect samples from the shore, a bridge, pier or other stable structure. Use of a boat or raft may also be required to obtain a representative sample.

Do not wade into a water body unless following a site-specific SSHP that provides for that activity. If wading is required, approach the sample site from downstream, being careful not to disturb any bottom sediment. Position the mouth of the sample container so it faces upstream while the sampling personnel are standing downstream.

Once the sampling point has been selected, it must be fixed by detailed description with a global positioning system (GPS) device, maps, photos, and/or with the aid of stakes, buoys, or other landmarks so that subsequent visits to the site will allow the identification of the sampling point. When locating sampling points in a stream or river, the reference to the bank of the river will be from the vantage of looking upstream.

4.4 Sampling Seeps, Springs, or Discharge Points

Collect samples from as close to the point of water discharge as possible. Avoid disturbing any materials surrounding the sample to minimize the potential for introducing suspended sediment into the sample. If the discharge is inadvertently contaminated with suspended sediment, wait until the discharge has become cleared of suspended sediment, or approximately 5 minutes if the discharge naturally contains suspended sediment.

5.0 SAMPLE COLLECTION

Samples collected for analysis of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) must not be composited. When collecting samples from surface waters, the following procedures will be used:

1. Remove the sample bottles from the coolers. Fill in all information indicated on the bottle label with an indelible ink marker or permanent ink ballpoint pen (as compatible with Section 2.2).
2. Do not mix the caps or rinse the sample containers.
3. Measure in-situ field parameters and record data in the field log book or on field forms. Where possible, take field measurements (pH, temperature, conductivity, etc.) directly from the surface water body (not the sample) in the location from which the sample was collected.
4. Remove the stopper/lid from the container and collect the surface water sample, either directly (Section 5.1) or with an intermediate container/device (Section 5.2)

Refer to Section 5.1 or Section 5.2 at this point.

5. Replace cap and seal container tightly. Place the sample container in a sealed plastic bag.
6. After the samples have been collected, immediately place them in an ice-filled cooler maintained at 4 degrees (˚C) ± 2 ˚C for shipment to the appropriate laboratory. All samples will be packaged in a manner consistent with the project-specific planning documents.
7. If a map of the sampling locations is not available prior to sampling, then include a drawing of the location of the sample relative to known site features (not to scale) in the field logbook, on field forms, or a piece of paper to provide the location of each sampling point.
8. Fill out a sample Chain-of-Custody Form to maintain an accurate record of sample collection, transport, analysis, and disposal. Refer to project-specific planning documents for chain-of-custody labeling procedures.
9. Decontaminate equipment after each sample.
10. Discard contaminated personal protective equipment (e.g., nitrile gloves, Tyvek suits, etc.), managing wastes as required in the planning documents.

5.1 Direct Sampling

Whenever possible, surface water samples should be collected directly into the sample container. This procedure reduces loss of volatiles, cross-contamination, or other alteration that could occur during transfer from a collection vessel into the sample container. Direct sampling – collecting the water sample directly into the laboratory-provided sampling container – includes the following steps to be preformed following Step 4 in Section 5.0:

Container with no preservative:

1. Face upwind in lentic water and face upstream in lotic waters.
2. Hold the container near its base, reach out in front of your body, and plunge it (mouth down) below the surface to about mid-water column, taking care not to disturb the bed. If the water is shallow, this may disturb the substrate and contaminate the sample, in which case, collect a sample at the water surface.
    a. Hold the cap underwater near the mouth of the sampling container.
    b. Once the desired depth is reached, slowly rotate the container towards the surface, controlling the flow of water into the sampling container.
    c. Fill the container to the appropriate level depending on laboratory requirements. Do not overfill the container (overfilling could result in a sample with artificially increased sediment concentration or dilution of sample preservative). Likewise, do not underfill the container. Note that if the sample is to be analyzed for VOCs, there must be zero headspace in the container.
    d. Cap the sampling container while still underwater, once the container is filled to the appropriate level.
    e. Make note of changes in methodology, if any.
3. If an extension pole or pond dipper is used from a dock/pier or from shore, securely attach the sample container (with its lid in place) to the holder with clasps or bands. Remove the container lid and follow the above procedure. Do not use this method if the container has a preservative.

Container with preservative:

If you can reach the water with your hand, use the following procedure.

1. Hold the container upright and place the lid over the mouth so that only a small area forms an opening.
2. Immerse the container about 6 inches under the water surface while holding the cap in position with your fingers as far away from the opening as possible.
3. Carefully observe the rate the container is filling and remove it from the water before the headspace area is reached. If overfilling occurs, get a new sample container and repeat.
4. This procedure does not work well in fast moving, shallow water, in which an intermediate container will need to be used (Section 5.2).

5.2 Sampling with Intermediate Containers and Devices

1. The intermediate container should be larger than the total volume required for all samples being collected so that the samples can be considered grab samples. If the intermediate container needs to be filled more than once, the samples would be considered integrated samples.

2. Rinse the intermediate container with water from the water body to be sampled, and pour the rinsate away from or downstream of the sampling location. For turbid sites, inspect and rinse out sediment or organic debris that may collect at the bottom of the container.
3. Fill the intermediate container with water following the technique described for direct samples as closely as possible, noting variances. Submerge the container to a depth that does not disturb the substrate, but also avoids sampling the surface layer.
4. Gently mix the water in the intermediate container, and then fill the sample containers.
    a. For an open-top container, mix the water by swirling it before pouring it into the sample containers. However, do not swirl the sample if the sample is to be analyzed for VOCs.
    b. For a closed-top container, slowly invert the container three times to mix the water.
    c. Carefully fill the sample containers from the intermediate container, leaving headspace if required. Do not overfill.
5. Use the following procedures to collect samples at depth using devices such as Kemmerer or Van Dorn bottles:
    a. Test Kemmerer or other sampling device for complete seal and ease of closure before lowering into water body.
    b. Securely attach nylon or polyvinyl chloride (PVC) string to device. Gently lower into water body until desired depth is reached. Tie off string to ensure device remains at desired depth.
    c. Wait approximately 30 seconds for water to flow through sampler at depth, to ensure sample will not contain water from upper strata.
    d. Attach signal weight to string. Send signal weight down to close sample device.
    e. Gently, but quickly, raise device.
    f. Release the first 50-100 milliliters from the Kemmerer or Van Dorn device outlet before beginning to fill sample containers.
    g. Fill all sample containers equally. Collect other field measurements required (e.g., temperature, turbidity).

5.3 Field Quality Control Samples

The type and frequency of samples should be identified in the project-specific planning documents. Field quality control samples are designed to evaluate if cross-contamination has occurred. Quality control samples may include trip blanks, equipment blanks, field duplicates, and field reagent blanks.

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STANDARD OPERATING PROCEDURE OESC007A

DRILLING METHODS AND PROCEDURES

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared by: Mark Wanek Project Geologist	Mark Wanek	1 December 2020
Reviewed by: Nathan Mullins Geologist		11 January 2023
Approved by: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	28 February 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to support safe, consistent, and effective drilling procedures in environmental applications. Drilling methods are briefly reviewed and drilling procedures described. Due to the wide variety of possible drilling techniques, only a generalized procedure for drilling is provided in this SOP. Detailed drilling specifications will be provided in project-specific work plans.

1.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses.

If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

2.0 SUMMARY AND METHODS

Drilling is routinely performed during environmental and geotechnical site investigations to obtain lithologic data and install piezometers or monitoring wells. Selection of a drilling method for a site is based on the purpose of the drilling, target drilling depth, project data quality objectives, and site-specific geologic conditions. Common drilling methods for performing site investigations are briefly described below. More complete descriptions of most drilling methods can be found in Groundwater and Wells (Driscoll 1986) and other references.

2.1 Solid-Stem Auger

The solid-stem or flight auger is typically used for drilling shallow (less than 50 feet), small-diameter borings in unconsolidated and cohesive materials such as silts and clays for subsurface soil sampling. The auger is drilled to the top of the desired sampling depth and withdrawn from the borehole; the soil sample is collected using a split-spoon or Shelby tube method. Because the borehole is not stabilized during sampling, solid-stem augering is not recommended in sandy or gravelly formations where caving of the borehole is likely.

2.2 Hollow-Stem Auger

The hollow-stem auger is the most commonly used drilling equipment used for environmental site investigations. It is typically used for drilling to depths of up to 150 feet. Hollow-stem augering is effective in most unconsolidated environments because the borehole is stabilized by the hollow-stem auger during formation sampling.

Formation sampling is accomplished through the hollow-stem auger using a split-spoon or Shelby tube sampler, or using a continuous-core sampling device. A variety of soil, soil gas, and groundwater sampling devices have been developed for use with the hollow-stem auger.

2.3 Air Rotary Drill

Air rotary drilling is typically used for consolidated or hard rock formations. Depth capabilities are up to thousands of feet. The system uses a roller-cone bit with compressed air to bring cuttings to the surface. Inflowing air is filtered to prevent potential airborne contaminants from entering the borehole. Out flowing air may present a health and safety concern if airborne contaminants are present and should be considered during preparation of site-specific safety and health plans.

Bedrock cores may be collected using core barrels after air rotary tooling is removed from the borehole. Collecting soil samples for chemical analysis is possible in some cases, but the process is not typically feasible.

2.4 Air Hammer

The air hammer method is typically used for drilling in hard rock with depth capabilities to thousands of feet. An air hammer uses a pneumatic drill at the end of the drill pipe to rapidly strike the rock while slowly rotating the drill string. Compressed air is used to evacuate soil cuttings to the surface.

As with air rotary drilling, core barrels may be used to collect bedrock cores following tooling removal. Collecting undisturbed soil samples for chemical analysis is possible in some cases, but the process is not typically feasible.

2.5 Cable Tool

The cable tool method of drilling can be used for unconsolidated or bedrock drilling. Depth capability is thousands of feet; however, the drilling rate is very slow compared with other drilling methods (typically less than 30 feet per day). The drilling system uses a heavy bit and drill string that is repeatedly raised and lowered in to break up the formation. Cuttings are removed by using a bailer or sand pump. A casing advance system can be used to stabilize the borehole in unconsolidated drilling applications. Subsurface soil sampling can be performed using split-spoon or Shelby tube methods.

2.6 Dual-wall Reverse Air Hammer

The dual-wall reverse air hammer method can be used in unconsolidated or bedrock applications. Depths, measured in thousands of feet, can be drilled rapidly by this method (greater than 30 feet per hour [ft/hr]). The system uses a dual-wall casing to inject air between the walls of the dual-wall pipe, which lifts the cuttings up through the inner casing.

Formation sampling in the unconsolidated zone can be performed using split-spoon or Shelby tube methods. These samples are collected through the inner casing.

2.7 Water/Mud Rotary

Water/mud rotary methods can be used in unconsolidated or bedrock applications and are typically used in unstable borehole conditions. Boreholes can be drilled to depths of several thousand feet. The system uses a tri-cone bit with water or mud as the circulation fluid to remove cuttings from the borehole. Because large quantities of water or bentonite slurry are introduced to the borehole, this drilling method is not typically used during environmental site investigations.

Core samples may be collected using core barrels. Collecting undisturbed soil samples for chemical analysis is not possible. However, this method can be used to drill down to a certain depth quickly before changing to another drilling method to facilitate sampling.

2.8 Rotosonic drilling

Rotosonic drilling, also known as vibracore or sonic drilling, is used in unconsolidated or bedrock drilling applications. Rotosonic drilling is capable to depths up to approximately 1,500 ft. Rapid drilling rates of more than 40 ft/hr are possible. The system uses an oscillating head unit that produces a sonic wave imparting energy to the drill bit to achieve penetration. The drill string is slowly rotated during drilling. A complete 4-in.-diameter core is collected in the core barrel in 5- to 20-ft lengths. No cuttings are generated as part of the drilling process. Split-spoon or Shelby tube samples may be collected through the drill string.

3.0 EQUIPMENT AND SUPPLIES

The following equipment and knowledge of site conditions is required:

- Drilling or augering equipment appropriate to site conditions, drilling depth, and other project requirements;
- Drill bits appropriate for the expected lithology or rock types;
- Soil sampling equipment including but not limited to split spoon samplers, Shelby tube samplers, and other soil or rock coring devices;
- Table or other work surface to place soil or rock samples for visual inspection, organic vapor screening, soil/rock logging and classification, and other observations;
- Organic vapor analyzer (if applicable);
- Explosimeter (if applicable);
- Noise meter (if applicable);
- Tremie pump/box and pipe;
- Grout mixer (may be combined with tremie equipment);
- Assorted tools such as wrenches and shovels;
- Plastic sheeting;
- Personal protective equipment (PPE), as required, and as specified in the Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP);
- Containers, labels, coolers, ice, chain-of-custody forms, and other equipment/supplies required for sample collection and shipment to laboratories;
- Emergency equipment as specified in the APP/SSHP including but not limited to fire extinguishers, first aid kits, and signaling devices; and

- Weighted tape.

4.0 METHODS AND PROCEDURES

Following is a general field procedure applicable for any drilling method. Specific procedures for sampling or data collection for a specific drilling rig or sampling tool will be detailed in the project plans.

1. Underground utilities must be cleared and site access permission obtained prior to drilling. See SOP OESC001A.
2. A permit may be needed from a state or local government entity if a well will be constructed. Check local and state regulations and confirm that required permits have been obtained.
3. Before drilling, check for overhead hazards such as power lines. Confirm and document that required separation distances are maintained in accordance with OSHA regulations and the APP/SSHP. For power lines with voltage less than 50kV, minimum separation is 10 ft and for power lines with voltage greater than 50kV, greater separation is required; see OSHA regulations.
4. Select a drilling technique that will provide representative data that meet the project data quality objectives while minimizing subsurface contamination, cross-contamination, and drilling costs.
5. Confirm that the driller is licensed and the drilling crew is trained and experienced. The crew is composed of a lead driller and one or more assistants.
6. Inspect the drill rig and drilling equipment before beginning drilling. The rig and all sampling equipment must be clean prior to bringing on site.
7. Decontaminate sampling equipment according to SOP OESC011A between each borehole.
8. A qualified geologist, engineer, or other environmental scientist trained in logging boreholes must be present during all drilling activities and will prepare the borehole log, well construction log, and/or destruction forms.
9. The geologist will monitor drilling operations, record drilling fluid losses/gains, collect groundwater data, and prepare and log soil samples.
10. The geologist will confirm that the drilling subcontractor brings sufficient equipment in operable condition to efficiently perform the required scope of work in accordance with the site-specific Work Plan.
11. No lubricants will be used on the threads of downhole drilling equipment unless approved by the geologist. If lubricants are used, they must be specified in the project plans and recorded in the field log book.
12. Surface runoff or other fluids will not be allowed to enter the borehole.
13. Manage investigation-derived waste in accordance with container requirements and procedures detailed in either the site-specific Waste Management Plan or the appropriate section of the Sampling and Analysis Plan.

14. Drilling fluids, including water, must be approved by the geologist before use on the site. The amount of fluid used and recovered, or lost to formation, must be recorded in the field log book.

15. Boreholes or incomplete wells that are left unattended, including overnight, will be covered and secured to prevent access or inflows and marked with safety cones, flagging, or protected with fencing.

4.1 Drilling In Unconsolidated Materials

The characteristics of the unconsolidated formation will determine the drilling method. The hollow-stem continuous-flight auger system is typically used in materials such as sand, silt, clay, and moderately cherty or gravelly deposits. A solid-stem auger system may also be used in these conditions provided the borehole will remain open for soil sampling after the augers are removed from the borehole. Large cobbles, boulders, or chert blocks will prevent auger penetration. Rotosonic, cable-tool, and dual-wall reverse air hammer method are effective in heterogeneous large grain deposits such as bouldery till or coarse alluvium.

4.2 Drilling In Bedrock

Boreholes in bedrock are typically drilled by either the air rotary or the air hammer method. A surface casing may be required if bedrock is overlain by unconsolidated deposits to maintain an open borehole and/or prevent vertical cross-contamination. The surface casing must be set in place using bentonite and/or cement before bedrock drilling. These sealing materials must be allowed to set up according to manufacturer specifications before drilling resumes. The initial borehole for a permanent installation should allow for an annular space of at least 2 in. outside the surface casing through which cement grout can be introduced to seal and stabilize the casing.

4.3 Borehole Abandonment / Well Destruction

Boreholes will be properly abandoned after sampling is completed, unless converted to a well. Refer to the project-specific planning documents for further guidance..

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STANDARD OPERATING PROCEDURE OESC007B

SOIL AND ROCK GEOLOGIC LOGGING AND CLASSIFICATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

QC Review Signatures		
Name/Role	**Signature**	**Date**
Prepared By: Michael Flack PG, CEG Sr. Hydrogeologist		21 September 2022
Approved By: Mathew Van Beek Corporate Quality Manager	Matt Van Beek	21 September 2022

1.0 PURPOSE AND LIMITATIONS

The general objective of this Standard Operating Procedure (SOP) is to identify the references, standards and methods to be used for description and characterization of soils, residuum, and bedrock.

- This SOP identifies and summarizes the references and standards that Oneida ESC Group (OESC) utilizes for soil and rock geologic logging and classification.
- This SOP provides a basis for consistency among practitioners responsible for documenting geologic conditions encountered <u>in the field</u>.
- This SOP <u>does not</u> cover electronic field data capture for field logging and data collection. Refer to the applicable SOPs for borehole logging with electronic field data capture.
- This SOP <u>does not</u> include application of *ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System),* which requires laboratory analysis.
- Any project-specific standards for soil and rock logging set forth in client contracts or agreements should be considered in addition to this SOP.

2.0 STANDARDS AND RELEVANCE

The following references are provided with relevance to this SOP.

2.1 SOIL CLASSIFICATION STANDARDS

Common soil classification standards that are incorporated into this SOP are summarized below:

- *ASTM D2488. Standard Practice for Description and Identification of Soils (Visual-Manual Procedures).* ASTM D2488 is based on the Unified Soil Classification System (USCS) with visual-manual procedures in the field. ASTM D2488 is a preferred standard for field classification of soil and is approved for use by agencies of the U.S. Department of Defense; it is referenced in *the EM 1110-1-1804* (USACE, 2001), and *Engineering Geology Field Manual* (USBR, 2001). **<u>When ASTM D2488 is used, the reporting and/or boring logs should state that the soil identification is based on visual-manual procedures.</u>**

- *USCS Technical Memorandum (TM) No. 3-357 by U.S. Army Engineer Waterways Experiment Station (USAEWES)* dated 1960, reprinted 1982. This memorandum is one of the original USCS standards; however, USCS procedures discussed in this SOP references ASTM D2488.
- *ASTM D1586M. Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.* This method describes the determination of relative density of coarse-grained soils and consistency of fine-grained soils by SPT. It references Terzaghi and Peck, 1967. **When ASTM D1586M is used, this should be stated in reporting and/or on the boring logs.**
- Schultz, M. R. et al., 2017, Best Practices for Environmental Site Management: A Practical Guide for Applying Environmental Sequence Stratigraphy to Improve Conceptual Site Models *in* Groundwater Issue, EPA/600/R-17/293, United States Environmental Protection Agency, September.

2.2 ROCK CLASSIFICATION STANDARDS

Common rock classification standards that are utilized for this SOP are summarized below. These also include brief descriptions of soil classification that reference USCS.

- U.S. Army Corps of Engineers *Engineer Manual (EM 1110-1-1804. Geotechnical Investigations* (USACE, 2001). Appendix D of this manual provides examples of field boring logs as Form 1836. Section 5-10 and Table B-2 include rock core logging descriptions and criteria including weathering, hardness, Rock Quality Designation (RQD), rock type and description, and fracture descriptions. In addition, this manual also discusses soil logging by ASTM D2488 for USCS.
- U.S. Bureau of Reclamation *Engineering Geology Field Manual* Second Edition Volume I (USBR, 2001). Chapter 4 provides detailed criteria for logging rock cores including weathering, hardness, RQD, rock type and description, and fracture descriptions. In addition, Chapter 3 provides detailed criteria for logging soil by USCS methods.
- *ASTM D6032-08. Standard Test Method for Determining RQD of Rock Core*. This standard provides the methodology for calculating RQD and classifying rock quality.

2.3 COLOR STANDARD

Per ASTM D2488, color may be an important property in identifying materials of similar geologic origin and depositional environments, and for identifying organic soils. Each project should state the color standard system supporting the logging program.

This SOP references the Munsell color system, which is widely used. It is encouraged and referenced in USCS TM No. 3-357 (USAEWES, 1982), EM 1110-1-1804 (USACE, 2001), and the Engineering Geology Field Manual (USBR, 2001).

3.0 EQUIPMENT FOR FIELD LOGGING

The following equipment are recommended to classify, describe, and log soil samples, rock samples, and subsurface conditions:

- Field Forms and Logbook
- Indelible black ink pens, and marking pencils or markers

- Clipboard
- Table or other work surface to place soil or rock samples for visual inspection, organic vapor screening, soil/rock logging and classification, and other observations
- Straight-edge
- Retractable steel tape with increments in 10ths and 100ths of feet
- Grain-size card
- 10x magnifying glass
- Munsell® soil color chart or other color chart
- Pocket penetrometer and/or Torvane Shear Vane (optional, for shear strength testing of cohesive soils)
- Dilute (10 percent) hydrochloric acid
- Protractor (for rock fracture orientation or other soil horizon details)
- Rock hammer (for rock hardness testing)
- Water level meter
- No. 10 to 200 sieves (optional)

4.0 SOIL CLASSIFICATION USCS SUMMARY AND TABLES

This section summarizes the ASTM Standard D2488 key points for soil classification by visual-manual procedures. Below is a checklist of descriptions that should be documented on soil boring logs.

Refer to Figure 2 Soil Boring Log Example for the format to document soil classification on boring logs. Refer to ASTM D2488 for in-depth logging instructions, and Appendix A of this SOP for details regarding field equipment and field tests on soil.

Table 4-1 Soil Description USCS Checklist (modified from ASTM D2488)

USCS Group Name and Symbol

- USCS Group name (Poorly Graded Sand, Silty Sand, Lean Clay with Sand, etc.)
- USCS Group symbol (SP, SM, CL, etc.)

Moisture Content and Color

- Moisture: dry, moist, wet
- Color (default to record in moist condition)

Particle Size, Shape, and Characteristics

- Percent of cobbles or boulders, or both
- Percent of gravel, sand, and fines, or all three
- Particle-size range (include maximum particle size/dimension)
  a. Gravel-size—fine, coarse;
  b. Sand-size—fine, medium, coarse;
  c. Silt-size
  d. Clay-size
- Particle angularity: angular, subangular, subrounded, rounded
- Particle shape: (if applicable) flat, elongated, flat and elongated
- Additional description of fine-grained particles *(refer to Appendix A for field test procedures)*:
  a. Plasticity of fines: non-plastic, low, medium, high
  b. Dry strength: none, low, medium, high, very high
  c. Dilatancy: none, slow, rapid
  d. Toughness: low, medium, high
  e. If intact fine-grained soil, note consistency: very soft, soft, firm, hard, very hard

Other Characteristics

- Intact soil structures: stratified, laminated, fissured, slickensides, lensed, homogeneous
- Odor (mention only if organic, unusual, or impacted). (No attempt should be made to “sniff the soils”). Per health and safety requirements, the photo ionization detector/flame ionization detector (PID/FID) or other organic vapor analyzer should be used to establish the presence of volatile organic compounds (VOCs) (please refer to SOP OESC005B for field monitoring protocols).
- Reaction with HCl: none, weak, strong
- Cementation: weak, moderate, strong
- Local soil or geologic horizon or formation name (if known)
- Geologic interpretation and lithologic composition
- Additional comments: such as presence of roots or root holes, presence of mica, gypsum; surface coatings on coarse-grained particles; caving or sloughing of auger hole or trench sides; difficulty in augering or excavating.

For fine grained soils (silt, clay, etc.), assign USCS group and symbol based on results of manual tests listed below. Procedures are additionally described in Appendix A and ASTM D2488.

Table 4-2 Identification of Inorganic Fine-Grained Soils by Manual Tests (from ASTM D2488)

Soil Symbol	Dry Strength	Dilatancy	Toughness and Plasticity
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

Soil Logging for Environmental Sequence Stratigraphy (ESS) Analysis

The following soil logging details are recommended, for subsurface data quality for use in ESS analysis (Schultz et al, 2017). All of these are compatible with the USCS classification except that grain size sorting is listed here for ESS recommendation.

Table 4-3 Soil Logging for ESS Analysis

(For steps 1-3, logger may refer to a grain-size card)

1. Measure the grain-size
    a. Look for and describe any major changes in the grain-size trends (e.g., jump of grain-size from predominantly clay to predominantly very coarse sand).
    b. Understand that USCS grain size classification may be limited, but is still most common.
2. Determine sorting and gradation of grain sizes
    a. Soil grain size gradation is used for engineering, is required for USCS, and should be listed. In general, a well graded soil is typically poorly sorted, and a poorly graded soil is typically very well sorted.
    b. Sorting categories are: very well sorted, well sorted, moderately sorted, poorly sorted, very poorly sorted.
    c. Note: If naming certain coarse-grained soils, such as Silty Sand (SM), the USCS classification doesn't imply sorting in the name, so the logger should include it. *For example, a Silty Sand (SM) might be moderately sorted.*
3. Record the particle-shape and angularity
    a. Angularity: Angular, subangular, rounded, subrounded (USCS)
    b. Shape: Flat, elongated, flat and elongated (USCS)
4. Determine lithological composition
    a. Clastics versus carbonates
    b. Cementation (e.g., silica, illite, calcareous)
    c. Provenance of clasts (e.g., igneous, volcaniclastic, sedimentary, metamorphic)

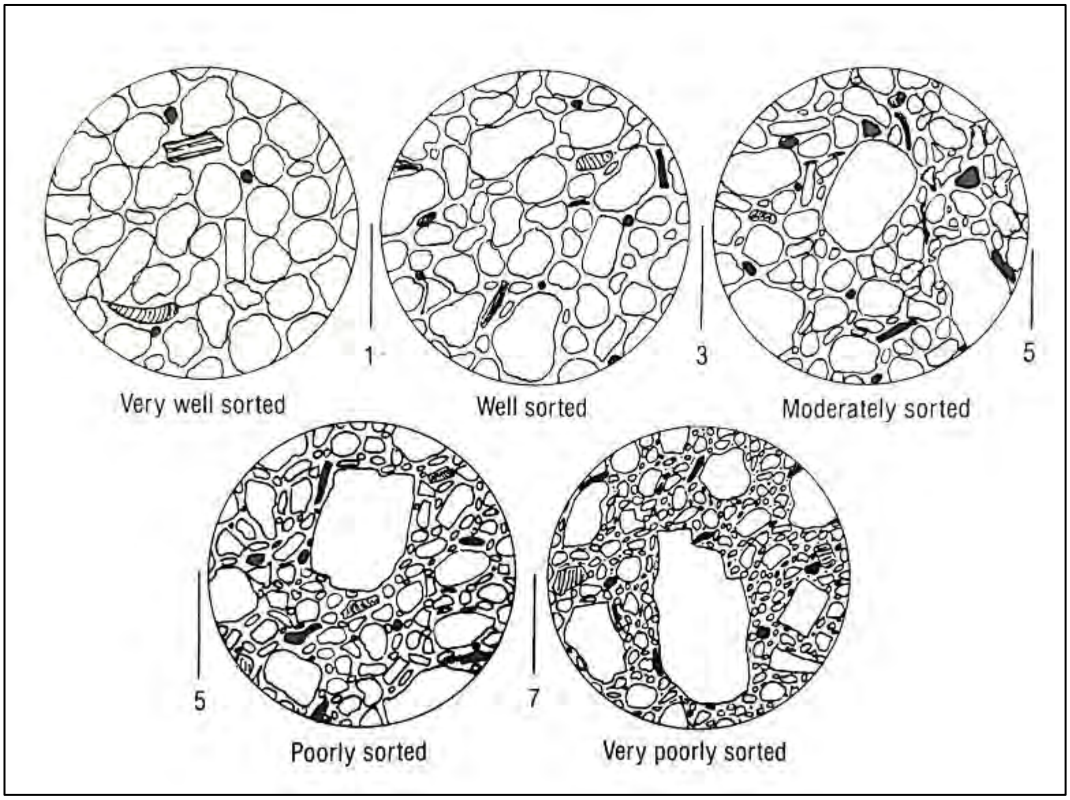

Figure 1 Grain size sorting (Compton, 1985).

5.0 ROCK CLASSIFICATION EM 1110-1-1804 SUMMARY AND TABLES

Key features to document in logging of bedrock are characteristics that affect or indicate fluid and constituent migration. These include rock type and weathering characteristics, rock structure, and discontinuities or fractures. The details in Table 5-1 should be documented on rock drilling logs to the extent practicable. Intact rock cores provide ideal samples for classification. The quality of rock sample data (e.g., quality of the core) may be a limitation on the ability to classify bedrock.

Refer to Figure 3 Rock Core Log Example for an example format to document rock classification on logs. Refer to USBR (2001) for in-depth rock logging instructions, and Appendix A of this SOP for details regarding field equipment, methodology for computing RQD, and chart for determining rock type.

Table 5-1 Rock Description Checklist (modified from Table B-2 EM 1110-1-1804 and USBR, 2001)

1. Rock Type
    a. Rock Type/Name. (e.g., granite, sandstone, schist). Estimate rock types as well as possible; however, rock classification will depend on the character of the sample, and its integrity and suitability to classify the rock in the field (*refer to Figures 2, 3, and 4 in Appendix A)*.
    b. Color. Describe color when wet. Use Munsell or other color charts. The name of the chart should be noted on the log form. Where applicable, use adjectives such as light, dark, or mottled, or shades and tones (e.g., grayish blue).
    c. Moisture. (dry, moist, wet)
    d. Hardness.
        (1) Very soft: can be deformed by hand.
        (2) Soft: can be scratched with a fingernail.
        (3) Moderately hard: can be scratched easily with a knife. From USBR: core or fragment breaks with moderate hammer blow.
        (4) Hard: can be scratched with difficulty with a knife. From USBR: heavy hammer blow required to break specimen.
        (5) Very hard: cannot be scratched with a knife. From USBR: repeated heavy hammer blows required to break or chip.
    e. Degree of Weathering.
        (1) Unweathered: no evidence of any mechanical or chemical alteration. From USBR: hammer rings when crystalline rocks are struck.
        (2) Slightly weathered: slight discoloration on surface, slight alteration along discontinuities, less than 10 percent of the rock volume altered, and strength substantially unaffected. From USBR: hammer rings when crystalline rocks are struck, body of rock is not weakened by weathering.
        (3) Moderately weathered: discoloring evident, surface pitted, with alteration penetrating well below rock surface; weathering "halos" evident; 10 to 50 percent of the rock altered, and strength noticeably less than fresh rock. From USBR: hammer does not ring when rock is struck, body of rock is slightly weakened.
        (4) Highly weathered: entire mass discolored, alteration pervading nearly all the rock with some pockets of slightly weathered rock noticeable, some minerals leached away, and only a fraction of original strength retained (with wet strength usually lower than dry strength). From USBR: Rock has dull sound when struck with hammer; rock is weakened, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness.
        (5) Decomposed: rock reduced to a soil with relict rock texture (saprolite), and generally molded and crumbed by hand.
    f. Lithology, Macro Description of Mineral Components. Use standard adjectives such as shaly, sandy, silty, and calcareous. Note inclusions, concretions, nodules, etc.

g. Texture and Grain Size.

(1) Sedimentary rocks

Texture	**Grain Diameter**	**Particle Name**	**Rock Name**
*	80 mm	Cobble	Conglomerate
*	5 to 80 mm	Gravel	
Coarse-grained	2 to 5 mm		
Medium-grained	0.4 to 2 mm	Sand	Sandstone
Fine-grained	0.1 to 0.4 mm		
Very fine-grained	0.1 mm	Clay, silt	Shale, claystone, siltstone

[*] Use clay-sand texture to describe conglomerate matrix.

(2) Igneous and metamorphic rocks:

Texture	**Grain Diameter**
Very coarse-grained / pegmatitic	> 10 mm
Coarse-grained	5 mm
Medium-grained	1 to 5 mm
Fine-grained	0.1 to 1 mm
Aphanitic	0.1 mm

2. Rock Structure

a. Bedding.

(1) Massive: 3 ft thick.

(2) Thick bedded: beds from 1 to 3 ft thick.

(3) Medium bedded: beds from 0.3 ft to 1 ft thick.

(4) Thin bedded: beds less than 0.3 ft thick.

b. Shape of Rock Blocks.

(1) Blocky: nearly equidimensional.

(2) Elongated: rod-like.

(3) Tabular: flat or bladed.

c. Degree of Fracturing and Spacing.

(1) Unfractured: fracture spacing 6 ft.

(2) Slightly fractured: fracture spacing 3 to 6 ft.

(3) Moderately fractured: fracture spacing 1 to 3 ft.

(4) Highly fractured: fracture spacing 0.3 to 1 ft.

(5) Intensely fractured: fracture spacing 0.3 ft.

3. Discontinuities ***(modified with USBR, 2001).***

a. Rock Quality Designation (RQD) fracture index (see Appendix A). Add total length of solid core that is 4 inches (100 mm) or more long in the run. Divide the sum by the length of the run and record as a percentage.

b. Fractures/Joints

(1) Type (bedding, cleavage, foliation, schistosity, and extension).

(2) Openness (tight, slightly open [<1 mm], moderately open [1 to 3 mm], open [3 to 10 mm], moderately wide [10 to 30 mm], wide [>30 mm])

(3) Moisture in discontinuities (water-bearing? dry, moist, wet)

(4) Fillings

- Thickness (in millimeters)
- Composition (iron oxide staining, carbonate, clay gouge, saprolitic, etc)
- Weathering/alteration
- Hardness

(5) Healing (not healed, partly healed [<50%], moderately healed [>50%], completely healed)

(6) Character of Discontinuity Surfaces

- Roughness (stepped, rough, smooth, striated, slickensided, wavy)
- Weathering/alteration
- Hardness

c. Faults and Shear Zones.

(1) Single plane or zone: how thick?

(2) Moisture (water-bearing? dry, moist, wet)

(3) Character of sheared materials in zone.

(4) Direction of movement, and slickensides.

(5) Clay fillings, gouge (thickness in millimeters).

d. Solution Cavities and Voids.

(1) Size.

(2) Moisture (water-bearing? dry, moist, wet)

(3) Shape: planar, irregular, etc.

(4) Orientation: (if applicable) developed along joints, bedding planes, at intersections of joints and bedding planes, etc.

(5) Filling: percentage of void volume and type and of filling material (e.g., sand, silt, clay, etc.).

6.0 LOG DOCUMENTATION AND OTHER INFORMATION

Field logs will be prepared on the appropriate drilling log form. Each log will be signed by the geologist or engineer.

6.1 DESCRIPTION OF SURFACE CONDITIONS

On drilling logs, include a description of surface conditions, vegetative characteristics, and proximity to potential sources of constituent sources (e.g., 20 feet south of petroleum underground storage tank, adjacent to drainage ditch).

6.2 DOCUMENTATION OF DRILLING PROCEDURES AND PERFORMANCE

Record the following drilling information:

- Type and size of drill rig
- Diameters and lengths of samplers
- Depths at which drilling or sampling equipment are changed
- Types of temporary casing
- Drilling rates and rig noise (for example chattering of the bit as an indication of hard rock or well-cemented soils)
- The amount of water introduced into the boring and the amount recovered

Utilize field notes to record any problems or variances. Refer to SOP OESC002A for Field Documentation guidance.

6.3 SOIL SAMPLE INFORMATION

Record the following information for soil samples:

- Sample name
- Interval sampled
- Type of sampler
- Length of sample recovered for each sample interval

6.4 STRATIGRAPHIC CONTACTS, LITHOLOGIC CHANGES, AND GEOLOGIC INTERPRETATION

- A geologic interpretation may be provided with each description. This may include a generic interpretation (such as alluvium or saprolite), geologic age, and/or formation name.
- Note the presence of fossils, which may be complete or fragmented in cores and drill holes.
- Note the presence of any identified minerals (for example: Glauconite, Mica, Heavy minerals, Kaolin, Sulfides [such as pyrite and marcasite], Siderite, Manganese oxide, Gypsum, Feldspar, Chert, Lignite, Iron oxides).
- Note additional lithologic observations such as “sand predominantly quartz” or “gravel predominantly shale fragments.”

Note potential sources of secondary porosity that could influence infiltration and movement of water such as root channels (relic or active); fractures; animal burrows; cracks related to desiccation and wetting, freezing and thawing, or subsidence

6.5 WEATHERING IN SOIL AND FROM ROCK

Note soil and rock weathering in the logs such as mineral weathering (e.g., feldspar to clay, iron oxides on biotite). These changes often may be manifested by changes in color and the development of zones of cementation that can be readily recognized in the field.

6.6 GROUNDWATER OBSERVATIONS

Identify the depth at which the geologic material is either dry, moist, or wet, as described in Section 4.0 of this SOP. Record the depth to water observed in the borehole during and at the completion of drilling. Also record the depth to water once stabilized and record the time allowed for levels to stabilize. In dry borings, record the absence of water. If a borehole is left open overnight, then record any water level observations before leaving the site and prior to starting work the next day.

6.7 ENVIRONMENTAL FIELD MEASUREMENTS, OBSERVATIONS, AND ODORS

Document the presence of impacts in samples or cuttings.

- Describe any unusual discoloration, coatings, sheens, odors, or other potential indication of impacts.
- Record the results of field headspace screening or other field screening test results. (Refer to SOP OESC005B, Soil VOC Field Screening Methods).
- Document any odors from the soil or rock such as organic, chemical, hydrocarbons.

6.8 BOREHOLE STABILITY

Identify any interval of borehole instability including conditions such as running or heaving sands. Include the depths at which such conditions are encountered.

6.9 REMARKS OR NOTES

For other notes or remarks, include pertinent information such as volume of gain or loss of water, the performance of in situ tests, the time each day’s activities begin and end, approximate distance drill hole was offset from original location if any, drilling equipment changes, and drilling rate, to name a few. Other information may be recorded at the discretion of field personnel.

7.0 QUALITY ASSURANCE

Key elements of quality assurance applicable to borehole logging and characterization of subsurface conditions include:

- Planning/definition and communication of procedures and standards
- Training/staffing
- Independent review
- Laboratory testing of representative samples

For planning, review available site-specific data and selection of appropriate logging criteria. Plan for any electronic data capture as needed, for example lithologic logging software on tablets.

Obtain logging training and/or utilize experienced staff for the field project. Staff responsible for borehole logging should review this SOP periodically as a reminder and a basis for continual improvement and consistency. New staff are accompanied by experienced personnel in the field until a reasonable level of proficiency is demonstrated. Field logs should be reviewed daily to check for completeness and consistency. Final logs may be edited for presentation to eliminate redundancy.

Following completion of the field program, field logs will be reviewed and edited prior to preparation of final logs by a trained and qualified person other than the project field representative. Logs will be checked for completeness, accuracy, and consistency between soil descriptions.

If lithologic samples are collected for laboratory / physical testing, the test results will be compared with field descriptions and a representative result will be documented on the final log. At the discretion of the qualified geologist and project manager, both results of laboratory tests and field descriptions may be included on the final logs.

The standards used for logging will be included on the logs to provide back-up for the methods used (for example):

> “Soil logged by ASTM D2488 visual-manual procedures. Soil color was logged using Munsell Soil Color chart *[insert year]*.” and/or
>
> “USCS classification revised by ASTM D2487 where laboratory results for particle-size characteristics, liquid limit, and plasticity index were available.” or
>
> “Relative density and consistency were determined by ASTM D1586 *[insert SPT, manual, Torvane, penetrometer]* methodology.”

8.0 REFERENCES

ASTM Standard D 1586M-18, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils," ASTM International, West Conshohocken, PA.

ASTM Standard D 2488-09a, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)," ASTM International, West Conshohocken, PA.

ASTM Standard D 6032-08, "Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core," ASTM International, West Conshohocken, PA, www.astm.org.

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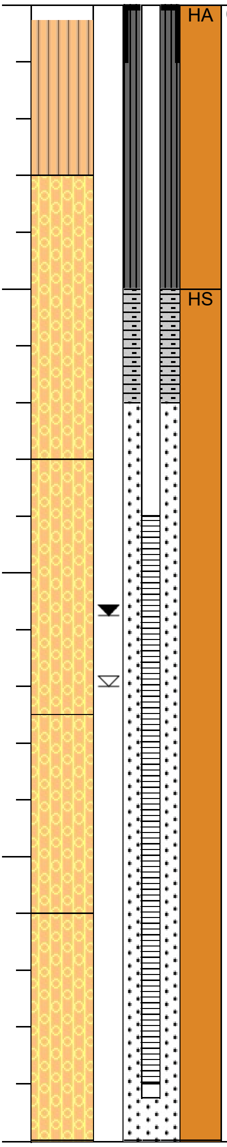
FIGURES

	Client:	**WELL LOG**
	Project:	**Well No.** **MW2207xSS209P**
	Address:	**Page:** **1 of 2**

Drilling Start Date:	**07/25/2022 14:02**	Boring Depth (ft):	**20**	Well Depth (ft):	**20**
Drilling End Date:	**07/25/2022 14:19**	Boring Diameter (in):	**8.25**	Well Diameter (in):	**2**
Drilling Company:		Sampling Method(s):	**HS - HSA Cuttings, HA - Hand auger**	Screen Slot (in):	**0.010**
Drilling Method:	**Hollow Stem**	DTW During Drilling (ft):	**12**	Riser Material:	
Drilling Equipment:	**Auger MARL M5T**	DTW After Drilling (ft):	**10.74**	Screen Material:	
Driller:		Ground Surface Elev. (ft):	**N/A**	Seal Material(s):	
Logged By:		Location (Lat, Long):	**N/A**	Filter Type:	**Sand 2/12**



DEPTH (ft)	COLLECT Sample Type	Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION	MEASURE PID (ppm)	Lab Sample	DEPTH (ft)
0	HA	08:40		5.00	(0') Grass			0
					(0.25') Sandy SILT (ML); 65% fines (mostly silt); 35% fine sand; medium-stiff, brown (10YR 4/3), moist			
					(3') SILTY SAND (SM); 55% fine sand; 45% fines (mostly silt, trace clay); medium dense, yellowish brown (10YR 5/6), moist			
5	HS	14:08		15.00	(5') As Above			5
					(8') SILTY SAND (SM); 55% fine sand; 45% fines (mostly silt, few clay); medium dense, brown (10YR 4/3), wet			
10								10
					(12.5') SILTY SAND (SM); 65% fine sand; 35% fines (some silt); loose, dark yellowish brown (10YR 4/4), wet			
15								15
					(16') SILTY SAND (SM); 65% fine sand; 35% fines (some silt, few clay); loose, dark yellowish brown (10YR 4/4), saturated			
20								20

NOTES: Hole precleared to 5' on 07/25/2022 08:40 by Gregg Drilling using hand auger. Boring logged as adjacent to MW2208xSS209P. Monitoring well constructed. Logged as adjacent to MW2208xSS209P. Monitoring well constructed. 7 bags of sand, 3/4 bag of bentonite pellet, 2 bags cement for 15 gallons of water

Checked by: Colton Ranson

	Client:	**WELL LOG**
	Project:	**Well No.** **MW2207xSS209P**
	Address:	**Page:** **2 of 2**

Drilling Start Date:	**07/25/2022 14:02**	Boring Depth (ft):	**20**	Well Depth (ft):	**20**
Drilling End Date:	**07/25/2022 14:19**	Boring Diameter (in):	**8.25**	Well Diameter (in):	**2**
Drilling Company:	**Gregg Drilling**	Sampling Method(s):	**HS - HSA Cuttings, HA - Hand auger**	Screen Slot (in):	**0.010**
Drilling Method:	**Hollow Stem Auger**	DTW During Drilling (ft):	**12**	Riser Material:	
Drilling Equipment:	**MARL M5T**	DTW After Drilling (ft):	**10.74**	Screen Material:	
Driller:	**Angel Alcarez**	Ground Surface Elev. (ft):	**N/A**	Seal Material(s):	
Logged By:	**Rachel Ofili**	Location (Lat, Long):	**N/A**	Filter Type:	**Sand 2/12**

DEPTH (ft)	LITHOLOGY	WATER LEVEL	WELL COMPLETION	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	MEASURE		DEPTH (ft)
				Sample Type	Time	Blow Counts	Recovery (ft)		PID (ppm)	Lab Sample	
20								(20') Boring terminated			20
25											25
30											30
35											35
40											40

NOTES: Hole precleared to 5' on 07/25/2022 08:40 by Gregg Drilling using hand auger. Boring logged as adjacent to MW2208xSS209P. Monitoring well constructed. Logged as adjacent to MW2208xSS209P. Monitoring well constructed. 7 bags of sand, 3/4 bag of bentonite pellet, 2 bags cement for 15 gallons of water

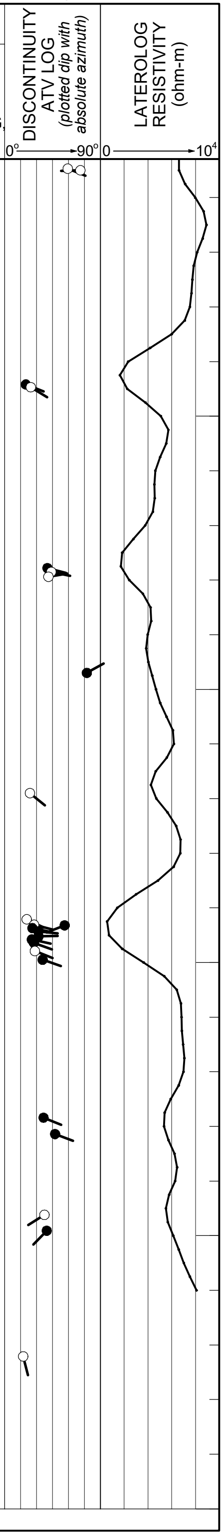
Checked by: Colton Ranson

PROJECT NUMBER:	BOREHOLE NUMBER: RB-2	SHEET 4 OF 4

Rock Core Log

PROJECT : Investigation
LOCATION : project location
ELEVATION : 955.47 ft msl (ground surface) (NAVD88)
DRILLING CONTRACTOR AND DRILL RIG : Drillco, Atlas Copco CT14
COORDINATES : ft (NAD83)
DRILLING METHOD AND EQUIPMENT : PQ/HQ rock coring
WATER LEVEL : NA
START : mm/dd/yyyy
END : mm/dd/yyyy
LOGGER : Geologist name

DEPTH BELOW GROUND SURFACE (ft)	CORE RUN (ft)	RECOVERY (ft)	RQD (%)	FRACTURES PER FOOT	UNIT	LITHOLOGY ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	DISCONTINUITIES DENSITY, SPACING, DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING, ROD DROPS, ETC.
	17	5	100		Unweathered Bedrock		Smooth (R5), Slightly Open (01)	
80	18	5	100	0.8		**GRANODIORITE** medium dark gray (N4), wet, medium to coarse grained, change to 60% mafics (hornblende and biotite), 30% quartz, 10% felsics, fine grained, 1/8" to 1/2" thick veins of felsic minerals in various directions, hard, slightly weathered	Slightly Fractured (FD3), 76' mechanical break at 76' 78.2', 30°, Moderately Rough (R3), Clean (T0), Slightly Open (01) 78.6', 20°, Moderately Rough (R3), undulating, Clean (T0), Slightly Open (01), wet 80.2' mechanical break	
85	19	5	100	0.8			80.9', 40°, Moderately Rough (R3), planar, Clean (T0), Slightly Open (01) Slightly Fractured (FD3) 81.9', 30°, Smooth (R5), undulating, Very Thin (T1), FeOx staining, Slightly Open (01), wet 83.5', 50°, Smooth (R5), undulating, Very Thin (T1), Slightly Open (01) 84.2', 60°, Smooth (R5), undulating, Very Thin (T1), Slightly Open (01) 85.3', 65°, Smooth (R5), planar, Very Thin (T1), Slightly Open (01), wet	
90	20	5	89	0.4		fracture zone with FeOx weathering	Slightly Fractured (FD3) 88.3' to 89', fracture zone with rubble, 40°, Rough (R2), planar, FeOx staining, Moderately Open to Open (02 to 03), wet 89.8' and 90.7' mechanical breaks	
95	21	5	100	0.4			Slightly Fractured (FD3) 92', 40°, Slightly Rough (R4), planar, Moderately Open (02) 93.1', 93.9', mechanical breaks 94.1', 40°, Slightly Rough (R4), planar, possible weathering on surface, light colored minerals on surfaces, Moderately Open (02), wet 95.2' mechanical break	
	22	1.5	100	0.0			Unfractured (FD0), 95.9' mechanical breaks only along weakness planes in rock 96', 40°, Smooth (R5), planar, Slightly Open to Moderately Open (01 to 02)	
100	23	2	100	0.0			96.6', 20°, Moderately Rough (R3), undulating, Moderately Open (02) 97.8', 98', 98.5' mechanical breaks Unfractured (FD0)	



Corehole terminated at 100 ft bgs.

Logged by USBR (2001) standard.

APPENDIX A

STANDARD OPERATING PROCEDURE OESC007B – APPENDIX A
Select Geologic Logging Details and Procedures

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 SOIL FIELD TESTS AND OTHER DETAILS

1.1 SOIL TYPE

The USCS groups soils into three major divisions: coarse-grained soils, fine-grained soils, and highly organic soils. The characteristics that define these soil groups, and procedures involved in identifying the individual components, are described in the following paragraphs.

Soil is considered coarse-grained if greater than 50 percent of the sample is 0.075 millimeters [mm] (No. 200 sieve) or greater in size.

Soil is considered fine-grained if greater than 50 percent of the sample is smaller than 0.075 mm (No. 200 sieve). Fines can be further subdivided into silt and clay. ASTM D2488 defines the terms “silt” and “clay” solely based on the plasticity characteristics of material finer than 0.075 mm.

Organic soils contain sufficient organic matter, living or in the process of decay, to significantly affect the engineering properties of the soil. Most organic soils can be considered a special category of fine-grained soils. Topsoil, humus, peat, organic silt, organic clay, and diatomaceous earth are common examples. The water content of organic soils is typically very high. Organic soils invariably have very low shear strength in their natural state, but may exhibit high tensile strength in certain directions because of fibrous materials. Observations of color and odor are of value for the identification of soils. Dark gray, black, and various shades of brown are characteristic colors. Organic soils frequently change color when exposed to air. Many organic soils, particularly marine peats, and silts, have a distinctive odor of hydrogen sulfide. This odor is especially apparent in fresh samples.

- **Organic silts and clays** typically exhibit slight to medium plasticity and form threads that are very weak, soft, and spongy near the plastic limit. Less effort is required to pull fine-grained non-fibrous organic soils apart than inorganic fines. A clean break is generally formed. The smear of organic silts and clays, although smooth, is very dull.
- **Peat** is an organic soil characterized by the presence of vegetable matter such as leaves, sticks, grass, wood, and/or moss in various stages of decomposition. These components generally impart a fibrous texture to the soil. Peat is typically brown or black in color. Peat and organic silt are common components of freshwater swamps, bogs, and tidal flats.
- **Diatomaceous earth** Diatomaceous earth is composed primarily of the siliceous skeletal remains of diatoms that accumulated in lakes and swamps. The amount and nature of impurities is highly variable and may include sponge spicules and radiolarian remains as well as organic and inorganic silt and clay. Diatomaceous earth reacts rapidly to the dilatancy test and typically dries to a highly friable soil. Color ranges from white to yellow to various shades of brown and gray.
- Identification of organic soils may be aided by the location with respect to topography. Low-lying swampy areas frequently contain highly organic soils.

1.2 FIELD TESTS FOR DETERMINING RELATIVE PERCENT OF SOIL GRAIN SIZES

A rough determination of relative grain size percentages can be made by either:

1. Spreading the sample out in the palm of the hand and making a visual estimate,

2. Carefully washing the fines from a portion of a sample, by mixing the soil with water and pouring off the clouded suspension of fines and water, and then comparing with an unaltered portion, or
3. Mixing a sample with water in a jar/vial and allowing the mixture to settle. The coarse-grained components will fall out of suspension in approximately 20 to 30 seconds.
4. If available, the modified use of sedimentology sieves in the field may also be used to make a visual estimate of grain sizes in a sample (Laboratory sieve analysis can provide quantitative results of grain sizes which are classified by ASTM D2487).

When describing bulk samples or soils exposed in an excavation, the percentages of cobbles and boulders should be estimated by volume. The remaining soil matrix should be described independently.

Soil components should be identified as described at the beginning of this section. The relative percentages of different fractions should be described based on estimates to the nearest 5 percent, and can be used with terms from ASTM D2488, as summarized below.

Table A-1: Soil Component Terms (ASTM D2488)

Description	**Criteria**
Mostly	50 - 100 percent
Some	30 - 45 percent
Little	15 - 25 percent
Few	5 - 10 percent
Trace	Particles are present but estimated to be less than 5 percent

The component with the highest percentage should be recorded first followed by the next highest percentage.

Gradation within the sand and gravel fractions must be defined or it is assumed that all fractions are present. When recording gradation, always begin with the coarser fraction, (e.g., mostly coarse to fine gravel, and mostly medium to fine sand).

1.3 FIELD TESTS FOR SOIL DENSITY AND CONSISTENCY

Density relates to cohesionless, coarse-grained soils (such as sand), while consistency relates to cohesive, fine-grained soil (such as silt or clay). Both can be estimated from the standard penetration test (SPT). The standard penetration test is defined as the number of blows required to drive a standard 2-inch outside diameter split barrel (spoon) sampler through 18 or 24-inches of undisturbed soil using a free falling 140-pound weight. The blow count is recorded in 6-inch increments. The first 6 inches is a seating drive. The sum of the blows required for the second and third 6-inch increments is defined as the penetration resistance (**N-value**); however, the size of the sampler and hammer efficiency can affect the N-value; <u>see below section on SPT corrections for calculating N-values.</u>

Consistency can also be evaluated by manual criteria (described in ASTM D1586 or ASTM D2488) or with a pocket penetrometer (PP) or vane shear instrument such as a Torvane (TV). When using these methods to estimate consistency, sample disturbance should be considered. Per USBR (2001), evaluating undrained strength in clays, are better served with vane shear, unconfined compression, or

CPT testing rather than SPTs. SPT data should not be used to estimate the compressibility of clays. To evaluate compression behavior of clays, use either empirical factors based on water content and Atterberg limits or obtain undisturbed samples for laboratory consolidation testing.

Terms for describing the density or consistency of a soil are presented below from ASTM D1586, and as described from Terzaghi and Peck (1967).

Table A-2: Relative Density of Sands by SPT (from Fig. X2.1 of ASTM D1586)

Cohesionless (Coarse-Grained) Soils	
SPT N-Value*	**Relative Density**
0-4	Very loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
> 50	Very Dense

**Refer to SPT N-Value corrections prior to making final designation.*

Table A-3: Consistency of Fine-Grained Soil by SPT and Qu (ASTM D1586 and Table 6 of ASTM D2488)

N-Value**	**Consistency**	***Consistency (manual criteria only) *from ASTM D2488***	**Manual Criteria**	**Unconfined Compressive Strength (Qu) (Tons/Sq. Ft.)*****	**Undrained Shear Strength (Su) (Tons/Sq. Ft.)******
<2	Very Soft	*Very Soft*	Thumb will easily penetrate soil more than 1 inch	<0.25	<0.12
2-4	Soft	*Soft*	Thumb will easily penetrate soil about 1 inch	0.25 - 0.5	0.12 - 0.25
4-8	Medium Stiff	*Firm*	Thumb will easily indent soil about ¼ inch	0.5 - 1	0.25 - 0.5
8-15	Stiff		Indented by thumb ¼ inch only with great effort	1 - 2	0.5 - 1
15-30	Very Stiff	*Hard*	Thumb will not indent soil. Readily indented with fingernail	2 - 4	1 - 2
> 30	Hard	*Very Hard*	Indented with difficulty with thumbnail	>4	>2

*	*Consistency designated by manual criteria only per ASTM D2488.*
**	*Refer to SPT N-Value Corrections prior to making final designation.*
***	*Measured with pocket penetrometer.*
****	*Measured with TV or similar vane shear instrument.*

1.3.1 SPT N-Value Corrections

SPT procedures must adhere to the ASTM D1586 so that blow counts yield meaningful N-values; however, ASTM D1586 does not discuss the use of common samplers such as California modified split spoon and "Dames and Moore" samplers. To use N-values from other samplers, a correction factor must be applied. In general, correction factors to convert California modified sampler blow counts to equivalent SPT range from 0.44 to 0.65 (Rogers, 2006).

In addition, to verifying that sampler N-values can be obtained, the hammer system efficiency for collecting blow counts must also be taken into consideration. Equipment and site-specific factors may include hammer system efficiency (a 140-lb hammer dropping 30 in. = 4,200 ft-lbs raw input energy). The project must determine that the hammer efficiency if for the project. In Skempton (1986), the original SPT hammer had about a 60 percent efficiency (N_{60}), so an "N_{60}"corrected blow count was adopted for use. N_{60} values are a common adopted value, however, site-specific hammer efficiency measurements may allow for site-specific corrections. N_{60} values may be reported on logs; however, never place N_{60} corrected data solely on the boring log. The log shall contain only the measured N values or both (ASTM D1586M).

1.4 FIELD TESTS FOR CLASSIFYING FINES

Several tests can be performed in the field to determine the plasticity and assign a group name to a soil sample (ASTM D2488). These tests, which include the dilatancy test, soil thread test, toughness, dry strength, smear and stickiness, and the test tube test, are described below. Prior to performing these tests, particles larger than the No. 40 sieve (0.42 mm - medium sand and larger) should be removed.

1.4.1 Dilatancy Test

Select a representative sample approximately 0.5 cubic inch in volume and add water until the soil has a soft but not sticky consistency. Form a pat of the wet soil in the palm of one hand and shake it horizontally, vigorously striking the side of the hand with the other hand several times. Alternately squeeze and release the pat of wet soil. Note the rate at which water appears while shaking and disappears while squeezing. Materials that are predominantly silt will show a dull-dry surface upon squeezing and a glassy-wet surface upon releasing the pressure and upon shaking or vibrating the pat. With increasing clay content this phenomenon becomes less pronounced due to lower mobility of pore water. Rapid reaction to the shaking test is typical for uniform fine sand and diatomaceous earth, as well as for inorganic silts.

1.4.2 Soil Thread Test for Plasticity and Toughness

Following completion of the dilatancy test, attempt to roll the test specimen into a thread between the palms or by hand on a smooth surface. Roll the sample into the smallest thread possible, adjusting the water content as needed. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. If it is too dry, add water a few drops at a time, thoroughly kneading the soil to assure a uniform moisture content. Note the final minimum diameter attained before the thread breaks or crumbles.

The ability to roll soil into threads indicates plasticity and the presence of clay. The smallest thread diameter possible without crumbling is indicative of the degree of plasticity.

1.4.3 Dry Strength

Mold the test sample to the consistency of putty, adding water if necessary. Shape the test specimen into a ball or angular fragment about 0.5 inch in diameter. Allow the sample to dry completely by air-drying. Test the strength of the fragment by crushing between the fingers. The dry strength increases with increasing plasticity. Occasionally, the presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strength. The presence of calcium carbonate can be detected with dilute hydrochloric acid. Silty fine sands and silts have about the same slight dry strength; however, they can be distinguished by the feel upon crushing. Fine sand feels gritty, whereas silt typically has the smooth feel of flour.

1.4.4 Smear and Stickiness

A high degree of stickiness and a very smooth smear in the natural state are indicative of high plasticity.

Although the primary basis for classification of fines is soil plasticity as discussed previously, the procedure described below for estimating the grain-size distribution of fine-grained soil components can also be helpful.

1.5 SOIL DESCRIPTIVE ELEMENTS

1.5.1 Soil Type (Group Name and Symbol)

"Well-graded" is an engineering term that indicates a continuous distribution of particle sizes from the coarsest to finest particle size of the relevant fraction. "Poorly-graded" pertains to sediments that lack a continuous distribution of grain sizes. Poorly graded include uniformly-graded (predominantly one particle size or well sorted) and gap-graded or step-graded (one or more particle sizes absent) sediments. These terms may be included as secondary descriptive elements.

These terms should not be confused with the geologic terms used to describe sorting. A uniformly graded sediment would be described as well-sorted using this terminology.

Guidelines for the use of modifiers and other descriptive terms which may be included in the USCS group name are presented below.

Use of "with":

1. If a soil is predominantly sand or gravel but contains an estimated 15 percent or more of the other granular component, add "with sand" or "with gravel" to the group name.
2. If a soil contains any cobbles or boulders, add "with cobbles" or "with boulders" to the group name.
3. If a fine-grained soil contains (little) 15 to 25 percent sand, gravel or both, add "with sand" or "with gravel" to the group name (whichever is more predominant). Use "with sand" if the related percentages are equal.
4. If a granular soil contains 10 percent (few) fines, add "with silt" or "clay" to the group name.

Use of adjective modifier:

1. If a fine-grained soil contains 30 percent or more sand or gravel (some), add "sandy" or "gravelly" to the group name (e.g., SANDY SILT, GRAVELLY LEAN CLAY).
2. If a granular soil contains more than 15 percent (little) fines, use an adjective modifier (e.g., SILTY SAND, CLAYEY GRAVEL).

Use of dual symbols:

1. If a granular soil is estimated to contain 10 percent fines use a dual symbol.
    a. the first symbol shall correspond to a clean gravel or sand,
    b. the second symbol shall correspond to a gravel or sand with fines (e.g., GW - GC, SP - SM).
2. CL-ML (see USCS Plasticity Chart - do not use this combination unless substantiated by laboratory analyses).

Use of borderline symbols:

1. Use to indicate a soil with properties that do not distinctly place the soil into a specific group (e.g., CL/CH, GM/SM, ML/SM).
2. Using the USCS, “and” may be used to indicate that soils are interbedded by linking group names (e.g., LEAN CLAY [CL] AND POORLY GRADED SAND [SP])

1.5.2 Moisture Condition

The moisture condition of the soil shall be described on the field boring log. Soils are described as dry, moist, or wet based on the following criteria:

Table A-4: Description of Soil Moisture (ASTM D2488)

Description	**Criteria**
Dry	Absence of moisture, dusty, dry to the touch
Moist	Moisture clearly evident, but no visible water
Wet	Visible free water; usually soils collected from below water table

1.5.3 Color

For consistency purposes color is identified using the Munsell Soil Color Chart. The chart facilitates color correlation across a site. Color should be noted for moist samples. Where color is logged from dry samples, this should be noted on the logs.

The color description should not be capitalized and should be followed by the alpha-numeric Munsell code in parentheses as shown in the following examples:

- pale red (2.5 YR 6/2)
- very dark brown (7.5 YR/2)

Variations due to mottling in soil color should also be noted using the Munsell soil color notation.

1.5.4 Plasticity and Cohesiveness

A plasticity designation should be provided if a sediment sample is predominantly fine-grained (see section 2.3.5). The cohesiveness of soils, including both fine- and coarse-grained components, should be noted. Soils in which the adsorbed water and particle attraction work together to produce a mass that holds together and deforms plastically at varying water contents are known as cohesive soils. A predominantly coarse-grained soil could be cohesive in character with as little as 20 percent fines, depending upon the overall gradation of the material and the plasticity characteristics of the fines. A soil accurately classified as GC or SC is cohesive.

Mixtures of coarse- and fine-grained soils should be described as cohesive or cohesionless.

1.5.5 Stratification/Structure

Most geologic structures may be characterized as stratified, massive, or some variation of the two. Some terminology for describing soil structure or stratification is defined in below.

Table A-5: Soil Stratification Terms (ASTM D2488)

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Massive (Homogeneous)	Same color and appearance throughout.

The identification of naturally occurring fractures or planes of weakness can be made through the recognition of surface coatings, changes in oxidation state of adjacent materials, or stress surfaces such as slickensides. Common surface coatings include carbonates, organics, secondary iron, manganese oxide, and silt or clay. Changes or mottling in color adjacent to a fracture surface are generally indicative of a change in oxidation state associated with a naturally occurring fracture.

1.5.6 Other Descriptive Elements in Soil

Understanding of subsurface conditions at a site is dependent on detailed descriptions of soil or sediment samples. The following additional characteristics should be described, if pertinent. These additional elements should be appended to the primary description, separated by a semicolon (refer also to Section 4.0 of this SOP):

- Angularity, size, and shape of coarse-grained components
- Hardness of coarse-grained components
- Presence of boulders or cobbles
- Fossils
- Accessory minerals
- Lithology of coarse-grained components

- Cementation or presence of calcareous materials
- Odor
- Weathering zone
- Presence of roots, root holes, animal burrows or other macro-pores

1.5.6.1 Angularity and Shape of Coarse-Grained Components

A description of the angularity of coarse-grained sand, gravel, cobbles and boulders may provide a basis for interpretation of geologic origin and correlation of geologic units encountered at different locations. The terminology below should be used.

Table A-6: Grain Angularity (ASTM D2488)

Description	**Criteria**
Angular	Particles have sharp edges and relatively planar sides with unpolished surfaces.
Sub-angular	Particles are similar to angular description but have rounded edges.
Sub-rounded	Particles have nearly planar sides but have well-rounded edges.
Rounded	Particles have smoothly curved sides, no edges.

Table A-7: Grain Shape (ASTM D2488)

The shape of gravel, cobbles, and boulders should be described as follows:

Description	**Criteria**
Flat	Particles with width/thickness of >3 inches
Elongated	Particles with length/width of >3 inches.
Flat and elongated	Particles meet criteria for both flat and elongated.

1.5.6.2 Hardness of Coarse-Grained Components

Coarse sand and larger particles may be described as “hard” if particles do not crack, fracture, or crumble under a hammer blow.

1.5.6.3 Presence of Cobbles and Boulders

Note the presence of cobbles or boulders. This may be evident through observation of drill advance or by fragments recovered in samples. Make a volumetric estimate of the percent of cobbles or boulder present if possible. Alternatively, make a qualitative description such as “occasional” or “numerous” cobbles or boulders. If cobbles or boulders are present, “with cobbles” or “with boulders” should be appended to the USCS group name.

1.5.6.4 Cementation and/or Presence of Calcareous Materials in Soil

The degree of cementation of coarse-grained soils should be described, if relevant to the sample. The criteria for this description are summarized in the table below.

Table A-8: Degree of Cementation (ASTM D2488)

Description	**Criteria**
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Calcium carbonate is a common cementing agent. The amount of calcareous material present in a sample can be classified according to the reaction with dilute hydrochloric acid. The classification is summarized in the table below.

Table A-9: Acid Reaction (ASTM D2488)

Description	**Criteria**
None	No visible reaction.
Weak	Some reaction with bubbles forming slowly.
Strong	Violent reaction with bubbles forming immediately.

2.0 ROCK TYPES AND RQD FIELD TEST

2.1 ROCK TYPES (IGNEOUS, METAMORPHIC, SEDIMENTARY)

Rock type names should be documented to the extent practicable; however, classification is dependent upon the character and integrity of the sample and its suitability for field classification. Some drilling methods destroy the rock texture and crystal boundaries, which may limit the ability for detailed rock classification.

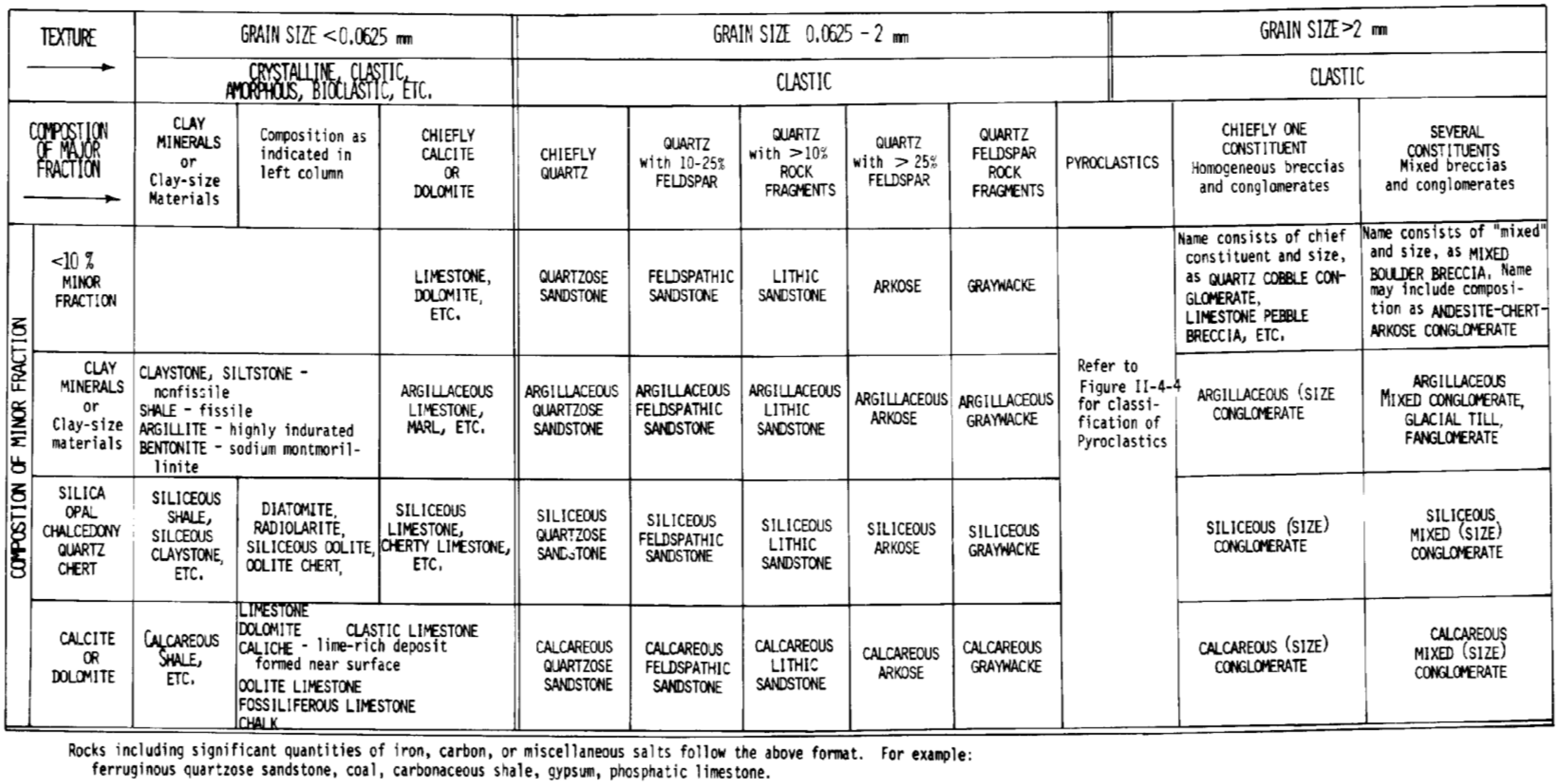
Where sample integrity allows for suitable rock classification, utilize the following charts for rock type: Figure 2: igneous rocks; Figure 3: sedimentary rocks; and Figure 4: metamorphic rocks (USBR, 2001). Refer to Table 5-1 of this SOP for additional details on rock logging classification.

CONTINUED ON NEXT PAGE.

<table>
<tr><td colspan="2">COLOR</td><td colspan="8">LIGHT → DARK</td><td rowspan="4">SPECIAL TYPES</td></tr>
<tr><td colspan="2">QUARTZ</td><td>> 10 %</td><td>< 10 %</td><td>> 10 %</td><td>< 10 %</td><td colspan="2">> 10 %</td><td colspan="2">< 10 %</td><td rowspan="3">CHIEFLY PYROXENE AND/OR OLIVINE</td></tr>
<tr><td colspan="2" rowspan="2">FELDSPAR</td><td colspan="2" rowspan="2">POTASSIUM FELDSPAR > 2/3 TOTAL FELDSPAR</td><td colspan="2" rowspan="2">POTASSIUM FELDSPAR 1/3-2/3 TOTAL FELDSPAR</td><td colspan="4">PLAGIOCLASE > 2/3 TOTAL FELDSPAR</td></tr>
<tr><td>> K-SPAR 10 % TOTAL</td><td colspan="2">SODIC PLAGIOCLASE</td><td>CALCIC PLAGIOCLASE</td></tr>
<tr><td colspan="2">CHIEF ACCESSORY MINERALS</td><td colspan="2">HORNBLENDE
BIOTITE
MUSCOVITE</td><td colspan="2">HORNBLENDE
BIOTITE
PYROXENE</td><td colspan="3">HORNBLENDE, BIOTITE, PYROXENE</td><td>PYROXENE
OLIVINE</td><td>SERPENTINE
IRON ORE</td><td rowspan="3">PEGMATITIE - Very coarse grained, normally silicic, rock (or small irregular mass).
APLITE - Fine-grained rock having sugary texture.
LAMPROPHYRE - Dark rock with high percentage FeMg materials as phenocrysts and in ground mass.</td></tr>
<tr><td>Fine to coarse > 0.1 mm</td><td>EQUIGRANULAR Batholiths, lopoliths, stocks, large laccoliths, thick dikes and sills.</td><td>GRANITE</td><td>SYENITE</td><td>QUARTZ MONZONITE</td><td>MONZONITE</td><td>GRANODIORITE</td><td>QUARTZ DIORITE</td><td>DIORITE</td><td>GABBRO</td><td>PERIDOTITE</td></tr>
<tr><td rowspan="2">PORPHYRITIC *</td><td>FINE TO COARSE GRAIN GROUND MASS Laccoliths, dikes, sills, plugs, small stocks, margins, of larger masses</td><td>GRANITE PORPHYRY</td><td>SYENITE PORPHYRY</td><td>QUARTZ MONZONITE PORPHYRY</td><td>MONZONITE PORPHYRY</td><td>GRANODIORITE PORPHYRY</td><td>QUARTZ DIORITE PORPHYRY</td><td>DIORITE PORPHYRY</td><td>GABBRO PORPHYRY</td><td>PERIDOTITE PORPHYRY</td></tr>
<tr><td>APHANITIC GROUND MASS Dikes, sills, laccoliths, surface flows, margins of larger masses, welded tuffs.</td><td>RHYOLITE PORPHYRY</td><td>TRACHYTE PORPHYRY</td><td>QUARTZ LATITE PORPHYRY</td><td>LATITE PORPHYRY</td><td colspan="2">DACITE PORPHYRY</td><td>ANDESITE PORPHYRY</td><td>BASALT PORPHYRY</td><td rowspan="2">RARE</td><td rowspan="3">* TRAP - dark-colored aphanitic rock,
* FELSITE - light-colored aphanitic rock.
* These are somewhat vague terms and generally should not be used.</td></tr>
<tr><td rowspan="2">APHANITIC < 0.1 MM</td><td>MICROCRYSTALLINE Dikes, sills, surface flows, margins of larger masses, welded tuffs.</td><td>RHYOLITE</td><td>TRACHYTE</td><td>QUARTZ LATITE</td><td>LATITE</td><td colspan="2">DACITE</td><td>ANDESITE</td><td>BASALT</td></tr>
<tr><td>GLASSY Surface flows, margins of dikes and sills, welded tuffs.</td><td colspan="3">OBSIDIAN - dark colored
PITCHSTONE - resinous
VITROPHYRE - porphyritic
PERLITE - concentric fractures
PUMICE - light colored, finely vesicular
SCORIA - dark colored, coarsely vesicular</td><td colspan="6">Normally it is not possible to determine the compositon of these rocks. They are customarily designated by the names at the left. Basic glass is rare so rocks named, except scoria, will normally be silicic. If the approximate composition (by close association) can be determined, the name may be prefixed by the name of the appropriate aphanitic rock, for example, "trachyte obsidian" or "latite vitrophyre". In general, scoria is basic; basic obsidian is called "tachylite"; and spherulite tachylite is "variolite".</td></tr>
</table>

* The names in these rows should be used if there are >50% phenocrysts. If there are < 50% phenocrysts, the adjective "porphyritic" should be used, for example, "porphyritic granite".

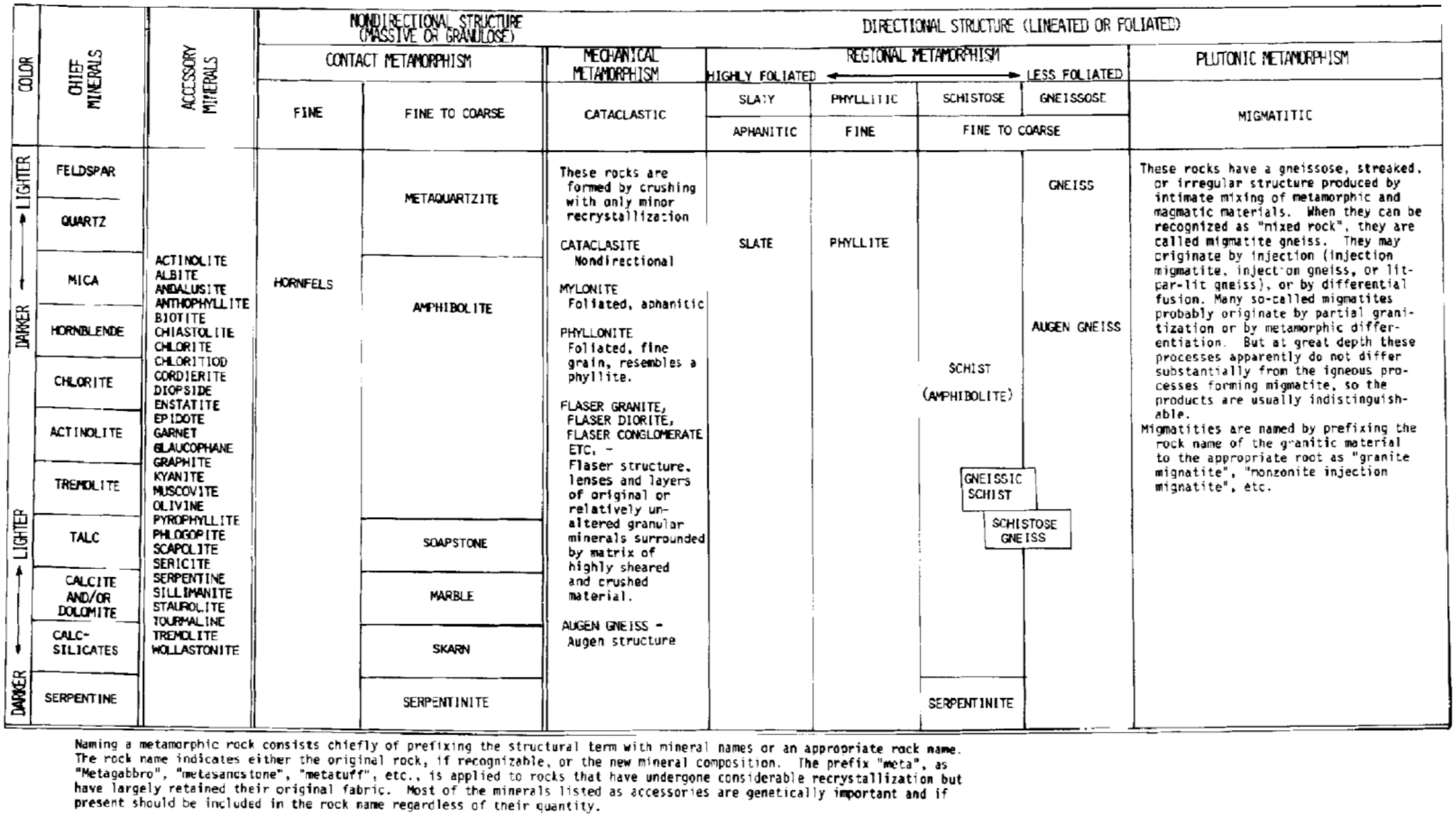
Figure A-1: Optional classification of igneous rocks (USBR, 2001)



TEXTURE →		GRAIN SIZE <0.0625 mm			GRAIN SIZE 0.0625 - 2 mm						GRAIN SIZE >2 mm	
		CRYSTALLINE, CLASTIC, AMORPHOUS, BIOCLASTIC, ETC.			CLASTIC						CLASTIC	
COMPOSTION OF MAJOR FRACTION →		CLAY MINERALS or Clay-size Materials	Composition as indicated in left column	CHIEFLY CALCITE OR DOLOMITE	CHIEFLY QUARTZ	QUARTZ with 10-25% FELDSPAR	QUARTZ with >10% ROCK FRAGMENTS	QUARTZ with > 25% FELDSPAR	QUARTZ FELDSPAR ROCK FRAGMENTS	PYROCLASTICS	CHIEFLY ONE CONSTITUENT Homogeneous breccias and conglomerates	SEVERAL CONSTITUENTS Mixed breccias and conglomerates
COMPOSTION OF MINOR FRACTION	<10 % MINOR FRACTION			LIMESTONE, DOLOMITE, ETC.	QUARTZOSE SANDSTONE	FELDSPATHIC SANDSTONE	LITHIC SANDSTONE	ARKOSE	GRAYWACKE	Refer to Figure II-4-4 for classification of Pyroclastics	Name consists of chief constituent and size, as QUARTZ COBBLE CONGLOMERATE, LIMESTONE PEBBLE BRECCIA, ETC.	Name consists of "mixed" and size, as MIXED BOULDER BRECCIA. Name may include composition as ANDESITE-CHERT-ARKOSE CONGLOMERATE
	CLAY MINERALS or Clay-size materials	CLAYSTONE, SILTSTONE - nonfissile SHALE - fissile ARGILLITE - highly indurated BENTONITE - sodium montmorillinite		ARGILLACEOUS LIMESTONE, MARL, ETC.	ARGILLACEOUS QUARTZOSE SANDSTONE	ARGILLACEOUS FELDSPATHIC SANDSTONE	ARGILLACEOUS LITHIC SANDSTONE	ARGILLACEOUS ARKOSE	ARGILLACEOUS GRAYWACKE		ARGILLACEOUS (SIZE CONGLOMERATE	ARGILLACEOUS MIXED CONGLOMERATE, GLACIAL TILL, FANGLOMERATE
	SILICA OPAL CHALCEDONY QUARTZ CHERT	SILICEOUS SHALE, SILCEOUS CLAYSTONE, ETC.	DIATOMITE, RADIOLARITE, SILICEOUS OOLITE, OOLITE CHERT,	SILICEOUS LIMESTONE, CHERTY LIMESTONE, ETC.	SILICEOUS QUARTZOSE SANDSTONE	SILICEOUS FELDSPATHIC SANDSTONE	SILICEOUS LITHIC SANDSTONE	SILICEOUS ARKOSE	SILICEOUS GRAYWACKE		SILICEOUS (SIZE) CONGLOMERATE	SILICEOUS MIXED (SIZE) CONGLOMERATE
	CALCITE OR DOLOMITE	CALCAREOUS SHALE, ETC.	LIMESTONE DOLOMITE CLASTIC LIMESTONE CALICHE - lime-rich deposit formed near surface OOLITE LIMESTONE FOSSILIFEROUS LIMESTONE CHALK		CALCAREOUS QUARTZOSE SANDSTONE	CALCAREOUS FELDSPATHIC SANDSTONE	CALCAREOUS LITHIC SANDSTONE	CALCAREOUS ARKOSE	CALCAREOUS GRAYWACKE		CALCAREOUS (SIZE) CONGLOMERATE	CALCAREOUS MIXED (SIZE) CONGLOMERATE

Rocks including significant quantities of iron, carbon, or miscellaneous salts follow the above format. For example: ferruginous quartzose sandstone, coal, carbonaceous shale, gypsum, phosphatic limestone.

Figure A-2: Optional classification of sedimentary rocks (USBR, 2001)



COLOR	CHIEF MINERALS	ACCESSORY MINERALS	NONDIRECTIONAL STRUCTURE (MASSIVE OR GRANULOSE)		DIRECTIONAL STRUCTURE (LINEATED OR FOLIATED)					
			CONTACT METAMORPHISM		MECHANICAL METAMORPHISM	REGIONAL METAMORPHISM HIGHLY FOLIATED ← → LESS FOLIATED				PLUTONIC METAMORPHISM
			FINE	FINE TO COARSE	CATACLASTIC	SLATY	PHYLLITIC	SCHISTOSE	GNEISSOSE	MIGMATITIC
						APHANITIC	FINE	FINE TO COARSE		
LIGHTER ↕ DARKER	FELDSPAR	ACTINOLITE ALBITE ANDALUSITE ANTHOPHYLLITE BIOTITE CHIASTOLITE CHLORITE CHLORITIOD CORDIERITE DIOPSIDE ENSTATITE EPIDOTE GARNET GLAUCOPHANE GRAPHITE KYANITE MUSCOVITE OLIVINE PYROPHYLLITE PHLOGOPITE SCAPOLITE SERICITE SERPENTINE SILLIMANITE STAUROLITE TOURMALINE TREMOLITE WOLLASTONITE	HORNFELS	METAQUARTZITE	These rocks are formed by crushing with only minor recrystallization CATACLASITE Nondirectional MYLONITE Foliated, aphanitic PHYLLONITE Foliated, fine grain, resembles a phyllite. FLASER GRANITE, FLASER DIORITE, FLASER CONGLOMERATE ETC. - Flaser structure, lenses and layers of original or relatively unaltered granular minerals surrounded by matrix of highly sheared and crushed material. AUGEN GNEISS - Augen structure	SLATE	PHYLLITE		GNEISS	These rocks have a gneissose, streaked, or irregular structure produced by intimate mixing of metamorphic and magmatic materials. When they can be recognized as "mixed rock", they are called migmatite gneiss. They may originate by injection (injection migmatite, injection gneiss, or lit-par-lit gneiss), or by differential fusion. Many so-called migmatites probably originate by partial granitization or by metamorphic differentiation. But at great depth these processes apparently do not differ substantially from the igneous processes forming migmatite, so the products are usually indistinguishable. Migmatities are named by prefixing the rock name of the granitic material to the appropriate root as "granite mignatite", "monzonite injection mignatite", etc.
	QUARTZ									
	MICA			AMPHIBOLITE						
	HORNBLENDE								AUGEN GNEISS	
	CHLORITE							SCHIST (AMPHIBOLITE)		
	ACTINOLITE									
	TREMOLITE							GNEISSIC SCHIST		
LIGHTER ↕ DARKER	TALC			SOAPSTONE					SCHISTOSE GNEISS	
	CALCITE AND/OR DOLOMITE			MARBLE						
	CALC-SILICATES			SKARN						
	SERPENTINE			SERPENTINITE				SERPENTINITE		

Naming a metamorphic rock consists chiefly of prefixing the structural term with mineral names or an appropriate rock name. The rock name indicates either the original rock, if recognizable, or the new mineral composition. The prefix "meta", as "Metagabbro", "metasancstone", "metatuff", etc., is applied to rocks that have undergone considerable recrystallization but have largely retained their original fabric. Most of the minerals listed as accessories are genetically important and if present should be included in the rock name regardless of their quantity.

Figure A-3: Optional classification of metamorphic rocks (USBR, 2001)

2.2 Rock Quality Designation (RQD)

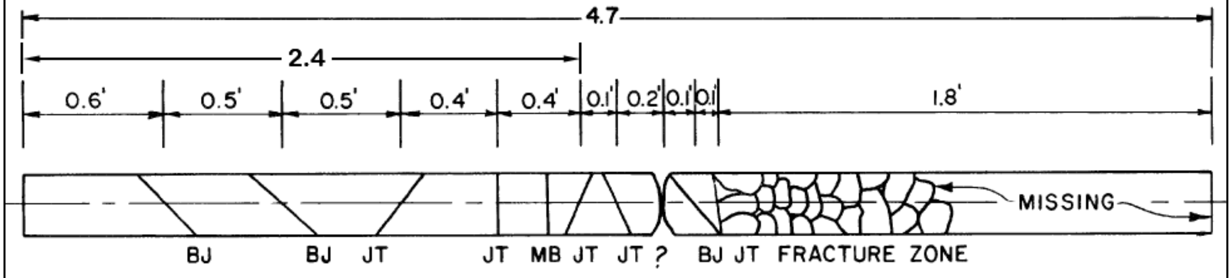
The RQD is the total length of core pieces (unweathered bedrock) greater than or equal to four inches (10 centimeters) in length divided by the total length of the core run. RQD is expressed as a percentage and recorded in the PERCENT RQD column for each core run.

Care must be taken to correctly identify natural bedrock breaks from mechanical breaks (breaks caused by drilling). Mechanical breaks are often, but not always, accompanied by fresh bedrock appearance. Generally, natural breaks should first be considered as caused by a joint. Other natural breaks of the core may be due to:

- Irregular and rounded surfaces that reflect considerable grinding of the core due to rotation during drilling along a plane of weakness.
- Rather smooth surfaces that cannot be rejoined but which show no signs of weathering.
- Weathered surfaces.

Include all pieces of core which are greater than or equal to four inches (10 centimeters) in length and bounded by natural surfaces. As a general guideline, if a core segment can be rejoined with only a hairline separation, it should be included in computing the percent RQD.

1. PERCENTAGE OF SOLID CORE SEGMENTS LONGER THAN 0.33 ft (100mm) RELATIVE TO CORE RUN LENGTH, EXCLUDING MECHANICAL BREAKS.
2. RECORDED AS CALCULATED PERCENTAGE FOR EACH RUN.
3. BEST FOR N-SIZE OR LARGER SIZE CORE.
4. MAY NOT BE APPLICABLE FOR VERY LOW STRENGTH, FISSILE OR FOLIATED ROCKS WHICH BREAK OR PART EASILY.



$$\text{RQD} = \frac{\text{Sum of length of pieces} \geq 0.33\,\text{ft (4in)}}{\text{(total length of core run)}} \times 100 = \frac{2.4}{4.7} \times 100 = 51\,\%$$

Figure A-4: Rock Quality Designation (RQD) computation (modified from USBR, 2001)

STANDARD OPERATING PROCEDURE OESC007C

HAND AUGER BORINGS

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Stacy Kowalski Project Geologist	Stacy Kowalski	9 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	20 April 2023

1.0 INTRODUCTION

This Oneida ESC Group (OESC) field Standard Operating Procedure (SOP) covers soil boring using a hand auger for the purpose of performing shallow soil investigation and sampling.

A hand auger can be used for any purpose where disturbed samples can be used, such as soil, sediment, or waste samples associated with environmental site assessments. The hand auger is a tool suitable for collecting multiple samples at different locations due to its ease of setup and decontamination.

The equipment required is simple and readily available. Depths of auger investigations are; however, limited by groundwater conditions, soil characteristics, and the equipment used. A disadvantage of using a hand auger is the limited depth of penetration and the potential for auger refusal caused by coarse grained soils. Additionally, the potential exists for borehole collapse at depth that could affect discrete soil sampling.

1.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses.

If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures, and protocols to avoid sample contamination from outside sources.

2.0 EQUIPMENT AND MATERIALS

The following is a list of equipment recommended for hand auger soil boring:

- Site Health and Safety Plan (HASP) and Sampling and Analysis Plan (SAP).
- Two- or four-inch diameter barrel hand auger (stainless steel for collecting samples for chemical analysis).
- Hand auger flight extension rods.
- T-handle for hand auger rotation.
- Key tool or quick connect pins for interchanging hand auger flights.

- Stainless steel bowl and spoon for soil homogenization.
- Decontamination equipment, e.g., buckets, brushes, Alconox®, deionized water, or other specified material.
- Sample containers, bubble bags, Ziploc plastic bags, cooler, ice, sample labels, chain-of-custody forms, shipping labels, custody seals.
- Field logbook and pens.
- Tape measure, survey stakes or flags, hand-held global positioning system (GPS), site maps, etc. for locating samples.
- Plastic sheeting for creating a clean work area for sampling, and to contain soil cuttings.
- 55-gallon drum and other materials for investigation derived waste (IDW) containment.
- Health and safety monitoring equipment and logs (as required).

3.0 HAND AUGER BORING PROCEDURE

1. Verify that the area for boring installation has been cleared for utilities (both underground and overhead) and property access/right-of-entry has been granted.
2. Be aware of all site safety and health considerations for the work to be performed.
3. Understand the sampling data quality objectives.
4. Using a shovel or other suitable surface grubbing tool, clear away surface vegetation and debris from the borehole location.
5. Decontaminate the hand auger barrel and extension rods prior to use.
6. Install the cutting tooth from the hand auger barrel into the soil.
7. Advance the hand auger by simultaneously pushing and rotating it into the subsurface to the desired depth or until the length of the barrel is filled with soil. Note: The typical length of the hand auger flights is 5 feet. Therefore, additional hand auger flights will be required for depths greater than 5 feet.
8. Withdraw the barrel from the borehole. Transfer the soil/sediment/sludge from the auger barrel to plastic sheeting or other containment until the depth of sample is reached.
9. Identify soil types during each advancement in the field logbook or boring log as required.
10. Return the hand auger barrel to the borehole and repeat procedure.
11. Periodically measure the borehole depth with the tape measure to ensure an accurate depth interval.
12. Continue the above procedures until the end-of-boring or sample depth is reached.

13. VOC samples will be collected immediately from the auger barrel and preserved, if necessary (refer to project-specific planning documents). Place remaining soil into the stainless-steel bowl and thoroughly homogenize the soils before filling remaining containers.
14. Refer to project-specific planning documents for requirements related to sampling, logging, borehole abandonment, decontamination, and waste management for the project.

4.0 REFERENCES

ASTM Standard D1452M-16 (2016). "Standard Practice for Soil Exploration and Sampling by Auger Borings," ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D6311-98 (2014). "Standard Guide for Generation of Environmental Data Related to Waste Management Activities: Selection and Optimization of Sampling Design," ASTM International, West Conshohocken, PA, www.astm.org.

STANDARD OPERATING PROCEDURE OESC007D

SUBSURFACE SOIL SAMPLING

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared by: Mark Wanek Project Geologist	Mark Wanek	23 February 2021
Reviewed by: Robert Price Senior Geologist		07 March 2023
Reviewed by: Brennan Johnson, CIH, CSP Corporate Health and Safety Manager	Brennan Johnson	07 March 2023
Approved by: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	07 March 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to define the requirements for collecting subsurface soil samples. For the purpose of this SOP, subsurface soil samples are those samples collected in the unconsolidated zone at a depth of 1-foot (ft) or greater below ground surface (bgs). Refer to project-specific planning documents for procedures related shallower sample depths.

1.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses.

If groundwater samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures, and protocols to avoid sample contamination from outside sources.

2.0 SAFETY

Safety considerations for subsurface soil sampling projects may include working in and around excavations and other hazards. Personnel must be familiar with requirements of the project-specific Accident Prevention Plan and Site-specific Safety and Health Plan (SSHP), and with Oneida ESC Group's Injury and Illness Prevention Plan, which provide guidance for mitigating hazards on the site and associated with the work being performed.

3.0 EQUIPMENT

Refer to the project-specific planning documents regarding the sampling tools to be deployed. This section describes basic equipment needs for the different methods that may be used.

3.1 General

The following general equipment is required:

- Nitrile inner gloves, outer gloves (as needed) of material resistant to suspected contaminants

- Equipment and meters for obtaining field measurements specified in the project-specific planning documents and SSHP
- Field logbook or field forms; soil sampling form (if used)
- Chain-of-custody forms and custody seals
- Camera
- Global Positioning System (GPS) unit
- Pen with black waterproof, ballpoint, non-erasable ink
- Sample tags/labels and appropriate forms/documentation
- Appropriate sample containers as specified in project-specific planning documents
- Insulated sample storage cooler(s) and ice
- Plastic re-sealable bags and waterproof sealing tape
- Rinse bottles and Type II reagent water, deionized water, or PFAS-free laboratory supplied water as specified in the project-specific planning documents
- Decontamination equipment and supplies
- Plastic sheeting
- Investigation derived waste (IDW) containment as specified in project-specific planning documents

3.2 Hand Augering

The following equipment is needed for hand-augering:

- Hand auger (i.e., flighted-, bucket-, or tube-type augers) and/or slide hammer sampler
- Extension rods, as needed
- Wrench(es)
- Stainless-steel hand trowel or sampling spoon
- Large [minimum 12-inch (in.) diameter] stainless-steel, glass, or Pyrex® mixing bowl
- Sufficient sampler liners for collecting VOC samples
- Stainless-steel blade to trim excess soil from end of liners (if used)
- PTFE (Teflon®) or silicon tape
- Sufficient end caps to cover both ends of sampler liners (if used)
- Sufficient non-LDPE plastic sheeting to contain all soil cuttings

3.3 Equipment for Sampling Excavations, Trenches, and Test Pits

The following equipment may be used for excavations, trenches, and test pits (refer to project-specific planning documents):

- Backhoe or other excavation equipment

- Extension ladder(s) (capable of extending from bottom of excavation to at least 42-inches above the ground surface; at least two per excavation accessed)
- Trench/pit shoring and bracing equipment (as required in excavation plan)
- Stainless-steel hand trowel or sampling spoon for shallow excavation wall/floor samples, slam sampler for collecting soil cores, hand auger, or other sampling devices
- Large (minimum 12-in.-diameter) stainless steel glass, or Pyrex® mixing bowl (if compositing)
- Sampler to be used to collect samples for VOC analyses
- Sufficient sampler liners and end caps for collecting geotechnical cores, if planned

3.4 Split-Spoon Sampling (Based on ASTM D1586 /D1586M)

The following equipment is needed for split-spoon sampling (including California-modified):

- Drilling rig equipped with a 140-pound (lb.) drop hammer and sufficient hollow-stem augers to drill to the depths required by the project-specific planning documents
- Sufficient numbers and types of split-spoon samplers so that at least one is always decontaminated and available for use – p typically a minimum of three
- Sufficient non-LDPE plastic sheeting to contain all soil cuttings

3.5 Thin-Walled Sampling (Based on ASTM D1587/ D1587M)

The following equipment is needed for thin-walled sampling:

- Drilling rig equipped with a 140-lb drop hammer and sufficient hollow-stem augers to drill to the depths required by the site Work Plan
- Sufficient numbers and types of thin-walled samplers so that at least one is always decontaminated and available for use; thin-walled samplers generally are used only once
- Sufficient non-LDPE plastic sheeting to contain all soil cuttings
- Sufficient number and types of plastic end caps to cover both ends of all thin-walled samplers
- Allen wrenches
- PTFE (Teflon®) or silicon tape

3.6 Direct Push Technologies

The following equipment is needed for use with direct push technologies (DPT), such as the Geoprobe™ system:

- DPT rig and all associated hardware, including sampler as described in the project-specific planning documents
- Sampler liners as specified (e.g., stainless-steel, acetate, or brass)
- Stainless-steel safety blade or liner cutting system to open acetate liners for soil sample collection
- Sufficient plastic end caps to cover both ends of sampler liners (if used for geotechnical samples)

- PTFE (Teflon®) or silicon tape to secure liner caps

3.7 Continuous Core Sampler

The following equipment is needed for continuous core sampling:

- Drilling rig with continuous coring capability (i.e., hollow-stem auger or Rotosonic drill)
- Sufficient plastic sheeting to contain soil cuttings and cover ground surface under the drill rig
- Sufficient clear plastic sleeves to hold Rotosonic drill cores
- Drive sleeves (if used to collect samples for off-site laboratory VOC analyses) in accordance with the project-specific planning documents
- Stainless-steel blade to trim excess soil from end of drive sleeves (if used)
- Teflon® or silicon tape
- Sufficient vinyl end caps to cover both ends of the drive sleeves (if used)

4.0 PROCEDURES

4.1 Subsurface Sampling Preparations for All Methods

The collection of subsurface soil samples is an intrusive event and requires knowledge of the site and careful planning before commencing. Several standard steps should be taken before beginning any subsurface sampling activity.

Refer to the project-specific planning documents for additional guidance and requirements regarding utility permits and dig clearance.

1. Verify the site location by existing maps and surface features. Check for surface features or artifacts (e.g., manhole covers and overhead power lines) that could impede movement on the site or indicate a previously unidentified hazard.
2. If allowed and approved, photograph the site before commencing work.
3. Mark off the boundaries of the work site with flagging or other means to prohibit access by unauthorized personnel. All sites should have a single, clearly marked entrance through which all personnel should enter and exit. Sites having a high contamination level or where activities may unearth highly contaminated materials will also have an exclusion zone, contamination reduction zone, and support zone.
4. Check to see that all the necessary equipment (including personal protective equipment and samplers) is available at the site, is in good working condition, and has been properly decontaminated.
5. Check that all monitoring equipment is properly calibrated and operating. Document on calibration forms.
6. Set up the management system for investigation derived waste as described in the project-specific planning documents.

At no time should samples, decontaminated sample sleeves, or decontaminated samplers be touched by ungloved hands. A new or decontaminated pair of gloves must be used for each sample collected. Great care should be exercised to ensure that no contaminated tool or device is inserted into the borehole. All downhole tools and samplers must be kept off the ground and/or free from contamination until they are used in the boring.

4.2 Hand Augering

Hand augering consists of manually advancing the auger into the soil to collect subsurface soil samples, generally at depths of 10 ft or less. There are several types of hand augers available (e.g., Iwan, ship, closed spiral, and open spiral). All these devices are used in much the same way. The auger is attached to the bottom of a length of steel rods that have a crossbar (handle) at the top. The operator advances the auger by rotating the crossbar while pressing the auger into the ground. As the auger advances, it fills with soil. When the auger is filled with soil, the unit is removed from the hole, cleared, and reinserted. Additional rods are added until the desired depth is reached.

4.2.1 Restrictions and Limitations

The restrictions and limitations for hand augering are:

- The strength of the operator and the quality of the samples required generally limit the use of hand augers to a depth of less than 10 ft.
- Dense, highly compacted soils or soils with high clay content and/or abundant gravel will significantly increase the difficulty of hand augering. Loose, dry, sandy, non-compacted soils will be easier to auger through but are more likely to slough into the hole and may not be retained in the auger.
- Hand-augured samples should only be collected above (or slightly below) the water table to avoid cross-contaminating samples and to reduce the likelihood of borehole collapse.

4.2.2 Method for Hand Auger Sampling

The steps for hand-auger sampling are:

1. Using a decontaminated auger, advance the boring to the desired depth.
2. Place soil cuttings on a length of non-LDPE plastic sheeting spread out next to the boring. Cuttings should be placed in stratigraphic order to document changes as the boring progresses.
3. After reaching the desired sampling depth, remove the auger from the boring and decontaminate before re-inserting into the borehole to collect the sample. Alternative sampling devices may be used to collect the sample.
4. Insert the decontaminated auger into the boring and advance until full. If definitive samples are required for VOC analyses, an auger or slide hammer sampler with a properly positioned sampling sleeve will be used. The type and material of the sleeve will be specified in the planning documents.
5. Remove auger from borehole and field screen with the method and equipment specified in the planning documents.
6. Extract sample and place in specified containers. If a liner was used, remove liner from auger/slide hammer and place aluminum foil on ends (shiny side away from sample), cap and seal both ends of the liner with Teflon® or silicon tape, and place appropriate label on the liner.
7. Place sample container (e.g., liner and jar) in resealable plastic bag and place bag containing sample into an insulated cooler with ice. Samples should be maintained at 4 ±2 degrees Celsius

(˚C) from the time of collection until received at the laboratory in accordance with planning documents.

8. Collect the GPS coordinates of the sample location, draw a sketch of the sampling location in the field logbook or on field forms, and note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook or field forms.
9. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the planning documents.
10. Repeat steps 1 through 9 until sampling is completed.
11. Dispose of cuttings and disposable equipment as outlined in the planning documents.
12. Plug and abandon completed boreholes as specified in planning documents.
13. Decontaminate all equipment and personnel.

4.3 Excavations, Trenches, and Test Pits

The section addresses soil sampling from excavations such as test pits, trenches, or similar, as well as from naturally-occurring openings or sloped surfaces such as stream banks, fissures, or slumps. In this section, the term “excavation” refers to all such sampling locations.

4.3.1 Restrictions and Limitations

The restrictions and limitations of samples from excavations are:

- The depths that can be economically reached by test pits/trenches are limited.
- Large volumes of potentially contaminated material must be handled in excavating and reclaiming the test pit/trench.
- All fluids removed from the excavation must be assumed to be contaminated and must be contained and tested before disposal.
- Additional safety measures may be necessary.

4.3.2 Method for Excavation Sampling

Be aware that the project-specific planning documents may provide for collecting soil samples from the excavator bucket at the surface, rather than entering the excavation to collect samples. This method must be defined in an approved planning document if it is to be used.

1. Find each sample location by measuring from a reference point such as a monument, stake, building, or excavation corner starting point. Ensure sample locations are selected in accordance with the approved planning documents. GPS survey equipment may be used to locate and/or record sampling locations in large excavations.
2. Collect sufficient sample material to fill the laboratory-provided sample containers.
3. Place sample container (e.g., liner and jar) in re-sealable plastic bag and place bag containing the sample immediately into an insulated cooler with ice. Samples should be maintained at 4 ±2°C from the time of collection until received at the laboratory in accordance with the approved planning documents.

4. Record sampling information in the field logbook or sampling forms (if used). Use a to-scale site plan or draw a sketch of the excavation and record sample locations. Note the sample identification number, sample elevation or depth from ground surface, time of collection, field screening result, and laboratory analysis requested for each sample.
5. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific planning documents.
6. Repeat steps 1 through 5 until sampling is completed.
7. Decontaminate all reusable equipment and decontaminate personnel.

4.4 Split-Spoon Sampling

The split-spoon sampler consists of a threaded steel pipe that is split in two pieces along the axis of the pipe. A hardened steel driving shoe is screwed onto the downhole end and a threaded head with a check valve is screwed onto the top. The sampler is driven into undisturbed soil. The sampler collects the soil sample in the enclosed tube, which prevents mixing and cross-contamination of the sample. Soil samples may be collected for geotechnical information and/or chemical analyses. When done properly, this method will result in samples for screening and definitive data for all analytes except VOCs. Collect screening samples for VOC analyses directly from the sampler. To obtain definitive samples for VOCs, liner sleeves must be used in the sampler.

4.4.1 Restrictions and Limitations

The restrictions and limitations for split-spoon sampling are:

- Loose, dry, non-compacted, and/or highly saturated materials may not be retained in the sampler. This condition may require the use of a basket (sand catcher) or spring retainer in the cutting shoe of the sampler.
- Soils with a high cobble or rock fragment content may clog the sampler and prevent adequate collection of a sample or result in refusal of the sampler.

4.4.2 Method for Split-Spoon Sampling

The steps for split-spoon sampling are:

1. Using decontaminated augers, auger to the desired depth.
2. Place drill cuttings on non-LDPE plastic sheeting spread next to the boring or handle as specified in the site Work Plan.
3. Upon reaching the desired sampling depth, attach a decontaminated split spoon to the sampling rods and insert into boring. If definitive analyses are required for VOCs, a split spoon with properly positioned sampling liners will be used. The type and material of the liners will be specified in the project-specific planning documents.
4. Position the drive hammer on the sampling rods and lightly tap the rods to seat the sampler.
5. A 140-lb hammer is repeatedly dropped 30 in. while counting the number of blows required to drive the sampler each 6-in. interval. Cease driving when the sampler is full, or when 50 blows of the hammer have moved the sampler less than 1 in.

6. Remove the split spoon from the boring. Carefully open the split spoon and immediately field screen the sample with the equipment specified in the project-specific planning documents. Collect VOC samples first following the specified procedures. Extract the sample and place it in appropriate containers, as specified.
7. Immediately after collection, place sample containers in re-sealable plastic bags and place bags containing samples into an insulated cooler. Samples should be maintained between 4 ±2°C from the time of collection until received at the laboratory in accordance with the planning documents. Samples should never be frozen.
8. Note the sample identification number, depth, time of collection, field screening result, lithological description, and laboratory analyses requested for the samples in the field logbook.
9. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific planning documents.
10. Repeat steps 1 through 9 until total required depth is reached.
11. Remove the augers from the boring.
12. Dispose of cuttings and disposable equipment as outlined in the approved planning documents.
13. Plug and abandon borehole as specified in the approved planning documents.
14. Decontaminate all equipment and personnel.

4.5 Thin-Walled Sampler

The thin-walled sampler (also known as a Shelby tube) consists of a one-piece hollow steel tube that is usually 2 to 5 in. in diameter and from 1 to 3 ft in length. The thin-walled sampler is mechanically pushed or driven into undisturbed soil. The sampler collects a column of relatively undisturbed soil in the tube. This method generally is used to collect samples for geotechnical information; it also may be used to collect soil for chemical analyses. When done properly, this method will result in samples for screening and definitive analyses for all analytes. Screening samples for VOC analyses may be collected directly from the sampler in the field. For definitive VOC samples, the entire sampler must be properly sealed and sent to the laboratory.

4.5.1 Restrictions and Limitations

The restrictions and limitations for thin-walled sampling are:

- Loose, dry, non-compacted, and/or highly saturated materials may not be retained in the sampler.
- Soils with significant cobble or rock fragment content may clog or damage the sampler or cause refusal of the sampler.
- It can be difficult or impossible to properly extrude soils from the sampler on-site. When samples are needed for chemical analyses, another sampling device is preferable.

4.5.2 Method for Using the Thin-Wall Sampler

The steps for using the thin wall sampler are:

1. Using decontaminated augers, auger to the desired depth.
2. Place drill cuttings on plastic sheeting or handle as specified in the planning documents.

3. After reaching the desired sampling depth, attach a decontaminated thin wall sampler to the sampling head and screw onto the sampling rods. Insert the sampler into the boring.
4. Position the drill head (ram) on the sampling rods and, using the rig hydraulics, push the sampler to the required depth (i.e., fill the tube) or until refusal. A smooth, sustained push will generally yield the best sample. If the rig hydraulics cannot push the tube, it can be driven using the drive hammer. The weight of the hammer, height of drop, and number of blows should be recorded in the field logbook.
5. Twist the drill rods clockwise to break loose the sample. Withdraw the sampler from the boring.
6. Detach the sampler from the sample rods and remove the tube from the sampling head.
7. For geotechnical analyses, trim off excess soil from either end of the tube/rings until it is at least flush with the rim. Cap and seal both ends of the tube and mark the "up" end. The sealed tube should be handled carefully to minimize vibration or impacts and should be transported to the laboratory in the upright position.
8. If no geotechnical analyses are planned, the sample may be extruded from the tube on-site, field screened, and placed in appropriate containers. The VOC screening sample must be collected first and as soon after extruding the soil from the container as possible. Proceed to fill the other containers as necessary.
9. Immediately after collection, place sample containers in re-sealable plastic bags and place bags containing samples into an insulated cooler. Samples should be maintained at 4°± 2°C from the time of collection until received at the laboratory in accordance with project planning documents.
10. Note the sample identification number, depth, time of collection, field screening result, lithological description (if known), and laboratory analyses requested for the samples in the site sampling logbook.
11. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific planning documents.
12. Repeat steps 1 through 11 until total required depth is reached.
13. Remove the augers from the boring.
14. Dispose of cuttings and disposable equipment as outlined in the planning documents.
15. Plug and abandon borehole as specified in the planning documents.
16. Decontaminate all equipment and personnel.

4.6 Direct Push Soil Sampling

DPT rigs advance a hollow sampling probe into the subsurface by applying static pressure (relying on vehicle weight), percussion, vibration, or any combination thereof, to the above ground portion of the sampler. Extensions are added to the probe system until the sampler has been advanced to the desired sampling depth. The sampler is recovered from the borehole and the sample removed from the sampler. The sampler is cleaned, and the procedure repeated for the next desired sampling interval. Sampling can be continuous for full depth borehole logging or incremental for specific interval sampling. Samplers used can be protected type for controlled specimen gathering or unprotected for general soil specimen.

4.6.1 Restrictions and Limitations

The restrictions and limitations for DPT sampling are:

- The standard 1-in. diameter soil probe sampler can collect only 100 grams of soil. Larger diameter cores (e.g., the Geoprobe Macro-Core® system) are available. If large sample volumes are required, two (or more) DPT holes may have to be drilled and sampled.
- Different DPT rigs have different depth capabilities; the project data quality objectives (for sample depth and considering anticipated soil types) must be considered when selecting the appropriate DPT rig.
- DPT is not appropriate for sampling in consolidated materials (rock, weathered rock, cemented soils), highly compacted soils (heavy clays), gravelly soils (unconsolidated tills, alluvium) that prevent penetration of the sampler. Additionally, sticky wet soils (saturated “fat” clays) may be penetrable but create friction that prevents efficient extraction of the probe.

4.6.2 Method for Direct-Push Sampling

The steps for direct-push subsurface soil sampling are:

1. For definitive samples for VOC analyses, the large-bore sampler must be used (the large-bore sampler allows the use of liner sleeves). A 12-in. probe rod is recommended to start the standard 24-in. and large-bore samplers.
2. Attach a decontaminated sampler to the lead probe rod.
3. Drive or push the sampler to the desired depth. Some soil conditions may warrant using a retractable or solid drive point to pre-probe the hole to the desired depth. Do not attempt to drive the sampler into bedrock or other impenetrable layer.
4. After reaching the desired sampling depth, remove the drive cap and lower extension rods into the inside diameter of the probe rods using couplers to join the rods.
5. Disengage the stop-pin from the drive head with the extension rods.
6. Remove the extension rods and attached stop-pin from the probe rods.
7. If the top of the probe rod is already in the lowest driving position, attach another probe rod before driving. Replace the drive cap onto the top probe rod.
8. Mark the top probe rod with a marker or tape at the appropriate distance above the ground surface (allow 24-in. for the large-bore sampler). Drive the probe rods and sampler the designated distance. Be careful not to over-drive the sampler, which would compact the soil sample in the tube and make sample extrusion difficult.
9. Extract the probe rods from the hole and recover the sampler. Examine the sampler to confirm that a sample has been recovered.
10. When using the standard sampler, extrude the soil from the sampler, field screen as specified in the planning documents, and place in appropriate, labeled containers. This method yields screening samples for all analytes, and definitive samples for all methods except VOCs.
11. When using the large-bore sampler, remove the cutting shoe and withdraw the sample sleeves. Immediately field screen the sleeves as specified in the project-specific planning documents. Place aluminum foil on the ends of the sample, cap and seal both ends of the sleeves with Teflon or silicon

tape (the sleeve for VOC analyses first) and label appropriately. This method yields screening and definitive samples for all analytes.

12. Place sample containers (e.g., liners and jars) in re-sealable plastic bags and place bags containing samples into an insulated cooler with ice. Samples should be maintained at 4° ±2° C from the time of collection until received at the laboratory.
13. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook.
14. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific planning documents.
15. Repeat steps 1 through 14 until sampling is completed.
16. Plug and abandon the borehole as specified in the site planning documents.
17. Dispose of non-salvageable equipment as outlined in the site planning documents.
18. Decontaminate all equipment and personnel.

4.7 Continuous Core Sampler

The continuous core sampler is a steel tube that may be split in half and held together by threaded collars or may be in one piece. The sampler is usually 5 or 10 ft in length with a 3 to 5 in. diameter. The device may be driven ahead of hollow-stem augers or advanced into the soil by vibration and/or rotary action.

4.7.1 Restrictions and Limitations

The restrictions and limitations for using the continuous core sampler are:

- Loose dry, non-compacted and/or highly saturated loose organic materials may not be retained in the sampler or may break apart when extruded from the sampler.
- Gravelly soils may prevent adequate recovery of sample or cause refusal of the sampler.
- Dense and/or highly compacted soils may be difficult to extrude from the sampler. A split-spoon sampler with sleeves is a better choice if highly compact soils may be encountered and VOC samples are needed.

4.7.2 Continuous Core Sampler Methodology

The steps for continuous core sampling are:

1. For definitive samples for VOC analyses, 2 in.-diameter, 4-in.-long stainless-steel or brass sleeves must be used.
2. Using the approved drilling method and a decontaminated continuous core sampler, advance to the desired depth.
3. After reaching the desired sampling depth, remove the sampler from the boring and extrude the sample into a holding tray. It may also be desirable to extrude the sample into a clear, re-sealable plastic bag as it is being placed in the holding tray.
4. Select the desired sampling point on the core. Lightly scrape the core with a decontaminated stainless-steel scoop or spoon to remove surface soil and place samples into the appropriate

containers. This method yields screening samples for all analytes, and definitive samples for all methods, except VOCs.

5. When using the 2-in. diameter, 4-in. long stainless-steel or brass sleeve for definitive VOC samples, the length of the sampling sleeve should be equal to or smaller than the diameter of the core to ensure that no headspace exists in the VOC sample. Drive the sleeve into the core at the desired sampling point. The sleeve can then be extracted and immediately capped and sealed.
6. Place sample containers (e.g., liners and jars) in re-sealable plastic bags and place bags containing samples into an insulated cooler with ice. Samples should be maintained at 4° ±2° C from the time of collection until received at the laboratory.
7. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook.
8. Remove contaminated gloves and don fresh gloves for each new sample. Decontaminate re-used sampling equipment in between each sample. Collect equipment rinsate samples at the frequency required by the project-specific planning documents.
9. Repeat steps 2 through 8 until sampling is completed.
10. Plug and abandon the borehole as specified in the planning documents.
11. Dispose of cuttings and non-salvageable equipment as outlined in the planning documents.
12. Decontaminate all equipment and personnel.

4.8 Collection and Homogenization of Composite Samples

Composite samples consist of a series of discrete grab samples that are mixed together to characterize the average composition of a given material. The discrete samples used to make up a composite sample are of equal volume and are collected in an identical fashion. There are two basic types of composite soil samples: areal and vertical. Areal composites are collected from individual grab samples from the same horizontal strata or depth; vertical composites are collected from individual grab samples from within a single vertical profile (i.e., one borehole).

It is important that a composite sample be truly representative of the various sample locations or intervals making up the composite. Therefore, proper homogenization techniques should be followed to generate a composite sample. In addition, the equipment used to composite the sample must not affect the sample quality.

The target analytes are a factor in equipment selection; refer to the project-specific planning documents and section 1.1 of this SOP to confirm that equipment is made of acceptable materials for the constituents to be analyzed.

Samples to be analyzed for VOCs and, in some cases, semivolatile organic compounds (SVOCs), must be collected and contained immediately as discrete samples and, therefore, cannot be composited directly. Compositing of samples to be analyzed for VOCs or SVOCs should be performed by the analytical laboratory.

These steps must be followed when compositing soil samples.

1. Determine where composite sample(s) will be obtained as indicated in the project-specific planning documents.

2. Obtain samples by one of the various methods outlined in this SOP.
3. For split-spoon or Shelby-tube or other cores methods from a specified depth or range of depths, extract or extrude the sample from the split spoon or Shelby tube onto a stainless-steel tray or bowl.
4. For hand-auger samples: The sample is acquired directly from the withdrawn auger by using a clean spatula or spoon. Extract or extrude the sample from the hand auger onto a clean stainless-steel tray or bowl.
5. Divide the soil in the sample tray or bowl into quarters. Each quarter is mixed separately and then all quarters are mixed together into the center of the pan using a clean spatula or spoon. Follow this procedure several times until the sample is thoroughly mixed. The extent of mixing will depend on the nature of the material and should be done to achieve a consistent (homogenous) physical appearance (texture, color, moisture level, etc.) prior to filling sample containers.
6. Once mixing is completed, divide the sample material in half and fill containers by scooping sample material alternately from each half. Transfer subsamples of the composited sample into the appropriate sample containers. Seal, wipe clean, and label sample containers. Use the same care in handling these samples as is used for other samples from the site.
7. Place sample containers (e.g., liners and jars) in re-sealable plastic bags and place bags containing samples into an insulated cooler with ice. Samples should be maintained at 4° ±2° C from the time of collection until received at the laboratory.
8. Note on the chain-of-custody form that the sample is a composite. Record homogenization procedures on the sample log form or in the field notebook. Photographs before and after sample homogenization may be helpful for documentation.

4.8.1 Field Quality Control Samples

The type and frequency of samples should be identified in the project-specific planning documents. Field quality control samples are designed to evaluate if cross-contamination has occurred. Quality control (QC) samples may include trip blanks, equipment blanks, field duplicates, and field reagent blanks, per the planning documents.

5.0 REFERENCES

ASTM International. 2018. ASTM D1586/ D1586M-18e1. Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.

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United States Environmental Protection Agency (USEPA). 1987. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001.

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STANDARD OPERATING PROCEDURE OESC 007E

DIRECT PUSH TECHNOLOGIES

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Stacy Kowalski Project Geologist	Stacy Kowalski	16 December 2020
Reviewed By Cody Wilgus Project Geologist		10 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	10 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to define techniques and requirements for use and operation of direct push technologies (DPT) for collection of subsurface soil, groundwater, and soil gas samples and data. DPT refers to tools and sensors that are "pushed" into the ground without the use of drilling to collect soil or to make a path for the tool. While others manufacturer similar equipment, Geoprobe® is considered by some to be the industry-standard for DPT and is the focus of this SOP.

The following restrictions/limitations apply to the procedures described in this SOP:

- DPT is limited to sampling depths up to approximately 100 feet (ft) in unconsolidated, sandy soils and to shallower depths in compacted clayey or gravelly soils and tills.
- Small diameter well installations may not meet well installation requirements in some states; therefore, groundwater data collected from this type of well are not necessarily accepted as definitive data. Always check with your local regulatory agency for well installation requirements.

1.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

2.0 SUMMARY AND METHODS

2.1 DPT Uses, Advantage and Disadvantages

DPT can be used in nearly any condition amenable to hollow-stem-auger drilling and provides a cost-effective alternative to traditional subsurface investigative methods. DPT is limited to soils and unconsolidated materials that can be penetrated with the available equipment.

DPT is well suited to the site characterization process. The samples collected using this technique are commonly analyzed using on-site gas chromatography for rapid analytical turnaround time and in-field decision making. By using DPT in combination with appropriate on-site analytical equipment (gas chromatograph/mass spectrometer, atomic absorption, X-ray fluorescence, immunoassay, etc.), the sampling plan can be adjusted in the field to ensure the vertical and lateral extent of soil and/or groundwater contamination is determined before demobilization. DPT is also used for a wide range of other environmental applications such as remedial action installation (e.g., injection of bioremediation materials), remediation system monitoring, cleanup confirmation sampling, hydrologic studies, and geotechnical studies.

A typical DPT rig is the Geoprobe®, a vehicle-mounted, hydraulically powered, percussion and probing machine manufactured by Geoprobe Systems, Inc. of Salina, Kansas. Other manufactures offer similar or different features. DPT rigs rely on a relatively small amount of static (vehicle) weight combined with percussion or vibration as the energy for advancement of a tool string to collect soil gas, soil, and/or groundwater samples. Static forces are used to push the probe to depths of more than 40 ft in some soils. With the addition of percussion or vibration to the static force, probes can be driven to depths in excess of 100 ft.

The advantages of DPT systems are:

- Lower cost
- Ease of mobilization, versatility of use, can be used in limited access areas where larger and taller drilling equipment will not fit
- Rapid sample collection
- Absence of borehole cuttings, thus minimizing investigation-derived waste and risk to workers associated with contaminated soils or vapors
- Ability to collect undisturbed soil and groundwater samples without constructing permanent monitoring wells
- Access to much greater depths than those achieved with hand-driven probing equipment
- Ability to rapidly obtain a continuous record of stratigraphy using the soil conductivity logging system.

Disadvantages of DPT systems are:

- Depth limitations and difficulty or inability to drive probes through larger size gravels or boulders, semi-consolidated soils, and hard rock
- The hole left in the ground after removal of DPT equipment may not stay open making it difficult to seal the hole with bentonite or grout
- Smaller diameter probes and wells can limit options for purging/sampling equipment and methodology
- Small diameter cores limit the amount of sample material produced for extensive laboratory analyses

2.2 DPT Tools

Geoprobe Systems, Inc. also offers the following tools and add-ons for sample and data collection (listed to provide information, not endorsement of any particular tool or product):

1. **Large Bore Soil Sampler**. A closed piston sampler for soil sampling at discrete depths. The design allows the sampler to remain completely sealed while driven to depth. It recovers 22-inch (in) long x 1.0625-in diameter core to depths of over 60 ft (depending on soil conditions).

2. **Macro-Core® Soil Sampler**. Uses a variety of liner materials in a hollow steel corer. It is typically used to depths of 30 to 60 ft. Can be used as an open sampler (continuous core) or fitted with a closed piston (discrete sampler). It recovers a 1.5-in diameter by 2- to 4-ft long core.

3. **Dual Tube Sampling Systems**. Uses two sets of probe rods to collect continuous soil cores. One set of rods is driven into the ground as an outer casing, providing a sealed hole from which soil samples may be recovered without the threat of cross-contamination. The second, smaller set of rods are placed inside the outer casing, holding a sampler liner in place as the outer casing is driven one sampling interval. The small rods are then retracted to retrieve the filled liner. Not covered in this SOP.

4. **Membrane Interface Probe**. Provides near real-time total volatiles data from subsurface soil probe to on-board photoionization detector or flame ionization detector or both detectors in series. Not covered in this SOP.

5. **GeoTech Cone Penetrometer**. Cordless cone penetration testing (CPT) technology that uses acoustic transmission of soil resistance data for real-time assessment of subsurface soil conditions. Not covered in this SOP.

6. **Small Diameter Monitoring Wells**. Prepacked well screens in two sizes (0.5-in inner diameter [ID] x 1.375-in outer diameter [OD] or 1.0-in ID x 2.5-in OD).

7. **Screen Point 15 Groundwater Sampler**. The "Screen Point 15" is a 1.0-in OD steel groundwater sampling point with an exposed screen length of 41 in (longer screens may be custom ordered). This is commonly referred to as a Hydropunch.

8. **Groundwater Profiler**. Discrete interval sampling using 6-in or 12-in screen lengths. The tool is advanced through Geoprobe's® 2.125-in probe rods. Large screen openings allow pre-sample development and hydraulic conductivity testing as well as discrete zone sampling.

Variations and customizations of the tools listed above are also available for Geoprobe Systems, Inc. and other vendors.

3.0 EQUIPMENT AND MATERIALS

3.1 DPT

The following, or similar, may be required:

- Heavy-duty, four-wheel-drive pickup, van, or all-terrain vehicle)
- Rear-mounted hydraulic probe driving and removal system
- Rotary impact drill for asphalt/concrete penetration
- Vacuum volume pump system for soil gas sampling and groundwater purging
- Hardened steel sampling probes and accessories

3.1.1 Small Diameter Monitoring Well Installation

- Casing drive seat
- Expendable drive point
- Drive-point O-ring (per manufacturer specification)
- Prepacked screen

- Granular or powdered bentonite
- Polyvinyl chloride (PVC) protective casing
- Service cap
- Stainless steel casing
- Casing O-rings (per manufacturer specification)

3.1.2 Sampling

3.1.2.1 Soil Gas

- Retractable soil gas points for vertical profiling
- Expendable soil gas points for discrete depth-interval sampling
- 3/16-in Teflon® (unless PFAS sampling), polyethylene, or polypropylene tubing and soil gas points
- Permanent implants for soil gas sampling, air sparging, or performance monitoring
- Stopcocks and replaceable septa or sample syringes
- Tedlar® bags, glass oils gas bulbs with Teflon® (unless PFAS sampling), or stainless-steel canisters for gas samples

3.1.2.2 Soil

- Soil conductivity tools for stratigraphic definition
- Closed-piston large-bore and/or macro-core soil samplers for discrete depth soil sampling with liners, extruders and dowels for discharging soil, and other soil sampling accessories

3.1.2.3 Groundwater

- Screen point samplers or mill-slotted well points for shallow groundwater sampling
- Water trap for vacuum pump purging or semi-volatile sampling
- Peristaltic or bladder pump (depending on well depth), appropriate tubing for groundwater purging and sampling;
- Field analytical equipment (water quality meter, turbidimeter, water level indicator)

3.1.3 Miscellaneous

- Personal protective equipment (PPE) as specified in the site-specific Health and Safety Plan (HASP)
- Measuring tape
- Plastic sheeting, garbage bags, caution tape and posts
- Wooden stakes or flags to mark locations
- Probing tools including sufficient numbers of probe rods to avoid extensive decontamination, drive caps, pull caps, drive points, extension rods, sample liners, cleaning accessories, subassemblies, and adapters
- Stainless steel spoons and bowls
- Appropriate sample containers, Ziploc bags, ice, cooler, and sample labels
- Log book, boring logs, and activity appropriate field documentation forms

3.2 Decontamination

The following decontamination equipment may be required:

- Plastic buckets and/or troughs
- Laboratory-grade detergent (phosphate free)
- High-pressure hot water cleaner
- Stiff bristle brushes capable of cleaning the inside and outside of equipment
- Sprayers or wash bottles
- Disposable wipes or rags
- Aluminum foil
- Potable water
- Deionized, organic-free water ASTM type ii or equivalent
- Pesticide-grade or better methanol, or pesticide-grade or better isopropanol if required by the state or region (note: use of methanol is preferred to isopropanol because of the potential for generation of acetone as a photodegradation product of isopropanol)

4.0 PROCEDURES FOR DPT SITE STUDIES

4.1 Pre-Field Planning

Review all project plan documents including the HASP, Site-Specific Work Plan (WP), and Sampling and Analysis Plan (SAP). Contact 811 Dig or equivalent service to have underground utilities marked. Be aware of any site-specific hazards related to subsurface drilling, including overhead hazards. Ensure that geologic conditions at the site are amenable for DPT drilling. Concrete coring may be required prior to DPT advancement.

4.2 Mobilization

Before initiating any DPT survey, the following items must be completed:

- Secure site access (permissions) and any required personnel clearance (SOP OESC 001A).
- Field check each location for drilling rig accessibility.
- Stake all initial and optional/potential sampling locations.
- Clear utilities and secure dig permits for each location (SOP OESC 001A).
- Estimate or measure at nearby monitoring wells the depth to groundwater (vadose zone thickness).
- Plot sampling locations and other information, such as approximate surface elevation and estimated depth to groundwater, on a map for field use.

4.3 Decontamination

All downhole DPT sampling equipment and all equipment directly contacting the samples will be decontaminated (following SOP OESC 011A) before initial use, reuse, and between drilling locations. Waste should be handled following procedures included in ASTM Standard D 6311 (ASTM, 2022), client-specified procedures, and requirements of the receiving disposal facility when applicable.

4.4 Soil Gas Sampling

There are three types of Geoprobe® sampling tools that can be used for sampling soil gas: (1) sampling through probe rods using an expendable point, (2) sampling through probe rods using a retractable point, and (3) sampling through inner tubing using the post-run tubing (PRT) system. The PRT system is the preferred sampling method for the following reasons:

- Increases speed and accuracy of soil gas sampling
- Eliminates problems associated with rod leakage and sample carryover (preserves sample integrity)
- Reduces the probe rod decontamination time
- Uses a simple design for ease of use and vacuum-tight sealing
- Requires no management of inner tubing during probing

4.4.1 Vertical Profiling

Vertical profiling consists of collecting soil gas samples from various depths at a single location. The depth of the soil gas sample with the most significant response will indicate the optimum soil sampling depth. Vertical profiling should generally be done at a number of locations during the soil gas survey to assess the variability of contaminants in the vadose zone. Knowledge of the subsurface lithology can also assist in determining the optimum depth to collect soil gas samples. New tubing must be used for each sample to prevent cross-contamination.

4.5 Soil Sampling

The Geoprobe® system has two different types of soil-sampling tools: 1) the Large Bore soil sampler—a closed piston (discrete interval) sampler; and 2) the Macro-Core soil sampler—a longer and larger-diameter sampler that can be used in an open tube mode for ground surface sampling and in a closed piston mode for depth discrete subsurface sampling. Both types of samplers are pushed or driven and do not generate cuttings. Soil sampling activities should follow procedures described in ASTM Standard D 6282M-14 (ASTM, 2016).

4.5.1 Large Bore and Macro-Core Sampler Use and Specifications

The Large Bore sampler is generally more applicable to intermittent depth-discrete sampling while the Macro-Core with its greater length and volume is more appropriate for shallower continuous coring and/or when greater sample volume is needed for extensive laboratory analysis. The Macro-Core sampler is equipped with a closed-piston tip for discrete sample collection. Except for surface coring (i.e., 0 to 4-ft depth), the Macro-Core sampler must always be used in the closed piston mode to ensure depth discrete sample integrity. Equipment specifications are provided in the following table for each of these soil-sampling devices.

Geoprobe® Drive Soil Samplers

Name of sampler	Sample tube dimensions (in)	Core dimensions (in)	Volume [milliliters (mL)]	Liners	Depth capability (ft)
Large Bore	24 by 1.375	22 by 1.0625	320	Yes	60+
Macro-Core	48 by 2	45 by 1.5	1303	Yes	30+

Liners are available for the Large Bore sampler in clear plastic (CAB), brass, stainless steel, and polytetrafluoroethylene (PTFE, Teflon). Liners are available for the Macro-Core sampler in clear plastic (PVC and polyethylene terephthalate glycol [PETG]), stainless steel, and PTFE. When cores are retrieved, the plastic liners can be cut longitudinally to screen soils for contaminants and lithologic logging and to remove soils for laboratory analysis. In addition, the plastic liners can be cut circumferentially to isolate and cap segments for later analysis of volatile organic compounds (VOCs).

4.5.2 Soil Sampling Procedures

The following steps must be followed when sampling soil with the Geoprobe® system. The driller is responsible for the assembly, probing, stop pin removal, and obtaining the soil with the DPT. The driller will be familiar with the operation and procedures for soil sampling using the Large Bore and Macro-Core samplers, respectively.

4.5.2.1 Sampling

- If contaminants of concern include VOCs, then the soil core should immediately be sampled for laboratory samples, then head-space screening samples, and screened for VOCs by a hand-held organic vapor analyzer (OVA) across the entire length of core. Refer to SOP OESC 005B for VOC head-space screening methods.
    a. Instrument readings should be recorded in the field book and/or boring log.
    b. Record sample recovery (sample length/drive length).
    c. VOC sample volumes should be collected from the least disturbed area of the samples possible. The sample volume should be quickly containerized for OVA headspace analysis of VOCs, and for on-site and/or off-site analysis of VOCs per specifications in site-specific SAP. Refer to SOP OESC 007D for soil sample collection and preservation for VOC analysis.
    d. Sample liner section ends should be immediately capped for off-site VOC laboratory samples.
    e. Sampling for other analytes (e.g., inorganics and SVOCs) should follow VOC sampling. Sample volumes should be collected from the remainder of the soil sample after it has been thoroughly homogenized.
    f. Label all samples immediately upon sampling.

4.5.3 Documentation

The soil sampling process must be fully documented using a soil boring log form and related requirements of SOP OESC 007D. Soil lithology should be logged according to the requirements of SOP OESC 007B. All screening measurements, sample identification numbers, and other relevant information identified on the soil boring log must be recorded for each boring.

4.6 Groundwater Sampling

DPT groundwater sampling should follow procedures included in ASTM Standard D 6001M (ASTM, 2020). There are three types of well point configurations that can be used with the Geoprobe® to collect groundwater samples. All three types of well points are driven into the saturated zone with the Geoprobe®, and a sample of the groundwater is collected through the hollow probe rods.

The different well points available are:

- An expendable point (which is disconnected by pulling up on the probe rods to expose the open bore of the probe rod)
- A mill-slotted well point
- A screen point sampler

The expendable point is generally not recommended because sand and silt can flow up the probe rod and clog the sampling apparatus. The mill-slotted well point is recommended for relatively clean unconsolidated sand aquifers where silts and clays are minor or nonexistent. The screen point sampler, which contains a fine screen within a perforated steel sheath, is recommended for most hydrogeological settings.

To avoid potential cross-contamination and mixing, multiple groundwater samples should never be taken vertically at different depths from within the same borehole. The lateral swing lever allows groundwater sampling from separate, adjacent probes without moving the vehicle. This mode should be used to preserve sample integrity from each depth during vertical profiling of groundwater contamination.

4.6.1 Screen Point Sampler Procedure

The Geoprobe® screen point sampler consists of an expendable stainless steel probe point, a 1.0-in OD screen and riser attached to the probe point, a stainless-steel sheath that covers the screen during probing, and a head assembly. The 41-in long screens are wire-wound stainless steel or slotted PVC. Screens can be custom fabricated up to a length of 48-in. The screen section remains totally enclosed in the sheath until it is pushed out into the formation at the desired depth. Groundwater samples should be pumped from the probing rods or pumped directly from the screen section using flexible tubing, a PRT adapter, and a peristaltic or bladder pump (or vacuum pump with an in-line trap), depending on depth to water.

The driller is responsible for the assembly, probing, exposing the screen, and removal of rods with the DPT. The driller will be familiar with operation and procedures for groundwater sampling with the Screen Point 15 Groundwater Sampler.

4.6.2 Temporary Piezometers

For some hydrogeologic settings, where aquifer transmissivity is very low, substantial time is needed for enough groundwater sample volume to enter the screen point or similar type sampler. Temporary piezometers should be installed where this occurs. The installation of a temporary piezometer allows the sampling rig to move on to the next location in situations where slow recharge would cause excessive stand-by time.

A temporary piezometer is constructed of a 1-in inner diameter by 5-ft long slotted PVC screen connected to a 1-in diameter blank section(s) of PVC pipe as necessary for the boring depth.

- The PVC piezometer is manually pushed down into the borehole after all the sampling rods and screen points have been removed from the borehole.
- The temporary piezometer can sit in the borehole as long as needed for sufficient groundwater sample volume to be collected.
- Groundwater samples are collected using the same methods as described above for Screen Point Samplers.
- After the sample is collected from the temporary piezometer, the piezometer can be manually removed and discarded.
- The associated borehole can then be backfilled per Section 5.7 (see below).

4.6.3 Small Diameter Wells

A permanent groundwater sampling point, known as a small-diameter well or micro-well, can be installed using the Geoprobe®. The well is installed using an expendable drive point attached to stainless steel casing. After driving conventional probe rods to the desired screen depth, the casing is driven around the probe rods to total depth. The probe rods are then removed and a pre-packed stainless-steel screen is placed at the base of the hole while the casing is retracted, leaving the screen exposed to the aquifer in the lower section of the hole. An alternative approach is to use an expendable point with the Macro Core Sampler and install a 2-in PVC well in the hole. Well installation should follow procedures included in ASTM Standard D 6724 (ASTM, 2016). These methods are further described below.

The advantages of small-diameter wells are:

- No drill cuttings or other investigation-derived wastes are generated during the installation of a small diameter well.
- A small diameter well is less expensive to install than a conventional well, and requires no seals and grout above the screen.
- The small diameter well can be developed, purged, and sampled just like a conventional monitoring well.
- The water produced during development and purging is minimal because of the small diameter (volume) of the well.

For further information, see SOP OESC 008D.

4.6.4 Small Diameter Wells Using Prepacked Well Screens

This method uses a prepacked stainless-steel screen that is placed at the base of the hole while the casing is retracted to up above the top of screen. Geoprobe® prepacked screens come in two sizes: 0.5-in ID x 1.375-in OD x 36-in length and 1.0 in ID x 2.5-in OD x 5-ft length. Other companies offer prepacked screens of various lengths and diameters that can be installed similar to the Geoprobe® products.

The driller is responsible for decontamination of all downhole equipment, advancement of the pilot hole, assembly of the well, and removing the equipment after sampling is complete. The driller will be familiar with details regarding operation and procedures for small diameter well installation.

4.6.5 Two-Inch Diameter PVC Wells

The basic installation procedure is similar to above, except that an expendable point is used and the well is installed through a 2 5/8-in ID Macro Core Sampler. The Macro Core is used to advance a continuous core boring to the desired depth. A 2-in ID Schedule-40 PVC well screen is placed into the ID of the Macro Core which is fitted with an expendable endpoint.

As the Macro Core is pulled up, the expendable point and the PVC well screen stay at depth. Because the expendable point is only slightly larger than the two-inch PVC, it creates a very small annulus around the PVC. It may be possible to install a sand filter pack and a granulated bentonite seal with a small diameter tremie pipe after the Macro Core casing is pulled up; although, some bridging should be anticipated.

This application performs best in sandy soil conditions where there is relatively little resistance to DPT advancement of the sampler and formation collapse will occur around the screen. Depth limitations are site specific, but are generally 30 ft or less. Once installed, the 2-in PVC can be used for groundwater sampling, air sparging, or soil vapor extraction (SVE) systems. Because this well installation is non-standard, check with local well installation regulations regarding use of data from these wells. The well should be completed at the surface using standard wellhead completion procedures (see SOP OESC 008D).

4.6.6 Sampling Small Diameter and Two-Inch Diameter PVC Wells

Small diameter wells can be developed, purged, and sampled by using a peristaltic or bladder pump. The 2-in PVC wells can be developed, purged, and sampled using standard monitoring well techniques. SOP OESC 008D provides information regarding the methods and requirements for development/purging. SOP OESC 008F provides information regarding the methods and requirements for groundwater sampling.

4.6.7 Documentation

The small diameter or micro-well installation process must be fully documented in the field logbook and (if used) the appropriate field forms, in accordance with SOP OESC 002A. Development, purging, and sampling of small diameter or micro-wells should be completely documented. The locations and elevations of each well should be accurately surveyed.

4.7 Plugging And Abandonment

All probed holes—whether soil gas, soil, or groundwater test holes—must be properly plugged and abandoned. Holes should be filled with bentonite slurry, granular bentonite, or 3% bentonite cement from total depth to the surface. The plugging material can be poured into shallow holes less than 5-ft in depth. Deeper holes will require tremie placement of the plugging material. When plugging a small diameter well, the casing is retracted a few inches and extension rods are used to push out the grout plug and expendable point. A grout tube is then inserted out of the grout hole at the end of the screen, and a high-pressure grout pump is used to pump grout into the boring as the casing rods and screen are withdrawn using the Casing Puller Assembly. The driller is responsible for well plugging and abandonment.

5.0 QUALITY CONTROL

Any departure from the specified SOPs must be submitted and approved before deviating from the requirements. Deviations shall be sufficiently documented to allow repetition of the activity as actually performed.

6.0 REFERENCES

ASTM D 6001M (2020). Standard Guide for Direct-Push Groundwater Sampling for Environmental Site Characterization. Available from: http://www.astm.org/Standards/D6001.htm

ASTM D 6282M-14 (2014). Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations. Available from: http://www.astm.org/Standards/D6282.htm

ASTM D 6311-98 (2022). Standard Guide for Generation of Environmental Data Related to Waste Management Activities: Selection and Optimization of Sampling Design, ASTM International, West Conshohocken, PA. Available from: https://www.astm.org/d6311-98r22.html.

ASTM D 6724M (2016). Standard Guide for Installation of Direct Push Groundwater Monitoring Wells. Available from: http://www.astm.org/Standards/D6724.htm

Geoprobe Systems, Inc., tools and equipment, accessed May 2006 at http://www.geoprobe.com

STANDARD OPERATING PRACTICE OESC007I

LYSIMETER SAMPLING

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Moriah Mason Staff Environmental Scientist	Moriah B. Mason	21 December 2020
Reviewed By: Savannah Rice Environmental Engineer	Savannah Rice	10 January 2023
Approved By: Matthew Van Beek Corporate Risk Management	Matt Van Beek	10 January 2023

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) presents general procedures for the routine collection of soil pore water (liquid) from the vadose zone using pressure/vacuum and high pressure/vacuum lysimeters.

2.0 SUMMARY AND METHOD

Water in the vadose zone is present as a thin film covering the surface of soil particles held in capillaries and pores under a state of intermolecular tension caused by capillary forces. A lysimeter is a subsurface device that applies a vacuum at a targeted depth to extract the pore liquid from the interstices of soil particles. Once the vacuum exceeds the negative pore pressure or soil/water tension, the pore-liquid flows into the porous ceramic containment vessel. Pressure is then applied forcing the extracted liquid to the surface into a containment vessel.

The amount of pressure/vacuum required to extract a sample depends upon the depth below ground surface (bgs). A high pressure/vacuum lysimeter can extract pore liquid at depths of 100 feet bgs (Soil Moisture Equipment Corporation, 2017). Analytical results of pore liquid samples from the vadose zone provide information regarding contaminant transport and attenuation in the vadose zone (ASTM, 2018). Two people are generally required to perform lysimeter sampling.

Safety and health considerations are described in the project Health and Safety Plan (HASP).

2.1 PFAS SAMPLING CONSIDERATIONS

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

3.0 EQUIPMENT AND SUPPLIES

The following equipment may be required to perform pore liquid sampling with a lysimeter. Consult the project data quality objectives (DQOs), Sampling and Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP) to determine what equipment is required for specific projects:

- Personal protective equipment as required by the HASP
- Pressure/vacuum pump equipped with vacuum gauge (peristaltic or hand pump)
- Soil moisture meter
- Boring logs showing lithology from the sampling interval
- Clean, graduated glass container such as an Erlenmeyer flask
- ¼-inch O.D. polyethylene nylon tubing
- Triple deionized water in a sterile bottle (at least 500 mL per lysimeter)
- Rubber pinch valves or O-rings
- Sample containers for pore liquid samples, as designated in the SAP and/or QAPP

4.0 SAMPLING PROCEDURES

Pore liquid samples from the vadose zone are collected by applying a vacuum to the pressure/vacuum lysimeter via a pressure/vacuum peristaltic or hand pump. Pore liquid is drawn into the lysimeter over a collection interval determined by project requirements, typically ranging from hours to several weeks. Pressure is then applied to the lysimeter, and the sample is driven to the surface for collection. Collecting samples from permeable sediments such as sands will require less vacuum than impermeable sediments such as silts and clays (Soil Moisture Equipment Corporation, 2017).

4.1 APPLYING THE VACUUM

Vacuums applied to coarse-grained sediments typically should not exceed 60 centibars (cbars). Vacuums applied to fine-grained sediments typically should not exceed 80 cbars. Stronger vacuums on coarse-grained sediments may result in loss of moisture in the vicinity of the lysimeter, which can create a barrier. Soil in contact with the ceramic cup may become dry, resulting in high pore liquid tensions that may inhibit sample collection. The appropriate vacuum will be determined by reviewing previous sampling records and lithology in the sampling interval.

1. Set the pump on vacuum and attach the black pressure/vacuum line to apply the prescribed vacuum to the lysimeter.
2. Close the green sample line with a rubber pinch valve.
3. Turn the pump on while monitoring the in-line gauge.
4. Once the vacuum reaches the prescribed target, use a rubber pinch valve to close off the black pressure/vacuum line while simultaneously turning off the pump (two people are recommended for this step).
5. Remove the pump from the line.

6. Allow sufficient time for the unit to fill with pore-liquid.
7. Attach the pump to the black pressure/vacuum line.
8. Open the line by removing the rubber pinch valve from the black pressure/vacuum line. Listen for a rush of air when the valve on the black pressure/vacuum line is opened. If no rush of air is noted, then the vacuum must be reset.
9. The green sample line must remain closed; if the green sample line is opened before the black pressure/vacuum line, the sample may be lost back to the formation.

4.2 SAMPLE COLLECTION

1. Check the pump and verify that it is set on pressure instead of vacuum.
2. To collect a water sample, first apply pressure to the black pressure/vacuum line of the lysimeter, then immediately remove the rubber pinch valve from the green sample line (two people are recommended for this step).
3. Secure the green sample line to the clean graduated measuring container (Erlenmeyer flask or a different graduated container). Continue to apply pressure until the contents of the lysimeter are evacuated into the graduated measuring container.
4. Record volume of pore liquid collected. Fill laboratory sample containers as required in the SAP/QAPP from the graduated measuring container.
5. Cover or plug tube endings upon completion to prevent contamination (Soil Moisture Equipment Corporation, 2017)

If no water is produced and the sound of depressurization was not observed in the black pressure/vacuum line, then it is likely the vacuum failed, and the process will need to be repeated.

If not enough pore-liquid is collected to fill the sample container, note in the field records that no sample was collected.

5.0 REFERENCES

ASTM International. 2018. D4696-18: Standard Guide for Pore-Liquid Sampling from the Vadose Zone. July.

Soil Moisture Equipment Corporation. 2017. 1920F1 Pressure-Vacuum Soil Water Samplers. March.

STANDARD OPERATING PROCEDURE OESC 008D

MONITORING AND EXTRACTION WELL INSTALLATION AND DEVELOPMENT

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Stacy Kowalski Geologist	Stacy Kowalski	22 December 2020
Prepared By: Robert Price Senior Geologist		22 February 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	28 February 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to provide guidelines for the design, construction methods, materials, and installation of piezometers, groundwater monitoring wells, and extraction wells. This document also provides procedures for well development. Site-specific procedures will depend on project objectives, geologic conditions, and applicable state and federal regulations and standards.

2.0 SUMMARY AND METHODS

Groundwater wells are installed to provide information on site hydrogeology and groundwater quality. OESC will design, install, and construct monitoring wells so they are: (1) adequately sealed to prevent surface contamination or cross contamination between aquifers; (2) capable of yielding high quality groundwater samples representative of true water quality; (3) adequately protected from vehicles or other traffic; and (4) in compliance with applicable state and federal regulations. Piezometers and extraction wells at remedial sites may also be used for groundwater quality monitoring and should; therefore, be installed with the same care as monitoring wells.

The procedures set forth in this SOP apply to all personnel who are responsible, both directly and indirectly, for the design of well systems, oversight of drilling and construction operations, and evaluation of the suitability and reliability of monitoring wells and data/measurements obtained from the monitoring wells.

2.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses.

If groundwater samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

2.2 Qualifications

All drilling personnel must meet all applicable Occupational Safety and Health Administration (OSHA) requirements. The supervising geologist, engineer, or hydrogeologist must be fully knowledgeable and experienced with state and federal requirements/regulations for groundwater monitoring programs.

3.0 PROCEDURES

Multiple drilling methods are described in SOP No. OESC 007A, “Drilling Methods and Procedures.” Well design and construction elements are described in the project Sampling and Analysis Plan (SAP) or equivalent document. The drilling methods, well design, and well construction will adhere to the criteria and methodologies presented in the SAP. The proposed well design will be based on existing geologic and groundwater elevation data from previous investigations, if available.

All equipment, well materials, and tools that will enter the borehole will be decontaminated before borehole entry and will remain clean until installed in the borehole. If needed, they will be steam-cleaned. Well materials that are cleaned and wrapped by the manufacturer do not need to be cleaned unless the factory wrap is damaged or the materials show signs of staining.

3.1 Well Design Specifications

3.1.1 Well Screen

Well screen materials for monitoring wells will be selected depending upon the known or suspected chemical contaminants at the site, and so that the completed monitoring well provides data meeting project data quality objectives (DQOs). Extraction well screening will further meet the objective of a functional pumping well. The screen slot size will be determined to maintain compatibility with the aquifer and filter pack material. In general, the screen will be sized to retain over 90 percent of the filter pack and be either factory-slotted or continuous wrap design. Well screen materials will be of the same diameter and strength material as the well riser and will be a non-contaminating material that is compatible with the anticipated or known groundwater chemistry and/or contaminants at the well site. No glues, adhesives, lead shot, or lead wool will be used to connect the riser sections or screen. No field slotted screens will be permitted (e.g., machined in the field).

3.1.2 Filter Pack

Filter pack material will be clean, washed, well-rounded silica sand sized to perform as a filter between the formation material and the well screen. The filter pack gradation shall have a uniformity coefficient (C_u) of not more than 2.5 and shall be sized so that the well screen will retain 90 percent of the filter pack material. A grain size distribution curve for the filter pack materials used at each site will be included with the submittal of well construction diagrams (selected filter pack gradations for existing monitoring wells will be also taken into account).

If a pertinent grain-size distribution curve is available for a particular site or monitoring well, then the following procedure will be used to design a filter pack.

1. Multiply the D30 size (from the grain-size distribution graph) by a factor of 4 to 9 (Pack-Aquifer ratio). A factor of 4 is used if the formation is fine-grained and uniform (C_u is less than 3), 6 if it is coarse-grained and non-uniform, and up to 9 if it is highly non-uniform and contains silt. Head

losses through filter packs increase as the Pack-Aquifer (P-A) ratios decrease. To design a fairly stable filter pack with a minimum head loss, the D30 size will be multiplied by a factor of four.

2. Plot the point from step 1 on the 30 percent abscissa of a grain-size distribution graph and draw a smooth curve with a uniformity coefficient of approximately 2.5.
3. A curve for the permissible limits of the filter pack is drawn plus or minus 8 percent of the desired curve with the C_u of less than 2.5. The appropriate-sized filter pack can then be chosen from the grain-size distribution curves of various filter packs.
4. Select the slot openings for the well screen that will retain 90 percent or more of the filter packs.

This design will be based on the gradation of the finest aquifer materials anticipated to be affected by the screened part of the monitoring wells (USEPA, 1996).

If no pertinent grain-size distributions curves are available, then 0.010-inch slotted or continuous wrapped screen will be used with appropriately sized filter pack material in accordance with the following table adapted from ASTM D 5092M-16 (ASTM, 2016).

Size of Screen opening, mm (in.)	**Slot No.**	**Sand Pack Mesh Size Name(s)**	**1% Passing Size (D-1), mm**	**Effective Size (D-10), mm**	**30% Passing Size (D-30), mm**
0.125 (0.005)	5	100	0.09 to 0.12	0.14 to 0.17	0.17 to 0.21
0.25 (0.010)	10	16 to 40	0.25 to 0.35	0.4 to 0.5	0.5 to 0.6
0.50 (0.020)	20	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5
0.75 (0.030)	30	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5
1.0 (0.040)	40	8 to 12	1.2 to 1.4	1.6 to 1.8	1.7 to 2.0
1.5 (0.060)	60	6 to 9	1.5 to 1.8	1.7 to 2.0	2.5 to 3.0
2.0 (0.080)	80	4 to 8	2.0 to 2.4	2.4 to 3.0	2.6 to 3.1

In addition to the primary filter pack installed along the screened interval of the monitoring well, a secondary filter pack consisting of finer material will be installed to prevent bentonite pellets from commingling with the primary filter pack. This is discussed further in Section 2.4.1.

3.1.3 Well Riser

Well riser (casing) will consist of new material with threaded, flush joints. The riser material will be of the same diameter and strength material as the well screen and will be a non-contaminating material that is compatible with the anticipated or known ground water chemistry and/or contaminants at the well site. If PVC pipe is used, PVC pipe will bear markings identifying the material as that specified and will carry the seal of the National Sanitation Foundation and will, as a minimum, conform to the requirements of ASTM F 480-14/SDR 13.5. Schedule 40 PVC is acceptable for wells less than 100 feet deep and Schedule 80 is recommended for wells greater than 100 feet deep. Unless noted in the site-specific work plans, monitoring wells will be nominal 2-inch inside diameter. Riser sections will be joined by threaded, flush-joint couplings. No adhesives or other sealing materials will be used.

3.1.4 Well Plumbness and Alignment

All risers shall be set round, plumb, and true to line. Centralizers may be required for deep wells or wells being installed in caving material. To verify plumbness and alignment, a 10-foot section of pipe will be run through the entire length of the well. The pipe shall be decontaminated between well in accordance with SOP No. OESC 011A, "Sampling Equipment Decontamination Procedures". String or rope used to lower the pipe will be discarded in between each well.

3.1.5 Bentonite Seal

A minimum 2-feet thick bentonite seal will be placed above the filter pack seal using a tremie pipe. The bentonite seal will be composed of commercially manufactured sodium bentonite pellets, which do not exceed 0.25-inch diameter. Clean, potable water will be used to hydrate the bentonite (minimum 4 hours of hydration), as discussed in Section 2.4.1 of this SOP.

3.1.6 Annular Seal

Cement grout will be placed above the bentonite seal to the ground surface. The cement grout will consist of a mixture of Portland cement (ASTM C 150) and water in the proportion of approximately 6 to 7 gallons of approved potable water per bag of cement (94 pounds). In addition, 3 to 5 percent by weight of sodium bentonite powder will be added. The minimum acceptable grout weight will be 14 pounds per gallon (lbs/gal). The cement grout weight will be determined using a mud balance. Water may be added to the mix in small amounts, at the discretion of the field geologist, to increase viscosity as necessary. The following table provides specifications for various grout slurry densities.

Grout Slurry Densities

Percentage Bentonite	Water ratio	Minimum density [pounds per gallon]	Volume (ft^3/sack)
2	6.0 gal/sack of cement	14.7	1.36
3	6.5 gal/sack of cement	14.4	1.45
4	7.2 gal/sack of cement	14.1	1.55
5	7.8 gal/sack of cement	13.8	1.64

3.1.7 Well Protection

At all times during well installation, precautions will be implemented to prevent well tampering or the entrance of foreign material into the well. Run-off, surface soil or objects (tools, etc.) will be prevented from entering the borehole during well installation. Wells will be secured at the surface with a stand-up protector pipe or traffic-rated flush mounted well vault equipped with a lock. Wells completed with stand-up pipe in high vehicle traffic areas or areas where well damage could occur due to site activities will be surrounded by a minimum of three brightly painted steel bollards around the completed well.

3.2 Borehole Completion

Procedures for the drilling and advancement of soil borings are presented in SOP Nos. OESC 007B, “Soil and Rock Geologic Logging and Classification,” and OESC 007D, “Subsurface Soil Sampling”. Drilling techniques employed must minimize disturbance of subsurface samples and must not introduce contamination to the subsurface or allow contaminants within the shallow hydrogeologic units (if any) to migrate to deeper units.

3.3 Well Construction

At all times during the progress of the work, precautions will be taken to prevent tampering with the well or entry of foreign materials. Measures will be implemented to prevent run-off from entering the well during construction. Prior to well construction, the borehole will be sounded. In competent bedrock, the borehole may be pumped to remove drilling fluid, cuttings, and fine particles resulting from the drilling. Ideally, a stabilized water level will be attained in the borehole prior to well installation.

The casing/screen assembly will be installed as follows:

- Prior to installation of the casing and screen, the lengths and diameters of all components (including the bottom plug or cap) will be measured and recorded on the casing/well screen log. The casing riser and screen assembly will be installed round, plumb, and true to line.
- A bottom plug will be attached to the bottom of the screened section.
- Approximately 6-inches of filter pack sand will be placed in the bottom of the well boring.
- The well screen will be connected to the riser sections of the casing assembly. For wells intended to monitor the upper surficial aquifer near the water table, the well screen will be installed so as to straddle the free water surface, extending both above and below the water table to accommodate seasonal or other variations in its elevation. In all cases, the top of the screen will be located at least 2-feet below the base of the down-hole seal.
- For wells installed to depths exceeding 40-feet, centralizers will be placed at locations just above the screen and above the location of the bentonite seal. The centralizers will be placed at 30-foot intervals along the riser casing. Centralizers will not be used if their installation prevents the placement of the annular materials.
- Well risers will extend between 2- and 2.5-feet above the ground surface. If a flush finish completion is conducted, the placement of annular materials will be done in such a way that the inside of the well casing is protected.
- The primary filter pack will be placed in the annulus between the well material and borehole using a tremie pipe, starting with the tremie at the bottom of the borehole and working the tremie upward as the filter pack is installed. If necessary, potable water may be used to aid tremie installation. The drill casing will be raised incrementally during the installation of the filter pack to prevent bridging. Attempts will be made to keep the bottom of the drill casing below the top of the filter pack during installation. The level of the top of the filter pack in the annulus will be verified by tag-line measurement during all phases of installation.

- Prior to completion of filter pack installation, the well may be pre-developed using a surge block and/or bailer to allow the filter pack to settle.

- The filter pack will extend at least 2-feet above the top of the screen. A secondary fine-grained filter pack will be installed using a tremie pipe if bentonite slurry seals are used for well construction. The secondary fine grain filter pack will have a minimum thickness of 1-foot above the primary filter pack. The volume of the installed filter pack will be compared with the annular volume to verify proper placement of the filter pack. Material accounting will be recorded in the field logbook as will the volume of potable water used (if any).

- A bentonite seal will be placed immediately above the filter pack. At a minimum, either a 3 foot thick granular bentonite seal or a minimum 4-foot thick bentonite slurry seal will be used. Bentonite slurry mixtures will be composed of calcium bentonite with a high solids content, unless otherwise specified. The density of the recommended bentonite slurry will be confirmed with a mud scale. Pouring of the granular bentonite is acceptable for boreholes less than 50-feet deep where the annular space is large enough to limit the potential for bridging and to allow measurements to ensure that the granular bentonite has been placed at proper intervals. For depths greater than 50-feet, the granular bentonite and the bentonite slurry will be installed through a tremie pipe. The level of the top of the bentonite seal will be verified by tag-line measurement prior to grouting. The bottom of the drill casing will be left in the borehole as close as possible above the bentonite seal. Granular bentonite seals will hydrate a minimum of 4 hours.

- For depths greater than 50-feet, the borehole is to be pressure-grouted using a side-discharging tremie pipe that is maintained 3-feet above the bentonite seal and will be used to slowly install the cement/bentonite grout mixture. The drill casing will be pulled incrementally during the grouting procedures to limit borehole collapse. Grout will be pumped into the annulus through the tremie pipe until undiluted grout flows from the borehole at the ground surface. The grout will be allowed to cure for 24 hours at a minimum prior to development, or longer if deemed necessary or as required by local regulations. After 12 hours, the depth of the grout will be checked. If it has collapsed more than 10-percent of the well depth, the well will be checked for soundness. The annulus will be refilled with grout to the desired depth.

3.3.1 Double-Cased Wells

Secondary (outer) casings will be installed in the borehole when drilling a monitoring well that will be installed at depths below relatively impermeable (confining) layers or below depths of known contamination. The purpose of the surface casing is to prevent cross-contamination between two aquifer zones and/or, when flowing sands make it impossible to install a monitoring well using conventional methods, to properly install the monitoring well to the desired depth. There are several methods available to accomplish double casing of wells. The following paragraphs present one commonly used method.

A pilot borehole will be drilled and the surface casing installed slightly below the known depth of contamination or a minimum of 2-feet into the confining layer. The diameter of the surface casing will be sufficient to contain the inner casing and a 2-inch annular space. The material of the surface casing may vary (PVC or carbon steel), but it will be chemically inert and able to withstand potential chemical degradation and forces exerted on the casing during its installation and the monitoring well construction.

The outer casing will be grouted by the tremie method from the bottom to within 2-feet of the ground surface. The grout will be pumped into the annular space between the outer casing and the borehole wall. This will be accomplished by either placing the tremie tube in the annular space and pumping the grout from the bottom of the borehole to the surface; or placing a grout shoe or plug inside the casing at the bottom of the borehole and pumping the grout through the bottom grout plug and up the annular space on the outside of the casing. If the outer casing is set into very tight clay, both of the above methods may have to be used, because the clay usually forms a tight seal in the bottom and around the outside of the casing preventing grout from flowing freely during grout injection. A minimum of 24 hours will be allowed for the grout seal to cure before attempting to drill through it. The grout mixture used to seal the outer annular space will be a neat cement mixture of one 94-lb bag of Type I Portland Cement, 4-pounds of bentonite powder, and no more than 8-gallons of water.

When drilling through the seal, care will be taken to avoid cracking, shattering, and/or washing out the seal. If caving conditions exist such that the outer casing cannot be sufficiently sealed by grouting, the outer casing will be driven into place and a grout seal placed in the bottom of the casing. The boring will be advanced through the surface casing to the target depth for monitoring well installation. The monitoring well will be installed in accordance with the methods presented in Section 2.2.3. The borehole beneath the surface casing will be of sufficient diameter to maintain a 2-inch annular space between the monitoring well and the borehole well. Removal of outer casings, sometimes referred to as temporary surface casings, after the well screens and casings have been installed and grouted is not acceptable. Attempting to remove outer surface casings after the inner casing has been grouted could jeopardize the structural integrity of the well.

3.3.2 Temporary Casing Method Using Rotosonic Drilling Techniques

Rotosonic drilling techniques allow for the construction of monitoring wells through a temporary casing advanced during borehole advancement. The outer casing (to 12-inches in diameter) will be advanced past the upper aquifer while a bentonite grout mixture is being pumped under pressure into the small annular space between the borehole wall and the outside of the casing.

3.3.3 Well Head Completion

The following well head completion procedures will be followed:

1. Grout to within 5-feet of the ground surface.
2. Wait a minimum 12 hours prior to well head completion.
3. Place a 2-foot layer of fine sand above the grout.
4. Install the stand-up protector pipe (protector pipe size must be at least 2-inches larger in diameter than the well casing) over the well casing.
5. Place concrete between the borehole and stand-up protector pipe casing to a depth of 6-inches beneath the ground surface for installation of the concrete pad.

The protective casing will be provided with a (vented) locking cap and a brass padlock. All locks used at an individual site will be keyed alike. Duplicate keys will be made available to the client.

Wells will have a minimum of a 3-foot by 3-foot by 6-inch-thick concrete pad, sloped away from the well, with the top outer edge level to the final ground elevation. At locations where vehicular traffic is likely, the concrete pad will be reinforced with reinforcement wire or rebar. In trafficked areas, three or four 3-inch diameter or larger concrete-filled steel posts (bollards), brightly painted, will be equally spaced around the well and cemented in place around the concrete pad. The base of these posts shall extend 2-feet below ground surface and be approximately 3- feet tall. After the well is installed, the area will be cleaned and all discarded material will be properly disposed.

3.3.4 Documentation and Recording

A well construction form will be completed for each well. The well construction form will include an accurate hand-drawn "as built" diagram of each well. The following information will be recorded on the form:

- Project and site names, well number, and the total depth of the completed well;
- Depth of grouting or sealing, and the amount of cement and/or bentonite used, and the total borehole depth and elevation;
- Depth, elevation, and type of well casing;
- Installation date or dates, and name of the driller, drilling company, and the geologist installing the well;
- All pertinent construction details of monitoring wells, such as depth to and description of all annular fill materials; gradation of filter packs; length, location (depth and elevation), diameter, slot size, material, and manufacturer of well casing and screen; position of centralizers; and location of blank pipe or intermediate casing installed in the well;
- Description of surface completion, including protective steel casing, protective pipes, and concrete surface seal; and
- Surveyed coordinates and elevation of top of ground and top of well riser. A discussion of information to include in the boring logs is presented in SOP No. OESC 007B, “Soil and Rock Geologic Logging and Classification.” All original well record forms, field report forms, and geologic logs will be maintained in the project file.

3.4 Well Development

The primary objective of installing a monitoring well at a site is to collect groundwater samples representative of the quality of groundwater surrounding the well. Well development is an important component of monitoring well completion. Monitoring wells will be sufficiently developed to ensure that they meet their intended data quality objectives. The purposes of well development are the following:

- Assure that groundwater enters the well screen freely and at ambient velocities, thus yielding a representative groundwater sample and an accurate fluid level measurement;

- Remove all water and drilling additives that may have been introduced into the borehole and formation during drilling and installation activities;
- Break up fine materials that may have been smeared along the borehole wall during drilling; and
- Remove fine-grained sediments entrained in the filter pack and within the well itself so that groundwater samples have minimal turbidity and excessive silting of the well does not occur.

The criteria that will be utilized to evaluate whether these objectives have been met are presented in Section 3.3.

3.4.1 General

Well development will be completed no sooner than 24 hours after the completion of grouting, or longer if deemed necessary or as required by local regulations. Well development may be performed using a downhole pump, peristaltic pump, bailer and/or surge block. Different equipment may be used sequentially to accomplish proper well development (e.g., surge block then pump). The water level and thickness of sediment in the well will be measured and recorded in the field logbook prior to development, as discussed below. Instrumentation or equipment inserted into the well will be properly decontaminated in accordance with SOP No. OESC 0011A, "Sampling Equipment Decontamination Procedures." Downhole tubing will be dedicated to the well until development has been completed then will be discarded. Development water will be containerized and managed following OESC SOP 012A – Derived Waste Management Procedures and guidance found in ASTM Standard D 6311-98 (ASTM, 2014).

Before beginning development of a well, place plastic sheeting on the ground around the well head. Open the well cap and obtain an organic vapor reading using a photoionization detector (PID) or comparable equipment. The purpose of the organic vapor reading is to provide important health and safety and water quality information.

3.4.2 Well Development Using a Bailer

A bailer may be used to remove accumulated sediment from the bottom of the well as a first step in well development. A slight surging action may help to mobilize the sediment so that it can be more easily removed.

If a well is slow to recharge such that use of a submersible pump is impracticable, then a bailer may be used to complete well development. This change in well development procedures must be approved by the OESC Project Manager.

3.4.3 Surging

A surge block may be used to create a surging action for short periods of time to help break up or loosen any sediment in the well. A bailer or pump may be used to remove the silty water that results from surging. The surge block will be composed of inert material that will not affect the water quality in the well. The diameter of the surge block will be 0.125- to 0.25-inches smaller than the inside diameter of the well.

Ensure that the surge block can move freely up and down the inside of the well without obstructions. The vertical action of the surge block will be accomplished either manually or mechanically with drill rods or wireline.

Care will be taken in the length of the strokes, the velocity of the up and down movement, and the duration of each surge block cycle. Surging can be detrimental to the well integrity if performed too vigorously.

NOTE: Surging can increase turbidity in wells constructed in fine-grained aquifers and should be used with caution or should not be performed at all (Paul et al, 1988). Detailed discussions are presented in Aller (1991) and ASTM D 5521M (ASTM, 2018); responsible personnel will review these discussions before beginning well development with the surge block method in wells completed in fine-grained media.

3.4.4 Over-pumping

Following the removal of suspended sand-sized sediment, the well development process will include over-pumping the well with the submersible bladder pump. In over-pumping, the pump is operated at a capacity that substantially exceeds the yield of the formation (i.e., the capacity of the formation to deliver water to the well). This flow velocity well exceeds the flow velocity that will be induced during the purging process of well sampling.

3.4.5 Well Development Criteria

During development, field parameters and turbidity will be recorded approximately once every well volume removed (or as practicable) once the water has begun to clear.

If well development is completed using over-pumping, field parameters will be measured in a flow-through cell attached to the pump outflow tubing. If development is by bailer, field parameters can be measured down-hole, except for turbidity, which will be measured at the surface. (Note: field parameters measured in water dumped from a bailer into an open bucket will have little validity due to agitation and exposure to atmospheric conditions.) Field parameters will be measured in accordance with SOP No. OESC E005A, “Field Parameter Measurements in Water”. Continue well development until the following criteria have been met:

- Three times the volume of water lost to formation during drilling has been purged from the well.
- Field parameters have stabilized for three consecutive measurements. Typical field parameter stabilization criteria include:

pH	± 0.2 pH units
Temperature	less than 10% change
Specific Conductance	less than 10% change
Dissolved Oxygen	± 0.2 mg/L
Oxidation Reduction Potential	± 10%
Turbidity	less than 50 nephelometric turbidity units (NTUs)

(**NOTE**: Check the site-specific SAP or Field Sampling Plan for criteria to use to determine stabilization)

- The duration of well development has been at least 4 hours, even if parameters have not stabilized.
- The yield of the well is representative of the transmissivity of the aquifer.

The OESC Project Manager will be notified if well development criteria cannot be met and does not seem achievable after four hours of well development activity.

3.4.6 Well Development Documentation

Well development will be documented on a well development/purge summary form, which will include the following information:

- Date and weather
- Pre- and post-development water levels
- Method(s) of development, equipment used, duration for each method
- Measured thickness of sediment at bottom of well prior and after the development (if any)
- Field parameter measurements and time of measurement
- Volume of water removed between measurements
- Cumulative total volume of water removed prior to each measurement
- Pumping rate(s), if applicable
- Total time of development

Additional observations, such as apparent yield of the well, detected odors and discoloration will also be noted on the development log.

Optional: After final well development, collect approximately one liter of the well water in a clear glass container for photographic documentation. Hold container against white background, label glass jar with well ID and photograph in color. The photograph is part of the permanent well development log.

4.0 REFERENCES

Aller, L. et al., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, EPA 600/4-89/034, 1989.

ASTM Standard C 150M-20 (2020). "Standard Specification for Portland Cement," ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D 5092M-16 (2016). "Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers," ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D 5521M-18 (2018). "Standard Guide for Development of Ground-Water Monitoring Wells in Aquifers," ASTM International, West Conshohocken, PA, www.astm.org.

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Lohman, S.W., Groundwater Hydraulics, U.S.G.S, Professional Paper No. 708, 1972.

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U.S. Environmental Protection Agency, RCRA Ground-Water Monitoring Draft Technical Guidance, Office of Solid Waste, November 1992.

U.S. Environmental Protection Agency, Region I - *Low Stress (Low Flow) Purging and Sampling Procedure for The Collection of Groundwater Samples from Monitoring Wells*, EQASOP-GW4, Region 1 Low Stress (Low Flow) SOP Revision Number 4, July 30, 1996, Revised September 19, 2017, 30 pages.

STANDARD OPERATING PROCEDURE OESC008E

FLUID LEVEL MEASUREMENT IN WELLS

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Stacy Kowalski Geologist	Stacy Kowalski	21 December 2020
Reviewed By: Cody Wilgus, Project Geologist		9 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	12 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to establish a uniform procedure for accurate measurement and recording of fluid levels in wells, and identify the references, standards, and methods to be followed. Fluid levels in wells consist of groundwater from static or dynamic conditions or contamination such as free product.

2.0 SUMMARY AND METHOD

General practices for fluid level measurements are described in these steps:

1. Review and follow health and safety requirements in the Health and Safety Plan (HASP) (Section 3.0).
2. Identify or determine the established reference point for each well (Section 4.0)
3. Collect fluid level measurements by following the procedures for the selected measuring equipment: electric water level indicator, pressure transducer with data logger or oil/water interface probe (Section 5.0). Selection of the proper equipment (and special procedures) will depend on the objectives of the fluid level measurements and local hydrogeologic conditions of where they are collected.
4. Record fluid level measurement data for each well in a field logbook (Section 6.0). Repeat the collection of fluid measurements at well locations that appear to be inconsistent or substantially different from prior data. This may be necessary if there is uncertainty about the reason(s) for the variation. As a standard of good practice, if two measurements of static water level made within a few minutes do not agree within about 0.01 or 0.02 foot in observation wells having a depth to water of less than 200 feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable (EPA, 1989).
5. Decontaminate the measuring equipment after collecting fluid level measurements from each well (Section 7.0).

Each of these steps is described in detail in the following sections.

2.1 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

3.0 HEALTH & SAFETY REQUIREMENTS

Review the HASP prior to mobilizing to the field and be aware of potential hazards of working around wells, well vaults, and contaminated media. Implement controls in the HASP to eliminate or minimize the risk of injury from the hazards.

Monitor well head vapors and volatiles in the breathing zone with a gas detector at the well if it is required by the HASP. Perform monitoring after opening the well lid and prior to measuring water levels.

Wear personal protective equipment (PPE) specified in the HASP for groundwater level measurement activities, such as chemically-resistant disposable gloves, steel-toed boots, hard hats, safety glasses and safety vests.

Dispose or decontaminate PPE, materials, and tools at each well to confine the contamination to the well and prevent cross-contamination between wells. Change disposable gloves after measuring the groundwater level at each well.

Collect groundwater level measurements in the order of the least contaminated well to the most contaminated well, to reduce the possibility of cross-contamination between wells. Review historical concentrations of contaminants at each well to determine the order of wells to collect the measurements.

4.0 PERSONNEL QUALIFICATIONS

Users of this SOP should be qualified to perform fluid level measurements in wells and have successfully completed any requisite training identified by their supervisor. This activity does not require a license or certification.

5.0 EQUIPMENT AND SUPPLIES

The following equipment is normally required for general water level measurements. Refer to Section 7.2.1 for equipment list specific to using pressure transducers and data loggers.

- Water level indicator and/or interface probe
- Decontamination equipment
- Tools for opening well box and well cap (e.g., wrench, sockets, keys/combo for padlock)
- Spare batteries for water level indicator

- Watch for recording measurement time
- Field logbook or field forms
- Site-specific sampling plan
- Hand-held radios and/or cellular telephones
- PPE specified by the HASP

6.0 REFERENCE POINT DETERMINATION

Fluid levels should be collected relative to an established reference point. Follow these steps to confirm or establish and document the reference point for each well:

1. Review project site information to confirm if the reference point for each well has been surveyed or established. An established reference point should be tied in with the NAVD88 (North American Vertical Datum of 1988) or a local datum.
2. Notch or permanently mark the top of casing on the north side of the well casing if the well does not have a marked or surveyed reference point.
3. Document the new reference point for the well in the field records and notify the Project Manager, who will determine if or when they need to be surveyed for vertical elevation.

7.0 FLUID LEVEL MEASUREMENT EQUIPMENT PROCEDURES

This section describes the procedures for the most common equipment used for fluid level measurements: electrical water level meter, pressure transducer with data logger and oil/water interface probe. The manufacturer’s operating instructions for each equipment should also be reviewed and followed.

Note: Devices used to measure groundwater levels should be verified annually against a National Institute of Standards and Technology (NIST) traceable measuring tape. These devices should check to within 0.01 foot per 10 feet of length with an allowable error of 0.03 foot in the first 30 feet. Before each use, these devices should be prepared according to the manufacturer’s instructions (if appropriate) and checked for obvious damage (EPA, 2020).

7.1 Electrical Water Level Meter

A battery-supplied electrical water level meter consists of an electrode suspended by a spool of insulated wires. An ammeter, indicator light, or audible signal is used to indicate when the electrode touches the fluid surface. Other sounding methods using older technologies are not covered in this SOP.

The procedures for the electrical water level meter are as follows:

1. Check batteries on the meter with the battery indicator test button prior to going to the field. The test button should have an audible sound when pressed and battery life is sufficient. Have backup batteries on hand.

2. Turn power switch to "on" and test battery by pressing the battery indicator test button and confirming an audible sound is heard.
3. Lower the probe into the well until a sharp deflection is noted on the meter, the indicator light is illuminated, or the audible tone is activated. You may have to adjust the sensitivity of the probe.
4. Verify that the electrode is functioning properly and indicating the water surface at the same depth each time by moving the probe up and down several times. Try to keep tape away from well casing as moisture that accumulates on the casing can cause the tape to stick to the casing and falsely trigger the electrode.
5. Hold the probe cable or tape at the reference point location on the well pipe at the exact depth where the probe indicates the water surface. Record the reading at the reference point to the nearest 0.01 foot.

If the depth of the well needs to be measured, follow these steps:

1. Lower the probe until a definite decrease in cable tension indicates the bottom of the well (turn power to “off” to avoid signal sounding during total depth measurement). Retract the cable slightly to remove slack and ensure total depth is measured from the reference point.
2. Verify bottom depth by repeatedly lowering and slowly retrieving the probe cable just until you “feel” the bottom. You should also be able distinguish a soft bottom versus a hard bottom with the probe. A soft bottom indicates the presence of silt (make a note of it in field logbook and/or field form). Most instruments have the sensor at the bottom of the probe so the depth reading is accurate without adjustment. Avoid overagitating sediment at the bottom of the well, which could impact water quality measurements and laboratory samples.
3. Hold the probe cable at the measuring reference point on the well pipe at the exact depth where the probe indicates well bottom. Record the reading to the nearest 0.01 foot.
4. Remove the probe from the well and decontaminate in accordance with project-specific procedures, health and safety requirements and/or standard operating procedures (see SOP No. OESC 011A, “Sampling Equipment Decontamination Procedures”).

7.2 Pressure Transducers and Data Loggers

Pressure transducers are used to collect continuous or periodic water level data in wells as part of an aquifer pumping test for long term monitoring of aquifers or surface water bodies or for a controlled field experiment requiring hydrologic monitoring. Pressure transducers may have built-in data loggers or be connected to a dedicated data logger. Check with the manufacturer for equipment specifications and setups.

Note: pressure transducers may be “open cable” (automatically corrects for barometric pressure), or standard (requires separate collection of barometric pressure data and later normalization of hydraulic and barometric pressure data sets).

7.2.1 Equipment List for Pressure Transducers and Data Loggers

The following equipment is normally required for water level measurements using pressure transducers and data loggers:

- Manual water level indicator, pressure transducers sized for the well diameter, and data logger(s)
- Decontamination equipment
- Equipment to shelter the data logger (if surface mounted)
- Portable computer (laptop, hand-held) and data storage device
- Power source for electronic devices
- Communication cables for data linking (if not built into transducer/data logger)
- Stopwatch (if required)
- Field logbook or field forms
- Recording barometer and recording tide gauge (if required by conditions)
- Site-specific sampling plan
- Operation manual for data logger and/or pressure transducers
- Two-way radios and/or cellular telephones

7.2.2 Practice for Continuous Recording Using Transducers

General procedures, pre-test and post-test activities and the specific activities for the test are outlined below. Consult with the transducer/data logger user manual and your site-specific work plan for site specific procedures.

7.2.2.1 Pre-Test/Post-Test Activities

1. Decontaminate downhole equipment (e.g., pressure transducers and water level monitoring devices) before and after use as per SOP OESC011A.
2. Check manufacturer's specifications regarding site contaminants and concentrations to ensure the downhole equipment can withstand exposure to these substances while submerged in the well fluid.
3. Calibrate and test pressure transducers and data loggers before using them for fluid level measurement and data-logging.
    a. Run an inherent self-test program of the unit to test the operational integrity and configuration of the data logger. Pressure transducers are calibrated by the manufacturer prior to shipment.
    b. Check the depth readings of the pressure transducers and data loggers by placing the pressure transducer below the water table at a known depth and taking a reading, moving the pressure transducer up or down a measured distance and taking another reading. During the field check of factory calibration, the expected water level must match the transducer-recorded water level within less than one percent.

   c. Record all testing information in the field logbook or field form. If the transducer does not appear to be recording properly, return the equipment to the manufacturer or equipment rental company for replacement.

4. Record the serial numbers of each pressure transducer and well to which they are assigned that will be used in for the entire test duration.

5. Set up the pressure transducer in accordance with the manufacturer's operations manual. Most transducers can be pre-programmed with the well's reference elevation, well name, time of measurements, time between measurements, averaging methods, etc.

6. Synchronize time recording devices for all pressure transducers to a master clock before the test.

7. Collect fluid levels measurements in the wells manually, e.g., with electric sound level meter, and record in the field logbook immediately before placing the transducers in the wells and before beginning a test.

7.2.2.2 General Procedures

1. Lower pressure transducer gently down the well and install below the lowest anticipated change in water level, but not so low that the range of the transducer might be exceeded at the highest anticipated change in level.

2. Secure pressure transducer in place and allow stabilization for approximately one hour prior to initiating programmed data collection to ensure measurement accuracy.

3. Download and review data from the automatic data recorder periodically within the test duration.

4. Conduct manual water level readings periodically throughout the test and record readings and time collected. Manual water level measurements are usually required to provide periodic backup data the event of data logger or transducer failure and quality assurance/quality control (QA/QC) data. Manual water level readings may disturb the water column and should be recorded and referenced in conjunction with the reading collected by the data logger.

7.3 Free Product Interface Probe

Free product interface probes use a battery-operated oil/water interface probe that operates similarly to an electric water level meter. However, the probe will have a sensor for non-water liquids with an audible sound distinct from the audible sound for water.

Light non-aqueous phase liquid (LNAPL) floating on the water table may be present in a well. Dense non-aqueous phase liquid (DNAPL) sinks through water and may be present in the bottom of a well. LNAPL or DNAPL also may be referred to as immiscible fluid or free product. Free product levels are measured using an oil/water interface probe with the following procedures:

- Lower the oil/water interface probe into the well casing until the point of contact with water or immiscible fluids. When the interface probe is in contact with immiscible fluids, a solid audible tone is activated.

- Slowly move the probe up and down several times to get the exact depth measurement at the top of the immiscible fluid. The interface between water and immiscible fluid will be determined when an oscillating audible tone is activated.
- Record both readings on the field form or in the field logbook. Record any audible signal, despite measurable free product thickness. The probe may be detecting “sheen” levels of product.

7.4 Non-Stretching Tape

Use non-stretching tapes only. Water level measurement devices should be accurate to ± 0.01 foot.

8.0 DATA REPORTING

All water level field data shall be entered in field logbooks and/or on the appropriate field form and will include the following information:

- Date of measurement (at top of page).
- Time water level is measured at each well.
- Weather conditions, especially significant changes in atmospheric pressure.
- Station location (monitoring well or piezometer identification).
- Serial number of measurement or recording device(s); if more than one device is used, indicate which device is used for each measurement.
- Comments regarding well condition (surface completion integrity, etc.).
- Measuring reference point, usually top of casing at marked location or north on casing.
- Depth to product (if present), to nearest 0.01 foot.
- Depth to water, to nearest 0.01 foot.
- Depth to bottom of well, to nearest 0.01 foot.

9.0 DECONTAMINATION

Decontaminate equipment used for measuring fluid levels before and after use and between collecting water level measurements at different wells.

- Follow decontamination procedures in accordance with project-specific procedures, HASP and/or Equipment Decontamination Procedures in SOP OESC 011A.
- Use only an approved cleaning solvent (e.g., isopropanol) for removal of product from the interface probe. Refer to the operating manual for the equipment.
- Perform thorough decontamination of the interface probe to decrease the likelihood of cross contamination between well locations.

10.0 SPECIAL CONSIDERATIONS FOR WATER LEVEL MEASUREMENTS

Site-specific procedures will depend on project objectives and local hydrogeologic conditions. Measure water levels according to the following conditions.

Static groundwater level measurements under non-pumping conditions:

- Collect ground-level measurements for wells within a single 12-hour period if the wells will be used to define a potentiometric surface. Groundwater elevations can change rapidly in response to various environmental conditions.

Static groundwater level measurements during groundwater sampling:

- Collect water level measurements prior to purging particularly for the low-flow sampling method (see SOP OESC 008F, “Monitoring Well Sampling”).
- Collect water level and total depth measurements with the water level indicator (Section 7.0) to calculate the volume of static water within the well. Static water volume will be used to estimate the total volume of water to be purged prior to sample collection and to establish when a well has fully recharged following purging.

Groundwater level measurements during well construction and well development:

- Measure water levels in the borehole before well construction to determine placement of the well screen (verify with water level measurements in other nearby wells).
- Measure water levels immediately following well construction and prior to development to ensure the presence of groundwater.
- Measure water levels periodically during over-pumping (well development) to collect data for well performance evaluation (see SOP OESC 008D, “Monitoring and Extraction Well Installation and Development”).
- Collect groundwater level measurements a minimum of 12 hours after the completion of well development activities to ensure that static water levels have been reached.
- The elevation (hydraulic head) data are then contoured on a to-scale base map to illustrate the potentiometric surface (distribution of hydraulic head) of the aquifer.

Groundwater level measurements with wells under vacuum:

- Wells sealed with vacuum caps must sit open before collecting water level measurements. The water level in the well should equilibrate to atmospheric pressure. **Note:** wells in tight formations under confining conditions can build up considerable air pressure within the well casing. Remove vacuum-seal caps with caution.

11.0 REFERENCES

U.S. Environmental Protection Agency, Superfund Groundwater Issue: Accuracy of Depth to Water Measurements. EPA/540/4-89/002. March 1989.

U.S. Environmental Protection Agency, Groundwater Level and Well Depth Measurement. LSASDPROC-105-R4. May 15 2020.

STANDARD OPERATING PROCEDURE OESC008F

MONITORING WELL SAMPLING

TABLE OF CONTENTS

Table

Attachment

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Mark Wanek Project Geologist	Mark Wanek	28 April 2022
Reviewed By: Megan Duley, PE Senior Engineer	Megan Duley	20 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	20 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of groundwater sampling is to produce groundwater quality data that is representative of the current groundwater conditions over a specific volume of aquifer (United States Environmental Protection Agency [USEPA] 2002).

The procedures in this SOP apply to permanent monitoring wells but may be used for sampling temporary wells, extraction wells, and other types of wells with appropriate modifications. This SOP addresses procedures for collection of aqueous samples only. This SOP does not include procedures for collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples or collection of aqueous samples when LNAPL or DNAPL are present.

2.0 SUMMARY OF METHOD

This standard operating practice (SOP) addresses the supplies, equipment, and procedures used to purge wells and collect groundwater samples for chemical and natural attenuation parameters. In all cases, the methods, equipment, and procedures in this SOP should be performed in accordance with the project Quality Assurance Project Plan (QAPP) or Sampling and Analysis Plan (SAP).

2.1 PFAS SAMPLING CONSIDERATIONS

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If groundwater samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

3.0 PRE-FIELD SAMPLING PREPARATIONS

3.1 DOCUMENT AND INFORMATION REVIEW

Prior to obtaining equipment and supplies, review site-specific plans and historical information. The entire project team, including field personnel, the Project Manager (PM) and the designated quality assurance manager must review the sampling objectives and procedures specified in the QAPP or SAP, in addition to the following:

1. Site-specific Safety and Health Plan (SSHP), Activity Hazard Analyses (AHAs), Safety Data Sheets (SDS), and other safety-related information. Consider what personal protective equipment (PPE) is necessary and what decontamination procedures must be followed.

2. The sampling program data quality objectives (DQOs) should be thoroughly developed, presented and understood by all parties involved in the sampling. The purpose of the sampling effort and data use(s) should be clearly defined when developing the DQOs. For example, DQOs for site assessment sampling to determine if a contaminant is present may differ from those for determining the nature and extent of a contaminant. Differences in the sampling objectives may dictate the type of sampling equipment used, type of information collected, sampling protocol, and analytical scheme (California Department of Toxic Substances Control [DTSC], 2005) Specifically, review the following:

    a. Historical sampling data (if available) to determine the order of well sampling so that the historically least contaminated wells at the site will be sampled first, progressing to the most contaminated wells last.

    b. Monitoring well construction logs and available water level data for all wells to be sampled to prepare for the conditions that will be encountered and the approximate volume of water to be purged.

    c. Sample container requirements, preservatives, holding times, etc. to prepare for collection, preservation, and shipping of samples, including where to collect quality control (QC) samples specified in the QAPP or SAP.

    d. Department of Transportation (DOT) hazardous material sampling requirements that may apply to chemical reagents, calibration supplies, and/or samples that contain reportable quantities of hazardous substances.

3.2 OBTAIN EQUIPMENT AND SUPPLIES

Attachment 1 provides an equipment and supplies checklist that may be used as a guide when preparing for a groundwater sampling event. Prepare purchase requisitions and place orders for the following at least 10 days before the sampling event:

1. All necessary sampling equipment and expendable supplies.

2. Decontamination supplies and spill response supplies (as necessary)

3. Appropriate containment vessels for purge and decontamination water (e.g., plastic or steel drums, poly tanks).

4. Sample bottles from the laboratory including sufficient bottles for blanks, duplicates, matrix spike/matrix spike duplicates MS/MSD, and extras to cover breakage.

5. Deionized (DI) water for equipment blanks as specified in the QAPP or SAP (grade of DI water).

3.3 CHECK EQUIPMENT AND SUPPLIES

Prior to the sampling event, inspect and check all equipment and supplies.

1. Check the sample container set:
    a. The designated quality assurance manager and the field sampling team inspect the sample container set to verify that necessary bottles, preservatives, and blanks have been provided, and they match the requirements specified in the QAPP or SAP.
    b. The PM documents by signature that all necessary sampling supplies have been provided to satisfy data quality objectives of the sampling event.
2. Inspect sampling equipment to confirm it is functional and in good repair. Keep contact information for suppliers of rented equipment. Use the field logbook to document equipment repair/maintenance performed.
3. Check expendable field supplies to verify there are adequate quantities for the entire event.
4. Check chemical reagents required for decontamination, sample collection, and sample preservation.
5. Verify that field instrument calibration standards are not expired.
6. Review pump parameters. Selection of a pump that is not suited to site conditions can affect sample quality and result in unnecessary time delays and costs. Details of pump-related equipment are presented in the Section 5.0.

4.0 INITIAL SAMPLING STEPS

4.1 WELLHEAD SAFETY

Check the well head for the presence of volatile chemicals or gases with an organic vapor analyzer as required by the Site Safety and Health Plan (SSHP). Follow SSHP requirements and procedures for vapor monitoring in the breathing zone during sampling.

1. After opening the well, check the atmosphere in the well and the area around the well for volatile organic compound (VOCs) using a photoionization detector (PID) or flame ionization detector (FID). Record this reading on the field data form or in field logbook (background reading). If measured levels of VOC vapors and/or methane exceed action levels identified in the SSHP, take appropriate actions.
2. If necessary, during purging/sampling, monitor VOCs in the breathing zone. If measured levels of VOC vapors exceed action levels as given in the SSHP, take appropriate actions.

4.2 WELL GAUGING AND INSPECTION

Inspect wells to be gauged and/or sampled to evaluate the condition of surface casings, surface seals, well identification, and condition of the casing. Compare the well construction to as-built information, including total well depth. Use the field logbook and/or sampling forms to note conditions that could affect water level data or sample integrity. If observed well conditions indicate that data obtained from the well could be compromised, notify the PM, who will determine if the well should be sampled.

Measure water levels following the procedures in SOP OESC008E, “Fluid Level Measurement in Wells.” Water levels should be measured in each of the wells prior to purging or sampling to obtain accurate water level data. Measure and record all data prior to insertion of purging or sampling equipment. Contact the OESC PM for further instruction if unanticipated NAPL is encountered in a well.

Measure the total depth of each well in accordance with procedures defined in SOP OESC008E unless otherwise specified in a site-specific sampling plan or other guidance. The measurement will be used to calculate the volume of water standing in the well casing and to evaluate the potential presence of sediment.

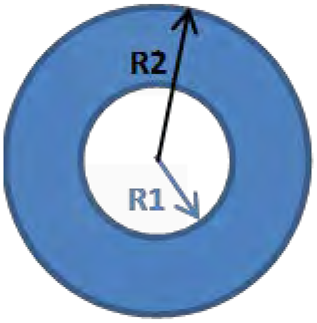
Notify the PM if you encounter the following conditions, which could affect sample representativeness:

1. Water is present in the well sump below the screened interval (the well should be annotated as “dry” on the gauging log)
2. Less than 1 foot of water is present in the well (the well should be annotated as “dry” on the gauging log)
3. The top of the water column is above the screened interval (the well should be identified as “submerged screen” on the gauging log). In this case, the pump inlet should be placed within the screened interval.

4.3 ESTIMATE WELL VOLUME

The following formula may be used to calculate total volume (V_{Total}):

$V_{Total} = V_{well} + V_{filter\ pack}$
$V_{well} = 7.48\pi * h_1 * R_1^2$
$V_{filter} = 7.48\pi * h_2 * (R_2^2 - R_1^2) * 0.30$
$V_{Total} = 7.48\pi * \{(h_1 R_1^2) + 0.30 * h_2[(R_2^2 - R_1^2]\}$



The image above depicts the plan view of well casing and annulus, where:

1. R1 is the radius of the well casing in feet;
2. R2 is the radius of the borehole in feet;
3. h1 is the height of the water column inside the well casing; and
4. h2 is the height of the water column inside the filter pack

If the water table is at the height of the top of the filter pack, $h_1 = h_2$; if the water table is higher than the top of the filter pack, $h_1 > h_2$; and if the water table is lower than the top of the filter pack then $h_1 < h_2$.

To calculate a *casing volume* of water, use $R_1=R_2$, or $R_2-R_1=0$.

5.0 LOW-FLOW GROUNDWATER SAMPLING PROCEDURES

Low-flow groundwater sampling involves purging the well at the lowest sustainable pumping rate until monitored groundwater quality parameters indicate representative groundwater is available for sampling (Section 5.3, Table 1). This method minimizes stress (drawdown) to the system. Flow rates will depend on site-specific hydrogeology. Low-flow sampling includes the following:

1. Minimize drawdown in the well during purging so that geochemical changes caused by aeration of groundwater as it passes through the filter pack and aquifer are avoided; generally, a head-loss of 0.3 feet or less is considered acceptable. Minimized drawdown also prevents mixing of stagnant well casing water (water above the screened interval) with aquifer water.
2. Maintain a low, but sustainable flow rate during purging, using a pumping mechanism that produces a flow rate less than 1000 milliliters per minute (ml/min). Typical low-flow pumping rates are between 100 and 500 ml/min, but the sustainable low-flow pumping rate must be established at each well.
3. Minimize well disturbance caused by high velocity flows, dewatering, water cascading through the well screen, etc.
4. Minimize purge water volume by relying on water quality parameter stabilization to determine when to collect the sample.
5. Obtain reliable water quality parameters by using a calibrated multi-parameter probe with an in-line flow-through cell.
6. Maintain laminar flow throughout the sample tubing and flow-through cell; keep all lines and the cell completely filled (air free) during parameter measurement and sampling.

Samples are collected when field-measured water quality parameters have stabilized (Section 5.3), indicating the presence of formation water.

5.1 LIMITATIONS

The low-flow purge and sampling techniques described in this section are not appropriate for wells with slow recharge. These low-yield wells may not be suitable for low-flow sampling, as the minimal sustainable pumping rate may still generate significant drawdown or completely dewater the well. Wells suited for low-flow procedures are screened in moderate to highly permeable material.

Passive Recharge Wells

A passive recharge well is a well that cannot sustain a minimal flow rate of 50 ml/min without drawing down the water column. To determine if a well is passive in recharge:

1. Set the initial purge rate between 40 and 60 ml/min for the first 10 minutes of purging, and monitor the water level for drawdown every 2 to 3 minutes.

2. If the water level is being drawn down, adjust the setting so that the flow rate is as close to 50 ml/min as possible. If the water level is still dropping after another minute, then the well is determined to be passive in recharge.

If the well is passive, then the flow rate should be placed as low as time will allow, until the minimum purge volume is removed. The well should be noted as passive and the steps used to determine that the well is passive should be noted on the purge log. One round of water quality readings will be recorded on the purge log prior to sampling (AECOM, 2012).

5.2 LOW-FLOW SAMPLING EQUIPMENT

- Water level indicator
- Pump and controller
- Properly sized tubing
- In-line flow-through cell
- PID or FID
- Multi-parameter probe (YSI 3500 or equivalent)
- Graduated liter beaker and stopwatch
- Five-gallon bucket or a purge water collection/disposal drum

5.3 WATER QUALITY PARAMETER MEASUREMENT

The low-flow sampling procedure requires recording groundwater quality parameters monitored in a flow-through cell equipped with a multi-parameter probe. Typically, monitor and record pH, temperature, specific conductance, oxygen reduction potential (ORP), dissolved oxygen (DO), and turbidity at approximately 3- to 5-minute intervals during purging; use of a data logger is recommended. When water quality parameters have stabilized, collect the sample(s). “Stability” is defined as three consecutive readings within the criteria listed in Table 1 or as defined in the project QAPP or SAP.

Table 1. Example Parameter Stabilization Criteria

Measurement	Criteria
pH	± 0.1 pH unit
Temperature	± 1˚ Celsius
Specific conductance	± 5 percent
ORP	± 10 millivolts (mV)
DO	± 10 percent (when DO is greater than 1.0 milligrams per liter [mg/L])
Turbidity	± 10 NTUs (when turbidity is greater than 10 NTUs)

Collect groundwater samples after field parameters have stabilized. If these parameters do not stabilize or if the turbidity does not reach ≤10 NTUs. A maximum volume should be designated for your site after which a sample may be collected, regardless of parameter stability.

5.4 SUBMERSIBLE PUMP PROCEDURES

Submersible pump types that are suitable for low-flow sampling include bladder pumps and positive displacement pumps. Common brand names include QED Micropurge™ (bladder), Grundfos Redi-Flo 2 (positive displacement), Fultz (progressive cavity), and Keck (progressive cavity) pumps. Other pump brands are available. The pump will be selected based on site conditions.

Generally, a submersible pump is used with the pump intake set within the saturated well-screen interval at least 2 feet off the bottom of the well. A peristaltic pump with appropriate controller may be used for low-flow sampling in wells less than 25 feet of head. In that case, follow specific sample collection methods in Section 5.5.3 for VOC samples, as peristaltic pumping may induce loss of VOCs due to pressure changes at the pump head. Connect the pump discharge tubing to an in-line flow-through cell equipped with water quality probes (temperature, pH, dissolved oxygen [DO], etc.). Collect the sample after water quality parameters have stabilized.

5.4.1 Equipment

- Water level indicator
- Pump and controller
- Properly sized tubing
- In-line flow-through cell
- PID or FID
- Multi-parameter probe (YSI 3500 or equivalent)
- Graduated liter beaker and stopwatch
- Container for collection of purge water (e.g., five-gallon bucket)

5.4.2 Purging

Perform the following procedures at each well:

1. Review the performance history of the well to estimate the purge rate and pumping conditions that can be expected.
2. Use a water level indicator to measure the depth to static water level to the nearest 0.01-foot and recorded from the measuring point on the well casing, and recorded. Calculate the volume of water in the well (per Section 4.3) and record on purge/sample log.
3. Assemble the pump and sampling line components taking care not to contact the components with potentially contaminated media, and ensure that the discharge line is affixed so that the initial discharge is captured in either a graduated 5-gallon bucket or a purge water collection/disposal drum.
4. Measure depth to water after deployment of the pump; allow the well to recover to static water levels before pumping. Keep the water level indicator in the well to monitor water levels during purging.
5. Set up the flow-through cell with multiparameter probe and connect to the pump discharge line. Attach the flow-through cell discharge line to a bucket to capture purged water. Manage purge

water in accordance with the project QAPP or SAP and/or Work Plan. Take necessary precautions to prevent spilling potentially contaminated water.

6. Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs.
7. Adjust pumping rates to the minimum rate required to maintain a steady flow of water through all tubing and the flow-through cell and to prevent formation of air bubbles in the pump discharge line.
    a. Check water levels in the well frequently (once every 3 to 5 minutes). Adjust the pump until there is less than 0.3 to 0.5 feet of drawdown. If the minimal drawdown that can be achieved exceeds 0.5 feet but remains stable, continue purging until indicator field parameters stabilize.
    b. Using a stopwatch and a graduated cylinder or container, periodically measure the pumping rate. Monitor the water level, pumping rate, cumulative withdrawal, and field parameters every 3 to 5 minutes. Record the pumping rate and field indicator parameters.
8. Avoid aerating a submerged well screen, as this can lead to chemical changes in the groundwater. If it appears that low-flow purging will draw the water column below the top of the screened interval, the sampling team may need to adjust the purging procedure to allow recovery between purging events. In this case, leave the pump in position and continue to monitor depth to water. Use professional judgment to balance time, length of purging, stability of water quality parameters, and the need to collect a sample.
9. If head loss in a well does not stabilize, is greater than 0.3 feet (from static) using the lowest-possible flow rate of the pump, or if the well dewaters, then low-flow sampling may not be feasible for that well (Section 5.1). The sampling team should inform the Field Team Leader and/or PM if this is the case. An alternative procedure for sampling the well may need to be approved by the Client Representative and the change in procedure noted as a variance to the work plan (see project-specific QAPP or SAP).
10. When the indicator field parameters are stabilized (Table 1, Section 5.3), purging is complete and samples may be collected. The pump should not be moved or adjusted between purging and sampling.

5.4.3 Sample Collection

The following steps apply to each type of submersible pump discussed in the subsequent subsections.

1. Measure and record field parameters in the flow-through cell one final time, including pH, temperature, specific conductance, ORP, DO and turbidity.
2. Refer to the project-specific QAPP or SAP for sampling order, sample containers, preservatives, and holding times. When using a submersible pump, samples are usually collected in the following order (as applicable):
    a. VOCs
    b. Dissolved gases (methane, ethane, ethene)
    c. Gasoline range organics (GRO),

   d. Semivolatile organic compounds (SVOCs), diesel range organics (DRO), PFAS, total petroleum hydrocarbons (TPH)

   e. Polychlorinated biphenyls (PCBs) and pesticides

   f. Metals

   g. Other organics

   h. Other inorganics

3. Disconnect the flow-through cell and collect the samples from the pump discharge tube. If necessary, attach a disposable filter and follow the field-filtering procedure discussed in Section 10.0.

4. The typical sampling flow rate is 100 ml/min, but should be as low as possible while still maintaining laminar flow through completely water-filled tubing (no air bubbles) for collection of VOC samples. Record the sampling flow rate on the purge/sample log.

5. Completely fill VOC sample vial so the water forms a convex meniscus at the top, then cap the vial so that no air space (bubble) is present in the vial. Turn the vial over and tap it smartly to check for bubbles that indicate air space. If bubbles are observed, open the vial, fill the septum cap with additional sample and slowly pour into the vial to form a convex meniscus again at the top and attempt to recap the vial. If the first attempt to generate an air-free volatile organic analysis (VOA) vial is unsuccessful, discard the vial and collect another sample vial. If the sample is spilled during this procedure, discard the vial and collect another sample vial.

6. Completely fill the containers for all other analyses.

7. After the samples have been collected, they should immediately be placed in an ice-filled cooler. The sampling team will keep the coolers in their possession until relinquished to the on-site laboratory or to the Sample Coordinator, or until shipped to an off-site fixed-base laboratory.

8. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. Follow the manufacturers' instructions included with the test kits to conduct the field analyses. Record the field test results in the field logbook or sampling log.

5.4.4 Pump-Specific Guidance

5.4.4.1 Grundfos Redi-Flo

The Grundfos Redi-Flo 2 is most suitable for moderate- to high-yield wells where water quality parameters stabilize quickly. It should be noted that this pump generates heat at low flow rates, which may degrade sample quality. This factor will be considered during pump selection. In addition to the equipment and steps described in Sections 5.4.1 through 5.4.3, the following apply when using a Grundfos Redi-Flo 2:

Equipment

- Generator (minimum 3,500 watt)
- Wire-tie or sampling tape

Steps

1. Assemble the pump and sampling line components:
    a. Connect the safety cable and appropriate length of tubing to the discharge port of the Grundfos pump.
    b. Roll out pump and cable and mark desired pump depth (minimum 2 feet above bottom of well) on the cable with a wire-tie or sampling tape.
    c. Measure sufficient tubing to set up the flow-through cell, cut tubing and attach to pump.
    d. Use nylon wire-ties to bind safety cable, power line, and discharge tubing together to prevent tangling of lines downhole.
    e. Insert the pump into the well. Maintain a slight tension on the controller wire and the safety cable. Slowly lower the pump and complete surface setup.
    f. Make the proper connection, hook up the pump discharge tubing to the flow-through cell, and place the flow-through cell discharge tubing into the purge drum.
2. Start the generator, plug in the controller, and check all tubing and instruments to ensure proper connection.
3. Follow Section 5.4.2 Steps 5 through 10.

5.4.4.2 Impeller-Type Pumps

An impeller pump uses a positive displacement pump head. Water is introduced into the pump through a mesh screen into the pump cavity. Once in the pump cavity, electric rotors transfer the water up the tubing. This section describes typical impeller pump operation using the Fultz pump as an example. In addition to the equipment and steps described in Section 5.4.1 through 5.4.3, the following apply when using an impeller-type pump:

Equipment

- Power inverter so that pump can be powered from a 12-volt vehicle electric port.
- Hose and hose reel (optional, but recommended for deep wells)

Steps

1. Connect the pump power cable to the source of electricity.
2. Follow Section 5.4.2.

5.4.4.3 Bladder Pumps

A bladder pump uses compressed gas to pressurize the pump chamber, which squeezes an internal bladder filled with groundwater. The cyclical pumping action creates a pulsing flow of water out the pump discharge tube. The pressurized gas does not come into contact with the water. This pumping method is considered to be among the best for VOC sampling (US EPA, 2002).

Bladder pumps may be installed as well-dedicated pumps for on-going monitoring programs (such as at landfills), or portable bladder pumps with removable disposable bladders are available. In addition to the equipment and steps described in Sections 5.4.1 through 5.4.3, the following apply when using a bladder pump:

Equipment

- Compressed gas supply (compressed gas tanks or oil-less air compressor)

Steps

1. Follow steps in Section 5.4.2, except that the pump is powered with compressed gas from a tank or from an oil-less air compressor.

5.5 PERISTALTIC PUMP PROCEDURES

A peristaltic pump may be used for low-flow sampling for wells with 25 feet or less of head. Peristaltic pumps offer distinct advantages over submersible pumps because they are highly portable and easy to use. However, peristaltic pumps cause a pressure change in the sample at the pump head, which may result in sample degassing. Section 5.5.3 provides guidance to avoid sample degassing for VOC sampling.

In addition to the equipment and steps described in Sections 5.4.1 through 5.4.3, the following apply when using a peristaltic pump.

5.5.1 Equipment

- Forward and reverse switch and a speed controller
- Inverter and battery/vehicle electrical port
- Power cables
- Pliable silicon tubing (such as Tygon™) is required for the pump head to function properly. Some peristaltic pumps (e.g., Barnant™) can accept various tubing diameters and provide a lever mechanism for the pump head, making installation of the tubing easy. Record the make and serial number of the equipment you use on the sampling log.

5.5.2 Purging

1. Attach the in-line flow-through cell with multi-parameter probe to the discharge line after the rotor heads.
2. Position discharge tubing from the in-line flow-through cell over a bucket or drum to capture purge water.
3. Use a graduated liter beaker and stopwatch to measure the flow rate. The pump is generally powered by connecting the power cables to an inverter plugged into a battery or vehicle electrical port.
4. Attach intake tubing to Tygon™ (or equivalent) tubing that goes through pump mechanism.
5. Carefully insert the intake tubing down into the well to minimize disturbance of the water column. Lower the intake tubing end to the middle of the saturated screened interval or at least 2 feet off the bottom. Avoid tagging the bottom of the well.

6. Attach the discharge tubing to the flexible pump-head tubing and attach in-line flow-through cell.
7. Connect power and turn the pump on (forward direction) at a low pumping rate setting.
8. While measuring water levels in the well, adjust the pumping speed until the lowest sustainable rate with minimal steady-state drawdown is attained. The pumping rate should induce no more than 0.3 foot of drawdown. If excessive drawdown or well dewatering is noted, then low-flow sampling procedures may not be feasible at this well. Refer to procedures for slow-recharging wells in Section 5.5.4.
9. Continue purging until water quality parameters have stabilized, as discussed in Section 5.3. After field parameters have stabilized, collect the sample as described below.

5.5.3 Sample Collection

1. After parameters have stabilized, turn off the pump. Disconnect the flow-through cell from the pump discharge tubing and place sample container at tubing end. Turn on the pump and fill sample containers.
2. Refer to the project-specific QAPP or SAP for sample containers, preservatives, and holding times. When using a peristaltic pump, samples are usually collected in the following order (as applicable):
    a. DRO and GRO
    b. SVOCs, PFAS, TPH
    c. PCBs and pesticides
    d. Metals
    e. Other organics
    f. Other inorganics
    g. VOCs
3. Because this procedure involves removing the tubing from the well, collect VOC samples last in the sampling order. Take care to not contaminate the tubing if it will be replaced into the well. Use plastic sheeting around the well head to protect the tubing from contact with the surface.
4. For VOC samples, use the following procedures:
    a. With the intake tubing completely filled with groundwater, turn the pump off.
    b. Carefully pull the intake tubing out of the well and position the tubing end over the VOA sample vials. The water will stay in the tubing because of a pressure differential created by the pumping action (there is less pressure in the tubing than in the surrounding atmosphere).
    c. Reverse the pump flow direction at a very low flow rate and pump water out of tubing into VOAs.

5. When metals analysis is required, determine if field filtering before sample preservation is required. Generally, if turbidity in the sample is 10 NTUs or less, the groundwater sample will be considered representative of total metals and does not need to be filtered prior to preservation. If low-flow sampling produces a sample with turbidity greater than 10 NTUs, then the sample may need to be filtered, use an in-line disposable 0.45 micrometer (µm) filter prior to sampling (Section 10.0). The project QAPP or SAP should specify the turbidity targets for unfiltered metals samples.
6. After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. Follow the guidelines in SOP OESC005A, "Field Parameter Measurements in Water" and the manufacturer's instructions included with the test kits to conduct the field analyses. Record the field test results in the field logbook and/or the groundwater-sampling log.

5.5.4 Peristaltic Pump Procedures for Slow Recharge Wells

Slow recharge wells that go dry even with low-flow purging may be sampled using low-flow procedures adjusted to prevent well dewatering and aeration.

In a slow-recharge well with a submerged screen (static water level above screened interval), slowly pump out the well casing water until about 6 inches of water remain above the well screen top. Do not pump the water below the screen level; avoid aeration of the screen. Allow the well to recover to at least 80 percent of the measured static water level. Repeat this procedure at least twice to ensure influx of aquifer water into the screened interval and then collect the sample.

For sampling, lower the tubing intake to mid-screen depth (or minimum 2 feet above well bottom) and pump using as low a flow rate as possible. Collect VOC samples last, following the procedure described in Section 5.5.3. Monitor water levels to prevent drawdown into the screen, if possible. Maintain a pumping rate that prevents air bubble formation in the intake tubing.

For water table wells (static water level within screened interval) with slow recharge rates, if excessive drawdown occurs then low-flow sampling procedures are not applicable, and an alternative sampling method will be necessary. Refer to the project-specific QAPP or SAP, or contact the PM for instructions.

6.0 POLYETHYLENE-BASED PASSIVE DIFFUSION BAG SAMPLERS

6.1 METHOD DESCRIPTION AND LIMITATIONS

Polyethylene-based passive diffusion bag (PDB) samplers are an alternative to traditional pump or bailer groundwater sampling methods for VOCs. The samplers consist of a low-density polyethylene (LDPE) sleeve containing DI water. The LDPE sleeve acts as a semi-permeable membrane allowing chemical equilibrium between the internal and surrounding fluid (groundwater). The PDB sampler is suspended within the screened interval of the well and allowed to equilibrate with groundwater for a standard time period (typically, one to 14 days). The PDB sampler is then retrieved from the well and emptied into standard 40- ml vials for VOC analyses. PDB samplers are discarded after use.

This method is not suitable for certain ketones, ethers (e.g., methyl *tert*-butyl ether [MTBE]), and alcohols; inorganic compounds; SVOCs; pesticides; PFAS; or polychlorinated biphenyls. Deployment of PDB samplers in wells containing NAPLs requires special procedures that are not discussed in this SOP.

The underlying principle of the PDB method is that groundwater within the screened interval of the well is in dynamic equilibrium with the aquifer; in other words, groundwater is flowing freely through the well. The method may not provide representative samples in stagnant flow situations or where well efficiency is compromised by improper development or fouling.

6.2 PDB STORAGE

Before deployment, PDB samplers should be kept away from potentially cross-contaminating circumstances such as long-term storage with chemicals or fuels. Follow manufacturer's instructions for storage conditions and shelf-life.

6.3 PDB SAMPLER PROCEDURE

Pre-sampling planning should consider the need for two mobilization events, one to install the samplers and a second event to retrieve them.

6.3.1 PDB Deployment

The following procedures are adapted from the United States Geological Survey user's guide for PDB samplers (Vroblesky, 2001).

1. PDB samplers can be obtained either pre-filled (field ready) or unfilled. Unfilled samplers have a plug and funnel to allow for field filling of DI water and sample recovery. To fill the sampler, remove the plug from the sampler bottom, insert the short funnel into the sampler, and pour laboratory-grade deionized water into the sampler. The sampler should be filled until water rises and fills the funnel half way. Remove excess bubbles from the sampler. Reattach the plug.

2. Place the PDB sampler directly into the well and allow it to equilibrate to the groundwater flowing through the well. Pre-sample purging is not required. If measurement of groundwater quality parameters (e.g., DO, pH, ORP) is required, these data can be collected using a down-hole multi-parameter probe following PDB sampler retrieval.

3. The PDB sampler may be attached to a weighted line, or weights can be attached directly to the sampler.

    a. If the well screen interval is shallow and the PDB contains an attachment ring, the weights can be directly attached.

    b. If the well screen interval is deep, consider using a weighted line approach. The weights attached to the bottom of the line should be stainless-steel and can be reused for future sampling events with proper decontaminated.

    c. Braided polyester line is appropriate for one-time use; Teflon™-coated stainless-steel wire can be used multiple times with proper decontamination (or dedicated to a well).

    d. Sufficient weight should be added to counterbalance the buoyancy of the PDB samplers. One approach is to have the weight resting on the bottom of the well with the line taut above the weight. If this method is used, careful calculations must be made to ensure the PDB is placed within the correct screen interval. (Note that turbidity in the well will not affect the PDB sample quality.) Calculate the distance from the bottom of the well up to the point where the PDB sampler is to be placed. The PDB sampler must be completely submerged during the entire deployment period. Check groundwater elevations (water column height) and fluctuation trends (e.g., seasonal effects) before selecting this method.

   i. For 5-foot long or shorter well screens, the center point of the PDB sampler should be the vertical midpoint of the saturated well-screen length.

   ii. For 5- to 10-foot long well screens, it is common to utilize multiple PDB samplers vertically along the length of the well screen for at least the initial sampling to determine whether contaminant stratification is present and to locate the zone of highest concentration.

   iii. Lower the weight and weighted line down the well until the weight rests on the bottom of the well and the line above the weight is taught. The PDB samplers should now be positioned at the expected depth.

   iv. Secure the assembly in this position. A suggested method is to attach the weighted line to a hook on the inside of the well cap. The well should be sealed in a way to prevent surface water invasion.

4. Allow the system to remain undisturbed as the PDB sampler equilibrates.

Quality Assurance (QA)/QC duplicate procedures still apply to PDB samplers (typically, one field duplicate for every 10 field samples). Duplicate bag samples should be set at the same vertical depth if the well diameter allows, this can be done with a clip attachment.

6.3.2 PDB Recovery

The amount of time that the sampler should be left in the well depends on site conditions. Conditions that affect the sample equilibrium time include the target chemicals, chemical concentrations, groundwater temperature, and local groundwater flow velocity. Very low-flow velocity and cold temperature conditions have not yet been evaluated for this method.

1. Remove the PDB sampler from the well by using the attached line. Avoid agitating the samplers or exposing them to heat.

2. Examine the surface of the PDB for evidence of algae, iron, or other coatings and for tears in the membrane (note in field book). If there is a tear in the membrane, the sample should be rejected. If the PDB is coated, that condition should be noted in the data validation report.

3. Detach and remove the PDB sampler from the weighted line. Remove excess liquid from the exterior of the bag to minimize the potential for cross contamination.

6.3.3 PDB Sample Transfer

Have all required bottles ready for filling (pre-preserved 40-ml VOA vials). Transfer water from sampler immediately upon recovery.

Remove the hanger and weight assembly from the sampler. Invert the sampler so that the fill plug is pointed upward, then remove the plug. The water can be recovered by directly pouring in a manner that minimizes agitation or by pouring through a VOC discharge accessory inserted in place of the plug. Control discharge rate by tilting or manipulating the sampler.

Place sample containers immediately on ice to ensure sample preservation.

6.3.4 Comparison Sampling for VOCs

If comparison sampling (to verify PDB sample results) is to be performed using conventional sampling methods, the sample should be collected as soon as possible after the PDB is retrieved from the well. Comparison samples should be, if possible, shipped in the same cooler as the PDB samples and analyzed within the same sample data group.

7.0 HYDRASLEEVE™ SAMPLERS

7.1 METHOD DESCRIPTION AND LIMITATIONS

Polyethylene-based HydraSleeve™ samplers are an alternative to traditional pump or bailer groundwater sampling methods for all analytical parameters. The disposable sampler is designed to collect a representative water sample from a monitoring well without purging, by collecting a discrete sample from only the fresh formation water in the screened interval of the well. The sample is collected with no drawdown in the well and minimal sample agitation. The sampler is suspended within the screened interval of the well and allowed to equilibrate with groundwater for a standard time period (usually a minimum of one day). The sampler is then retrieved from the well and emptied into standard laboratory provided containers for analyses. The samplers are discarded after use.

Deployment of the HydraSleeve™ samplers in wells containing NAPLs may require special procedures that are not discussed in this SOP.

The underlying principle of the HydraSleeve™ method is that groundwater within the screened interval of the well is in dynamic equilibrium with the aquifer; in other words, groundwater is flowing freely through the well. Therefore, the method may not provide representative samples in stagnant flow situations or where well efficiency is compromised by improper development or fouling. Vertical gradients within a well can influence sample results. HydraSleeve™ samplers can be deployed in a vertical array and the resultant data used to adjust future sampling plans.

Water quality parameters such as pH, temperature, dissolved oxygen, and specific conductance cannot be measured using this sampling device. However, these data may be acquired down-hole with the appropriate instruments prior to sampling with this device.

7.2 HYDRASLEEVE™ STORAGE

Before deployment, HydraSleeve™ samplers should be kept away from potentially cross-contaminating circumstances such as long-term storage with chemicals or fuels. Follow manufacturer’s instructions for storage conditions and shelf-life.

7.3 HYDRASLEEVE™ SAMPLER PROCEDURES

The following procedures are adapted from a published field manual for use of the HydraSleeve™ (GeoInsight, 2016).

7.3.1 HydraSleeve™ Assembly

1. Remove HydraSleeve™ from package and grasp top to pop open.
2. Squeeze side fins together at top to bend reinforcing strips outward.
3. Attach line to hole at top of HydraSleeve™.
4. Fold the two holes at bottom of HydraSleeve™ together and attach weight.

5. Sampler is ready to insert into the well.

7.3.2 HydraSleeve™ Deployment

To collect a representative groundwater sample without purging, the well must be allowed time to re-equilibrate after placement of the sampler. When a device is lowered into a well, some mixing of the water column occurs. The diameter of the device and its shape greatly affect the degree of mixing. The flat cross-section of the empty HydraSleeve™ minimizes the disturbance to the water column as the sampler is lowered into position, reducing the time needed for the well to return to equilibrium.

There are three basic methods for holding a HydraSleeve™ in position as the well equilibrates.

1. Top-Down Deployment: Measure the correct amount of suspension line needed to "hang" the top of the HydraSleeve™ (s) at the desired sampling depth (in most cases, this will be at the bottom of the sampling zone). The upper end of the tether can be connected to the well cap to suspend the HydraSleeve™ at the correct depth until activated for sampling.
2. Bottom Deployment**:** Sound the well to determine the exact depth. Lower the weighted HydraSleeve™ into the well and let it touch the bottom. Very slowly (less than 1/2 foot per second [fps]) raise the sampler to the point where the check valve is at the depth the sample is to be collected. Attach the suspension line to the top of the well to suspend it at this depth. (It is often easier to measure a few feet from the bottom of the well up to the sample point, than it is to measure many feet from the top of the well down.) Alternately, the sampler can be left on the bottom until the well re-equilibrates. For sampling, it can be very slowly pulled (< 1/2 fps) to sampling depth, then activated to collect the sample, and retrieved to the surface.
3. Bottom Anchor**:** Determine the exact depth of the well. Calculate the distance from the bottom of the well to the desired sampling depth. Attach an appropriate length anchor line between the weight and the bottom of the sampler and lower the assembly until the weight rests on the bottom of the well, allowing the top of the sampler to float at the correct sampling depth.
4. Multiple Interval Deployment**:** There are two basic methods for placing multiple HydraSleeves™ in a well to collect samples from different levels simultaneously.
    a. Attached to a Single Tether: To use three or more samplers simultaneously, it is recommended to attach them all to a tether for support to prevent the sampling string from pulling apart. The weight is attached to a single length of suspension line and allowed to rest on the bottom of the well. The top and bottom of each HydraSleeve™ are attached to the tether at the desired sample intervals. Cable tie or stainless-steel clips (supplied) work well for attaching the HydraSleeves to the line. Simply push one end of the clip between strands of the rope at the desired point before attaching the clip to the HydraSleeve™.
    b. Attached End to End: To place two or three stacked HydraSleeves™ for vertical profiling, use one of the methods described above to locate the bottom sampler. Attach the bottom of the top sampler to the top of the following HydraSleeve(s) ™ with a carefully measured length of suspension cable. Connect the weight to the bottom sampler. Note: if many HydraSleeves™ are attached to a tether, more weight may be required than with a single sampler.

7.3.3 HydraSleeve™ Recovery

The HydraSleeve™ must move upward at a rate of at least 1 foot per second (about the speed a bailer is usually pulled upward) for water to pass through the check valve into the sample sleeve. The total upward distance the check valve must travel to fill the sample sleeve is about 1 to 2 times the length of the sampler. For example, a 24-inch HydraSleeve™ needs a total upward movement of 24 to no more than 48 inches to fill. The upward motion can be accomplished using one long continuous pull, several short strokes, or any combination that moves the check valve the required distance in the open position. A special technique is used for sampling low-yield wells.

- Continuous Pull: Pull the HydraSleeve™ continuously upward from its starting point at a constant 1 to 2 feet per second until full. This method usually provides the least turbid samples and is analogous to coring the water column from the bottom up. When using this method, the screen interval should be long enough so the sampler fills before exiting the top of the screen.
- Short Strokes: Pull the sampler upward at about 1 to 2 feet per second for the length of the sampler and let it drop back to the starting point. Repeat the cycle 3 to 5 times. This method provides a shorter sampling interval than the continuous pull method (above), and usually reduces the turbidity levels of the sample below that of numerous rapid, short cycles (below). The sample comes from between the top of the cycle and the bottom of the sampler at its lowest point.
- Rapid, Short Cycles: Cycle the HydraSleeve™ up and down using rapid, short strokes (6-inch cycle at a minimum of one cycle per second) five to eight times. This method provides the shortest sampling interval. Dye studies have shown that when using this method, the sample flows into the check valve from along the length of the sampler and immediately above the check valve. The sample interval is from the bottom the sampler at its lowest point in the cycle to the top of the check valve at the peak of the cycle.

An optional top weight can be attached to compress the sampler in the bottom of the well if needed for an extremely short water column. With a top weight, the check valve is pushed down to within a foot of the bottom of the well.

7.3.4 HydraSleeve™ Sample Transfer

1. Have all required bottles ready for filling (pre-preserved 40-ml VOA vials). Transfer water from sampler immediately upon recovery.
2. The best way to remove a sample from the HydraSleeve™ with the least amount of aeration and agitation is with the short plastic discharge tube (included).
3. Squeeze the full sampler just below the top to expel water resting above the flexible check valve.
4. Push the pointed discharge tube (provided) through the outer polyethylene sleeve about 3-4 inches below the white reinforcing strips.
5. Discharge the sample into the desired laboratory provided containers. Raise and lower the bottom of the sampler or pinch the sample sleeve just below the discharge tube to control the flow of the sample. The sample sleeve also may be squeezed, forcing fluid up through the discharge tube.
6. Place sample containers immediately on ice to ensure sample preservation.

8.0 SAMPLING USING A BAILER

Bailers are constructed of polyvinyl chloride (PVC), Teflon™, stainless steel, or high-density polyethylene (HDPE) and consist of a cylinder with a bottom check valve and a means for attaching twine or rope at the top. The bailer is lowered into the well, allowed to fill with water, and is then removed. Bailers can be ordered in various diameters and lengths. Only single-use disposable bailers should be used for sampling.

8.1 LIMITATIONS

The use of bailers to purge and sample wells will typically provide samples that are less representative than the previously discussed methods. Sample quality is affected by aeration and agitation of the water column, mixing of stagnant water from the well casing with groundwater in the screened interval, generation of turbidity due to the surging action of the bailer, and other problems (Nielsen and Nielsen, 2002). The groundwater sample data from a bailer sample should always be qualified as "qualitative" due to the potential influences on the sample.

Use of bailers may also increase exposure of field personnel to contaminants and may not be advisable for sampling highly contaminated wells. For these reasons, bailer sampling is now generally considered to be the sampling method of last resort

Bailer sampling may be applicable for collecting samples of leachate or from other non-groundwater monitoring wells, or to collect a sample of LNAPL or DNAPL present in a monitoring well (which is not addressed in this SOP). NOTE: It is not necessary (or advisable) to purge before sampling separate-phase liquids from a well.

8.2 PURGING

The typical practice for using bailers is to purge out three well volumes, or until the well is dry, and then allow the well to recover before sampling.

1. Spread plastic sheeting over the top of the well casing, cutting an access hole in the plastic at the well opening. The plastic will keep the bailer and twine from touching the ground and well casing, to minimize the potential for cross-contamination of the sample.
2. Measure depth to water and total well depth. Attach the appropriate length of twine to the bailer (use non-tangling type of twine) and loop the other end to your wrist.
3. For water quality/chemical samples, remove the equivalent of three well volumes prior to sampling and allow well to recover.
4. Gently and slowly lower the bailer into the well and avoiding tagging the bottom to minimize sediment disturbance and water column aeration. Allow the bailer to fill with water and slowly remove.
5. Use a "windmill" motion of the arms to reel up the bailer and keep the line from tangling. A tripod and reel or a mechanical winch (i.e., a Smeal Rig) can be used to raise and lower a bailer if the well is deep.
6. Discharge purged water into bucket or drum. Record volumes removed on the purge/sample log. After removal of one well volume, measure the well recharge rate by periodically measuring and recording depth to water.

8.3 SAMPLING

After purging, allow the well to recover before sampling.

1. Water quality parameters such as pH, temperature, etc. may be obtained by measuring water quality parameters down-hole before or after sampling is completed using a multi-parameter instrument. If measured after sampling, allow the well to recover first.
2. Prepare bottles and chain-of-custody form for sample collection.
3. Once the well has recovered to at least 80 percent of static (recovery percentage allowed may depend on your sample volume needs), slowly lower the bailer into the water column.
4. The bailer should be lowered so that it is within the screened portion of the well. Slowly remove the bailer to minimize disturbance to the well.
5. Once at the surface, transfer the bailer contents to the sample containers. The preferred method is to insert a bottom-emptying device into the bottom of the bailer. The device is pressed into the hole in the bottom of the bailer, which unseats the bailer check ball. The preferred device has a valve or other mechanism that allows you to start/stop the flow. This process is more readily performed by two people.
6. Refer to project-specific QAPP or SAP for sample containers, preservatives, and holding times.
7. When using a bailer, samples should be collected in the following order (as applicable):
    a. VOCs
    b. Dissolved gases (methane, ethane, ethene)
    c. GRO
    d. SVOCs, DRO, PFAS, TPH
    e. PCBs and pesticides
    f. Metals
    g. Other organics
    h. Other inorganics
8. After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. Follow the guidelines in SOP OESC005A, “Field Parameter Measurements in Water” and the manufacturer’s instructions included with the test kits to conduct the field analyses. Record the field test results in the field logbook and/or the groundwater-sampling log.

9.0 BIO-TRAP® SAMPLERS

Bio-Trap® samplers are passive sampling tools that contain Bio-Sep® beads that are deployed in monitoring wells to collect microbes over time to determine if biodegradation is occurring in the subsurface. The procedures outlined in this SOP for Bio-Trap® samplers are specific to the samplers manufactured by Microbial Insights, Inc. located in Rockford, Tennessee (www.microbe.com) and are adapted from the manufacturer's protocol.

Other manufacturers may provide similar methods and equipment for meeting the sampling objective; the project-specific QAPP or SAP should indicate the specific sampling equipment to be used for the project.

9.1 METHOD DESCRIPTION AND LIMITATIONS

The sampler is suspended within the well screen for 30 to 60 days, and then removed from the well, transferred to a zippered bag, placed on ice in a cooler, and sent to the laboratory for analysis.

9.2 EQUIPMENT STORAGE

Bio-Trap® samplers should be purchased no earlier than two weeks prior to the intended deployment to minimize potential microbial contamination, chemical contamination, and drying. The samplers must remain sealed and refrigerated until they can be deployed in the field and should be kept in a cooler on ice in the field prior to deployment.

9.3 SAMPLER DEPLOYMENT

1. Wear sterile gloves at all times when handling Bio-Trap® samplers.
2. If the monitoring well into which the Bio-Trap® sampler will be deployed has not been purged recently, purging three well volumes is recommended to ensure contact with formation water and to reduce the well bore effect.
3. Wearing sterile gloves, remove the Bio-Trap® sampler from the zippered bag and attach the nylon attachment loop to a nylon line.
4. Suspend the sampler where significant contaminant concentrations exist. If no data are available on the vertical distribution of contaminants, suspend the sampler 1 to 1.5 feet below the top of the water table if the contaminants of concern are petroleum hydrocarbons or in the middle of the saturated screen if the contaminants of concern are chlorinated hydrocarbons.
5. If large fluctuations in the water level are anticipated during the incubation period, the Bio-Trap® sampler should be suspended from a float per the manufacturer's directions. The float should be made of a non-reactive inert material to both groundwater and subsurface contaminants.

9.4 SAMPLER RECOVERY

1. Remove the Bio-Trap® sampler from the well and cut off the braided nylon line used to suspend the sampler.
2. Transfer the sampler to a labeled, zippered bag and double bag it in a one-gallon zippered bag.
3. Immediately place the bagged sampler on ice (which must be double-bagged) in a cooler and ship the samplers to the laboratory for next day delivery.

10.0 FIELD FILTERING OF SAMPLES

Field filtering of groundwater samples may be required for samples to be analyzed for dissolved metals. Field filtering is appropriate for samples with turbidity of greater than 5 to 10 NTUs (depending on the project-specific QAPP or SAP), but is unnecessary for samples with equal to or less than 5 NTUs.

1. Filter groundwater samples immediately upon collection, prior to chemical preservation of the sample. Filtration should be completed in as short a time as possible while minimizing sample aeration, agitation, pressure changes, temperature changes, and prolonged contact with ambient air.
2. The project-specific QAPP or SAP should specify if and when (for which wells) field filtering will be performed, and the type of filter that will be used. Typically, 0.45 µm disposable capsule filters are used for groundwater sampling.
3. If using a pump to sample the well, attach the filter to the outflow tubing and fill the sample containers from the outflow end of the filter.
4. If using a bailer for sampling, transfer the sample to a clean container and filter the sample using a peristaltic pump with an in-line filter. Alternatively, there are apparatuses to pressurize a transfer container or the bailer, which forces the sample through a filter.
5. Follow manufacturer's instructions for use of the filters. Pre-condition the filter prior to filtering the sample by pumping a sufficient volume of sample water through the filter to completely saturate it. Discard the preconditioning filtrate (place in purge water container). Collect sample after the filter has been pre-conditioned.
6. After collection of the filter sample, add the appropriate field preservative. Field preservation information should be included in the project-specific QAPP or SAP.

11.0 GROUNDWATER QUALITY CONTROL SAMPLES

All QA/QC sampling activities must comply with the requirements of the project QAPP or SAP. QC samples may include equipment (rinsate) blanks, field blanks, material blanks, duplicates, matrix spike and matrix spike duplicates, and trip blanks.

Equipment rinsate samples (equipment blanks) are usually collected after sampling a known or suspected contaminated well to assess the effectiveness of decontamination procedures. Equipment blanks are taken in the field by pouring laboratory-grade Type II reagent grade water through the decontaminated pump or other sampling device, then collecting the rinsate into the proper sample containers. The equipment blank is preserved, labeled, and stored in exactly the same manner as a groundwater sample.

Field blanks are collected to assess if ambient sources of contamination, such as fumes from internal combustion engines, may affect groundwater sample quality. Collect a field blank while at a groundwater sampling location in an area where an ambient atmospheric source is present. Pour laboratory-grade DI water into the sample containers (typically VOA vials) and treat exactly the same as a groundwater sample.

Duplicate samples are collected to evaluate the accuracy and precision of the contract laboratory. Duplicate samples are collected at the same time as the associated environmental samples (called field or original samples). All of the sample bottles for a particular analysis for both the duplicate and the environmental samples will be filled before filling the sample bottles for the next analysis. For instance, fill all the VOC bottles prior to filling the SVOC bottles.

Trip blanks are submitted to the laboratory to evaluate the potential for cross-contamination of VOCs within the shipping cooler. Appropriate sample containers filled with analyte-free water will be sealed and provided by the laboratory. Trip blanks accompany sample shipments containing VOC samples (see project QAPP or SAP for frequency of trip blanks). Keep trip blanks with sample containers during all stages of the sampling effort.

12.0 FIELD EQUIPMENT CLEANING PROCEDURES

Sampling equipment, including electrical water level tapes, flow-through cell, pumps, etc. should be decontaminated upon arrival on-site (unless guaranteed clean by supplier) and between each well. Field decontamination procedures may be specified in the project QAPP or SAP. Otherwise, use the decontamination procedures in SOP OESC011A, “Sampling Equipment Decontamination Procedures.”

Generally, sample the least contaminated wells first (if known) as an additional precaution against introducing contaminants into the wells and samples. If decontamination is performed in the field, all rinse water must be contained in a manner that prevents the introduction of contamination to the site environment. See SOP OESC012A, “Investigation Derived Waste Management Procedures.”

13.0 SAMPLE MANAGEMENT AND CHAIN-OF-CUSTODY PROCEDURES

After each sample is collected, samples will be labeled and handled in accordance with methods specified in the project-specific QAPP or SAP. Guidelines for sample labeling, chain-of-custody procedures, sample packaging, and sample shipping procedures are provided in SOP OESC010C, “Sample Labeling, Control, and Shipping.” Note that DOT hazardous material sampling requirements may apply to samples that contain reportable quantities of hazardous substances.

14.0 FIELD DOCUMENTATION

Thoroughly document groundwater sampling procedures, equipment, and events. Additional field documentation procedures are presented in SOP OESC002A, “Field Records and Documentation.”

Maintain field notes to provide a daily record of sampling and events. Follow site-specific requirements for completing daily field activities logs, purge logs, and groundwater sampling logs.

15.0 REFERENCES

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ATTACHMENT 1

GROUNDWATER SAMPLING EQUIPMENT AND SUPPLIES CHECKLIST

Tools

- ☐ 3/4" and 9/16” socket or wrench
- ☐ 15/16” socket wrench (for drums)
- ☐ Screwdriver, pliers
- ☐ Mallet
- ☐ Wire cutters and/or knife
- ☐ Crescent wrench

Decontamination/IDW Supplies

- ☐ Isopropyl and DI water spray bottles
- ☐ DI water (4 x 5-gallon carboys)
- ☐ 30-gallon vessel w/20-gallon potable water
- ☐ 20-gallon carboy with decontamination solution
- ☐ 30-gallon vessel with 20 gallons soapy water
- ☐ Brushes
- ☐ Liquinox
- ☐ Trash bags
- ☐ Plastic wash tubs
- ☐ Fluid containment (drums or poly tanks)

Miscellaneous Supplies

- ☐ Well keys and caps
- ☐ Extra locks
- ☐ Nylon wire ties
- ☐ Bolt cutters
- ☐ Extra bolts
- ☐ Tubing cutter

Sample Equipment / Instruments

- ☐ Water quality probe (Troll or equivalent)
- ☐ Calibration fluids, fresh
- ☐ PID and calibration kit
- ☐ ASTM II deionized water
- ☐ Turbidity Meter
- ☐ Disposable bailer, bailer twine
- ☐ Pump, tubing, reel, related supplies
- ☐ Pump converter/inverter (if needed)
- ☐ Water level and/or Oil/Water indicator
- ☐ Generator (if needed)
- ☐ Compressed air or air compressor (if needed)
- ☐ Flow-through cell

Field Logs and Documentation

- ☐ Field activity daily log (if required)
- ☐ Groundwater elevation logs
- ☐ Purge/Sample Logs
- ☐ Sample Container Labels
- ☐ Task-Specific QAPP, SAP or Work Plan
- ☐ Real time air monitoring log
- ☐ COC
- ☐ Site well map
- ☐ Master sample data sheet
- ☐ Equipment list

Sample Supplies

- ☐ Poly sheeting
- ☐ Duct tape, Clear plastic tape
- ☐ Paper towels
- ☐ Resealable baggies – all sizes
- ☐ Coolers w/ice
- ☐ Sample preservatives
- ☐ Sample containers appropriate for the COCs + reserves if breakage happens
- ☐ Filters (if required)
- ☐ String for bailers
- ☐ Tubing adapters and fittings
- ☐ Buckets and funnels
- ☐ Appropriate sample bottles
- ☐ Appropriate IDW containers
- ☐ Graduated plastic container (liter)

STANDARD OPERATING PROCEDURE OESC0081

BOREHOLE ABANDONMENT AND WELL DESTRUCTION

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared by: Nova Clite, PG Sr. Hydrogeologist	Nova Clite	26 June 2013
Updated by: Cody Wilgus, PG, MESM Project Geologist		24 May 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	30 May 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Practice (SOP) is to establish a uniform procedure for borehole abandonment and well destruction.

Methods must comply with applicable federal, state, and local laws and regulations. Applicable federal, state, and local laws and regulations must be considered during the project planning phase and addressed in the site-specific work plan. Permits are commonly required for abandonment/destruction of wells. A state-licensed driller is needed for these procedures.

- This SOP focuses mainly on smaller diameter remediation and monitoring wells, and piezometers, and not on large water production wells, injection wells, or oil wells.
- This SOP is not intended for abandoning artesian (flowing) wells and borings, which will require additional controls, including surface seals and pressure grouting with barite.

2.0 BOREHOLE ABANDONMENT PROCEDURES

2.1 Objective

The objectives of borehole abandonment are to eliminate physical hazards such as borehole collapse and to protect the subsurface environment by preventing a pathway for surface pollutants to migrate downward through the borehole.

2.2 Materials

Boring backfilling materials will meet State and/or local rules and regulations. Materials used for sealing shall have low permeability so that the volume of water and possible pollutants or contaminants passing through them will be of very minimal consequence. Grout should be impermeable and stable (will not decompose). If not otherwise specified in project planning documents, use the following types of material:

- Granular bentonite or bentonite chips may be used in shallow boreholes (typically less than 20 feet deep) or boreholes that do not penetrate groundwater. Bentonite will consist of commercially obtained calcium bentonite with high solids content. The specifications and source of the bentonite material will be recorded in the field notes.

- Cement grout will be used for boreholes that penetrate groundwater or are deeper than 20 feet. Grout will consist of a mixture of Portland cement (ASTM C150-07; ASTM, 2012) and water in the proportion of approximately 6 to 7 gallons of potable water per sack of cement (94 pounds), with 3 to 5 percent by weight of calcium bentonite powder will be added. The minimum acceptable grout weight will be 14 pounds per gallon (lbs/gal). The cement grout weight and volume (in cubic feet) will be calculated and recorded in the field notes. Water may be added to the mix in small amounts, at the discretion of the supervising geologist, to decrease viscosity as necessary to ensure proper filling of the borehole.

The following table provides specifications for various grout slurry densities.

Percentage Bentonite	**Water Ratio**	**Minimum density (lbs/gal)**	**Volume Bentonite (cubic feet/sack)**
2	6.0 gallon/sack of cement	14.7	1.36
3	6.5 gallon/sack of cement	14.4	1.45
4	7.2 gallon/sack of cement	14.1	1.55
5	7.8 gallon/sack of cement	13.8	1.64

2.3 Procedures

Boreholes should be backfilled as soon as practical after samples have been collected as specified in project planning documents (not covered by this SOP).

If boreholes will remain open overnight or for extended time periods, the surface must be secured to prevent unauthorized access or cross contamination, and in accordance with any regulatory requirements.

2.3.1 Boreholes Less Than 20 Feet Deep in Stable Soils

Granular, pellet, or chip bentonite may be used to backfill shallow boreholes (typically less than 20 feet deep) or borings that do not penetrate groundwater when the annular area is large and stable enough to limit the potential for borehole collapse and bridging.

- Add dry granular bentonite (or bentonite pellets or chips) in a maximum of 3-foot lifts and hydrate for a minimum of 30 minutes between lifts to ensure proper hydration of the plug. If time-release pellets are used, consult the manufacturer’s instructions for hydration times. Hydrate bentonite with sufficient potable water as indicated on the package instructions.
- Measure depths before and after hydration to ensure the granular bentonite has been properly emplaced.
- Check borehole after a minimum of 12 hours and backfill any shrinkage at ground surface.
- Repair the surface as required by the project planning documents and/or local regulations.

2.3.2 Boreholes Greater Than 20 Feet Deep or Boreholes in Unstable Soils

Boreholes greater than 20 feet deep that are advanced into unstable sediment or boreholes that penetrate groundwater will be pressure-grouted using a tremie pipe while the drill casing is gradually removed, as follows:

- Prepare grout slurry and weigh grout density as discussed in Section 2.2.
- Pressure-grout using a tremie pipe.
- Remove drill casing incrementally during the grouting procedures to limit borehole collapse, usually exposing no more than 3 feet of open borehole.
- Pump grout into the annulus through the tremie pipe until undiluted grout flows from the borehole at the ground surface. Typically for deep boreholes, it may be necessary during pressure grouting to remove some of the tremie pipe; however, the bottom of the tremie pipe will remain at a minimum of 10 feet below the top of the advancing grout mixture.
- Allow grout to cure for at least 24 hours; backfill any shrinkage with additional grout to ground surface. Granular, pellet, or chip bentonite may be used to backfill shrinkage of less than 2 to 3 feet; hydrate bentonite.
- Recheck any backfilled boreholes and repair the surface in accordance with the project planning documents and/or local regulations.

3.0 WELL DESTRUCTION PROCEDURES

3.1 Objectives

The objective of proper well destruction is to protect groundwater quality by preventing surface pollutants from migrating downward through and/or around the well casing, and to eliminate any physical hazards to humans and animals.

3.2 Procedures

Well destruction will be performed in accordance with state and local laws and regulations, which should be incorporated into the project planning documents to properly prepare for the work, and must be performed by a qualified well driller licensed in the project state. Required permits will be obtained prior to initiating work, which may proceed only at the approval of the enforcing or permitting agency. The enforcing agency should be contacted to determine requirements for disposal of all materials removed from a well to be destroyed; refer to the project planning documents.

The state-licensed driller will destroy wells using the following general procedures:

- Investigate monitoring well before it is destroyed to determine its condition and well construction details.
- Ensure there are no obstructions that will interfere with filling and sealing; remove any obstructions or undesirable materials prior to well destruction.
- Properly de-energize and cut electrical connections and remove in-well equipment such as the pump assembly, if present. Record the type and length of equipment removed from the well in field notes.

- Remove surface protective casing, well vault, or pump house.
- Wells or piezometers shall be destroyed by removing all material within the original borehole, including the well casing, filter pack, and annular seal, if required.
  - For shallow wells in soft soils (typically less than 25 feet deep), the well casing or entire well can be removed by pulling it from the ground.
  - For polyvinyl chloride (PVC)-cased wells, the casing may be over-drilled using a special guide bit.
  - In rare instances, well casings may be difficult to extract, and it may be proposed to perforate the casing, perform pressure grouting, and remove the upper 5 feet of casing. If the permitting or enforcing agency approves perforation and pressure grouting, then follow guidelines proposed in the permit.
  - If required by the project planning documents, capture and contain groundwater displaced during grouting and temporarily store it in 55-gallon drums, pending characterization and disposal.
- After casing removal or perforation, all voids will be completely filled with sealing material/grout in accordance with the steps provided in Section 2.0.

4.0 DOCUMENTATION

The supervising geologist/scientist is responsible for fully documenting the borehole abandonment or well destruction procedure. The following information will be documented in the field logbook and on the abandonment/destruction form:

- Name of property owner
- Address of owner and/or property
- Borehole or well location
- Borehole or well installation method and date
- Type of well (purpose, use)
- Construction of well, including total depth, diameter, depth of casing, well casing and screen material, diameter of borehole, filter pack material/height, etc.
- Geologic formation (characteristics), depth to bedrock (if applicable)
- Depth to groundwater at time of abandonment
- Materials and anticipated quantities to be used backfilling and/or grouting
- Actual quantities used for backfilling and/or grouting
- Description of abandonment/destruction procedures, materials, grout densities
- Description of drilling equipment, if used
- Drilling contractor, license number
- Step by step procedures executed

- Diagram or log of well destruction

5.0 REFERENCES

Aller, L. et al. 1991. Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells. United States Environmental Protection Agency (EPA). EPA160014-891034. March.

ASTM International (ASTM). 2018. ASTM D5299 / D5299M-18, Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.

ASTM. 2012. ASTM C150-07, Standard Specification for Portland Cement.

Sterrett, R. J. 2008. *Groundwater and Wells* (3rd ed.). Smyth Co Inc.

California Department of Water Resources (DWR). 1991. California Well Standards Bulletin 74-90. June.

California DWR. 1981. Water Well Standards: State of California Bulletin 94-81. December.

STANDARD OPERATING PROCEDURE OESC010C

SAMPLE LABELING, CONTROL, AND SHIPPING

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Moriah Mason Staff Environmental Scientist	Moriah B. Mason	15 December 2020
Reviewed By: Kristen Carlyon Peyton, CHMM Senior Chemist	Kristen Carlyon Peyton	11 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	11 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to present procedures for sample identification (ID), sample handling, and preparing chain-of-custody (COC) documentation. These procedures will facilitate maintaining the integrity of samples from the point of collection to laboratory arrival. COC documentation is used to communicate analytical instructions to the laboratory, provide the laboratory with a record of provided samples, and document proper handling by only authorized personnel.

This procedure applies to the shipping and packing of all non-hazardous samples. Non-hazardous samples are those that do not meet any hazard class definitions found in 49 CFR 107-178. Generally, most environmental samples do not meet any of the Department of Transportation’s hazardous materials definitions. See Section 3.5 for further information.

2.0 EQUIPMENT AND SUPPLIES

Field records and COC records will be recorded in black waterproof, ballpoint, non-erasable ink. Under no circumstances will permanent markers (e.g., Sharpies), white out, or erasers be used on field forms or COC forms.

3.0 PROCEDURAL STEPS

The following steps are intended to ensure the integrity of data obtained through sample collection.

3.1 Sample Nomenclature

The sample numbering protocol used for field samples and quality control (QC) samples should be outlined in the project-specific Sampling and Analysis Plan (SAP), Work Plan, Field Sampling Plan, Quality Assurance Project Plan (QAPP), and/or comparable document. Prior to preparing sample labels or a COC, this numbering protocol should be confirmed.

3.2 Sample Labeling

Samples of environmental media including soil, sediment, surface water, groundwater, waste, ambient air, and vapor samples, will be labeled according to the following procedures.

1. Label each sample container with the following information:
    - Date and time
    - Sample ID number
    - Project number
    - Sampler (name)
    - Preservative
    - Field filter (if applicable)
2. Record sample collection information in the field logbook and/or daily field record. Begin the sample collection entry with the time the sample is collected. Entries will be made in chronological order.
3. Sketch a drawing of the site in the field logbook if a map of the sampling location is not available prior to sampling. Properly identify and illustrate specific sampling points for future reference.

Errors must be corrected by a single line through the error, initialed, dated, and rewritten by the field personnel performing the correction. If possible, corrections should be made by the individual who made the error.

Adhesive labels placed on sample tags, logbooks, or sample containers should not be removed. Labels should never be placed over previously recorded information. Permanent markers may be used for information recorded on sample container labels; error correction will follow the same process detailed in the previous paragraph. *Note: Do not add additional adhesive labels to pre-tared, pre-labeled EPA Method 5035 vials (e.g., TerraCore, etc.) received from the laboratory. Record all information on the provided labels so as not to alter the tare weight of the vial.*

3.3 Chain of Custody

A COC is a legal document used to track the continuous possession of samples from their origin to completion of analysis and archiving/disposal in the laboratory. This uninterrupted record of custody is required to maintain integrity of samples. The following procedures will provide field personnel with techniques to complete sample labels and COCs in the field:

- Limit the amount of personnel handling samples during the sampling event.
- Each field team member is responsible for the proper handling and custody of samples collected until they are properly and successfully transferred to the next authorized person or facility. If the project has a Field Sample Coordinator (FSC), the field team will deliver samples to the FSC as soon as possible and that person will assume responsibility for completing the COC record.

- Prior to or immediately following sample collection, field personnel will complete sample labels for each sample container using black waterproof, non-erasable ink or permanent marker, and attach them to the sample containers. A sample label will be adhered or tied to the container.
- Sample containers will be placed in re-sealable plastic bags before placement on ice to prevent leakage. Double bagging sample containers and wrapping each container in bubble wrap is recommended to prevent leakage and breakage.

The following methodology will be used to complete the COC and to maintain an accurate record of sample collection, transport, analysis and disposal:

1. Samples will be accompanied by a COC form at all times. A COC record will be completed for all samples or materials collected. Each sample shipment must contain a separate COC form.
2. The COC form will be used by personnel responsible for the integrity of samples from the time of collection until receipt by the laboratory. The COC form will be signed by each individual who has the samples in their possession.
3. The COC documentation will include the project name and number, date, location, sampler's name/signature. The COC will also include necessary information for the laboratory, including the type of sample, number of sample containers, sample description, sample preservative, sample remarks (such as, a field-filtered or quality control sample), requested analysis, and turnaround time. This information should match the project SAP and be confirmed with the Project Chemist prior to field mobilization.
4. Several COC forms or COC continuation forms can be used to group samples under one COC. The continuation forms will reference the original COC number and all pages will be numbered.
5. One copy of the COC record will be retained by the FSC and a digital copy sent to the Project Chemist and Project Manager. The original record will be sent to the Project Manager after samples are accepted by the laboratory. This copy will become a part of the project file.
6. The first block for "Relinquished by" and "Received by" will be completed by the field sampler and transporter, respectively, if the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment.
7. The person transporting the samples to the laboratory or delivering them for shipment will sign the record form as "Relinquished by" at the time the samples are transferred. Lab personnel will sign the "Received by" section once the samples arrive to the lab.
8. The COC form will be kept in the possession of the person delivering the samples if the samples are transported directly to the laboratory. The sender must sign with date and time as "Relinquished by" before sealing coolers if the samples are shipped to the laboratory by commercial carrier. The COC form will be sealed in a plastic bag, taped on the inside lid. The shipping container will be sealed with two custody seals and securely taped on each prior to relinquishing to the shipper.
    a. For samples shipped by commercial carrier, the waybill or air bill will serve as an extension of the COC record between the final field custodian and receipt in the laboratory. The "Received by" section of the COC will be filled out with the identity of the commercial carrier (for example

"FedEx") and the waybill tracking number will be noted on the COC. The sender's copy of the waybill must be attached to the sender's copy of the COC form and the waybill tracking number recorded into the logbook.

   b. For shipments with multiple coolers, a copy of the COC(s) will be included with each cooler.
   c. The sample recipient will open the shipping containers, compare the contents with the COC record, verify that document control information is accurate and complete, and sign and date the record as "Received by." Discrepancies will be noted on the COC form or on a sample receipt form.
   d. The Project Chemist will be immediately notified of sample discrepancies and the samples in question will be segregated from normal samples.
   e. The digital copy of the COC form completed by the laboratory will be maintained in the project file.

3.4 Sample Packaging for Shipment

The following procedures will be used to prepare samples for shipment to the laboratory:

1. Proper packing to ensure that samples arrive at the laboratory in good condition.
   a. Durable plastic ice chests and coolers will be used. Tapes that may emit volatile organic compounds, such as duct tape, will not be used inside the container.
   b. Large heavy-duty plastic bags will line the cooler to prevent leakage.
   c. Approximately 2 inches of cushioning material such as bubble wrap, bagged ice, and/or absorbent pads will be placed in the bottom of the inner liner.
   d. Sample containers will be placed in clear, plastic, re-sealable bags. Double bagging sample containers is recommended to reduce leakage. Glass containers will be wrapped in bubble wrap or cushioning material to prevent breakage.
   e. Double bagged ice–sufficient to maintain less than 6° C during shipment–will be placed beneath, around, and on top of the sample containers. Void space will be filled with ice and/or bubble wrap to prevent sample container breakage during shipment. A temperature blank must be included in the shipment so the lab can verify the temperature upon arrival.
   f. The completed COC form will be placed in a re-sealable plastic bag and attached to the lid of the cooler with clear plastic packing tape.
   g. The large heavy duty garbage bag lining the cooler will be tied and fastened. The loaded cooler will be securely taped shut with heavy duty packing tape so that the cooler cannot be opened. If the cooler is equipped with a drain plug, it will be taped shut.
   h. The completed shipping label will be placed on the outside of the cooler.
   i. The sides of the cooler will be marked with "This Side Up" arrows and "Fragile" labels.

   j. Signed custody seals will be covered with clear packing tape and placed on the top and sides of each cooler so that the cooler cannot be opened without breaking the seal.

   k. Notify the laboratory of the expected shipment and coordinate with laboratory receiving hours. Special procedures may be required for sample receipt after hours or on weekends. In general, samples should be shipped priority overnight for delivery by **10:30 a.m.** to accommodate holding times between sample collection and analysis.

2. Comply with shipper weight limits.

3. Shipment records, including freight bills, post office receipts, and bills of lading, will be retained in the project file.

3.5 Sample Shipment Considerations (DOT and IATA Regulations)

Samples may be classified as hazardous materials/dangerous goods for shipment per Department of Transportation (DOT) and/or International Air Transport Association (IATA) regulations. If professional knowledge indicates that the sample does not contain hazardous materials above reportable quantities or characteristics above listed concentrations in the 40 CFR hazardous waste table, including pH, corrosivity, and ignitability criteria, samples do not have to be shipped as hazardous materials.

NOTE: IF YOU ARE NOT DOT-TRAINING CERTIFIED OR IATA-TRAINING CERTIFIED IF SHIPPING BY AIR, YOU CANNOT SHIP HAZARDOUS MATERIAL/ DANGEROUS GOODS. To do so risks large fines against the individual who signs the shipping bill.

For some chemicals and compressed gases, the quantity, limitations, and shipment requirements are given in 49 CFR 172.101, especially in the Hazardous Materials Table 172.101. Field personnel cannot classify samples based on the source or origin according to these regulations. The shipper is required to know actual or expected chemical concentrations of the material in the shipping container. Field personnel who are unsure about shipping from the field should call a qualified person in the office. Applicable regulations should be reviewed for each situation.

4.0 References

Department of Transportation, Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Laboratory Samples, March 1981.

International Air Transport Association (IATA), Dangerous Goods Regulations, current edition.

U.S. Department of Transportation Regulations, 49 CFR Parts 108-178.

United States Environmental Protection Agency Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.

______. 2020. Operating Procedure: Packing, Marking, Labeling and Shipping of Environmental and Waste Samples. 23 February.

STANDARD OPERATING PROCEDURE OESC011A

SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Sonja Donaldson OTIE Senior Geologist	Sonja Donaldson	15 December 2020
Reviewed By: Stacy Kowalski Geologist	Stacy Kowalski	12 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	12 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to establish uniform decontamination procedures for sampling equipment that may come into contact with contaminated media.

Alternative field decontamination procedures not specified in this SOP or in project plans must be approved by the project manager and recorded in the field logbooks.

Decontamination procedures are described for two types of equipment:

- **Equipment that does not contact samples**: equipment associated with the sampling effort, but that does not directly contact the sample. For example, drilling bits, field-screening sample jars, and flow-through cells.
- **Equipment that contacts samples**: equipment that comes in direct contact with the sample or portion of sample that will undergo chemical analyses or physical testing. For example, bowls, spoons/trowels, augers, and sample sleeves.

Use disposable sampling equipment when practicable to minimize the potential for cross-contamination.

2.0 GENERAL REQUIREMENTS

2.1 Equipment and Supplies

Detergent: Use a standard brand of phosphate-free laboratory detergent such as Liquinox® or Luminox®. Liquinox® is a traditional anionic laboratory detergent used for general cleaning. Luminox® is a specialized detergent capable of removing oils and organic contamination and is used in lieu of a solvent rinse step in cleaning equipment for trace contaminant sampling. Where not specified in this SOP or project-specific plans, either detergent is acceptable.

The use of a different detergent must be justified and documented in the field logbooks. Detergent must be kept in a clearly labeled clean plastic, metal, or glass container until used.

Tap Water: A potable water source will be identified for equipment decontamination procedures as part of the field planning activities. Tap water may be from an on-site or off-site source and is typically the project site municipal water supply source. Tap water can be stored in clean tanks, sprayers, or squeeze bottles, or may be applied directly from a tap water source. Specific requirements for tap water may be given in the project Sampling and Analysis Plan (SAP).

Deionized Water: Deionized water has been treated by passing through a standard deionizing resin column. Deionized water must be stored in clean glass, stainless steel, or plastic containers. Specific requirements for deionized water may be required per the project SAP. Some SAPs may require ASTM Type II deionized water that is laboratory-certified to contain no metals or other inorganic compounds.

Alcohol, Acids, and Solvents: Isopropanol, nitric acid, and hexane are typical fluids that may be used to clean field equipment. The project-specific SAP should specify if these materials can be used. Observe Department of Transportation (DOT) shipping requirements for these materials.

2.2 PFAS Sampling Considerations

Per- and polyfluoroalkyl substances (PFAS) are a class of manufactured compounds that are extensively used to make everyday items more resistant to stains, grease, and water. These chemicals have been used in a variety of industrial, commercial, and consumer products. Materials potentially containing PFAS are to be avoided when collecting samples for PFAS analyses. If samples will be collected and analyzed for PFAS, please refer to SOP Addendum No. 1 for guidelines, procedures and protocols to avoid sample contamination from outside sources.

2.3 Safety Procedures

Follow applicable health and safety procedures specified in the project-specific SAP and Health and Safety Plan (HASP) during equipment decontamination. At a minimum, the following personal protective equipment (PPE) will be worn and precautions followed in the decontamination area:

- Safety glasses with side shields or goggles and nitrile or latex gloves worn at all times during decontamination operations.
- Eating, smoking, drinking, chewing, or hand-to-mouth contact is not permitted during decontamination operations.

2.4 Storage of Field Equipment

Store field equipment in a contaminant-free environment following decontamination. Decontaminated equipment should never be stored near fuel sources, vehicle exhaust, or within the exclusion zone. Allow decontaminated equipment to air dry and wrap in plastic or aluminum foil pending further use. After decontamination, equipment should be handled only by personnel wearing clean latex or nitrile gloves to prevent recontamination.

3.0 DAILY QUALITY CONTROL AND PRODUCTION REPORTS

This section provides guidelines for specific Quality Control (QC) procedures to monitor the effectiveness of equipment cleaning procedures. Sampling and field equipment will be cleaned in accordance with the project-specific SAP or Quality Assurance Project Plan (QAPP). QC procedures will be recorded in the field log books.

3.1 Equipment Blank Samples

The effectiveness of equipment cleaning procedures will be evaluated by analysis of rinsate blank samples. Equipment rinsate blank samples will be collected and submitted for laboratory analysis in accordance with the project SAP. Different pieces of equipment will be selected for this procedure so a representative sampling of equipment is obtained during field activities.

The following procedures will be used to collect an equipment rinsate blank:

1. Complete the cleaning procedures listed in Section 4.0 of this SOP. Rinse the selected equipment with laboratory grade water. If the rinsate blank is collected from a submersible pump, rinse the sample contact portion of the disassembled pump with deionized water.
2. Collect the rinse water into the appropriate container; the project SAP or QAPP should specify the appropriate rinsate blank sample containers, preservatives, and analyses.
3. Follow the project SAP for identification of QC samples (blind or designated) in chain-of-custody forms.

4.0 CLEANING REUSABLE SAMPLE-CONTAINING EQUIPMENT

Follow the procedures outlined in this section when sample-contacting equipment is reused.

4.1 General

Equipment decontamination will take place in a designated area that is lined with plastic within the contamination reduction zone. Equipment decontamination liquid will be retained and containerized as specified in the project SAP or QAPP. The detergent and initial rinse water baths may be reused, but new solutions must be prepared periodically depending on the amount of equipment requiring decontamination.

4.2 Sampling Equipment For Organic Analyses

The following general procedure will be used when cleaning metallic, Teflon®, plastic, or glass field sampling equipment:

1. Wash equipment thoroughly with laboratory detergent and water, using a brush to remove particulate matter or surface film. Take care to avoid scratching the equipment.
2. Rinse equipment thoroughly with tap water.
3. Rinse equipment thoroughly twice with deionized water.
4. Allow equipment to air dry.
5. Wrap equipment in plastic or aluminum foil.

4.3 Sampling Equipment for Inorganic Analyses

Use the following procedures when cleaning field equipment for collection of samples for metals and other inorganic analyses:

1. Wash equipment thoroughly with laboratory detergent and water, using a brush to remove particulate matter or surface film. Take care to avoid scratching the equipment.
2. Rinse equipment thoroughly with tap water.
3. Rinse equipment using a 0.1 N nitric acid (if required).
4. Rinse equipment using distilled water.
5. Rinse equipment thoroughly twice with deionized water.
6. Allow equipment to air dry.
7. Wrap equipment in plastic.

4.4 Well Sampling Pumps

Dedicate sample tubing to a specific well to avoid cross-contamination. Use the following pump-cleaning procedures to clean downhole pumps between sampling locations.

1. Set up three tubs or buckets: one detergent wash, one tap-water rinse, and one deionized water rinse.
2. Place pump in the detergent bath. Recirculate the detergent-wash water through the pump for several minutes using a short length of tubing.
3. Wash the exterior of the electrical supply/control cables, hoses, and pump using a brush and soapy water. Rinse the soap from the outside of each with tap water.
4. Remove pump and place in tap water rinse bath and repeat recirculation pumping procedure.
5. Remove pump, place in deionized water rinse tub, and repeat recirculation procedure.
6. Collect pump-cleaning QC equipment rinsate blank samples at this time (see Section 3.1).
7. Allow to air dry and place clean pump in a large plastic bag or in a clean bucket until ready for use at next sampling location.

4.5 Bladder Pumps

The following steps provide generalized decontamination procedures for bladder pumps:

1. Follow decontamination procedures in Section 4.4 up to Step 3.
2. Disassemble the bladder pump by unscrewing the screened portion of the pump casing and removing the bladder.
3. Discard pump bladder.
4. Rinse parts thoroughly with soapy water.
5. Rinse parts thoroughly with tap water.
6. Rinse parts thoroughly with deionized water and allow to air dry.
7. Reassemble the pump with a new bladder.
8. Place the pump in a plastic bag or wrap with plastic film to prevent contamination during storage or transit.

4.6 Sampling Equipment Contaminated with Gummy or Oil Materials

Use of disposable sampling equipment is recommended for samples that contain adhesive, oily, greasy, or other hard-to-remove residues. If reusable sampling equipment becomes contaminated with these types of materials, it may be necessary to rinse the equipment with isopropanol to remove residues before proceeding with decontamination Step 1 (Sections 4.2 and 4.5). Additional decontamination procedures using specialized solvents or steam-cleaning may be required.

Sampling equipment that cannot be cleaned using the procedures in this SOP will be discarded as investigation-derived waste (IDW) and will be managed in accordance with SOP OESC012A, Investigation Derived Waste Management Procedures.

4.7 Sampling Equipment used for PFAS Sampling

For samples collected for PFAS analyses, Refer to SOP Addendum No. 1, and use the following procedures for decontamination of sampling equipment or components of equipment that come in contact with the sample:

1. Clean with tap water and Liquinox™ or Alconox™ detergent and potable water. Do NOT use the detergent Decon 90™. Do not use detergents that contain fluoro-surfactants.
2. Use a polyethylene or polyvinyl chloride (PVC) brush to remove particulate matter and surface films.
3. Rinse thoroughly with potable water.
4. Rinse thoroughly with laboratory-certified PFAS-free water.
5. Place on clean plastic sheeting to air-dry. Clean equipment will be placed on PFAS-free materials. <u>If plastic is used, it must be HDPE or PVC.</u> If the equipment is stored overnight, cover and secure with clean, unused plastic sheeting.
6. Wrap equipment in plastic and label for storage and/or transport prior to use. Do not wrap equipment in aluminum foil due to the potential of PFAS cross contamination.

5.0 MISCELLANEOUS EQUIPMENT CLEANING PROCEDURES

5.1 Field Analytical Equipment and Other Field Instrumentation

Follow the manufacturer's recommendations to decontaminate field analytical equipment and other field instrumentation.

Wash the exterior of sealed, watertight equipment with detergent, rinse with tap water, and allow to air dry before storage. The interior of equipment may be wiped with a damp cloth if necessary. Wipe other field instrumentation with a clean, damp cloth. Rinse conductivity probes, pH meter probes, dissolved oxygen (DO) meter probes, etc. with deionized water and allow to air dry before storage.

Clean the turbidity meter glass sample cuvette and dry with a soft cloth to prevent scratching of the sample cuvette. Check the desiccant in flow meters and other equipment and replace, if necessary, each time the equipment is cleaned.

5.2 Water Level Indicators

The following procedures apply to cleaning water level indicators and other sounding equipment. Water level indicators may be in contact with groundwater that will be sampled. Decontaminate water level indicators between each well.

1. Wash water level indicator thoroughly with laboratory-grade detergent and water using a brush to remove particulate matter or surface film.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized water.
4. Allow indicator to air dry.
5. Wrap indicator in aluminum foil or plastic at the end of the day.

5.3 Flow-Through Cell

The water quality meter and flow-through cell do not make contact with the sample because water samples are collected from the outflow tubing prior to passage through the flow-through cell.

1. Remove meter and tubing from the flow-through cell prior to decontamination.
2. Wash equipment thoroughly with laboratory-grade detergent and water; using a soft brush, remove particulate matter or surface film. Avoid scratching the cell surface.
3. Rinse equipment thoroughly with tap water followed by distilled water rinse.
4. Allow equipment to air dry.
5. Wrap equipment in plastic or in a resealable plastic bag.

5.4 Ice Chest and Shipping Containers

Keep sample-storage ice chests and reusable shipping containers clean to avoid cross-contamination. Wash interior and exterior with laboratory detergent, rinse with tap water, and air dry. Clean heavily contaminated containers to the extent possible; if rendered unusable properly dispose as IDW.

6.0 LARGE EQUIPMENT CLEANING PROCEDURES

6.1 Drilling Rigs

Decontaminate drilling equipment prior to commencement of drilling activities and between boreholes. The drilling subcontractor is responsible for conducting proper decontamination of drilling equipment.

Prevent or reduce tracking of potentially contaminated soil/sediment off the site or from one drilling location to the next by dry-brushing rig and support truck tires at each drilling location.

1. Construct a decontamination pad at an approved location.
2. Place drilling equipment in decontamination area and clean with pressure washer.
3. Remove particulate matter or surface films with tap water and phosphate-free detergent, scrubbing, and a tap water rinse.
4. Clean the inside of hollow drill rods with vigorous brushing, detergent, and steam cleaning, followed by a tap water rinse.
5. Remove equipment from the decontamination pad and allow to air dry. Drill rods and augers may be covered with clean new plastic until the equipment is used again. If stored overnight, secure the plastic to keep it in place.

Water used during the decontamination process will be pumped into 55-gallon drums and stored on site until proper disposal procedures can be conducted.

Upon completion of drilling activities, drilling equipment that contacted subsurface materials will be decontaminated prior to departure of the drilling equipment from the site.

7.0 DECONTAMINATION FLUID CONTAINMENT

Containerize decontamination liquids in DOT-approved 55-gallon drums or other approved containers. Label drums according to the procedures specified in the project SAP and SOP OESC012A and store in the designated IDW container storage location at the site.

8.0 REFERENCES

ASTM D5088-20. 2020. Standard Practice for Decontamination of Field Equipment Used at Waste Sites.

U.S. Environmental Protection Agency Region 4. 2020. Field Equipment Cleaning and Decontamination. No. LSADPROC-205-R4. June.

U.S. Environmental Protection Agency Region 4. 2019. Field Equipment Cleaning and Decontamination at the FEC. No. ASBPROC-206-R4. October.

AMEC. 2014. Final (Revision 1) Perfluorinated Compounds (PFCs) Release Determination at Multiple BRAC Bases Quality Program Plan. July.

STANDARD OPERATING PROCEDURE OESC011B

CALIBRATION PROCEDURES FOR FIELD EQUIPMENT

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared By: Emmanuel Vasquez OTIE Project Chemist		23 January 2019
Modified By: Cody Wilgus Project Geologist		11 January 2023
Approved By: Matthew Van Beek Corporate Quality Manager	Matt Van Beek	12 January 2023

1.0 PURPOSE AND LIMITATIONS

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for calibrating the following field analytical instruments: water quality field meters, photoionization detectors (PIDs), and multi-gas meters. Instrument calibrations is a key element for ensuring that measurements are accurate and representative.

2.0 WATER QUALITY FIELD METER CALIBRATION

Water quality parameters typically measured include:

- Temperature (Celsius and Fahrenheit)
- Oxidation reduction potential (ORP in millivolts)
- Specific conductance (microSiemens/centimeters at 25°C)
- Dissolved oxygen (percentage or micrograms/liter [µg/L]);
- pH
- Turbidity (Nephelometric Turbidity Units [NTUs])

2.1 Equipment

One or more instruments with specific detectors or a multiparameter meter may be used to measure the parameters identified above. Contact the equipment vendor immediately if the instrument manual is not included with the shipped equipment.

Turbidity should be measured with a separate turbidity meter (e.g., LaMotte 2020 or equivalent). The meter reads the amount of reflected light at 90 degrees to the incident angle of a light source shown on the sample. The turbidity meter should come equipped with two standards and one or two sample vials.

2.2 Standards and Materials

The Field Team Leader or equivalent is responsible for ensuring fresh calibration fluids are present as required for each instrument. The type, concentration, and expiration date of each calibration fluid must be recorded on the daily Calibration Record (Attachment 1 or equivalent).

The following standards/solutions are required for water quality meters:

- Dissolved oxygen (membrane, potassium chloride [KCl] solution)
- Oxidation reduction potential; ORP (Zobell solution)
- pH (three standard buffer solutions of pH 4, 7, and 10)
- Specific conductance (1,000 microSiemens/centimeter solution)
- Turbidity (factory standard that comes with the equipment)

2.3 Calibration Instructions

Follow the calibration instructions presented in the user manual for the instrument. Calibrate all water quality meters daily prior to first use. Recalibrate a meter throughout the day as warranted (if the meter is exhibiting anomalous readings or instrument drift).

2.4 Documentation

Report calibration information on the Daily Calibration Record – Multiparameter Probe (Attachment 1 or equivalent). Refer to SOP OESC002A Field Records for recordkeeping and documentation requirements related to field activities.

3.0 PHOTOIONIZATION DETECTOR CALIBRATION

PID calibrations is necessary to verify that the response of the PID matches the actual concentration of the calibration gases (zero and span gas). Calibrations is also used to determine the correction factor (CF) for measuring unknown gases with a PID calibrated to a known gas.

Calibration is generally performed between a “zero gas” (generally, clean atmosphere or using a zero filter) and calibration gas (“span gas”) of known concentration. Span calibration gas is typically 100 parts per million (ppm) isobutylene standard with a response factor applied. For PIDs that detect parts per billion (ppb), the span calibration gas is typically 10 ppm.

3.1 Equipment and Materials

The following equipment and materials are typically required for PID calibration:

- Span calibration gas canister
- Zero filter (optional)
- Flow regulator
- Polyethylene tubing assembly to connect the gas cylinder to the PID

Contact the equipment vendor immediately if the instrument manual is not included with the shipped equipment.

The PID should be equipped with a 10.6 or 11.8 electronvolt (eV), as required for the contaminants of concern. Lamp strength should be specified in the site-specific sampling and analysis plan and/or the site-specific health and safety plan based on anticipated volatiles present.

3.2 Calibration Instructions

Calibrate the PID in accordance with the manufacturer’s manual, which will be kept with the PID instrument case at all times.

1. Following the manufacturer's manual.
2. Calibrate and verify the PID at the job site in the morning before work begins; calibrate the PID at least once per day.
3. Check the Calibration Record to determine if the appropriate lamp is installed. If not, change the lamp following manufacturer's instructions.
4. Check filters as described in the manufacturer's instructions. If a filter is dirty, replace with a new filter.
5. Screw on the probe tip assembly to the detector body, ready polyethylene tubing, and calibration gas.
6. Confirm that the span gas concentration is matched to the PID range of the instrument.
7. Turn on the PID and initiate the calibration sequence following manufacturer's instructions. Ensure that the instrument reads 0 parts per million by volume (ppmv) before the attaching calibration gas source. If the instrument shows "wandering" or "up ramping" readings, ensure you are working in a clean environment and the instrument is clean (no dirt in the probe or detector). If ambient humidity is high, attach a hydrophilic filter to the probe, and recheck. When the reading is 0 ppmv, proceed with calibration, otherwise the PID may need servicing.
8. Attach flow regulator to calibration gas source (gas canister). Attach flow regulator to polyethylene tubing, which is then attached to the PID probe tip; open canister valve, and proceed with calibration.
9. The instrument reading should equal the calibration gas concentration multiplied by the response factor (e.g., 100 ppmv x 0.65 = 65 ppmv). If the zero air or calibration gas reading varies more the 2 ppmv from the expected reading, repeat the calibration.
10. Close the valve on the calibration gas and disconnect the gas source from the PID probe. Verify the instrument returns to a zero reading.
11. Record the date and time of the calibration or verification on the PID Calibration Record (Attachment 2 or equivalent) along with the test status.
12. If the calibration is not completed within the required parameters, or if the instrument will not produce the expected reading during the calibration verification, note the failure and attempted remedy on the Calibration Record. After attempting a remedy, repeat the calibration beginning with Step #2. If the calibration does not produce the expected result contact the office to obtain instructions for other potential remedies or to obtain a replacement PID. Do not use a PID that does not calibrate properly.

3.3 Documentation

A PID calibration log is provided as Attachment 2. Refer to SOP OESC002A Field Records for recordkeeping and documentation requirements related to field activities.

4.0 MULTI-GAS METER CALIBRATION

Several types of gas meter/monitors are available and commonly used during investigation and remediation work. Gases or vapors (or atmospheric conditions) that may require monitoring include:

- Lower explosive limit (LEL)

- Upper explosive limit (UEL)
- Toxicity
- Hydrogen sulfide (H2S)
- Carbon monoxide (CO)
- Dust/aerosols
- Hydrogen cyanide
- Methane
- Percent oxygen

Gas meters may monitor multiple or single parameters. Commonly used meters include:

- MSA Passport Gas Monitor (LEL, H2S, CO, and percent oxygen)
- Mini-ram Dust/Aerosol Monitor

Calibration procedures for each type of meter are included with the instruments. Calibrations must be performed on each instrument in accordance with the manufacturer's instruments once per day prior to use, at minimum.

Record the calibration procedures and results daily on the Multi-Gas Meter Calibration Record (Attachment 3 or equivalent).

5.0 REFERENCES

RAE Systems. Application Note AP-000 rev. 2. RAE Systems PID Training Outline. Available from: https://prod-edam.honeywell.com/content/dam/honeywell-edam/sps/his/en-us/products/gas-and-flame-detection/documents/Application-Note-000_RAE-Systems-PID-Training-Outline_04-05.pdf. Accessed November 8, 2022. =

RAE Systems. Application Note AP-214. Environmental Applications for PIDs. Accessed 8 November 2022 https://prod-edam.honeywell.com/content/dam/honeywell-edam/sps/his/en-us/products/gas-and-flame-detection/documents/Application-Note-214_Environmental-Applications-For-PIDs_12-05.pdf.

RAE Systems. Technical Note TN-120: Measuring PID Correction Factors for Volatile Compounds with RAE Systems Instruments. Accessed 8 November 2022. https://prod-edam.honeywell.com/content/dam/honeywell-edam/sps/his/en-us/products/gas-and-flame-detection/documents/Technical-Note-120_Measuring-PID-Correction-Factors-for-Volatile-Compounds-with-RAE-Syst.pdf.

U.S. Environmental Protection Agency, Region IV, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.

6.0 LIST OF ATTACHMENTS

Attachment 1 – Daily Calibration Record – Multiparameter Probe

Attachment 2 – PID Calibration Record

Attachment 3 – Multi-Gas Meter Calibration Record

ATTACHMENT 1

DAILY CALIBRATION RECORD – MULTIPARAMETER PROBE

Date:	Time:
Employee Name:	Equipment Name:
Contract/Project:	Equipment Serial #:
Maintenance Performed:	Comments:
CALIBRATION FIELD CHECK	
Calibration Standard: ORP: DO: Temp: pH (1 Point): Conductivity:	Concentration of Standard: ORP: DO: Temp: pH (2 Point): Conductivity:
Lot Number of Calibration: ORP: DO: Temp: pH: Conductivity:	Expiration Date of Calibration Standard: ORP: DO: Temp: pH: Conductivity:
Pre-Calibration Check Reading: ORP: DO: Temp: pH (2 Point): Conductivity:	Post-Calibration Check Reading: ORP: DO: Temp: pH (2 Point): Conductivity:
Post-Field Check Reading: ORP: DO: Temp: pH (2 Point): Conductivity:	
Adjustment(s):	
Calibration: ☐ Passed ☐ Failed Comments:	
Signature:	Date:

ATTACHMENT 2

PID CALIBRATION RECORD

PROJECT: ____

ACTIVITY/TASK: ____

DATE: ___________________________ TIME: _____________________________

STAFF PERFORMING CALIBRATION: ____

LOCATION: ____

CALIBRATION GAS TYPE: ☐ 100 ppm isobutylene in air OR ☐ other: _______________________

CAL GAS SUPPLIER: ____

CALIBRATION GAS TYPE: 100 ppm isobutylene in air OR ☐ other: _______________________

CAL GAS SUPPLIER: ____

INSTRUMENT MANUFACTURER/TYPE: ____

INSTRUMENT NO:____

LAMP ENERGY: ______________EV BATTERY STATUS: _______________

CALIBRATION READING WITH CAL GAS: _______________ IN AIR (BACKGROUND)_________________

CALIBRATION PASSED? ☐ YES ☐ NO

COMMENTS:

INSTRUMENT MANUFACTURER/TYPE: ____

INSTRUMENT NO:____

LAMP ENERGY: ______________EV BATTERY STATUS: _______________

CALIBRATION READING WITH CAL GAS: _______________ IN AIR (BACKGROUND)_________________

CALIBRATION PASSED? ☐ YES ☐ NO

COMMENTS:

ATTACHMENT 3

MULTI-GAS METER CALIBRATION RECORD

PROJECT: ____

ACTIVITY/TASK: ____

DATE: ____________________________ TIME: ____

STAFF PERFORMING CALIBRATION: ____

LOCATION: ____

CALIBRATION GAS TYPE: ☐ 100 ppm isobutylene in air OR ☐ other: ___________________________

CAL GAS SUPPLIER: ____

CALIBRATION GAS TYPE: ☐ Mixed Gas (2.5% methane (50% LEL), 50 ppm CO, 25 ppm H2S, and 20.9% oxygen) in Nitrogen OR ☐ other: ____

CAL GAS SUPPLIER: ____

DAILY CALIBRATION

INSTRUMENT MANUFACTURER/TYPE: ____

INSTRUMENT NO:____

LAMP ENERGY: ______________EV BATTERY STATUS: _______________

FRESH AIR CALIBRATION READING: _______________

CALIBRATION READING WITH CAL GAS: _______________ IN AIR

CALIBRATION PASSED? ☐ YES ☐ NO

CALIBRATION READING WITH CAL GAS: _______________ IN NITROGEN

CALIBRATION PASSED? ☐ YES ☐ NO

BACKGROUND READING: _________________

COMMENTS:

STANDARD OPERATING PROCEDURE OESC012A

INVESTIGATION DERIVED WASTE MANAGEMENT PROCEDURES

TABLE OF CONTENTS

QC Review Signatures

Name/Role	Signature	Date
Prepared by: Sonja Donaldson Senior Geologist	Sonja Donaldson	13 December 2020
Reviewed by: James Griffin Geologist		12 January 2023
Approved by: Mathew Van Beek Corporate Quality Manager	Matt Van Beek	12 January 2023

1.0 PURPOSE AND LIMITATIONS

The objective of this Standard Operating Procedure (SOP) is to provide general reference information on management of investigation-derived wastes (IDW) generated during site investigations. The following principles should be considered for management of IDW:

- **Minimization**: Generate the least amount of IDW and return as much waste to the site as permitted by law and protective of personnel and the environment.
- **Management**: Manage IDW in a manner that is consistent with the method of remediation of the site and complies with appropriate laws and regulatory requirements.
- **Mitigation**: The handling and disposition of IDW should be efficient, cost effective, appropriate, and conducted in accordance with government regulations, client requirements, consideration of liability, and in ways that minimize impact to the facility, the community, and the environment

This SOP does not address those areas in which waste contains radionuclide contamination. In addition, IDW associated with emerging contaminants may have additional requirements specified in site planning documents and additional SOPs.

2.0 SUMMARY AND METHODS

IDW management must be addressed and resolved for each project before initiating field activities.

2.1 Types of IDW

IDW may include, but is not limited to, the following items:

- Soil
- Sediment
- Sludge/slag
- Drum solids
- Drill cuttings
- Used glassware
- Dedicated/expendable equipment (bailers, fitters, hose, buckets, XRF cups, etc.)
- Trash

- PPE
- Decontamination equipment (buckets, brushes, clothing, tools, etc.)
- Field analytics waste (immunoassay, buffers, HACH kits, sample extracts)
- Drilling fluids
- Purge water
- Development water
- Decontamination fluids

2.2 Factors Influencing Disposal

The following factors control the disposition of IDW:

- Site contaminants and concentrations
- Volume or quantity of IDW
- Matrix affected by the contaminants, including groundwater and soil
- Site location - rural, residential, commercial, industrial
- Knowledge of site conditions (known and/or suspected contamination)
- Potential worker exposure
- Potential liability
- Potential environmental impacts
- State and federal regulatory requirements
- Cost

3.0 STANDARDS AND RELEVANCE

3.1 Characterization

IDW may contain hazardous substances as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Some CERCLA hazardous substances are hazardous wastes under Subtitle C of the Resource Conservation and Recovery Act (RCRA), while other substances are regulated by other federal laws such as the Safe Drinking Water Act (SDWA), Clean Air Act (CAA), Toxic Substances Control Act (TSCA), and the Clean Water Act (CWA). RCRA regulations, particularly the RCRA Land Disposal Restrictions, must be considered since they regulate treatment, storage, and disposal of many of the most toxic and hazardous wastes.

Handling methods for IDW with potential contaminants of concern are determined by reviewing site records, site assessment/characterization data, and institutional and generator knowledge about the site. IDW handling should follow guidelines and procedures outlined in ASTM D 6311-98 (ASTM 2022). Existing chemical data can be used to evaluate whether the wastes generated will exhibit hazardous characteristics (Environmental Protection Agency [EPA] 1991b). Applicable or relevant and appropriate requirements (ARARs) should be considered to establish handling methods. Establishing the status of the IDW with regard to RCRA is critical.

3.1.1 RCRA-Regulated Status

A waste is hazardous under RCRA if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 Code of Federal Regulations (CFR) 261.20 through 261.24 (i.e., characteristic wastes). Wastes also may be considered hazardous under RCRA if they are listed in 40 CFR 261.30 through 261.33 (i.e., listed wastes). In addition, the “mixture rule” and the “contained-in rule” apply to situations where a RCRA listed or characteristic waste is mixed with, or contained in soil, groundwater, surface water, or debris. The resulting waste is also regulated under RCRA. In the case of the “derived-from" rule,” a waste that is generated from treatment, storage, or disposal of a RCRA listed or characteristic waste is also a hazardous waste unless specifically exempted, per 40 CFR 261.3 (b). A waste that is not considered hazardous waste under RCRA may still contain hazardous substances regulated by federal, state, and local laws and regulations.

United States Environmental Protection Agency (EPA) guidance states it is permissible to handle a waste as nonhazardous with regard to RCRA until it is proved to be a RCRA hazardous waste (EPA 1991b). However, if available information and best professional judgment indicate that a waste should be managed as RCRA hazardous waste to maximize protection, RCRA Subtitle C requirements should be followed regardless of known status.

It is the responsibility of the client to determine the status of the waste as it relates to RCRA and other statutes. Other potential ARARs include the CWA, which contains the requirements for the discharge of aqueous IDW to surface water and treatment facilities; and TSCA, which contains requirements for handling IDW contaminated with polychlorinated biphenyls (PCBs) and asbestos, for example.

3.2 Generator Status

The period of time allowed for temporary storage of RCRA-Regulated Hazardous Waste varies depending on generator status. Therefore, generator status must be determined prior to field activities that may generate waste.

3.3 Placement of Wastes

RCRA hazardous waste is restricted under the Land Disposal Restrictions (LDRs), in that it establishes restrictions on “placement." To assist in defining "placement" at CERCLA sites, EPA uses the concept of Areas of Contamination (AOC). EPA Superfund LDR Guide 5 states, "An AOC is delineated by the areal extent (or boundary) of contiguous contamination. Such contamination must be continuous, but may contain varying types and concentrations of hazardous substances" (EPA, 1989).

Placement as defined by EPA occurs when waste:

- Is moved off site
- Is moved out of an AOC for treatment or storage then returned to the same or a different AOC and returned to the environment
- Is stored in a container within the AOC then returned to the same AOC and returned to the environment
- Is consolidated from several AOCs into a single AOC and returned to the environment

If placement does not occur, the LDRs are not applicable to the CERCLA action regardless of the contaminants in the waste. Therefore, the status of the waste as it relates to RCRA and the LDRs must be determined before containerizing or moving it outside an AOC.

4.0 RESPONSIBILITIES

The project team facilitates the identification of potential contaminants and characterization of IDW. IDW may be characterized on behalf of the client; however, the client is responsible for the final determination of IDW waste characteristics and disposal.

Project Personnel: The Project Manager, or equivalent, and field personnel are responsible for conducting field activities in accordance with project objectives, plans, procedures, and requirements.

Client: The client or owner is responsible for establishing the status of the waste as it relates to federal, state, and local regulations and designating the transportation, disposal method, and disposal facility. Designated representatives of the client are responsible for signing invoices, manifests, or bills of lading to transport and dispose of waste.

5.0 PLANS AND EQUIPMENT

The following plans are implemented during field activities:

- Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) that specifies waste characterization sample collection locations, methods, and analyses
- IDW Management Plan that identifies wastes, waste characterization, storage, management, and disposal practices for the site
- Accident Prevention Plan with activity hazard analyses and Site Safety and Health Plan (collectively, SSHP).

Equipment required for sampling and handling the IDW includes:

- Field screening equipment such as a photoionization detector (PID), organic vapor analyzer (OVA), or an on-site gas chromatograph (GC).
- Personal protective equipment (PPE) as specified in the SSHP.
- Sample collection equipment appropriate for the waste matrix and analytical method. Disposable equipment generally is the most efficient.
- Decontamination equipment which may include drop cloths, tubs or basins, wash solutions, rinse solutions, brushes, and paper towels. (Refer to SOP OESC011A).
- Waste disposal containers, which may include trash bags, 5-gallon pails, 55-gallon drums, and roll-off bins.

6.0 PROCEDURE

6.1 Marking and Labeling – Types of Labels

Containers of waste must be marked and labeled as indicated in the following sections. Include a contact name and telephone number on waste labels.

6.1.1 Uncharacterized Wastes

Mark containers of unknown wastes that are currently being tested but are not known or suspected to be a hazardous waste:

- Description of the Contents—Accurately describe the contents, such as “SOIL DRILL CUTTINGS” or “WELL DEVELOPMENT WATER.”

- Accumulation Start Date—Mark the accumulation start date on the container. The accumulation start date is the first day the waste is placed into the container.
- Unique Identifier—Mark containers with a unique identifier such as drum number, date, well number, and/or initials of the person responsible for the container.

This form of “non-classified” label may be used when the waste cannot be classified based upon generator knowledge, and/or when laboratory data is not yet available for evaluation. Do not use this label if the waste is known to be hazardous based upon client knowledge, Safety Data Sheet (SDS), site characterization testing, or historical data. If a non-classified label is used, the site must be revisited immediately after waste characterization and the appropriate label affixed to the containers (i.e., non-hazardous or hazardous waste label).

6.1.2 Non-Hazardous Waste

Non-Hazardous waste must be marked and labeled as described above, but using the GREEN (or similar) “Non-Hazardous Waste” label.

6.1.3 Hazardous Waste

Hazardous waste must be marked and labeled as described below.

- Hazardous Waste Label/Marking—Use the YELLOW “Hazardous Waste” label to meet EPA and United States Department of Transportation (DOT) marking requirements. This label must be completed and affixed to the container as soon as the waste is determined to be hazardous.
- Accumulation Start Date—The accumulation start date, the first date the waste is placed into the container, must be clearly marked and visible on the container. If the container is managed in a satellite accumulation area, the date the container is full also must be marked. Mark the start date where indicated on the Hazardous Waste label.
- DOT Labels—Containers of hazardous waste must be labeled according to DOT requirements prior to transport offsite for disposal. The DOT labels depend on the properties of the waste (see 49 CFR 172). The 4-inch diamond-shaped DOT labels are placed next to the yellow Hazardous Waste labels on the upper portion of the drum or container.

6.2 Manifests

Assist the client as needed by providing the information they will need to complete the manifest, and by reviewing the completed manifest. Only DOT-trained staff may provide this assistance to the client. OESC should not be named as the Generator.

The following information should be included:

- Any disposal facility reference numbers, such as the work order number
- Shipping name
- Hazard class
- Identification number
- Packing group

6.2.1 Pre-Shipment Manifest Review

Many disposal facilities offer pre-shipment review of the completed manifest to assure that the manifest is completed in accordance with federal, state, and facility requirements. Some clients also have their own in-house review process. Pre-shipment manifest review is recommended so manifesting errors can be corrected before the shipment leaves the site, and before manifest copies are distributed. This saves time and reduces the possibility for manifesting violations.

Before allowing the manifested waste to leave, the client must sign the manifest certification. The client or OESC representative must:

- Obtain the signature of the initial transporter and date of acceptance on the manifest,
- Retain one copy for the client files and make a photocopy for the project files, and
- Provide the remaining copies of the manifest form to the transporter.

6.2.2 Recordkeeping

The disposal facility is required by state and federal regulations to return the original signed hazardous waste manifest to the client within 35 days of the ship date. An exception report must be submitted to EPA by the generator if the manifest is not received within 45 days of the ship date.

6.3 Sample Collection

Representative samples of waste soil (e.g., drill cuttings, surface soils, and sediments) will be collected and submitted to an approved laboratory for analysis of RCRA characteristics, Toxicity Characteristic Leachate Procedure, and any analyses requested by the controlling regulatory agencies. Representative samples of waste fluid shall be collected and analyzed for contaminants of concern. If analytical samples were collected (such as from a monitoring well), the results of these analyses can be used to indicate the status of the fluids, but a waste disposal or treatment facility may require additional analyses.

Refer to SOP OESC012B, Sampling Waste in Containers, for additional information.

6.4 Waste Disposal by Type of Waste

6.4.1 Non RCRA-Regulated Waste

Waste may be moved to a central collection point for storage before determination of disposal method. Waste that is determined in the field to be free of contamination must be segregated from waste that exhibits contamination.

IDW must be removed from public access and stored in clean, sealed containers at a single, secure collection point at the facility until a final disposal method is determined. No IDW shall be removed from the facility or released to the environment without permission from the client and controlling regulatory agencies.

6.4.1.1 IDW Consisting of Soil or Other Solids

IDW soils may be placed back into boreholes when specified by a client-approved IDW management plan and approved by the client and regulatory agencies. Otherwise, IDW soils should be stockpiled on site in a plastic lined and plastic-covered area, placed in labeled containers, or if moved to a central collection point, kept segregated from other waste. Label the containers as described in Section 6.1, or post a sign adjacent to covered stockpiles. Include a contact name and telephone number on the label or sign.

6.4.1.2 IDW Fluids

IDW fluids may include drilling fluids, well development/purge water, groundwater, and decontamination fluids. Segregate IDW fluids by source of generation (e.g., keep drilling fluids separate from well development fluids) and by characteristics that may require extra processing, such as filtration to remove solids.

Containerize IDW fluids in labeled containers and store the containers at the site or at a central collection point until waste characterization testing is completed. Prepare labels as described in Section 6.1. The IDW shall be disposed of as directed by the client.

In some cases, the approved IDW management and the client may allow for purge water generated during groundwater sampling; groundwater; and decontamination fluids to be discharged to the ground at an approved on-site location for infiltration. However, this is highly unlikely and should only occur when the waste is not contaminated *and* with the explicit approval of the client and regulatory agencies.

6.4.2 RCRA-Regulated Hazardous Waste

Refer to Section 3.1 for information about the different categories of RCRA-regulated hazardous wastes.

6.4.2.1 IDW Consisting of Soil or Other Solids

Drill cuttings may be backfilled into boreholes if specified in a client-approved IDW management plan. Include the locations and sizes of the pits in the field logbook; this information will be documented in project reports. This procedure is in accordance with published EPA guidance (EPA 1991b).

Soils may be field-screened for volatile contaminants and stockpiled at the site in an area lined with and covered by, plastic sheeting. Black sheeting should be used, when possible, to resist breakdown of the plastic from exposure to sunlight.

Stockpiling the soil without containerization is not considered to be “placement” (described in Section 3.2), and thus avoids activating potential land disposal restrictions. Soils that are screened and found to have concentrations less than the established screening limit can be spread back on the site with the approval of the client and controlling regulatory agencies.

If it is logistically impossible to stockpile waste at a site or to perform field screening, then place IDW in approved containers, preferably a steel roll-off box. Containers must be labeled with contents, the date(s) of collection, and the location at which the waste was generated, if the IDW will be transferred to a disposal facility.

If the results of laboratory analyses are below established ARARs, the soils potentially may be spread back on the site or used by the client as fill material with regulatory agency approval. If analytical results indicate the IDW is RCRA-regulated, the approved on-site treatment facility should be used (if available), or the containers must be disposed at a RCRA-permitted treatment, storage and disposal facility (TSDF).

6.4.2.2 IDW Fluids

IDW fluids may include drilling fluids, development/purge water, and decontamination fluids. For areas in which known or suspected RCRA-regulated contamination exist, fluids will be containerized in properly labeled containers (i.e., drums or tanks) and stored at the site.

At the end of the waste generation process, if no samples of the fluids have been collected, a representative sample will be collected and analyzed for contaminants of concern. The results of analytical samples (such as from a monitoring well) may be used in place of collecting and analyzing additional IDW fluid samples. If analytical results indicate the IDW is RCRA-regulated or other contaminants are present at levels exceeding established ARARs, the on-site treatment facility should be used (if available), or the containers must be disposed of at a RCRA TSDF.

6.4.2.3 Number of Days Stored on Site

RCRA-regulated IDW may remain stored on site for the time period allowed by the generator status. The period of time allowed for temporary storage varies depending on generator status. Storage time begins the first day the waste is generated. Generator status must be determined prior to the field investigation and temporary storage cannot exceed that time period (which would be a maximum of 90 days). State time requirements may differ from Federal requirements and should be confirmed with the state regulatory agency.

6.4.3 Personal Protective Equipment

PPE required during handling or sampling of IDW or site-related wastes should be specified in the SSHP. Used PPE that cannot be adequately decontaminated to permit safe reuse will be collected, double plastic bagged, and placed in approved containers at a central collection point.

6.5 IDW Disposal Options

To summarize the information presented above, Table 1 presents disposal options for the five most common types of IDW. Additional details are provided below in this section.

Table 1. IDW Disposal Options

Type of IDW	Generation process	Disposal options
Soil/sludge/trash	Borehole drilling Test pits Soil sampling Sediment Sampling	Re-use onsite in accordance with client requirements Return to borehole/pit Send to an existing on-site treatment/disposal unit (TDU) Containerize and dispose of appropriately Store for future disposal
Aqueous	Well installation Well purging during sampling/development and pump/treat tests Decontamination	Pour onto ground Send to Publicly-Owned Treatment Works (POTW) or facility treatment works Send to on-site TDU Containerize and dispose of appropriately Store for future disposal
PPE	Investigation/ remediation	Send to on-site TDU Place in on-site municipal/industrial dumpster Containerize and dispose of appropriately Store for future disposal

6.5.1 On-Site Treatment

If on-site disposal of the waste is not permitted, a method of treating the waste on site should be selected. The effectiveness of a treatment method is a function of the suite of contaminants involved and, therefore, must be chosen on a case-by-case basis. Approved treatment methods will vary from state to state, and a list of approved methods should be obtained from the controlling regulatory agencies. A preferred treatment option should be established before initiating field operations.

6.5.2 Off-Site Disposal

If on-site disposal is prohibited and no treatment method is viable or permitted, the waste may be handled under the waste disposal contracts in place at the facility. This option likely results in disposal at sanitary or hazardous waste landfills. For RCRA hazardous wastes, the client's RCRA waste generating status restrictions apply and an influx of IDW from site investigations could potentially affect the client's generator status.

For CERCLA sites, EPA must confirm that a specific off-site disposal facility is acceptable.

7.0 REFERENCES

ASTM International. 2022. ASTM D 6311-98 (2022), Standard Guide for Generation of Environmental Data Related to Waste Management Activities: Selection and Optimization of Sampling Design.

Code of Federal Regulations, 40 CFR, Parts 261.20 through 261.33. https://www.govinfo.gov/content/pkg/CFR-2017-title40-vol28/xml/CFR-2017-title40-vol28-part261.xml

U.S. Environmental Protection Agency (U.S. EPA). 1986. Memorandum, Discharge of Wastewater from CERCLA Sites into POTWs, OSWER Directive 9330.2 04. April.

________. 1989. Superfund LDR Guide 5, Determining When LDRs Are Applicable to CERCLA Response Actions, OSWER Directive 9347.3 05FS.

_______.1990. Guidance on Remedial Actions for Superfund Sites with PCB Contamination, Office of Emergency and Remedial Response, EPA/540/G 90/007. August.

________. 1990. CERCLA Compliance with the CWA and SDWA, Fact Sheet 9234.2 06/FS, Office of Solid Waste and Emergency Response. February.

________. 1991a. Management of Investigation Derived Waste, Superfund Publication 9345.3 02FS, Office of Solid Waste and Emergency Response. February.

________. 1991b. Management of Investigation Derived Waste During Site Inspections, OSWER Directive 9345.3 02, Office of Solid Waste and Emergency Response, May.

________. 2017. Memorandum - Waste Determination and Disposal of Remediation Waste Implementation Procedures. April.

Appendix B

Laboratory Accreditation

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc.
has assessed the Organization of:

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2017 General Requirements for the competence of Testing and Calibration Laboratories and the United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) requirements identified within the DoD/DOE Quality Systems Manual (DoD/DOE QSM) Version 5.4 October 2021 and is accredited in accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates the technical competence for the defined scope and the
operation of a laboratory quality management system
(as outlined by the joint ISO-ILAC-IAF Communiqué dated April 2017):

Environmental Testing
(As detailed in the supplement)

Accreditation claims for such activities shall only be made from the addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation Body's duty to observe and comply with the said rules.

Initial Accreditation Date:	*Issue Date:*	*Expiration Date*
November 17, 2016	March 28, 2023	April 30, 2025

Revision Date:
September 03, 2023

Accreditation No:	*Certificate No:*
91667	L23-262-R1

For PJLA

Tracy Szerszen
President

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: **www.pjlabs.com**

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 (Draft 3) by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Aqueous	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonic Acid, 8:2FTS)	6948
1H, 1H, 2H, 2H-Perfluorohexanesulfonic Acid (4:2 Fluorotelomersulfonic Acid, 4:2FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctanesulfonic Acid (6:2 Fluorotelomersulfonic Acid, 6:2FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
4,8-dioxa-3H-perfluorononanoic Acid (ADONA)	6951
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	9460
N-ethyl perfluorooctanesulfonamide (EtFOSA)	9395
N-ethyl perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	4847
N-ethyl perfluorooctanesulfonamidoethanol (EtFOSE)	9431
N-methyl perfluorooctanesulfonamide (MeFOSA)	9433
N-methyl perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	4846
N-methyl perfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonamide (PFOSA)	6917
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 (Draft 3) by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Aqueous	
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
Solid	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonic Acid, 8:2FTS)	6948
1H, 1H, 2H, 2H-Perfluorohexanesulfonic Acid (4:2 Fluorotelomersulfonic Acid, 4:2FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctanesulfonic Acid (6:2 Fluorotelomersulfonic Acid, 6:2FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
4,8-dioxa-3H-perfluorononanoic Acid (ADONA)	6951
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	9460
N-ethyl perfluorooctanesulfonamide (EtFOSA)	9395
N-ethyl perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	4847
N-ethyl perfluorooctanesulfonamidoethanol (EtFOSE)	9431
N-methyl perfluorooctanesulfonamide (MeFOSA)	9433
N-methyl perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	4846
N-methyl perfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929

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Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 (Draft 3) by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Solid	
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonamide (PFOSA)	6917
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
Tissue	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonic Acid, 8:2FTS)	6948
1H, 1H, 2H, 2H-Perfluorohexanesulfonic Acid (4:2 Fluorotelomersulfonic Acid, 4:2FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctanesulfonic Acid (6:2 Fluorotelomersulfonic Acid, 6:2FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
4,8-dioxa-3H-perfluorononanoic Acid (ADONA)	6951
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	9460
N-ethyl perfluorooctanesulfonamide (EtFOSA)	9395
N-ethyl perfluorooctanesulfonamidoacetic Acid (EtFOSAA)	4847
N-ethyl perfluorooctanesulfonamidoethanol (EtFOSE)	9431
N-methyl perfluorooctanesulfonamide (MeFOSA)	9433
N-methyl perfluorooctanesulfonamidoacetic Acid (MeFOSAA)	4846
N-methyl perfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
Draft EPA Method 1633 (Draft 3) by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10123429
Tissue	
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonamide (PFOSA)	6917
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
EPA 533 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10091619
Drinking Water	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	6957
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanoic Acid (PFNA)	6906

Certificate of Accreditation: Supplement

Battelle

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	Code
Organic	
EPA 533 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10091619
Drinking Water	
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluoroundecanoic Acid (PFUnA)	6904
EPA 537.1.1 by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	10091642
Drinking Water	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluorotetradecanoic Acid (PFTA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Aqueous	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Aldrin	7025
alpha-BHC (a-BHC, alpha-Hexachlorocyclohexane)	7110
alpha-Chlordane (cis-Chlordane)	7240

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Aqueous	
beta-BHC (b-BHC, beta-Hexachlorocyclohexane)	7115
Chlorpyrifos (Dursban)	7300
cis-Nonachlor	7925
delta-BHC (d-BHC)	7105
Dieldrin	7470
Endosulfan I	7510
Endosulfan II	7515
Endosulfan Sulfate	7520
Endrin	7540
Endrin Aldehyde	7530
Endrin Ketone	7535
gamma-BHC (γ-BHC, Lindane)	7120
gamma-Chlordane	7245
Heptachlor	7685
Heptachlor Epoxide	7690
Hexachlorobenzene	6275
Methoxychlor	7810
Mirex	7870
Oxychlordane	3890
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-129 (2,2',3,3',4,5-Hexachlorobiphenyl)	9118
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103

Accreditation is granted to the facility to perform the following testing:	Code
Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Aqueous	
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
trans-Nonachlor	7910
Solid	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Aldrin	7025
alpha-BHC (a-BHC, alpha-Hexachlorocyclohexane)	7110
alpha-Chlordane (cis-Chlordane)	7240
beta-BHC (b-BHC, beta-Hexachlorocyclohexane)	7115
Chlorpyrifos (Dursban)	7300
cis-Nonachlor	7925
delta-BHC (d-BHC)	7105
Dieldrin	7470
Endosulfan I	7510
Endosulfan II	7515
Endosulfan Sulfate	7520
Endrin	7540
Endrin Aldehyde	7530
Endrin Ketone	7535
gamma-BHC (γ-BHC, Lindane)	7120
gamma-Chlordane	7245
Heptachlor	7685
Heptachlor Epoxide	7690

Accreditation is granted to the facility to perform the following testing:

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Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Solid	
Hexachlorobenzene	6275
Methoxychlor	7810
Mirex	7870
Oxychlordane	3890
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-129 (2,2',3,3',4,5-Hexachlorobiphenyl)	9118
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
trans-Nonachlor	7910
Tissue	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590

Certificate of Accreditation: Supplement

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EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Tissue	
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Aldrin	7025
alpha-BHC (a-BHC, alpha-Hexachlorocyclohexane)	7110
alpha-Chlordane (cis-Chlordane)	7240
beta-BHC (b-BHC, beta-Hexachlorocyclohexane)	7115
Chlorpyrifos (Dursban)	7300
cis-Nonachlor	7925
delta-BHC (d-BHC)	7105
Dieldrin	7470
Endosulfan I	7510
Endosulfan II	7515
Endosulfan Sulfate	7520
Endrin	7540
Endrin Aldehyde	7530
Endrin Ketone	7535
gamma-BHC (γ-BHC, Lindane)	7120
gamma-Chlordane	7245
Heptachlor	7685
Heptachlor Epoxide	7690
Hexachlorobenzene	6275
Methoxychlor	7810
Mirex	7870
Oxychlordane	3890
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-129 (2,2',3,3',4,5-Hexachlorobiphenyl)	9118
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065

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Contact Name: Jonathan Thorn Phone: 781-681-5565

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Organic	
EPA 8081 MOD (Battelle SOP 5-128) by Gas Chromatography Electron Capture Detector (GC/ECD)	10178402
Tissue	
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-28 (2,4,4'-Trichlorobiphenyl)	9252
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4'-Dichlorobiphenyl)	9256
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
trans-Nonachlor	7910
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
1,4-Dichlorobenzene	4620
1-Methylnaphthalene	6380
1-Methylphenanthrene	9501
2,3,5-Trimethylnaphthalene	6852
2,6-Dimethylnaphthalene	6188
2-Chloronaphthalene	5795
2-Methylnaphthalene	6385
2-Methylphenanthrene	4953
3,6-Dimethylphenanthrene	5957
Acenaphthene	5500
Acenaphthylene	5505
Anthracene	5555
Benzo(a)Anthracene	5575
Benzo(a)Pyrene	5580
Benzo(b)Fluoranthene	5585
Benzo(b)Thiophene	NC
Benzo(e)Pyrene	5605

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
Benzo(g,h,i)Perylene	5590
Benzo(k)Fluoranthene	5600
Chrysene	5855
cis-Decalin	4621
Dibenz(a,h)Anthracene	5895
Dibenzofuran	5905
Dibenzothiophene	5910
Fluoranthene	6265
Fluorene	6270
Indeno(1,2,3,cd)Pyrene	6315
Naphthalene	5005
Perylene	6608
Phenanthrene	6615
Pyrene	6665
trans-Decalin	9587
Solid	
1,4-Dichlorobenzene	4620
1-Methylnaphthalene	6380
1-Methylphenanthrene	9501
2,3,5-Trimethylnaphthalene	6852
2,6-Dimethylnaphthalene	6188
2-Chloronaphthalene	5795
2-Methylnaphthalene	6385
2-Methylphenanthrene	4953
3,6-Dimethylphenanthrene	5957
Acenaphthene	5500
Acenaphthylene	5505
Anthracene	5555
Benzo(a)Anthracene	5575
Benzo(a)Pyrene	5580
Benzo(b)Fluoranthene	5585
Benzo(b)Thiophene	NC
Benzo(e)Pyrene	5605
Benzo(g,h,i)Perylene	5590
Benzo(k)Fluoranthene	5600
Chrysene	5855

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
cis-Decalin	4621
Dibenz(a,h)Anthracene	5895
Dibenzofuran	5905
Dibenzothiophene	5910
Fluoranthene	6265
Fluorene	6270
Indeno(1,2,3,cd)Pyrene	6315
Naphthalene	5005
Perylene	6608
Phenanthrene	6615
Pyrene	6665
trans-Decalin	9587
Tissue	
1,4-Dichlorobenzene	4620
1-Methylnaphthalene	6380
1-Methylphenanthrene	9501
2,3,5-Trimethylnaphthalene	6852
2,6-Dimethylnaphthalene	6188
2-Chloronaphthalene	5795
2-Methylnaphthalene	6385
2-Methylphenanthrene	4953
3,6-Dimethylphenanthrene	5957
Acenaphthene	5500
Acenaphthylene	5505
Anthracene	5555
Benzo(a)Anthracene	5575
Benzo(a)Pyrene	5580
Benzo(b)Fluoranthene	5585
Benzo(b)Thiophene	NC
Benzo(e)Pyrene	5605
Benzo(g,h,i)Perylene	5590
Benzo(k)Fluoranthene	5600
Chrysene	5855
cis-Decalin	4621
Dibenz(a,h)Anthracene	5895
Dibenzofuran	5905

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-157) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
Dibenzothiophene	5910
Fluoranthene	6265
Fluorene	6270
Indeno(1,2,3,cd)Pyrene	6315
Naphthalene	5005
Perylene	6608
Phenanthrene	6615
Pyrene	6665
trans-Decalin	9587
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Biphenyl	5640
PCB-1 (2-Chlorobiphenyl, 2-Monochlorobiphenyl)	8915
PCB-100 (2,2',4,4',6-Pentachlorobiphenyl)	9177
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-104 (2,2',4,6,6'-Pentachlorobiphenyl)	9182
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-11 (3,3'-Dichlorobiphenyl)	8925
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-114 (2,3,4,4',5-Pentachlorobiphenyl)	9005
PCB-115 (2,3,4,4',6-Pentachlorobiphenyl)	9219
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-12 (3,4-Dichlorobiphenyl)	9270
PCB-123 (2,3',4,4',5'-Pentachlorobiphenyl)	9000
PCB-124 (2,3',4',5,5'-Pentachlorobiphenyl)	9222
PCB-125 (2,3',4',5',6-Pentachlorobiphenyl)	9224
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-127 (3,3',4,5,5'-Pentachlorobiphenyl)	9260
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-13 (3,4'-Dichlorobiphenyl)	9269

Accreditation is granted to the facility to perform the following testing:	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-130 (2,2',3,3',4,5'-Hexachlorobiphenyl)	9117
PCB-131 (2,2',3,3',4,6-Hexachlorobiphenyl)	9121
PCB-134 (2,2',3,3',5,6-Hexachlorobiphenyl)	9128
PCB-135 (2,2',3,3',5,6'-Hexachlorobiphenyl)	9127
PCB-136 (2,2',3,3',6,6'-Hexachlorobiphenyl)	9130
PCB-137 (2,2',3,4,4',5-Hexachlorobiphenyl)	9138
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-139 (2,2',3,4,4',6-Hexachlorobiphenyl)	9141
PCB-140 (2,2',3,4,4',6'-Hexachlorobiphenyl)	9140
PCB-141 (2,2',3,4,5,5’-Hexachlorobiphenyl)	9030
PCB-144 (2,2',3,4,5',6-Hexachlorobiphenyl)	9150
PCB-146 (2,2',3,4',5,5'-Hexachlorobiphenyl)	9144
PCB-149 (2,2',3,4',5',6-Hexachlorobiphenyl)	9151
PCB-15 (4,4'-Dichlorobiphenyl)	9273
PCB-151 (2,2',3,5,5',6-Hexachlorobiphenyl)	9035
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-154 (2,2',4,4',5,6'-Hexachlorobiphenyl)	9174
PCB-155 (2,2',4,4',6,6'-Hexachlorobiphenyl)	9176
PCB-156 (2,3,3',4,4',5-Hexachlorobiphenyl)	9050
PCB-157 (2,3,3’,4,4’,5’-Hexachlorobiphenyl)	9045
PCB-158 (2,3,3',4,4',6-Hexachlorobiphenyl)	9193
PCB-16 (2,2',3-Trichlorobiphenyl)	9173
PCB-163 (2,3,3',4',5,6-Hexachlorobiphenyl)	9199
PCB-164 (2,3,3',4',5',6-Hexachlorobiphenyl)	9201
PCB-166 (2,3,4,4',5,6-Hexachlorobiphenyl)	9217
PCB-167 (2,3',4,4',5,5'-Hexachlorobiphenyl)	9055
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-17 (2,2',4-Trichlorobiphenyl)	9185
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-171 (2,2',3,3',4,4',6-Heptachlorobiphenyl)	9106
PCB-172 (2,2',3,3',4,5,5'-Heptachlorobiphenyl)	9110
PCB-173 (2,2',3,3',4,5,6-Heptachlorobiphenyl)	9113
PCB-174 (2,2',3,3',4,5,6'-Heptachlorobiphenyl)	9116
PCB-175 (2,2',3,3',4,5',6-Heptachlorobiphenyl)	9115
PCB-176 (2,2',3,3',4,6,6'-Heptachlorobiphenyl)	9119
PCB-177 (2,2',3,3',4,5',6'-Heptachlorobiphenyl)	9114

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-178 (2,2',3,3',5,5',6-Heptachlorobiphenyl)	9124
PCB-179 (2,2',3,3',5,6,6'-Heptachlorobiphenyl)	9126
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-185 (2,2',3,4,5,5',6-Heptachlorobiphenyl)	9143
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-188 (2,2',3,4',5,6,6'-Heptachlorobiphenyl)	9146
PCB-189 (2,3,3',4,4',5,5'-Heptachlorobiphenyl)	9085
PCB-19 (2,2',6-Trichlorobiphenyl)	9188
PCB-190 (2,3,3',4,4',5,6-Heptachlorobiphenyl)	9191
PCB-191 (2,3,3',4,4',5',6-Heptachlorobiphenyl)	9192
PCB-193 (2,3,3',4',5,5',6-Heptachlorobiphenyl)	9195
PCB-194 (2,2',3,3',4,4',5,5'-Octachlorobiphenyl)	9090
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-197 (2,2',3,3',4,4',6,6'-Octachlorobiphenyl)	9104
PCB-198 (2,2',3,3',4,5,5',6-Octachlorobiphenyl)	9109
PCB-199 (2,2',3,3',4,5,5',6'-Octachlorobiphenyl)	9108
PCB-200 (2,2',3,3',4,5,6,6'-Octachlorobiphenyl)	9111
PCB-201 (2,2',3,3',4,5',6,6'-Octachlorobiphenyl)	9112
PCB-202 (2,2',3,3',5,5',6,6'-Octachlorobiphenyl)	9123
PCB-203 (2,2',3,4,4',5,5',6-Octachlorobiphenyl)	9133
PCB-205 (2,3,3',4,4',5,5',6-Octachlorobiphenyl)	9190
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-207 (2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl)	9101
PCB-208 (2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl)	9107
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-22 (2,3,4'-Trichlorobiphenyl)	9241
PCB-24 (2,3,6-Trichlorobiphenyl)	9247
PCB-25 (2,3',4-Trichlorobiphenyl)	9240
PCB-26 (2,3',5-Trichlorobiphenyl)	8935
PCB-27 (2,3',6-Trichlorobiphenyl)	9248
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-29 (2,4,5-Trichlorobiphenyl)	9253
PCB-3 (4-Chlorobiphenyl, 4-Monochlorobiphenyl)	9274

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-30 (2,4,6-Trichlorobiphenyl)	9254
PCB-31 (2,4',5-Trichlorobiphenyl)	8940
PCB-32 (2,4',6-Trichlorobiphenyl)	9255
PCB-33 (2,3',4'-Trichlorobiphenyl)	9239
PCB-37 (3,4,4'-Trichlorobiphenyl)	9266
PCB-4 (2,2'-Dichlorobiphenyl)	9189
PCB-40 (2,2',3,3'-Tetrachlorobiphenyl)	9132
PCB-41 (2,2',3,4-Tetrachlorobiphenyl)	9163
PCB-42 (2,2',3,4'-Tetrachlorobiphenyl)	9162
PCB-43 (2,2',3,5-Tetrachlorobiphenyl)	9169
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-45 (2,2',3,6-Tetrachlorobiphenyl)	9172
PCB-46 (2,2',3,6'-Tetrachlorobiphenyl)	9171
PCB-47 (2,2',4,4'-Tetrachlorobiphenyl)	9178
PCB-48 (2,2',4,5-Tetrachlorobiphenyl)	9181
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-5 (2,3-Dichlorobiphenyl)	8920
PCB-50 (2,2',4,6-Tetrachlorobiphenyl)	9184
PCB-51 (2,2',4,6'-Tetrachlorobiphenyl)	9183
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-53 (2,2',5,6'-Tetrachlorobiphenyl)	9186
PCB-54 (2,2',6,6'-Tetrachlorobiphenyl)	9187
PCB-56 (2,3,3',4'-Tetrachlorobiphenyl)	9207
PCB-6 (2,3'-Dichlorobiphenyl)	9249
PCB-60 (2,3,4,4'-Tetrachlorobiphenyl)	9221
PCB-63 (2,3,4',5-Tetrachlorobiphenyl)	9233
PCB-64 (2,3,4',6-Tetrachlorobiphenyl)	9236
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-67 (2,3',4,5-Tetrachlorobiphenyl)	9232
PCB-7 (2,4-Dichlorobiphenyl)	9257
PCB-70 (2,3',4',5-Tetrachlorobiphenyl)	9230
PCB-71 (2,3',4',6-Tetrachlorobiphenyl)	9237
PCB-74 (2,4,4',5-Tetrachlorobiphenyl)	9250
PCB-75 (2,4,4',6-Tetrachlorobiphenyl)	9251
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Aqueous	
PCB-80 (3,3',5,5'-Tetrachlorobiphenyl)	9264
PCB-81 (3,4,4',5-Tetrachlorobiphenyl)	8970
PCB-82 (2,2',3,3',4-Pentachlorobiphenyl)	9122
PCB-83 (2,2',3,3',5-Pentachlorobiphenyl)	9129
PCB-84 (2,2',3,3',6-Pentachlorobiphenyl)	9131
PCB-85 (2,2',3,4,4'-Pentachlorobiphenyl)	9142
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
PCB-9 (2,5-Dichlorobiphenyl)	9258
PCB-91 (2,2',3,4',6-Pentachlorobiphenyl)	9160
PCB-92 (2,2',3,5,5'-Pentachlorobiphenyl)	9164
PCB-95 (2,2',3,5',6-Pentachlorobiphenyl)	9166
PCB-97 (2,2',3,4',5'-Pentachlorobiphenyl)	9154
PCB-99 (2,2',4,4',5-Pentachlorobiphenyl)	9175
Solid	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Biphenyl	5640
PCB-1 (2-Chlorobiphenyl, 2-Monochlorobiphenyl)	8915
PCB-100 (2,2',4,4',6-Pentachlorobiphenyl)	9177
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-104 (2,2',4,6,6'-Pentachlorobiphenyl)	9182
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-11 (3,3'-Dichlorobiphenyl)	8925
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-114 (2,3,4,4',5-Pentachlorobiphenyl)	9005
PCB-115 (2,3,4,4',6-Pentachlorobiphenyl)	9219
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-12 (3,4-Dichlorobiphenyl)	9270
PCB-123 (2,3',4,4',5'-Pentachlorobiphenyl)	9000
PCB-124 (2,3',4',5,5'-Pentachlorobiphenyl)	9222
PCB-125 (2,3',4',5',6-Pentachlorobiphenyl)	9224
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-127 (3,3',4,5,5'-Pentachlorobiphenyl)	9260
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-13 (3,4'-Dichlorobiphenyl)	9269
PCB-130 (2,2',3,3',4,5'-Hexachlorobiphenyl)	9117
PCB-131 (2,2',3,3',4,6-Hexachlorobiphenyl)	9121
PCB-134 (2,2',3,3',5,6-Hexachlorobiphenyl)	9128
PCB-135 (2,2',3,3',5,6'-Hexachlorobiphenyl)	9127
PCB-136 (2,2',3,3',6,6'-Hexachlorobiphenyl)	9130
PCB-137 (2,2',3,4,4',5-Hexachlorobiphenyl)	9138
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-139 (2,2',3,4,4',6-Hexachlorobiphenyl)	9141
PCB-140 (2,2',3,4,4',6'-Hexachlorobiphenyl)	9140
PCB-141 (2,2',3,4,5,5'-Hexachlorobiphenyl)	9030
PCB-144 (2,2',3,4,5',6-Hexachlorobiphenyl)	9150
PCB-146 (2,2',3,4',5,5'-Hexachlorobiphenyl)	9144
PCB-149 (2,2',3,4',5',6-Hexachlorobiphenyl)	9151
PCB-15 (4,4'-Dichlorobiphenyl)	9273
PCB-151 (2,2',3,5,5',6-Hexachlorobiphenyl)	9035
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-154 (2,2',4,4',5,6'-Hexachlorobiphenyl)	9174
PCB-155 (2,2',4,4',6,6'-Hexachlorobiphenyl)	9176
PCB-156 (2,3,3',4,4',5-Hexachlorobiphenyl)	9050
PCB-157 (2,3,3’,4,4’,5’-Hexachlorobiphenyl)	9045
PCB-158 (2,3,3',4,4',6-Hexachlorobiphenyl)	9193
PCB-16 (2,2',3-Trichlorobiphenyl)	9173
PCB-163 (2,3,3',4',5,6-Hexachlorobiphenyl)	9199
PCB-164 (2,3,3',4',5',6-Hexachlorobiphenyl)	9201
PCB-166 (2,3,4,4',5,6-Hexachlorobiphenyl)	9217
PCB-167 (2,3',4,4',5,5'-Hexachlorobiphenyl)	9055
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-17 (2,2',4-Trichlorobiphenyl)	9185
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-171 (2,2',3,3',4,4',6-Heptachlorobiphenyl)	9106
PCB-172 (2,2',3,3',4,5,5'-Heptachlorobiphenyl)	9110
PCB-173 (2,2',3,3',4,5,6-Heptachlorobiphenyl)	9113
PCB-174 (2,2',3,3',4,5,6'-Heptachlorobiphenyl)	9116

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-175 (2,2',3,3',4,5',6-Heptachlorobiphenyl)	9115
PCB-176 (2,2',3,3',4,6,6'-Heptachlorobiphenyl)	9119
PCB-177 (2,2',3,3',4,5',6'-Heptachlorobiphenyl)	9114
PCB-178 (2,2',3,3',5,5',6-Heptachlorobiphenyl)	9124
PCB-179 (2,2',3,3',5,6,6'-Heptachlorobiphenyl)	9126
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-185 (2,2',3,4,5,5',6-Heptachlorobiphenyl)	9143
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-188 (2,2',3,4',5,6,6'-Heptachlorobiphenyl)	9146
PCB-189 (2,3,3',4,4',5,5'-Heptachlorobiphenyl)	9085
PCB-19 (2,2',6-Trichlorobiphenyl)	9188
PCB-190 (2,3,3',4,4',5,6-Heptachlorobiphenyl)	9191
PCB-191 (2,3,3',4,4',5',6-Heptachlorobiphenyl)	9192
PCB-193 (2,3,3',4',5,5',6-Heptachlorobiphenyl)	9195
PCB-194 (2,2',3,3',4,4',5,5'-Octachlorobiphenyl)	9090
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-197 (2,2',3,3',4,4',6,6'-Octachlorobiphenyl)	9104
PCB-198 (2,2',3,3',4,5,5',6-Octachlorobiphenyl)	9109
PCB-199 (2,2',3,3',4,5,5',6'-Octachlorobiphenyl)	9108
PCB-200 (2,2',3,3',4,5,6,6'-Octachlorobiphenyl)	9111
PCB-201 (2,2',3,3',4,5',6,6'-Octachlorobiphenyl)	9112
PCB-202 (2,2',3,3',5,5',6,6'-Octachlorobiphenyl)	9123
PCB-203 (2,2',3,4,4',5,5',6-Octachlorobiphenyl)	9133
PCB-205 (2,3,3',4,4',5,5',6-Octachlorobiphenyl)	9190
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-207 (2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl)	9101
PCB-208 (2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl)	9107
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-22 (2,3,4'-Trichlorobiphenyl)	9241
PCB-24 (2,3,6-Trichlorobiphenyl)	9247
PCB-25 (2,3',4-Trichlorobiphenyl)	9240
PCB-26 (2,3',5-Trichlorobiphenyl)	8935
PCB-27 (2,3',6-Trichlorobiphenyl)	9248

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-29 (2,4,5-Trichlorobiphenyl)	9253
PCB-3 (4-Chlorobiphenyl, 4-Monochlorobiphenyl)	9274
PCB-30 (2,4,6-Trichlorobiphenyl)	9254
PCB-31 (2,4',5-Trichlorobiphenyl)	8940
PCB-32 (2,4',6-Trichlorobiphenyl)	9255
PCB-33 (2,3',4'-Trichlorobiphenyl)	9239
PCB-37 (3,4,4'-Trichlorobiphenyl)	9266
PCB-4 (2,2'-Dichlorobiphenyl)	9189
PCB-40 (2,2',3,3'-Tetrachlorobiphenyl)	9132
PCB-41 (2,2',3,4-Tetrachlorobiphenyl)	9163
PCB-42 (2,2',3,4'-Tetrachlorobiphenyl)	9162
PCB-43 (2,2',3,5-Tetrachlorobiphenyl)	9169
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-45 (2,2',3,6-Tetrachlorobiphenyl)	9172
PCB-46 (2,2',3,6'-Tetrachlorobiphenyl)	9171
PCB-47 (2,2',4,4'-Tetrachlorobiphenyl)	9178
PCB-48 (2,2',4,5-Tetrachlorobiphenyl)	9181
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-5 (2,3-Dichlorobiphenyl)	8920
PCB-50 (2,2',4,6-Tetrachlorobiphenyl)	9184
PCB-51 (2,2',4,6'-Tetrachlorobiphenyl)	9183
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-53 (2,2',5,6'-Tetrachlorobiphenyl)	9186
PCB-54 (2,2',6,6'-Tetrachlorobiphenyl)	9187
PCB-56 (2,3,3',4'-Tetrachlorobiphenyl)	9207
PCB-6 (2,3'-Dichlorobiphenyl)	9249
PCB-60 (2,3,4,4'-Tetrachlorobiphenyl)	9221
PCB-63 (2,3,4',5-Tetrachlorobiphenyl)	9233
PCB-64 (2,3,4',6-Tetrachlorobiphenyl)	9236
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-67 (2,3',4,5-Tetrachlorobiphenyl)	9232
PCB-7 (2,4-Dichlorobiphenyl)	9257
PCB-70 (2,3',4',5-Tetrachlorobiphenyl)	9230
PCB-71 (2,3',4',6-Tetrachlorobiphenyl)	9237
PCB-74 (2,4,4',5-Tetrachlorobiphenyl)	9250

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Solid	
PCB-75 (2,4,4',6-Tetrachlorobiphenyl)	9251
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4’-Dichlorobiphenyl)	9256
PCB-80 (3,3',5,5'-Tetrachlorobiphenyl)	9264
PCB-81 (3,4,4',5-Tetrachlorobiphenyl)	8970
PCB-82 (2,2',3,3',4-Pentachlorobiphenyl)	9122
PCB-83 (2,2',3,3',5-Pentachlorobiphenyl)	9129
PCB-84 (2,2',3,3',6-Pentachlorobiphenyl)	9131
PCB-85 (2,2',3,4,4'-Pentachlorobiphenyl)	9142
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
PCB-9 (2,5-Dichlorobiphenyl)	9258
PCB-91 (2,2',3,4',6-Pentachlorobiphenyl)	9160
PCB-92 (2,2',3,5,5'-Pentachlorobiphenyl)	9164
PCB-95 (2,2',3,5',6-Pentachlorobiphenyl)	9166
PCB-97 (2,2',3,4',5'-Pentachlorobiphenyl)	9154
PCB-99 (2,2',4,4',5-Pentachlorobiphenyl)	9175
Tissue	
2,4'-DDD	8580
2,4'-DDE	8585
2,4'-DDT	8590
4,4'-DDD	7355
4,4'-DDE	7360
4,4'-DDT	7365
Biphenyl	5640
PCB-1 (2-Chlorobiphenyl, 2-Monochlorobiphenyl)	8915
PCB-100 (2,2',4,4',6-Pentachlorobiphenyl)	9177
PCB-101 (2,2’,4,5,5’-Pentachlorobiphenyl)	8980
PCB-104 (2,2',4,6,6'-Pentachlorobiphenyl)	9182
PCB-105 (2,3,3',4,4'-Pentachlorobiphenyl)	8985
PCB-11 (3,3'-Dichlorobiphenyl)	8925
PCB-110 (2,3,3',4',6-Pentachlorobiphenyl)	8990
PCB-114 (2,3,4,4',5-Pentachlorobiphenyl)	9005
PCB-115 (2,3,4,4',6-Pentachlorobiphenyl)	9219
PCB-118 (2,3',4,4',5-Pentachlorobiphenyl)	8995
PCB-12 (3,4-Dichlorobiphenyl)	9270
PCB-123 (2,3',4,4',5'-Pentachlorobiphenyl)	9000

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-124 (2,3',4',5,5'-Pentachlorobiphenyl)	9222
PCB-125 (2,3',4',5',6-Pentachlorobiphenyl)	9224
PCB-126 (3,3',4,4',5-Pentachlorobiphenyl)	9015
PCB-127 (3,3',4,5,5'-Pentachlorobiphenyl)	9260
PCB-128 (2,2',3,3',4,4'-Hexachlorobiphenyl)	9020
PCB-13 (3,4'-Dichlorobiphenyl)	9269
PCB-130 (2,2',3,3',4,5'-Hexachlorobiphenyl)	9117
PCB-131 (2,2',3,3',4,6-Hexachlorobiphenyl)	9121
PCB-134 (2,2',3,3',5,6-Hexachlorobiphenyl)	9128
PCB-135 (2,2',3,3',5,6'-Hexachlorobiphenyl)	9127
PCB-136 (2,2',3,3',6,6'-Hexachlorobiphenyl)	9130
PCB-137 (2,2',3,4,4',5-Hexachlorobiphenyl)	9138
PCB-138 (2,2',3,4,4',5'-Hexachlorobiphenyl)	9025
PCB-139 (2,2',3,4,4',6-Hexachlorobiphenyl)	9141
PCB-140 (2,2',3,4,4',6'-Hexachlorobiphenyl)	9140
PCB-141 (2,2',3,4,5,5'-Hexachlorobiphenyl)	9030
PCB-144 (2,2',3,4,5',6-Hexachlorobiphenyl)	9150
PCB-146 (2,2',3,4',5,5'-Hexachlorobiphenyl)	9144
PCB-149 (2,2',3,4',5',6-Hexachlorobiphenyl)	9151
PCB-15 (4,4'-Dichlorobiphenyl)	9273
PCB-151 (2,2',3,5,5',6-Hexachlorobiphenyl)	9035
PCB-153 (2,2’,4,4’,5,5’-Hexachlorobiphenyl)	9040
PCB-154 (2,2',4,4',5,6'-Hexachlorobiphenyl)	9174
PCB-155 (2,2',4,4',6,6'-Hexachlorobiphenyl)	9176
PCB-156 (2,3,3',4,4',5-Hexachlorobiphenyl)	9050
PCB-157 (2,3,3’,4,4’,5’-Hexachlorobiphenyl)	9045
PCB-158 (2,3,3',4,4',6-Hexachlorobiphenyl)	9193
PCB-16 (2,2',3-Trichlorobiphenyl)	9173
PCB-163 (2,3,3',4',5,6-Hexachlorobiphenyl)	9199
PCB-164 (2,3,3',4',5',6-Hexachlorobiphenyl)	9201
PCB-166 (2,3,4,4',5,6-Hexachlorobiphenyl)	9217
PCB-167 (2,3',4,4',5,5'-Hexachlorobiphenyl)	9055
PCB-169 (3,3',4,4',5,5'-Hexachlorobiphenyl)	9060
PCB-17 (2,2',4-Trichlorobiphenyl)	9185
PCB-170 (2,2',3,3',4,4',5-Heptachlorobiphenyl)	9065
PCB-171 (2,2',3,3',4,4',6-Heptachlorobiphenyl)	9106

Certificate of Accreditation: Supplement

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-172 (2,2',3,3',4,5,5'-Heptachlorobiphenyl)	9110
PCB-173 (2,2',3,3',4,5,6-Heptachlorobiphenyl)	9113
PCB-174 (2,2',3,3',4,5,6'-Heptachlorobiphenyl)	9116
PCB-175 (2,2',3,3',4,5',6-Heptachlorobiphenyl)	9115
PCB-176 (2,2',3,3',4,6,6'-Heptachlorobiphenyl)	9119
PCB-177 (2,2',3,3',4,5',6'-Heptachlorobiphenyl)	9114
PCB-178 (2,2',3,3',5,5',6-Heptachlorobiphenyl)	9124
PCB-179 (2,2',3,3',5,6,6'-Heptachlorobiphenyl)	9126
PCB-18 (2,2',5-Trichlorobiphenyl)	8930
PCB-180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl)	9134
PCB-183 (2,2',3,4,4',5',6-Heptachlorobiphenyl)	9075
PCB-184 (2,2',3,4,4',6,6'-Heptachlorobiphenyl)	9139
PCB-185 (2,2',3,4,5,5',6-Heptachlorobiphenyl)	9143
PCB-187 (2,2',3,4',5,5',6-Heptachlorobiphenyl)	9080
PCB-188 (2,2',3,4',5,6,6'-Heptachlorobiphenyl)	9146
PCB-189 (2,3,3',4,4',5,5'-Heptachlorobiphenyl)	9085
PCB-19 (2,2',6-Trichlorobiphenyl)	9188
PCB-190 (2,3,3',4,4',5,6-Heptachlorobiphenyl)	9191
PCB-191 (2,3,3',4,4',5',6-Heptachlorobiphenyl)	9192
PCB-193 (2,3,3',4',5,5',6-Heptachlorobiphenyl)	9195
PCB-194 (2,2',3,3',4,4',5,5'-Octachlorobiphenyl)	9090
PCB-195 (2,2',3,3',4,4',5,6-Octachlorobiphenyl)	9103
PCB-197 (2,2',3,3',4,4',6,6'-Octachlorobiphenyl)	9104
PCB-198 (2,2',3,3',4,5,5',6-Octachlorobiphenyl)	9109
PCB-199 (2,2',3,3',4,5,5',6'-Octachlorobiphenyl)	9108
PCB-200 (2,2',3,3',4,5,6,6'-Octachlorobiphenyl)	9111
PCB-201 (2,2',3,3',4,5',6,6'-Octachlorobiphenyl)	9112
PCB-202 (2,2',3,3',5,5',6,6'-Octachlorobiphenyl)	9123
PCB-203 (2,2',3,4,4',5,5',6-Octachlorobiphenyl)	9133
PCB-205 (2,3,3',4,4',5,5',6-Octachlorobiphenyl)	9190
PCB-206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl)	9095
PCB-207 (2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl)	9101
PCB-208 (2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl)	9107
PCB-209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl)	9105
PCB-22 (2,3,4'-Trichlorobiphenyl)	9241
PCB-24 (2,3,6-Trichlorobiphenyl)	9247

Accreditation is granted to the facility to perform the following testing:	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-25 (2,3',4-Trichlorobiphenyl)	9240
PCB-26 (2,3',5-Trichlorobiphenyl)	8935
PCB-27 (2,3',6-Trichlorobiphenyl)	9248
PCB-28 (2,4,4’-Trichlorobiphenyl)	9252
PCB-29 (2,4,5-Trichlorobiphenyl)	9253
PCB-3 (4-Chlorobiphenyl, 4-Monochlorobiphenyl)	9274
PCB-30 (2,4,6-Trichlorobiphenyl)	9254
PCB-31 (2,4',5-Trichlorobiphenyl)	8940
PCB-32 (2,4',6-Trichlorobiphenyl)	9255
PCB-33 (2,3',4'-Trichlorobiphenyl)	9239
PCB-37 (3,4,4'-Trichlorobiphenyl)	9266
PCB-4 (2,2'-Dichlorobiphenyl)	9189
PCB-40 (2,2',3,3'-Tetrachlorobiphenyl)	9132
PCB-41 (2,2',3,4-Tetrachlorobiphenyl)	9163
PCB-42 (2,2',3,4'-Tetrachlorobiphenyl)	9162
PCB-43 (2,2',3,5-Tetrachlorobiphenyl)	9169
PCB-44 (2,2',3,5'-Tetrachlorobiphenyl)	8945
PCB-45 (2,2',3,6-Tetrachlorobiphenyl)	9172
PCB-46 (2,2',3,6'-Tetrachlorobiphenyl)	9171
PCB-47 (2,2',4,4'-Tetrachlorobiphenyl)	9178
PCB-48 (2,2',4,5-Tetrachlorobiphenyl)	9181
PCB-49 (2,2',4,5'-Tetrachlorobiphenyl)	8950
PCB-5 (2,3-Dichlorobiphenyl)	8920
PCB-50 (2,2',4,6-Tetrachlorobiphenyl)	9184
PCB-51 (2,2',4,6'-Tetrachlorobiphenyl)	9183
PCB-52 (2,2',5,5'-Tetrachlorobiphenyl)	8955
PCB-53 (2,2',5,6'-Tetrachlorobiphenyl)	9186
PCB-54 (2,2',6,6'-Tetrachlorobiphenyl)	9187
PCB-56 (2,3,3',4'-Tetrachlorobiphenyl)	9207
PCB-6 (2,3'-Dichlorobiphenyl)	9249
PCB-60 (2,3,4,4'-Tetrachlorobiphenyl)	9221
PCB-63 (2,3,4',5-Tetrachlorobiphenyl)	9233
PCB-64 (2,3,4',6-Tetrachlorobiphenyl)	9236
PCB-66 (2,3',4,4'-Tetrachlorobiphenyl)	8960
PCB-67 (2,3',4,5-Tetrachlorobiphenyl)	9232
PCB-7 (2,4-Dichlorobiphenyl)	9257

	Code
Organic	
EPA 8270E MOD (Battelle SOP 5-315) by Gas Chromatography Mass Spectrometry (GC/MS)	10242543
Tissue	
PCB-70 (2,3',4',5-Tetrachlorobiphenyl)	9230
PCB-71 (2,3',4',6-Tetrachlorobiphenyl)	9237
PCB-74 (2,4,4',5-Tetrachlorobiphenyl)	9250
PCB-75 (2,4,4',6-Tetrachlorobiphenyl)	9251
PCB-77 (3,3',4,4'-Tetrachlorobiphenyl)	8965
PCB-8 (2,4'-Dichlorobiphenyl)	9256
PCB-80 (3,3',5,5'-Tetrachlorobiphenyl)	9264
PCB-81 (3,4,4',5-Tetrachlorobiphenyl)	8970
PCB-82 (2,2',3,3',4-Pentachlorobiphenyl)	9122
PCB-83 (2,2',3,3',5-Pentachlorobiphenyl)	9129
PCB-84 (2,2',3,3',6-Pentachlorobiphenyl)	9131
PCB-85 (2,2',3,4,4'-Pentachlorobiphenyl)	9142
PCB-87 (2,2',3,4,5'-Pentachlorobiphenyl)	8975
PCB-9 (2,5-Dichlorobiphenyl)	9258
PCB-91 (2,2',3,4',6-Pentachlorobiphenyl)	9160
PCB-92 (2,2',3,5,5'-Pentachlorobiphenyl)	9164
PCB-95 (2,2',3,5',6-Pentachlorobiphenyl)	9166
PCB-97 (2,2',3,4',5'-Pentachlorobiphenyl)	9154
PCB-99 (2,2',4,4',5-Pentachlorobiphenyl)	9175
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Aqueous	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorododecane Sulfonic Acid (10:2 FTS)	9616
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
N-Ethyl Perfluorooctanesulfonamide (NEtFOSA)	9395
N-Ethyl Perfluorooctanesulfonamidoethanol (NEtFOSE)	9431
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846

Certificate of Accreditation: Supplement

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:	Code
Organic	
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Aqueous	
N-Methylperfluorooctanesulfonamide (NMeFOSA)	6954
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
N-Methylperfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	6957
Perfluoro-1-Octanesulfonamide (PFOSA)	9665
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexadecanoic Acid (PFHxDA)	6958
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctadecanoic Acid (PFODA)	6916
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
Solid	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorododecane Sulfonic Acid (10:2 FTS)	9616
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947

Certificate of Accreditation: Supplement

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Solid	
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
N-Ethyl Perfluorooctanesulfonamide (NEtFOSA)	9395
N-Ethyl Perfluorooctanesulfonamidoethanol (NEtFOSE)	9431
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846
N-Methylperfluorooctanesulfonamide (NMeFOSA)	6954
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
N-Methylperfluorooctanesulfonamidoethanol (MeFOSE)	6949
Nonafluoro-3,6-Dioxaheptanoic Acid (NFDHA)	6956
Perfluoro(2-Ethoxyethane)Sulfonic Acid (PFEESA)	6957
Perfluoro-1-Octanesulfonamide (PFOSA)	9665
Perfluoro-3-Methoxypropanoic Acid (PFMPA)	6965
Perfluoro-4-Methoxybutanoic Acid (PFMBA)	6966
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanesulfonic Acid (PFDoS)	6923
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexadecanoic Acid (PFHxDA)	6958
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctadecanoic Acid (PFODA)	6916
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914

Certificate of Accreditation: Supplement

Battelle

141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

	Code
Organic	
PFAS by LC/MS/MS Compliant with Table B-15 of QSM 5.3 or Latest Version by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	90000451
Solid	
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904
Tissue	
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	9490
1H, 1H, 2H, 2H-Perfluorodecane Sulfonic Acid (8:2 FTS)	6948
1H, 1H, 2H, 2H-Perfluorohexane Sulfonic Acid (4:2 FTS)	6946
1H, 1H, 2H, 2H-Perfluorooctane Sulfonic Acid (6:2 FTS)	6947
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA, 3-Perfluoroheptyl Propanoic Acid)	9340
2H,2H,3H,3H-Perfluorooctanoic Acid (5:3 FTCA)	9338
4,4,5,5,6,6,6-Heptafluorohexanoi Acid (3:3 FTCA, 3-Perfluoropropyl Propanoic Acid)	9353
9-Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid (9-Cl-PF3ONS)	6952
Ammonium 4,8-Dioxa-3H-Perfluorononanoate (ADONA)	6953
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) – GenX	9460
N-Ethylperfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	4846
N-Methylperfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	4847
Perfluoro-1-Octanesulfonamide (PFOSA)	9665
Perfluorobutanesulfonic Acid (PFBS)	6918
Perfluorobutanoic Acid (PFBA)	6915
Perfluorodecanesulfonic Acid (PFDS)	6920
Perfluorodecanoic Acid (PFDA)	6905
Perfluorododecanoic Acid (PFDoA)	6903
Perfluoroheptanesulfonic Acid (PFHpS)	9470
Perfluoroheptanoic Acid (PFHpA)	6908
Perfluorohexanesulfonic Acid (PFHxS)	6927
Perfluorohexanoic Acid (PFHxA)	6913
Perfluorononanesulfonic Acid (PFNS)	6929
Perfluorononanoic Acid (PFNA)	6906
Perfluorooctanesulfonic Acid (PFOS)	6931
Perfluorooctanoic Acid (PFOA)	6912
Perfluoropentanesulfonic Acid (PFPeS)	6934
Perfluoropentanoic Acid (PFPeA)	6914
Perfluorotetradecanoic Acid (PFTeDA)	6902
Perfluorotridecanoic Acid (PFTrDA)	9563
Perfluoroundecanoic Acid (PFUnA)	6904

Certificate of Accreditation: Supplement

Battelle
141 Longwater Drive, Suite 202, Norwell, MA 02061
Contact Name: Jonathan Thorn   Phone: 781-681-5565

Accreditation is granted to the facility to perform the following testing:

		Code
Preparation		
Aqueous		
EPA 3510C	Separatory Funnel Liquid-Liquid Extraction	
EPA 3640A MOD (Battelle SOP 5-191)	Gel-Permeation Cleanup	
EPA 3660B MOD (Battelle SOP 5-328)	Sulfur Cleanup	
Solid		
EPA 3640A MOD (Battelle SOP 5-191)	Gel-Permeation Cleanup	
EPA 3660B MOD (Battelle SOP 5-328)	Sulfur Cleanup	
NOAA NOS ORCA 71	Orbital Shaker	
Tissue		
EPA 3640A MOD (Battelle SOP 5-191)	Gel-Permeation Cleanup	
EPA 3660B MOD (Battelle SOP 5-328)	Sulfur Cleanup	
NOAA NOS ORCA 71	Tissuemizer Orbital Shaker	

Footnotes:

> Method codes are typically based on The NELAC Institute (TNI) Laboratory Accreditation Management System (LAMS) and are used to compare to the laboratory reported Performance Test (PT) results. Although the method code may not represent the specific method version, it is the method code used to represent the method/technology used to report PTs. (NC = No Code)

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

EUROFINS LANCASTER LABORATORIES ENVIRONMENT TESTING LLC
2425 New Holland Pike
Lancaster, PA 17601
Kenneth Boley Phone: 717-556-9413

ENVIRONMENTAL

Valid To: November 30, 2024 Certificate Number: 0001.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the laboratory's compliance with the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.4 of the DoD/DOE Quality Systems Manual for Environmental Laboratories, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP-MS Spectrometry, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.-Electronic Probes (pH, F^-, O_2), Oxygen Demand, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, TCLP, Total Organic Carbon, Turbidity, Liquid Chromatography/Mass Spectrometry/Mass Spectrometry, High Resolution Gas Chromatography/Mass Spectrometry

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Demands				
COD	---------------	EPA 410.4	EPA 410.4	---------------
Total Organic Carbon	---------------	EPA 9060A SM 5310C-2014	EPA 9060A SM 5310C-2014	EPA 9060A Lloyd Kahn
Anions				
Ammonia	---------------	EPA 350.1	EPA 350.1	SM 4500-NH3 B/C-2011
Fluoride	---------------	EPA 300.0 EPA 9056A	EPA 300.0 EPA 9056A	EPA 300.0 EPA 9056A
Nitrate (as N)	---------------	EPA 300.0 EPA 353.2 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056A	EPA 300.0 EPA 9056A
Nitrite (as N)	---------------	EPA 300.0 EPA 353.2 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056A	EPA 300.0 EPA 9056A

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Nitrate Nitrite Total	---------------	EPA 300.0 EPA 353.2 EPA 9056A	EPA 300.0 EPA 353.2 EPA 9056A	EPA 300.0 EPA 9056A
Bromide	------------------	EPA 300.0 EPA 9056A	EPA 300.0 EPA 9056A	------------------
Chloride	------------------	EPA 300.0 EPA 9056A	EPA 300.0 EPA 9056A	EPA 300.0 EPA 9056A
Sulfate	------------------	EPA 300.0 EPA 9056A	EPA 300.0 EPA 9056A	EPA 300.0 EPA 9056A
Wet Chemistry				
Acid Volatile Sulfide	------------------	------------------	EPA-821-R-91-100	EPA-821-R-91-100
AVS-SEM Distillation	------------------	------------------	EPA-821-R-91-100	EPA-821-R-91-100
Alkalinity	------------------	SM 2320B-2011	SM 2320B-2011	---------------
Biochemical Oxygen Demand (BOD)	------------------	SM 5210B-2016	SM 5210B-2016	---------------
Carbonaceous Biochemical Oxygen Demand (CBOD	------------------	SM 5210B-2016	SM 5210B-2016	---------------
Corrosivity	------------------	---------------	SW-846 Chapter 7	SW-846 Chapter 7
Conductivity	------------------	SM 2510B-2011	SM 2510B-2011	---------------
Cyanide	------------------	EPA 9012B	EPA 9012B	EPA 9012B
Ferrous Iron	------------------	SM 3500Fe B-2011	SM 3500Fe B-2011	------------------
Filterable Residue (TDS)	------------------	SM 2540C-2015	SM 2540C-2015	---------------
Flashpoint	------------------	EPA 1010A/B	EPA 1010A/B	EPA 1010A/B
Grain Size	------------------	---------------	---------------	ASTM D422 MOD
Hardness	------------------	EPA 130.2 SM 2340B-2011 SM 2340C-2011	EPA 130.2 SM 2340B-2011 SM 2340C-2011	------------------
HEM (Oil&Grease)	------------------	EPA 1664B	EPA 1664B	EPA 9071B
Hexavalent Chromium Digestion	------------------	---------------	---------------	EPA 3060A
Hexavalent Chromium	------------------	EPA 218.6 EPA 7196A EPA 7199	EPA 7196A EPA 7199	EPA 7196A EPA 7199
Ignitability	------------------	---------------	40 CFR 261.21	40 CFR 261.21
Non-filterable Residue (TSS)	------------------	SM 2540D-2015	SM 2540D-2015	---------------
Orthophosphate	------------------	EPA 365.3	EPA 365.3	------------------
Paint Filter	-----------------	-----------------	-----------------	EPA 9095B
pH	------------------	SM 4500 H+B-2011 EPA 9040B/C	EPA 9040B/C	EPA 9045C/D
Phenol	------------------	EPA 9066	EPA 9066	---------------
Reactivity Prep	------------------	---------------	SW-846 Chapter 7.3	SW-846 Chapter 7.3
Reactive Cyanide	-----------------	---------------	EPA 9012B	EPA 9012B
Reactive Sulfide	-----------------	---------------	EPA 9034	EPA 9034

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
SGT-HEM (Total Petroleum Hydrocarbons)	-----------------	EPA 1664B	EPA 1664B	EPA 9071B
Sulfide	------------------	EPA 376.1 EPA 376.2 SM 4500 S2D-2011 SM 4500 S2F-2011	EPA 376.1 EPA 376.2 SM 4500 S2D-2011 SM 4500 S2F-2011	---------------
Total Kjeldahl Nitrogen (TKN)	------------------	EPA 351.2	EPA 351.2	EPA 351.2
Total Phosphorus	------------------	EPA 365.1 SM 4500P F-2011	EPA 365.1 SM 4500P F-2011	EPA 365.1 SM 4500P F-2011
Total Residue	------------------	SM 2540B-2015	SM 2540B-2015	SM 2540G-2015
Metals				
Metals Digestion	------------------	EPA 3005A	EPA 3005A	EPA 3050B
Aluminum	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Antimony	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Arsenic	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Barium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Beryllium	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Boron	------------------	EPA 200.7 EPA 6010D	EPA 6010D	EPA 6010D
Cadmium	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Calcium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Chromium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Cobalt	EPA 200.7	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Copper	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Iron	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Lead	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Lithium	EPA 200.7	EPA 200.7 EPA 6010D	EPA 6010D	EPA 6010D
Molybdenum	------------------	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Magnesium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Manganese	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Mercury	EPA 245.1	EPA 245.1 EPA 7470A	EPA 245.1 EPA 7470A	EPA 7471B
Nickel	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Potassium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Selenium	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Silicon	------------------	EPA 200.7 EPA 6010D	EPA 6010D	EPA 6010D
Silver	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Sodium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Strontium	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Sulfur	EPA 200.7	EPA 200.7 EPA 6010D	EPA 6010D	EPA 6010D
Thallium	EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Thorium	------------------	EPA 6010D	EPA 6010D	EPA 6010D
Tin	EPA 200.7	EPA 200.7 EPA 6010D	EPA 6010D	EPA 6010D
Titanium	------------------	EPA 200.7 EPA 200.8 EPA 6010D	EPA 6010D	EPA 6010D
Tungsten	------------------	EPA 6010D	EPA 6010D	EPA 6010D
Uranium	------------------	EPA 200.8 EPA 6020B	EPA 6020B	EPA 6020B
Vanadium	EPA 200.7	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Zinc	EPA 200.7 EPA 200.8	EPA 200.7 EPA 200.8 EPA 6010D EPA 6020B	EPA 6010D EPA 6020B	EPA 6010D EPA 6020B
Zirconium	------------------	EPA 6010D	EPA 6010D	EPA 6010D
Purgeable Organics (Volatiles)				
Volatile Preparation	------------------	EPA 5030C	EPA 5030C	EPA 5035A
Acetone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Acetonitrile	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Acrolein	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Acrylonitrile	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Allyl chloride	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Amyl Alcohol	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Amyl Methyl Ether	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Butyl Alcohol	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Butyl Formate	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Benzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromochloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromodichloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromoform	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromomethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Butanone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
n-Butylbenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
sec-Butylbenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Butylbenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Carbon disulfide	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Carbon tetrachloride	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Chloro-1,3-butadiene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloroacetonitrile	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1-Chlorobutane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chlorodifluoromethane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Chloroethyl Vinyl Ether	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloroform	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1-Chlorohexane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Chlorotoluene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
4-Chlorotoluene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Cyclohexane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Cyclohexanone	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Di-Isopropyl ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Dibromochloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Dibromo-3-chloropropane	EPA 524.2	EPA 8260C/D EPA 8011	EPA 8260C/D EPA 8011	EPA 8260C/D
Dibromomethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Dibromoethane (EDB)	------------------	EPA 8260C/D EPA 8011	EPA 8260C/D EPA 8011	EPA 8260C/D

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
1,2-Dichlorobenzene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3-Dichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,4-Dichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
trans-1,4-dichloro-2-butene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Dichlorodi-fluoromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1-Dichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Dichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1-Dichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
cis-1,2-Dichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
trans-1,2-Dichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Dichlorofluoromethane	EPA 524.2	---------------	---------------	---------------
1,2-Dichloropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3-Dichloropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2,2-Dichloropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1-Dichloropropene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
cis-1,3-Dichloropropene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
trans-1,3-Dichloropropene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,4-Dioxane	------------------	EPA 8260C/D EPA 8260C/D SIM	EPA 8260C/D EPA 8260C/D SIM	EPA 8260C/D EPA 8260C/D SIM
Ethanol	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethylbenzene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethyl ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethyl Methacrylate	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethyl Tert-Butyl Ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Freon-113	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Gasoline Range Organics (GRO) [Volatile Petroleum Hydrocarbons (VPH)]	------------------	EPA 8015C EPA 8015D EPA 8260C/D NW TPH-Gx MA VPH AK101	EPA 8015C EPA 8015D EPA 8260C/D NW TPH-Gx MA VPH AK101	EPA 8015C EPA 8015D EPA 8260C/D NW TPH-Gx MA VPH AK101
Heptane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Hexane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Hexanone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Hexachlorobutadiene	EPA 524.2			
Hexachloroethane	EPA 524.2			
Isopropyl Alcohol	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Isopropylbenzene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,4-Isopropyltoluene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methylacrylonitrile	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Acetate	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Methyl Acrylate	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Iodide	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methylene Chloride	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Methacrylate	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Tert-Butyl Ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
4-Methyl-2-pentanone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methylcyclohexane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Nitropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Naphthalene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Pentachloroethane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Propionitrile	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
n-Propylbenzene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Styrene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Tert-Amyl Ethyl Ether	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,1,2-Tetrachloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,2,2-Tetrachloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Tetrachloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Tetrahydrofuran	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Toluene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,3-Trichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,4-Trichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,1-Trichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,2-Trichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Trichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Trichlorofluoromethane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,3-Trichloropropane	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,4-Trimethylbenzene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3,5-Trimethylbenzene	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
130BVinyl Acetate	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Vinyl Chloride	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Xylenes, Total	------------------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Xylene (o-Xylene)	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3+1,4-Xylene (m+p Xylene)	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Extractable Organics (Semivolatiles)				
Acenaphthene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Acenaphthylene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Acetophenone	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
2-Acetylaminofluorene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Alkylated PAHs	------------------	EPA 8270D/E SIM	EPA 8270D/E SIM	EPA 8270D/E SIM
4-Aminobiphenyl	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Amino-4,6-dinitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
4-Amino-2,6-dinitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
Aniline	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Anthracene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Atrazine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzaldehyde	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzidine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzoic acid	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzo (a) anthracene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (b) fluoranthene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (k) fluoranthene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (ghi) perylene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (a) pyrene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (e) pyrene	------------------	EPA 8270D/E SIM	EPA 8270D/E SIM	EPA 8270D/E SIM
Benzyl Alcohol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Biphenyl	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
bis (2-Chloroethoxy) Methane	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
bis (2-Chloroethyl) Ether	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
bis (2-Ethylhexyl) Phthalate	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
4-Bromophenylphenyl Ether	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Butyl benzyl Phthalate	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Caprolactam	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Carbazole	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Carbon Range Organics C8-C44 (including subsets of this range i.e. HRO, MRO, ORO, RRO)	------------------	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D
4-Chloroaniline	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Chloro-3-methylphenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Chlorobenzilate	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
1-Chloronaphthalene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Chloronaphthalene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Chlorophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Chlorophenyl phenyl ether	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Chrysene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Cresols (Methyl phenols)	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
cis-/trans-Diallate	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Diamino-6-nitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
2,6-Diamino-4-nitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
Dibenzo (a,h) acridine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Dibenzo (a,h) anthracene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Dibenzofuran	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
1,2-Dichlorobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,3-Dichlorobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,4-Dichlorobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3,3-Dichlorobenzidine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Diesel Range Organics (DRO) [Extractable Petroleum Hydrocarbons (EPH)]	------------------	EPA 8015C EPA 8015D NWTPH DX MA EPH TX1005 AK102/103 AK102/103-SV	EPA 8015C EPA 8015D NWTPH DX MA EPH TX1005 AK102/103 AK102/103-SV	EPA 8015C EPA 8015D NWTPH DX MA EPH TX1005 AK102/103
2,4-Dichlorophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,6-Dichlorophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Diethyl Phthalate	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Dimethoate	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
p-Dimethylaminoazobenze	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
7,12-Dimethylbenz (a) anthracene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Dimethylphenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Dimethyl Phthalate	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
3,3'-Dimethylbenzidine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Di-n-butyl Phthalate	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Di-n-octyl phthalate	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
3,5-Dinitroaniline	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
1,3-Dinitrobenzene	------------------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B MOD
1,4-Dinitrobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Dinitrophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Dinitrotoluene	------------------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B MOD
2,6-Dinitrotoluene	------------------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B MOD
1,4-Dioxane	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Diphenylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Diphenyl ether	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,2-Diphenylhydrazine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Ethyl Methanesulfonate	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Fluoroanthene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Fluorene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Hexachlorobenzene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Hexachlorobutadiene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexachlorocyclo-pentadiene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexachloroethane	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexachloropropene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
Indeno (1,2,3-cd) Pyrene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Isodrin	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Isophorone	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Isosafrole	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3-Methycholanthrene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Methyl-4,6-dinitrophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Methyl methane sulfonate	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1-Methylnaphthalene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
2-Methylnaphthalene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
2-Methylphenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Methylphenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Naphthalene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
1,4-Naphthoquinone	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
1-Naphthylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Naphthylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Nitroquinoline-1-oxide	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Nitroaniline	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3-Nitroaniline	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Nitroaniline	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Nitrobenzene	------------------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B MOD
Nitroglycerin	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
2-Nitrophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Nitrophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Nitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
3-Nitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
4-Nitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
5-Nitro-o-toluidine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitroso-di-n-butylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodiethylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodimethylamine	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
n-Nitrosomethylethylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosomorpholine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodi-n-propylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodiphenylamine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosopiperidine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosopyrrolidine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
2,2-Oxybis (1-chloropropane)	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentachlorobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentachloronitrobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentachlorophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentaerythritol Tetranitrate (PETN)	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
Perylene	------------------	EPA 8270D/E SIM	EPA 8270D/E SIM	EPA 8270D/E SIM
Phenacetin	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Phenanthrene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Phenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Picoline	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pronamide	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pyrene	------------------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Pyridine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Safrole	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,2,4,5- Tetrachlorobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,3,4,6-Tetrachlorophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Tetraethyl dithiopyrophosphate	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Tetraethy lead	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Tetryl	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
Thionazin	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
o-Toluidine	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,2,4-Trichlorobenzene	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,3,5-Trinitrobenzene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
2,4,5-Trichlorophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4,6-Trichlorophenol	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
O,O,O-Tri-ethylphosphorothioate	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4,6-Trinitrotoluene	------------------	EPA 8330B	EPA 8330B	EPA 8330B MOD
Organochlorine Pesticides				
Aldrin	------------------	EPA 8081B	EPA 8081B	EPA 8081B
alpha-BHC	------------------	EPA 8081B	EPA 8081B	EPA 8081B
beta-BHC	------------------	EPA 8081B	EPA 8081B	EPA 8081B
delta-BHC	------------------	EPA 8081B	EPA 8081B	EPA 8081B
gamma-BHC (Lindane)	------------------	EPA 8081B	EPA 8081B	EPA 8081B
alpha-Chlordane	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Chlordane (Technical)	------------------	EPA 8081B	EPA 8081B	EPA 8081B
2,4’-DDD	------------------	EPA 8081B	EPA 8081B	EPA 8081B
2,4’-DDE	------------------	EPA 8081B	EPA 8081B	EPA 8081B
2,4’-DDT	------------------	EPA 8081B	EPA 8081B	EPA 8081B
4,4’-DDD	------------------	EPA 8081B	EPA 8081B	EPA 8081B
4,4’-DDE	------------------	EPA 8081B	EPA 8081B	EPA 8081B
4,4’-DDT	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Dieldrin	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Dinoseb	------------------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Endosulfan I (alpha)	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Endosulfan II (beta)	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Endosulfan Sulfate	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Endrin	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Endrin Aldehyde	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Endrin Ketone	------------------	EPA 8081B	EPA 8081B	EPA 8081B
gamma-Chlordane	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Heptachlor	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Heptachlor Epoxide	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Hexachlorobenzene	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Hexachlorocyclopentadiene	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Methoxychlor	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Mirex	------------------	EPA 8081B	EPA 8081B	EPA 8081B
Toxaphene	------------------	EPA 8081B	EPA 8081B	EPA 8081B

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
PCBs (Aroclors)				
PCB-1016 (Arochlor)	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1221	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1232	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1242	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1248	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1254	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1260	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1262	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1268	------------------	EPA 8082A	EPA 8082A	EPA 8082A
PCB congeners (209)	------------------	EPA 1668A EPA 1668C	EPA 1668A EPA 1668C	EPA 1668A EPA 1668C
Herbicides				
2,4,5-T	------------------	EPA 8151A	EPA 8151A	EPA 8151A
2,4,5-TP (Silvex)	------------------	EPA 8151A	EPA 8151A	EPA 8151A
2,4-D	------------------	EPA 8151A	EPA 8151A	EPA 8151A
2,4-DB	------------------	EPA 8151A	EPA 8151A	EPA 8151A
Dalapon	------------------	EPA 8151A	EPA 8151A	EPA 8151A
Dicamba	------------------	EPA 8151A	EPA 8151A	EPA 8151A
Dichlorprop	------------------	EPA 8151A	EPA 8151A	EPA 8151A
Dinoseb	------------------	EPA 8151A	EPA 8151A	EPA 8151A
MCPA	------------------	EPA 8151A	EPA 8151A	EPA 8151A
MCPP	------------------	EPA 8151A	EPA 8151A	EPA 8151A
Pentachlorophenol	------------------	EPA 8151A	EPA 8151A	EPA 8151A
PCB Homologues				
Monochlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Dichlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Trichlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Tetrachlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Pentachlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Hexachlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Heptachlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Octachlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Nonachlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Decachlorobiphenyls	------------------	EPA 680	EPA 680	EPA 680
Dioxins/Furans				
2,3,7,8-TCDD	EPA 1613B	EPA 8290A	EPA 8290A	EPA 8290A
2,3,7,8-TCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8-PeCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
2,3,4,7,8-PeCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8-PeCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,7,8-HxCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,6,7,8-HxCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
2,3,4,6,7,8-HxCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8,9-HxCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,7,8,-HxCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
1,2,3,6,7,8-HxCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8,9-HxCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,6,7,8-HpCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,7,8,9-HpCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,6,7,8-HpCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
OCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
OCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total HpCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total HpCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total HxCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total HxCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total PeCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total PeCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total TCDD	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Total TCDF	------------------	EPA 8290A	EPA 8290A	EPA 8290A
Misc. Headspace Analysis				
Carbon dioxide	------------------	RSK-175	RSK-175	------------------
Ethane	------------------	RSK-175	RSK-175	------------------
Ethene	------------------	RSK-175	RSK-175	------------------
Methane	------------------	RSK-175	RSK-175	------------------
Acetylene	------------------	RSK-175	RSK-175	------------------
Propane	------------------	RSK-175	RSK-175	------------------
Hazardous Waste Characteristics				
Toxicity Characteristic Leaching Procedure	------------------	------------------	EPA 1311	EPA 1311
Synthetic Precipitation Leaching Procedure	------------------	------------------	EPA 1312	EPA 1312
ASTM Leaching Procedure	------------------	------------------	ASTM D3987-12	ASTM D3987-12
Other				
Perchlorate	------------------	EPA 6850	EPA 6850	EPA 6850
Hydrazine	------------------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Formaldehyde	------------------	------------------	EPA 8315A	EPA 8315A
Methylhydrazine	------------------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
1,1-Dimethylhydrazine	------------------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Acetic Acid	------------------	EPA 8015D	EPA 8015D	------------------
Butryic acid	------------------	EPA 8015D	EPA 8015D	------------------
Lactic Acid	------------------	EPA 8015D	EPA 8015D	------------------
Propionic Acid	------------------	EPA 8015D	EPA 8015D	------------------
Pyruvic Acid	------------------	EPA 8015D	EPA 8015D	------------------
Citric Acid	------------------	EPA 8015D	EPA 8015D	------------------
Formic Acid	------------------	EPA 8015D	EPA 8015D	------------------
Oxalic Acid	------------------	EPA 8015D	EPA 8015D	------------------
Quinic Acid	------------------	EPA 8015D	EPA 8015D	------------------
Succinic Acid	------------------	EPA 8015D	EPA 8015D	------------------

Parameter/Analyte	**Drinking Water**	**Non-Potable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Tartaric Acid	------------------	EPA 8015D	EPA 8015D	------------------
Volatile Preparation	------------------	EPA 5030C	EPA 5030C	EPA 5035A
Organic Extraction/Cleanup	------------------	EPA 3510C EPA 3511 EPA 3660B, 3620C, 3665A	EPA 3510C EPA 3511 EPA 3660B, 3620C, 3665A	EPA 3546 EPA 3550C EPA 3660B, 3620C, 3665A, 3640A

Parameter/Analyte	**Drinking Water**	**Nonpotable Water**	**Solid Haz.Waste**	**Tissue**
Per and Polyfluoroalkyl Substances (PFAS)				
N-ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
N-methyl perfluoroctanesulfonamidoacetic Acid (NMeFOSAA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorobutanesulfonic Acid (PFBS)	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorodecanoic Acid (PFDA) CASRN: 335-76-2	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorododecanoic Acid (PFDoA)	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoroheptanoic Acid (PFHpA) CASRN: 375-85-9	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorohexanesulfonic Acid (PFHxS) CASRN: 355-46-4	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste	Tissue
Perfluorohexanoic Acid (PFHxA)	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorononanoic Acid (PFNA)	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorooctanesulfonic Acid (PFOS)	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorooctanoic Acid (PFOA)	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorotetradecanoic Acid (PFTeDA) CASRN: 376-06-7	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorotridecanoic Acid (PFTrDA) CASRN: 72629-94-8	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoroundecanoic Acid (PFUnA) CASRN: 2058-94-8	EPA 537 EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Hexafluoropropylene oxide dimer acid (HF- PODA)	EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
4,8-Dioxa-3*H*-perfluorononanoic acid (ADONA)	EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste	Tissue
9-Chlorohexadecafluoro-3-oxanonane-1- sulfonic acid (9Cl-PF3ONS)	EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
11-Chloroeicosafluoro-3-oxaundecane-1- sulfonic acid (11Cl-PF3OUdS)	EPA 537.1 EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorobutanoic Acid (PFBA)	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoropentanoic Acid (PFPeA) CASRN: 2706-90-3	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2FTS)	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2-FTS) CASRN: 39108-34-4	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoropentanesulfonic Acid (PFPeS)	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2-FTS) CASRN: 27619-97-2	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoroheptanesulfonic Acid (PFHpS) CASRN: 375-92-8	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste	Tissue
Perfluorononanesulfonic Acid (PFNS)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorodecanesulfonic Acid (PFDS)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
10:2 Fluorotelomersulfonic Acid (10:2-FTS)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15	-------------
Perfluorododecanesulfonic Acid (PFDoS)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluorohexadecanoic Acid (PFHxDA)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15	-------------
Perfluorooctadecanoic Acid (PFODA)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15	-------------
Perfluorooctanesulfonamide (PFOSA)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE) CASRN: 24448-09-7	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
N-methyl perfluorooctanesulfonamide (NMeFOSA)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)	-------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste	Tissue
N-ethylperfluorooctanesulfonamide (NEtFOSA)	------------	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoro-3-methoxypropanoic acid (PFMPA) CASRN: 377-73-1	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 533	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
3-Perfluoropropylpropanoic acid (3:3 FTCA) CASRN: 356-02-5	---	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
2*H*,2*H*,3*H*,3*H*-Perfluorooctanoic acid (5:3 FTCA)	---	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633
3-Perfluoroheptylpropanoic acid (7:3 FTCA) CASRN: 812-70-4	---	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	PFAS by LCMSMS Compliant with QSM 5.3/5.4 Table B-15 EPA Draft Method 1633	EPA Draft Method 1633

End of DoD ELAP section of scope

In addition, in recognition of the successful completion of the A2LA evaluation process (including an assessment of the laboratory's compliance with ISO IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and for the test methods applicable to Kentucky Statute KRS 224.60-130(2)(a), and for the test methods applicable to the Wyoming Storage Tank Remediation Laboratory Accreditation Program), accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP-MS Spectrometry, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.-Electronic Probes (pH, F^-, O_2), Oxygen Demand, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, TCLP, Total Organic Carbon, Turbidity, Liquid Chromatography/Mass Spectrometry/Mass Spectrometry, High Resolution Gas Chromatography/Mass Spectrometry

Parameter/Analyte	**Tissue**	**Nonpotable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Other				
Perchlorate	Food & Food Products EPA 6850	EPA 6850	EPA 6850	EPA 6850
Hydrazine	-------------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Methylhydrazine	-------------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
1,1-Dimethylhydrazine	-------------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Volatile Preparation	-------------	EPA 5030C	EPA 5030C	EPA 5035A
Organic Extraction/ Cleanup	EPA 3546 EPA 3550C EPA 3660B EPA 3620C EPA 3665A EPA 3640A	EPA 3510C EPA 3511 EPA 3660B EPA 3620C EPA 3665A	EPA 3510C EPA 3511 EPA 3660B EPA 3620C EPA 3665A	EPA 3546 EPA 3550C EPA 3660B EPA 3620C EPA 3665A EPA 3640A

Parameter/Analyte	**Tissue**	**Nonpotable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Kentucky UST Program				
Metals				
Arsenic	-------------	-----------------	EPA 6010B	EPA 6010B
Barium	-------------	-----------------	EPA 6010B	EPA 6010B
Cadmium	-------------	-----------------	EPA 6010B	EPA 6010B
Chromium	-------------	-----------------	EPA 6010B	EPA 6010B
Lead	-------------	-----------------	EPA 6010B	EPA 6010B
Mercury	-------------	-----------------	EPA 7470A	EPA 7471A
Selenium	-------------	-----------------	EPA 6010B	EPA 6010B
Silver	-------------	-----------------	EPA 6010B	EPA 6010B
Purgeable Organics (Volatiles)				

Parameter/Analyte	**Tissue**	**Nonpotable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
Diesel Range Organics (DRO)	--------------	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D
Gasoline Range Organics (GRO)	--------------	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D
Wyoming Storage Tank Program				
Metals				
Cadmium	--------------	------------------	EPA 6010C	EPA 6010C
Chromium	--------------	------------------	EPA 6010C	EPA 6010C
Chromium (Total, hexavalent)	--------------	------------------	EPA 7196A	EPA 7196A
Lead	--------------	------------------	EPA 6010C	EPA 6010C
Purgeable Organics (Volatiles)				
Volatile Preparation	--------------	------------------	EPA 5030C	EPA 5035A
Benzene	--------------	------------------	EPA 8260D	EPA 8260D
1,2-Dichloroethane	--------------	------------------	EPA 8260D	EPA 8260D
1,2-Dibromoethane	--------------	------------------	EPA 8011	EPA 8011
Diisopropyl Ether	--------------	------------------	EPA 8260D	EPA 8260D
Ethyl Benzene	--------------	------------------	EPA 8260D	EPA 8260D
Ethyl tert-butyl Ether	--------------	------------------	EPA 8260D	EPA 8260D
Methyl tert-butyl Ether	--------------	------------------	EPA 8260D	EPA 8260D
Naphthalene	--------------	------------------	EPA 8260D	EPA 8260D
Toluene	--------------	------------------	EPA 5030C EPA 8260D	EPA 8260D
Tert-amyl Methyl Ether	--------------	------------------	EPA 8260D	EPA 8260D
Tert-butyl Alcohol	--------------	------------------	EPA 8260D	EPA 8260D
Xylenes, total	--------------	------------------	EPA 8260D	EPA 8260D
Gasoline Range Organics (GRO C6-C10)	--------------	------------------	EPA 8260D	EPA 8260D
Extractable Organics (Semivolatiles)				
Diesel Range Organics (DRO C10-C32)	--------------	------------------	EPA 8015C w/ EPA 3630 cleanup	EPA 8015C w/ EPA 3630 cleanup

End of KY, WY, and ISO 17025 section of scope

In recognition of the successful completion of the A2LA evaluation process, including an assessment of the laboratory's compliance with ISO/IEC 17025:2017 accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and, in the analyte, categories identified below:

Food and Feed (WHO 29)	**Food/Feed**
2,3,7,8-TCDD	EPA 1613B
2,3,7,8-TCDF	EPA 1613B
1,2,3,7,8-PeCDF	EPA 1613B
2,3,4,7,8-PeCDF	EPA 1613B
1,2,3,7,8-PeCDD	EPA 1613B
1,2,3,4,7,8-HxCDF	EPA 1613B
1,2,3,6,7,8-HxCDF	EPA 1613B
2,3,4,6,7,8-HxCDF	EPA 1613B
1,2,3,7,8,9-HxCDF	EPA 1613B
1,2,3,4,7,8-HxCDD	EPA 1613B
1,2,3,6,7,8-HxCDD	EPA 1613B
1,2,3,7,8,9-HxCDD	EPA 1613B
1,2,3,4,6,7,8-HpCDF	EPA 1613B
1,2,3,4,7,8,9-HpCDF	EPA 1613B
1,2,3,4,6,7,8-HpCDD	EPA 1613B
OCDF	EPA 1613B
OCDD	EPA 1613B
Food and Feed (WHO 29)	**Food/Feed**
6 marker PCBs (PCB28, PCB52, PCB101, PCB138, PCB153, and PCB180)	EPA 1668C
(PCB77, PCB81, PCB105, PCB114, PCB118, PCB123, PCB126, PCB156, PCB157, PCB167, PCB169, and PCB189)	EPA 1668C

Parameter/Analyte	**Tissue**	**Nonpotable Water**	**Solid Hazardous Waste**	
			Aqueous	**Solid**
12 Dioxin-like PCBs (dl-PCBs)/coplanar PCBs (PCB77, PCB81, PCB105, PCB114, PCB118, PCB123, PCB126, PCB156, PCB157, PCB167, PCB169, & PCB189)	EPA 1668C	------------------	---------------	---------------

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste
Per and Polyfluoroalkyl Substances (PFAS)			
N-ethyl perfluorooctanesulfonamidoacetic acid (NetFOSAA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorobutanesulfonic acid (PFBS)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorodecanoic acid (PFDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorododecanoic acid (PFDoDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoroheptanoic acid (PFHpA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorohexanesulfonic acid (PFHxS)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorohexanoic acid (PFHxA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorononanoic acid (PFNA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctanesulfonic acid (PFOS)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctanoic acid (PFOA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorotetradecanoic acid (PFTeDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorotridecanoic acid (PFTrDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoroundecanoic acid (PFUnDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (HFPODA)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
4,8-Dioxa-3H-perfluorononanoic acid (DONA)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoro-n-butanoic acid (PFBA)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoro-n-pentanoic acid (PFPeA)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod

Parameter/Analyte	**Drinking Water**	**Nonpotable Water**	**Solid Haz.Waste**
8:2 Fluorotelomersulfonic acid (8:2FTS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
4:2 Fluorotelomersulfonic acid (4:2-FTS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoropentanesulfonic acid (PFPeS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
6:2 Fluorotelomersulfonic acid (6:2-FTS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoroheptanesulfonic acid (PFHpS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorononanesulfonic acid (PFNS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorodecanesulfonic acid (PFDS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
10:2 Fluorotelomersulfonic acid (10:2-FTS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorododecanesulfonic acid (PFDoDS)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorohexadecanoic acid (PFHxDA)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctadecanoic acid (PFODA)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctanesulfonamide (PFOSA)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol (NMePFOSAE)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
N-methylperfluoro-1-octanesulfonamide (NMePFOSA)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol (NEtPFOSAE)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
N-ethylperfluoro-1-octanesulfonamide (NEtPFOSA)	---------------------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod

Accredited Laboratory

A2LA has accredited

EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL, LLC

Lancaster, PA

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.4 of the DoD/DOE Quality System Manual for Environmental Laboratories (QSM), accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated *April 2017*).

Presented this 21st day of November 2022.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1.01
Valid to November 30, 2024

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

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Appendix C

Quality Control Plan

Appendix C

Quality Management Plan
PFAS Fingerprinting and Background Study

Multiple Air Force Bases

Prepared for:

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814

Under Contract No./ Task Order No.
W91238-23-D-0023 / W91238-23-F0086

Prepared by:

Sustainment and Restoration Services, LLC
209 E. Victoria Street
Santa Barbara, California 93101

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Table of Contents

TABLES (IN TEXT)

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AHA	activity hazard analysis
ANG	Air National Guard
CQC	Contractor Quality Control
CQM	Contractor Quality Management
DAF	Department of the Air Force
DFOW	definable feature of work
DQCR	Daily Contractor Production and QC Report
ERPIMS	Environmental Resources Program Information Management System
FTL	Field Team Leader
IDW	investigation derived waste
OESC	Oneida Engineering, Science, Construction Group
OTIE	Oneida Total Integrated Enterprises, LLC
PFAS	per- and polyfluoroalkyl substances
PM	Project Manager
PMP	Project Management Plan
PWS	Performance Work Statement
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCD	Quality Control Directive
QC Plan	Quality Control Plan
QMP	Quality Management Plan
SOP	standard operating practice
SRS	Sustainment and Restoration Services, LLC
SSHO	Site Safety and Health Officer
TO	task order
UFGS	Unified Facilities Guide Specifications
UFP-QAPP	Unified Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers

1.0 OVERVIEW

Sustainment and Restoration Services, LLC (SRS) has been awarded Contract W91238-23-D-0023, Task Order No. W91238-23-F-0086 by the United States Army Corps of Engineers (USACE) Sacramento District. The project scope includes performance of per- and polyfluoroalkyl substances (PFAS) fingerprinting investigations and background studies at multiple Department of the Air Force (DAF) installations. This Quality Management Plan will be used by SRS to execute the performance objectives described in the Programmatic Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP). SRS will be supported by sister company Onieda Total Integrated Enterprises (OTIE), together referred to herein as Oneida. Oneida will be supported by subcontractor Battelle, collectively referred to as the Oneida Team.

Work on this contract, including quality control (QC), is performed under the direction of the USACE and DAF. Work will only proceed after approval and authorization from USACE and/or DAF.

This QMP describes the Contractor Quality Control (CQC) program for the work that Oneida will implement while conducting PFAS Fingerprinting and Background Studies. The QMP will be used during this contract and amended when necessary to address the specific needs outlined within the Performance Work Statement (PWS). This QMP follows the Unified Facilities Guide Specifications (UFGS) 01 45 00 – Contractor Quality Control.

This QMP will be updated by amendments, as necessary. Amendments to the QMP will be included in Attachment F.

In this QMP, the terms “compliance,” “compliant,” “non-compliance,” and “non-compliant” refer to whether or not work meets the requirements of the contract documents.

1.1 PROJECT WORK STATEMENTS, CONTRACT CLAUSES, AND PROPOSALS

Performance work statements, contract clauses, and proposals are the primary contract documents. These documents specify the scope of the project, establish administrative requirements, and provide reference to other contract documents.

1.2 VARIANCES AND CHANGE ORDERS

Following issuance of a contract, the need for modifying or clarifying the original contract documents to address new and changed requirements may arise. Modifications and clarifications are not unusual and will be managed using established procedures. Modifications and clarifications will be addressed in properly developed variances and change orders.

- Variances are technical directives issued by the USACE Project Manager (PM) to clarify or provide minor modification to the contract documents without changing project costs or project scope.
- Change orders are significant modifications to contract documents that have project cost impact, project period of performance impact, or change of scope impact. The USACE Contracting Officer, in accordance with the requirements of the Federal Acquisition Regulations, is the only person with authority to issue change orders.

2.0 CONTRACTOR QUALITY MANAGEMENT SYSTEM OVERVIEW

Oneida’s contractor quality management (CQM) system for this project is based on the three phases of control established by USACE and the requirements of UFGS (01 45 00.10 – Quality Control for Minor Construction) and 01 45 00 “Contractor’s Quality Control.” The CQM system consists of plans, procedures, and organization necessary to produce an end product that complies with contract requirements.

Effective CQC is established and maintained on a program or project through execution of the following elements:

- CQC personnel organization with clearly defined roles and responsibilities
- QC Plan, which consists of Oneida’s corporate Quality Management Plan, the Programmatic UFP-QAPP and installation-specific UFP-QAPP addenda for this project
- CQC meetings (incorporated in project and task preparatory planning and kickoff meetings, and daily tailgates)
- List of definable features of work (DFOWs)
- Submittal procedures
- Three phases of control (preparatory, initial, and follow-up) and QC oversight of project activities
- Testing requirements
- Procedures to complete construction deficiencies/rework items
- Documentation procedures
- Close-out procedures
- References

Each of these elements is described in this QMP.

3.0 CQC PERSONNEL ORGANIZATION

The personnel roles and responsibilities for the project are discussed below. Attachment A-1 contains the designation/appointment letters provided by the Oneida Program Manager for the Project QC Manager (QC Supervisor) and Alternate Project QC Manager.

3.1 PLAN ADMINISTRATION

Work for this project is being conducted under Contract No. W91238-23-D-0023 / Task Order No. W91238-23-F-0086. Work on this task order is performed under the direction of the USACE, Sacramento District with oversight provided by the DAF (Air Force Civil Engineer Center [AFCEC] and Air National Guard [ANG]).

The current project team for the USACE is as follows:

- Jessica Faragalli, Program Manager
- Daniel Czech, Contracting Officer
- Mike Riggle, Contracting Officer's Representative

3.1.1 Project Organization

SRS is the prime contractor and will perform all project management and oversight for the project activities. The core management team is provided in Table 1 and shown on the Organizational Chart in the Project Management Plan (PMP; SRS 2023) and Programmatic UFP-QAPP. Attachment A-2 includes staff resumes. Certifications for installation-specific field QC managers/site field team leads (FTLs)/site safety and health officers (SSHOs) will be provided to USACE prior to initiation of fieldwork at each installation.

Table 1 Oneida Project Quality Control Team

Project Role	Personnel
Corporate QC Manager	Matthew Van Beek, PE
Corporate Health and Safety Manager	Bradley Kuntz, CSP, CIH, CHMM, SMS
Program Manager	Jacques Marcillac, CEG, CHG
Project Manager (Oneida PM)	Megan Duley, PE
Project QC Manager or QC Supervisor (office)	Robert Price, PG, CEG
Alternate QC Manager (office)	Kristen Carlyon Peyton, CHMM
Field QC Manager or Site FTL or SSHO	Installation-specific (to be determined [TBD])

3.1.1.1 Contractor Quality Control Supervisor

The Corporate QC Supervisor, Matthew Van Beek, oversees all Oneida QA/QC activities, and will ensure that appropriate resources, training, and lines of authority are established to efficiently support the projects. The Corporate QC Manager will interface with the Oneida Project QC Manager and Oneida PM to ensure that project needs are being met.

3.1.1.2 Project Quality Control Manager

The Project QC Manager (QC Supervisor) and alternate Project QC Manager are listed in Table 1. They have been designated by Oneida's Program Manager to ensure the project is executed in accordance with the QC Plan. The Project QC Manager will report to the Oneida PM and will have direct communication with the FTL and the Field QC Manager to assist in project QC.

The Project QC Manager will provide overall project quality control oversight and advice for implementation of the scope of work and will coordinate correspondence and submittals to the USACE PM regarding QC issues. The Project QC Manager has the appropriate knowledge and experience to determine whether work is being performed in compliance with the project plans and specifications.

The Project QC Manager is responsible for certifying that the work activities have been completed in accordance with the contract specifications and PWS.

The Project QC Manager has the authority to issue a stop work order until corrective measures for QC are implemented. If a corrective measure is implemented, the Project QC Manager will verify that the corrective action approved by the Oneida PM has been implemented by the FTL.

3.1.1.3 Field Quality Control Manager

The Field QC Manger will work in close coordination with the Project QC Manager and will coordinate with the FTL as needed to implement the sampling and analysis plan in the field and ensure that all environmental compliance needs are being met. The Field QC Manger also will track corrective actions and report progress to the Project QC Manager and participate in preparatory, initial phase, and follow up meetings. At each installation, the Field QC Manger and FTL will coordinate to achieve contract compliance and to stop work when quality or safety objectives are not met.

3.1.1.4 Field Team Leader

For each installation, the FTL will be responsible for all work activities. The FTL will maintain a physical presence at the site at times when site work is being performed and will report directly to the Oneida PM.

The FTL has the authority to stop work for safety violations and remove personnel that fail to comply with the safety program, including subcontractor personnel.

3.1.1.5 Site Safety Health Officer

For each installation, the SSHO will be responsible for site safety during work at the project site. The SSHO will oversee safety for all project activities at times when site work is being performed and will report directly to the Oneida PM.

The SSHO will also track site safety and health corrective actions and report progress to the Oneida PM and FTL. The SSHO will coordinate with the FTL to achieve contract compliance and to stop work when safety objectives are not met. The SSHO has the authority to stop work for safety violations and remove personnel that fail to comply with the safety program, including subcontractor personnel.

4.0 QUALITY CONTROL PLANS AND PROCEDURES

There are three levels of documentation that will be used to define Oneida QC requirements: Corporate, Contract, and task order (TO) Level as outlined in Table 2.

Table 2 Corporate, Contract, and Task Order Levels of Documentation

Corporate Level
Oneida Corporate Quality Management Plan (QMP)
Oneida Field Standard Operating Practices (SOPs)
Contract Level
Quality Control Directives (QCD)
TO Level
Programmatic UFP-QAPP/ and UFP-QAPP Addenda
QMP
Project-Specific Submittals
Project Schedule
Submittal Register
Field QC Documentation
Inspection/Testing Reports

4.1 ONEIDA CORPORATE QMP

The Oneida Corporate QMP is used to prepare contract-specific QC documentation, including this QC Plan. This document will be referenced where appropriate in the project-specific QC documentation.

4.2 STANDARD OPERATING PRACTICES

Oneida Corporate SOPs will be used to implement routine technical tasks as described in the Work Plans. SOPs related to the work to be performed are appended to the UFP-QAPP. The SOPs may be supplemented with additional procedures if required; any deviations from the SOPs will be detailed in the Fingerprinting and Background Study reports.

4.3 QUALITY MANAGEMENT PLAN

This QMP has been developed to establish the CQC program that Oneida will implement for the project. It forms the basis for all project-specific QC documentation to be prepared for the contract.

4.4 QUALITY CONTROL DIRECTIVES

The Oneida QMP is implemented through QCDs. The QCDs are detailed procedural supplements, including instructions and forms, based on UFGS 01 45 00N.

5.0 CQC MEETINGS

Three types of meetings will be held to facilitate appropriate QC during execution of work:

- QMP Meeting (which can be incorporated in project preparatory planning and kickoff meetings)
- Coordination and Mutual Understanding Meeting (which can be incorporated in project preparatory planning and kickoff meetings)
- CQC Meetings (which can be incorporated in task preparatory planning and kickoff meetings, and daily tailgates)

QMP Meeting – Prior to submission of the QMP, Oneida and the Contracting Officer held a project kickoff meeting which included discussion of the CQC requirements for the contract.

Coordination and Mutual Understanding Meeting – Oneida will meet with the Contracting Officer if requested to discuss Oneida's CQC system. During the meeting, a mutual understanding of the CQC system will be developed. The following may be discussed: CQC forms for documenting the operations, control activities, testing, and administration of the system for both on-site and off-site work, and the coordination of Oneida's management, lines of communication, production, and QC personnel. There may be occasions when either party may wish to have another meeting to reconfirm mutual understandings, acquaint a new Project QC Manager with the contract requirements, or address deficiencies in the CQC system or procedures.

CQC Meetings – After the start of any work activities, the Field QC Manager will routinely conduct CQC meetings at the work site with the FTL and other QC staff. Frequency of these meetings will be dictated by the nature of the project and PWS requirements. Other personnel, including the Contracting Officer, are welcome to attend this meeting. The following topics will be addressed as applicable:

- Review minutes of previous meeting
- Review Accident Prevention Plan and Site Safety and Health Plan
- Review schedule and status of work
- Review status of submittals
- Review work to be accomplished between this and the next meeting
- Resolve QC and production issues
- Address items that may require revision to the QC Plan

6.0 DEFINABLE FEATURES OF WORK

One of the initial tasks during the planning execution of a contract is to establish the DFOWs. The process of CQM is applied to each DFOW. Where non-construction DFOWs are listed, a CQM-certified QC manager will not be required for full time onsite oversight.

A DFOW is a task that is separate from other tasks and has distinct QC requirements. In general, each specific task within the PWS that has a construction component and results in a physical product may be considered a DFOW. However, there may be occasions when more than one DFOW may exist under a single specification or PWS task.

It will be the Project QC Manager's responsibility to determine a reasonable set of DFOWs that will facilitate CQC and the three phases of construction QC, as further described in Section 8.0.

The base tasks of the PWS along with DFOWs for this project are included in Table 3.

Table 3 Performance Work Statement Task Matrix with Definable Features of Work

Project Task	PWS Reference	Definable Feature of Work (DFOW)
Project Management	4.1.1, 4.2.1, 4.3.1, 4.4.1-4.4.6, 10	*Not defined as features of work for the CQC program.*
Project Planning	6.1.1.1, 6.1.1.2	
Field Work	13.5, 13.6, 13.7	Temporary Monitoring Well Installation
		Non-construction DFOWs Sampling and analysis tasks Sampling of groundwater, surface water, and soil
Data Analysis and Reporting	6.1.2	Data deliverables and reporting

NOTES

Quality for Project Management and Planning will be evaluated by key milestones listed in the PMP.

Table 4, below, cross-references the DFOWs with the PWS and planning document specifications for this project. These DFOWs are further described in the UFP-QAPP Worksheet #14. Activities associated with the project will be conducted in accordance with the Programmatic UFP-QAPP and UFP-QAPP addenda; approved submittals; and procedures which provide specific methods and requirements for DFOW implementation. Any changes or updates to Table 4 can be discussed at project QC meetings and documented as an amendment to this QMP. Where non-construction activities are listed, a CQM-certified QC manager will not be required for full time onsite oversight.

Table 4 Definable Features of Work Descriptions and Matrix

PWS Ref.	Project Task	DFOW	Task Lead	QC Lead	Document References and Specification	Key Milestones / Deliverables to be Assessed	Performance Threshold per PWS Technical Exhibit 1
13.5 13.6 13.7	Fieldwork Includes the support tasks to complete the DFOWs: • Soil sampling • Groundwater sampling • Surface water sampling	Groundwater temporary monitoring well installation (including drilling)	Installation Specific (TBD)	Robert Price and Kristen Carlyon Peyton	UFP-QAPP WS 14 & 16, 17, and 21 UFP-QAPP SOPs	Boring log Purge logs	USACE acceptance of documents and submittals.
		Non-construction DFOWs Sampling and analysis tasks • groundwater gauging and sampling • soil sampling • surface water sampling	Installation Specific (TBD)	Robert Price and Kristen Carlyon Peyton	UFP-QAPP WS 14 & 16, 17, and 21 UFP-QAPP SOPs	Purge logs Sampling logs	
6	Reporting	Data Deliverables and Reporting	Installation Specific (TBD)	Robert Price and Kristen Carlyon Peyton	UFP-QAPP WS 14 & 16, 17, and 21 UFP-QAPP SOPs	Subsurface data ERPIMS submittals Installation specific Fingerprinting and Background Study Reports (draft and final).	

NOTE

ERPIMS = Environmental Resources Program Information Management System

Boring logs, purge logs, and other field documentation will be included in installation-specific Fingerprinting and Background Study Reports (draft and final versions). Lysimeter sampling (where relevant) will be conducted in accordance with groundwater sampling requirements.

7.0 SUBMITTAL PROCEDURES

Submittals regulate the timely flow of materials to be incorporated into the work of each definable feature and demonstrate that proposed materials, equipment, et al., are in compliance with the work plans and specifications. This section outlines the procedures for managing, scheduling, reviewing, and certifying submittals. These procedures will be used for submittals required of Oneida and its subcontractors.

Due to the nature of this project, most or all of the submittals will be PWS-specified work planning documents, QC forms, test results and the Fingerprinting and Background Study Reports. Each of these submittals will be uploaded to a private password-protected SharePoint site provided by Oneida, which will be used as supplemental management tools. SharePoint site information below (password required): https://workspaces.oescgroup.com/pfasfbgs/.

7.1 SUBMITTAL MANAGEMENT

As the Prime Contractor, SRS has responsibility for overall management and control of submittals. The submittal process will be keyed to the project schedule through the combined efforts of the Project QC Manager and the Oneida PM. Ultimately, the PM is responsible for and must certify that the submittals comply with contract plan and specification requirements. To accomplish this task, the PM will have the following duties:

- Integrate the submittal process into the project planning.
- Delegate submittal responsibilities to the proper individuals on the project team.
- Coordinate with subcontractor for the timely receipt of submittals required of them.
- Perform a detailed review of all submittals to ensure that they comply fully with contract specifications.
- Check the submittal schedule requirements against the accepted work schedule.
- Check and approve all items before submittal.
- Regularly review the submittal register to ensure that the register reflects current information.
- Fully describe, identify, and justify all variations in the transmittal package(s).
- Ensure that work does not begin without the properly accepted submittals.

The Deputy Project Managers will serve as Submittals Managers and will be responsible for the following:

- Prepare and maintain the project Submittal Register.
- Prepare and organize all submittal items before inspection and approval by Project QC Manager.
- Maintain and adjust dates on the Submittal Register as directed by the Project QC Manager and the USACE and DAF.
- Organize and maintain all submittals (accepted and unaccepted) for convenient reference.

7.2 SUBMITTAL SCHEDULING

All required submittals will be provided by Oneida in time for the review, approval, procurement, delivery, and QC Preparatory Phase of an item before it is needed for work activities. Submittals covering interrelated items or components forming a system will be coordinated and submitted concurrently.

The schedule dates on the initial Submittal Register will be keyed to the project schedule to ensure the timely flow of materials. Interval updates will be made to the Submittal Register at least every 30 days. Oneida will control procurement to ensure that each submittal is made on or before the scheduled submittal date on the accepted Submittal Register.

The current project schedule is available in the PMP and Programmatic UFP-QAPP. Proposed sample locations and fieldwork schedules will be presented in the installation-specific UFP-QAPP addenda.

8.0 THREE PHASES OF CONTROL

Construction Quality Management is the means by which Oneida confirms the quality of work performed by subcontractors and suppliers, and that it complies with contract requirements. In general, three phases of control will be conducted by the Project QC Manager for each DFOW as described in the following sections. Forms that will be used during site activities for the three phases of control developed for the PFAS Fingerprinting and Background Study contract are included in Attachments B and C.

8.1 PREPARATORY PHASE

The preparatory phase will be performed by the Project QC Manager prior to beginning work on each DFOW, after all required plans, documents, and materials are approved and accepted, and after copies are at the work site. This phase will include:

- Review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field will be made available by Oneida at the preparatory inspection. These copies will be maintained in the field and available for use by Government personnel until final acceptance of the work.
- Review of the contract.
- A check to ensure that all materials and equipment have been tested, submitted, and approved.
- Review of provisions that have been made to provide required control inspection and testing.
- Review the appropriate Activity Hazard Analyses (AHAs) to check that safety requirements are met.
- Discussion of procedures for controlling work quality, including repetitive deficiencies.
- Check to ensure that the portion of the work plan referencing the work to be performed has been accepted by the Contracting Officer.
- Discussion of the initial control phase.

This phase will include a Preparatory Phase Meeting (equivalent kickoff meeting) conducted by the Project QC Manager and attended by the Project FTL and other QC personnel as applicable. The results of the preparatory phase actions will be documented by separate minutes prepared by Oneida and distributed to the USACE PM and Technical Support Representative. Oneida will instruct applicable workers as to the acceptable level of workmanship required to meet contract specifications.

8.2 INITIAL PHASE

The initial phase of project control will be performed by the Project QC Manager, at the beginning of execution of each DFOW. The following will be accomplished:

- Check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
- Check safety to include compliance with and upgrading of the safety plan and AHAs. Review the AHAs with each worker.

- Verify adequacy of controls to ensure full contract compliance.
- Verify required control inspection and testing.
- Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- Resolve all differences.
- Notify the Government at least 24 hours in advance of beginning the initial phase. The Project QC Manager will document execution of this phase for each DFOW with an Initial Phase Inspection Report (Attachment B).
- The initial phase should be repeated for each new crew to work on-site, or any time acceptable specified quality standards are not being met.

8.3 FOLLOW-UP PHASE

Under this third phase, daily checks will be performed under the direction of the Project QC Manager to ensure that control activities, including control testing, are providing continued compliance with contract requirements until completion of the particular DFOW. The checks will be recorded in the CQC documentation. Final follow-up checks will be conducted and all deficiencies corrected prior to the start of an additional DFOW that may be affected by the deficient work. Oneida will not build upon nor conceal non-conforming work.

9.0 TESTING

After identification and scheduling of the DFOWs for the project, the Project QC Manager will direct the performance of the specified and appropriate tests to verify that control measures are adequate to ensure that work conforms to contract requirements. The location and frequency of tests required are provided in the project work plan. The Project QC Manager will perform the following activities and record and provide the corresponding data:

- Verify that testing procedures comply with contract requirements
- Verify that facilities and testing equipment are available and comply with testing standards
- Check instrument calibration data against certified standards
- Verify that recording forms, including all test documentation required, have been prepared

9.1 FIELD TESTING

The majority of testing for this project will be to verify instrument calibration, field sampling QC procedures, and lab analysis QC procedures. All equipment will be calibrated in accordance with the manufacturers' specifications. Field sampling will be conducted in accordance with the Programmatic UFP-QAPP and UFP-QAPP addenda.

The FTL will be the first line Oneida quality supervisor for field sampling tasks. In addition, the Project QC Manager may audit field sampling procedures and implementation at any time during the course of the fieldwork. The Test Report Form is included as Attachment D.

9.2 ANALYTICAL TESTING

Laboratory analysis will be conducted in accordance with the Programmatic UFP-QAPP. For QC procedures on analytical testing refer to that document.

10.0 SUBCONTRACT MANAGEMENT PLAN

10.1 SURVEILLANCE OF SUBCONTRACTORS OPERATIONS

Surveillance of subcontractor operations is the responsibility of the Oneida FTL and/or the Field QC Manager. They will record identified major discrepancies on the deficiency report and notify the subcontractor concerned. Any discrepancy from a preceding operation will be resolved before the item is covered. Major discrepancies will be followed up daily. When a major discrepancy is corrected, the date corrected and the person responsible will be noted.

10.1.1 Inspection Acceptance Procedures

All work will be performed according to contract plans and specifications. All rework or changes to scope of work specifications must be authorized by the USACE PM. All work will be recorded on the Daily Contractor Production and QC Report (DQCR). If discrepancies or deficiencies are identified, they will be handled according to the deficiency procedures discussed in Section 10.1.2.

10.1.2 Inspection Deficiency Procedures

Inspection deficiency procedures are intended to call to the attention of responsible supervisors all discrepancies in quality, workmanship, materials, equipment and supplies and unauthorized deviations from specifications. Oneida will use the following tracking system to document deficiencies during the project.

The Project QC Manager will record deficiencies on the Deficiency Report Form (Attachment C); this will include assigning a number to each deficiency, giving its location, and writing a concise description on the form.

When material, equipment, supplies, or workmanship are found to be deficient, the Project QC Manager will prepare a deficiency report and immediately furnish copies to the PM, FTL, and subcontractor's job representative. The USACE PM will receive a copy of the deficiency report attached to the DQCR. Upon completion of the deficiency report, the deficiency will be entered into the Deficiency Tracking Log (Attachment C). The Deficiency Tracking Log will be available on site for review upon request.

After reviewing the deficiency report, the Project QC Manager will examine the rejected items in the presence of the Oneida PM. If, in the opinion of any of these parties, any of the rejected items can be reworked to a usable condition, the deficiency report will note this. If, in their opinion(s), the item cannot be reworked, either practically or economically, the item will be scrapped and an entry made on the deficiency report.

Upon the completion of reworking specified items, the Project QC Manager will re-inspect the deficient item, noting the original requirement and the rework information on the Deficiency Report Form. If the work is found acceptable, it will be so noted on the Deficiency Report Form and the Deficiency Tracking Log. From this point, the item will be handled in the normal manner. If the item is still not acceptable to the Project QC Manager, Oneida will treat this item as a first-time rejection and it will be resubmitted for inspection only after further rework.

The Deficiency Log will be periodically reviewed by the Oneida PM with the Project QC Manager to decide how to resolve each uncorrected deficiency. They will establish timetables for resolving all deficiencies and convey the results of the periodic review to the USACE PM along with updated copies of the Deficiency Tracking Log.

11.0 DOCUMENTATION PROCEDURES

Project documentation is based on the requirements of contract documents and on the needs of specific projects. The Quality Control System will be used to input all data pertaining to inspections, testing, and hazard analysis to generate reports. Attachment D includes a Test Report Form for this project. A Materials Tracking Log is included in Attachment E.

11.1 QUALITY CONTROL POLICY

By adhering to this QC Plan, Oneida strives to obtain uniform, high-quality workmanship throughout all phases of the project. To ensure quality, we will observe the following principles:

- Apply the three-phase project control system to track adherence to the design requirements.
- Perform all work in an environmentally-acceptable manner, conforming to all federal, state, and local regulations.
- Maintain supervisory controls and written instruction governing quality control procedures and practices and clearly define responsibility and authority for compliance.
- Conform to all contractual requirements, specifications, applicable military standards, and the Oneida QC Plan.
- Notify Oneida project management and USACE PM of quality discrepancies requiring immediate correction. Assure that corrective action is implemented and properly documented.

11.2 LABOR AND EQUIPMENT HOURS

Hours of all site employees are recorded on the DQCR. The types and hours of equipment used at the site are also recorded on the DQCR.

11.3 HAZARD ANALYSIS

Hazard analysis is accomplished on this project site through the use of AHAs. AHAs are discussed during the preparatory and initial phases of control as part of the CQC meetings. All applicable project and subcontractor personnel sign the AHA to demonstrate that they are aware of the hazards and associated controls and mitigations for the work tasks.

11.4 CONTROL OF ON-SITE AND OFF-SITE CONSTRUCTION

11.4.1 Materials Certification

The Field QC Manager will inspect all work materials received at the site for the following:

- Correctness of material or item that was shipped and delivered to the site
- Items and material are delivered and unloaded in an undamaged condition
- Serial numbers, lot numbers, and other product identifiers are recorded as appropriate
- Material or item is properly stored

The Field QC Manager will record results of the receiving inspection on the Materials Tracking Log (Attachment E), which will be attached to the DQCR. If construction materials have identification tags, they will be removed and retained for the project file. The Field QC Manager has the authority to accept or reject materials. If material is rejected, the Field QC Manger will immediately contact the FTL, who will take action to replace the unacceptable material.

Copies of all purchase orders or subcontracts requiring inspection will be provided to the Field QC Manger for receiving and recordkeeping purposes. When the purchase order requires vendor certification of materials, equipment, or supplies, such certification will be verified as to accuracy and conformance, and may be used in lieu of a test for those properties covered by the certification. Copies of all certifications received will be maintained by the Field QC Manger, available to the government upon request, and submitted as provided in the contract specifications.

12.0 PROJECT CLOSEOUT PROCEDURES

Oneida will conduct project closeout in accordance with requirements of the contract documents and in close coordination with USACE project personnel. If the PWS does not include a project closeout specification, the UFGS specification 01 78 00N – Closeout Procedures will be used as a guideline for closeout.

Oneida will also perform QC Certifications according to contract specifications. QC certifications may include a QC Closeout Report, Invoice Certifications, and Completion Certification for each DFOW.

13.0 REFERENCES

Sustainment and Restoration Services, LLC (SRS). 2023. Draft Project Management Plan, PFAS Fingerprinting and Background Study. October.

ATTACHMENT A-1

Authorization Letter to Project Quality Control Manager

ONEIDA
Sustainment and
Restoration Services

Sustainment and Restoration Services
209 E. Victoria Street
Santa Barbara, California 93101
(805) 883-3980
www.oescgroup.com\srs

30 November 2023

Ms. Kristen Carlyon Peyton
1777 N. California Boulevard, Suite 310
Walnut Creek, CA 94596

RE: Appointment as Alternate Project Quality Control (QC) Manager for Task Order No. W9123823F0086: PFAS Fingerprinting and Background Study

Dear Ms. Carlyon Peyton:

This letter is to notify you of your appointment as Alternate Project Quality Control (QC) Manager for Task Order No. W9123823F0086: PFAS Fingerprinting and Background Study.

In the event that you are appointed Project QC Manager, you will implement and manage the QC program. You will attend the coordination and mutual understanding meeting and conduct the QC meetings. Additionally, as Project QC Manager, you will perform the three phases of Quality Control, perform submittal approval, ensure that testing is performed as necessary, and provide any QC certifications and documentation required by the contract. You will be responsible for managing and coordinating the three phases of control and documentation performed by testing laboratory personnel and any other testing and inspection personnel required by this contract.

In the event that you discover a deficiency in construction quality, you will immediately bring the deficiency to the attention of the project manager. You will verify that the project manager directs that the deficiencies be corrected, and that rework items are completed as necessary. If it becomes necessary, you have the authority to issue a stop work order so that QC issues can be resolved.

If you have any questions, please contact me.

Sincerely,

Jacques Marcillac
Program Manager
Sustainment and Restoration Services, LLC

ONEIDA
Sustainment and
Restoration Services

Sustainment and Restoration Services
209 E. Victoria Street
Santa Barbara, California 93101
(805) 883-3980
www.oescgroup.com\srs

30 November 2023

Mr. Robert Price
Sustainment and Restoration Services
317 E. Main Street
Ventura, CA, 93001

RE: Appointment as Project Quality Control (QC) Manager for Task Order No. W9123823F0086: PFAS Fingerprinting and Background Study

Dear Mr. Price:

This letter is to notify you of your appointment as Project Quality Control (QC) Manager for Task Order No. W9123823F0086: PFAS Fingerprinting and Background Study.

As Project QC Manager, you will implement and manage the QC program. You will attend the coordination and mutual understanding meeting and conduct the QC meetings. Additionally, as Project QC Manager, you will perform the three phases of Quality Control, perform submittal approval, ensure that testing is performed as necessary, and provide any QC certifications and documentation required by the contract. You will be responsible for managing and coordinating the three phases of control and documentation performed by testing laboratory personnel and any other testing and inspection personnel required by this contract.

In the event that you discover a deficiency in construction quality, you will immediately bring the deficiency to the attention of the project manager. You will verify that the project manager directs that the deficiencies be corrected, and that rework items are completed as necessary. If it becomes necessary, you have the authority to issue a stop work order so that QC issues can be resolved.

If you have any questions, please contact me.

Sincerely,

Jacques Marcillac
Program Manager
Sustainment and Restoration Services, LLC

ATTACHMENT A-2

Resumes

JACQUES MARCILLAC, RG, CHG, CEG

DIRECTOR OF OPERATIONS/PROJECT MANAGER/GEOLOGIST

EDUCATION

BS, Geological Sciences, University of California, Santa Barbara, 1996

REGISTRATIONS/CERTIFICATIONS

Registered Geologist: CA (#7421), 2002

Certified Hydrogeologist: CA (#902), 2008

Certified Engineering Geologist: CA (#2570), 2011

SPECIALIZED TRAINING

OSHA 40-Hour HAZWOPER

OSHA 8-Hour HAZWOPER Refresher, 2009

OSHA Trenching and Excavation Safety (29 CFR § 1926 (p).)

Waste Management (40 CFR § 256.16)

Project Management 101 and 102 (TTFW Training Course)

USACE Construction Quality Management for Contractors, 2009

First Aid and CPR/AED, 2009

OSHA 30-Hour Construction Safety & Health Certification, 2009

USACE EM-385-1-1 Fall Protection Certification, 2009

24-Hour California Compliance School Training, Modules I, II, III, IV and V, 2009

PROFESSIONAL AFFILIATIONS

Society of American Military Engineers

Geological Society of America

American Association of Petroleum Geologists

Coast Geological Society

American Association of Professional Geologist

Jacques is SRS's Director of Operations and has 22 years of overall experience in remediation technologies and applications with an emphasis in innovative remedial technology evaluation, pilot treatability studies, operations and maintenance (O&M), process optimization, and construction quality control (QC). Jacques is experienced with all aspects of project management including cost estimating, submittal QA/QC, budget management, field coordination and execution, and communications with federal, state and local regulatory agencies.

His past field work experience includes remedial pilot study implementation and operation, ex-situ and in situ remediation design and construction, remediation system operation, performance evaluation and optimization, multi-nested groundwater well installation, multi-nested vapor probe installation, borehole logging, soil sampling, groundwater and surface water sampling, soil gas and ambient air sampling, meteorological monitoring.

Jacques is also experienced in geotechnical feasibility studies and performing field assessments and geological risk analyses assessing seismic hazards such as fault-rupture, seismically induced ground shaking, liquefaction potential, slope stability, soil expansion hazards and settlement/subsidence hazards. Other responsibilities have included writing geology/soils, risk of upset, drainage and water quality sections of environmental impact reports involved with the NEPA/CEQA public planning and development process.

Multi-Media Environmental Compliance Services, Hazardous Waste Management at CA ARNG Armories throughout Northern California – Program Manager: Managed 12 task orders involving the removal, sampling, profiling, transportation and disposal of hazardous wastes from site investigations, operating field recovery treatment systems, and removal actions. Project included preparation of management plans for ACM and LBP per RCRA and NESHAP and tracking of management via CA ARNG Hazardous Material Tracking system. Oversaw air quality permit compliance, source mitigation, and documentation for field treatment system and demolition operations.

- *Camp Roberts Drinking Water Supply System.* Performed extensive sampling, testing, and monitoring activities to monitor compliance for NPDES Waste Discharge Requirements issued by Central Coast Regional Water Quality Control Board, the CDHS regulations, and supported the CA ARNG at community meetings; preparing materials and attending the CAB. Sampling was also performed at 14 CA ARNG facilities to characterize IDW waste streams for a variety of contaminants according to the management plans at those facilities and Project SAPs. Supported USAECs EPAS in an extensive audit of the Camp Roberts environmental program and briefed senior Base leadership on findings and recommendations.

- Updated and implemented SWPPP plans for three CA ARNG bases; while under OTIE compliance management, there were no NOVs or other safety or quality issues. Both hazardous and non-hazardous solid wastes were managed at several locations including soils, GAC, sludge, and filter bags from treatment systems. SPCCs were updated along with integrity testing and engineering certifications for fuel and waste AST facilities. Because the work was located in historic sites, within habitat of endangered species, and in UXO-sensitive locations, coordinated with several Base departments with cultural and environmental oversight in accordance with all federal, state, and local regulations. P2 protocols were in place at all locations to minimize waste streams during remediation.

Program Manager, Clean Construction Projects, USACE POCA and US Air Force SABER, Vandenberg AFB and Camp Roberts, CA – Program Manager. Responsible for resource management, proposal coordination, project quality document review, permitting (NPDES, SWPPP, SBAPCD asbestos abatement, etc.) and QA/QC program implementation involving several sustainment, restoration, and modernization (SRM) projects for large active military installations.

Asbestos Abatement and Demolition of Buildings 946 and 8430, USACE Sacramento District, Vandenberg AFB, CA – Project Manager. Managed a large-scale $1.6M demolition project at Buildings 946 and 8430, the latter of which was on an IRP site undergoing active remediation/monitoring and required HAZWOPER program considerations. Executed project management via web-based interactive project websites, with weekly updates of schedules, look-aheads, dailies, photos, etc., with an Air Force and USACE project team across three different time zones. Negotiated with COR to increase sustainability by using 350 tons of crushed CMU for engineered fill material at one of the building locations. Communicated with the project team per potential changed conditions, led to seamless mitigations by CO. Commended by USACE for excellent project execution and received an “Excellent” performance evaluation.

Abatement and Demolition for 16 Abandoned Buildings, CA ANG, Los Alamitos Joint Forces Training Base, CA – Program Manager/Permit Coordinator. Oversaw abatement and demolition of 16 structures (48 housing units) including the following tasks:

- Characterization of waste materials and development of project plans, including a Work Plan, Environmental Protection Plan (including SWPPP), and Accident Prevention Plan/Safety and Health Plan (APP/SSHP)
- Required permits and authorizations from the Regional Air Quality Control District, RWQCB and Los Alamitos facility departments

- Successful and safe abatement of asbestos and lead-based paint materials
- Mold abatement due to water leakage
- Building demolition
- Disposal of hazardous waste at an approved licensed disposal facility
- Recycling salvageable materials whenever feasible and cost effective
- Disconnection of water service to all 51 structures (201 housing units) at the site to eliminate water waste
- Removal and replacement of concrete foundations for future recycling
- Preparation of a final report documenting all characterization, abatement, demolition and disposal/recycling

Pemaco Superfund Site, CERCLA Remedial Investigation/Feasibility Study, US EPA Region 9, Maywood, CA – Project Geologist/Field Team Leader. Supported the preparation, coordination, mobilization and execution of a major remedial investigation for a former chemical blending facility in the urban Los Angeles area. Over 1,200 samples of various environmental media (soil gas, surface water, groundwater and soil) were collected in a 4-month period. Pre-field activities included writing field-related sections for the Sampling and Analysis Plan. Also wrote Standard Operating Procedures for several field techniques used on the project that have been adopted as company standards. Sampling and well installation activities included use of direct push (geoprobe and CPT) equipment, hollow stem and mud rotary drilling techniques, low flow sampling of groundwater wells using QED's Micopurge® system, and soil sampling using the Encore® sampling system. The project included use of prototype groundwater bladder pumps created for small diameter direct push wells for water sampling. As site health and safety officer, successfully supervised several rigs and field crews, coordinated and executed all field activities with no loss of time due to project planning deficiencies, safety violations or safety-related incidents.

- Personally logged approximately 1,650 feet of soil core from continuously cored borings ranging from 35 feet to 170 feet deep. Post-field activities included subsurface interpretation of a complex multi-zoned discontinuous aquifer system with multiple gradient directions and migration pathway orientations. This data was used for pumping tests and groundwater modeling and integrated into remediation efforts. Assisted with interpretation of analytical data resulting in the confirmation of multiple sources and co-mingling of a petroleum and chlorinated hydrocarbon plume.

- Field team leader for a large-scale step-drawdown and 72-hour continuous drawdown aquifer pump test involving multiple aquifer zones with over 12 observation points.
- Project coordinator and field team leader for 96-hour high vacuum dual phase extraction (HVDPE) pilot test on multiple aquifer zones. Completed data analysis and 2-D modeling for key input parameters for a large feasibility study for the project.
- Coordinated and led field team for multiple soil vapor, indoor air and outdoor air assessments to ascertain whether vapor migration of contamination was impacting residential neighborhood adjacent to the Pemaco site and to assess seasonal fluctuations in contamination concentrations and influences due to meteorological conditions and anthropogenic background sources. Assessments involved much community interaction with predominately non-English speaking Hispanic community. Interactions with community led to improved community perspective for the USEPA and the Superfund program.
- Field and technical lead for 2 remedial design optimization investigations of a multiple sourced chlorinated solvent leak through a complex vadose zone and aquifer system. Investigations done through the USACE-SCAPS team in conjunction with Oak Ridge National Laboratories (ORNL) using a membrane interface probe (MIP) attached to a CPT rig with an on-board IT/MS system allowing for simultaneous data collection of lithology and speciated chemical data.
- Involved in presentations and communications with City of Maywood and several other local agencies to integrate Superfund activities and environmental health concerns with plans for a public park built on the Pemaco property. These interactions have led to fast-track approvals of the proposed park through the California Environmental Quality Act (CEQA) process. Initiated ideas for park designs and mitigation measures to balance the need for the public park construction with the need to address health concerns for future park users and for future remediation efforts at the Pemaco site.
- Organizational leader and QA/QC officer for the large multi-volume RI/FS report associated with all the investigation phases and associated technical memorandums including aquifer and pilot testing reports, risk assessment documents and detailed analyses of remedial alternatives including several innovative technologies (6-phase heating, deep PRB walls and in situ oxidation). Technical lead in decision-making process associated with the Proposed Plan Document and Record of Decision for the selected remedial technologies. Currently, serving as technical lead for final remedial design documents.
- Coordinated, implemented and managed the drilling program for 65 dual phase extraction wells for the remedial action at Pemaco.

Assisted in well designs using various construction materials (PVC, stainless steel, low carbon steel, heat resistant CPVC and various combinations). All wells were installed within an accelerated timeframe due to logistical concerns and within budget. Designed and implemented an approved soil cuttings segregation procedure leading to significant IDW cost savings by being able to leave screened soils onsite to be used for park design grading.

Design/Implementation/Operation of Remedial Action at IR Site 24, Site 1 at NAS, Point Mugu, CA – Project Manager. Managed a $7.9M FFP project for design, construction, and O&M of a landfill cap for 3.5 acres for conversion to saline wetlands. When requested by the Navy, responded rapidly to adapt project/ construction activities to accommodate scope revision for conversion of the landfill cap into an RV Storage Area. Provided negotiation support with regulators and supported the NAVFAC RPM in RAB meetings with technical information and displays. Received “Outstanding” CCASS rating.

Site UST 02 MTBE Plume, Biobarrier O&M, Optimization, and Groundwater Monitoring, NAVFAC SW, NBVC Port Hueneme, CA – Project Manager. Managed onsite activity and technical direction for O&M of three in situ “biobarriers” consisting of 420 total system wells to treat a 1-mile long MTBE plume. Since assuming O&M responsibilities for two of the three biobarriers, project team has achieved successful continuous operation of each biobarrier for 20 months with no significant down-time and also implemented optimization actions to enhance system performance. Implemented a semi-annual, site-wide groundwater monitoring program involving 50 monitoring wells. Optimization supported successful regulatory negotiations to shut down the pump-and-treat system operating at the site for 5 years saving approximately $45K per year. Received “Outstanding” CCASS performance rating.

Landfill Monitoring and Perchlorate Release, California Army National Guard, Camp Roberts, CA – Project Manager/Technical Lead. Managed monitoring and remediation of an active MSW landfill and an inactive pre-1950 trench used for the disposal of military waste. Designed and implemented a vadose zone and groundwater detection monitoring program involving 15 deep (>150 feet) wells and several soil vapor probes. Prepared revised reports of waste discharge (ROWD) and designed and implemented an evaluation monitoring program for a perchlorate release in the deep bedrock aquifer system. Extensive knowledge of Federal and California landfill regulations. Currently preparing an initial engineering feasibility study (EFS) for the perchlorate issue. Successfully negotiated reduction in landfill gas sampling from quarterly to semi-annual resulting in a $20K per year cost savings to the CA ARNG (for a likely duration of 30 years).

Pipeline Removal, Soil Bioremediation and Remedial Investigation, Hutment Area Remediation, California Army National Guard, Camp San Luis Obispo, CA – Project Manager. Managed a $1.25M large removal action and remediation effort under a $5.8M IDIQ contract. Responsible for budgeting, coordinating, and removal of over 20,000 LF of petroleum piping at 11 OUs. RI to delineate isolated plumes spread over a 20-acre area originating from the removed pipeline. Performed soil vapor intrusion study to facilitate new construction permitting using CA ARNG planning protocol integrating GIS to identify future projects. Received environmental closure of 4 of the 11 OUs. Supervised excavation activities, soil processing activities and construction of two 1,000 cubic yard biopiles and a 200-foot x 160-foot self irrigating landfarm unit. Designed and supervised the construction of a phytoremediation barrier with an engineered root growth diversion system. Currently planning a large HVDPE pilot test at two separate areas to assess the technology to prevent groundwater impacts to adjacent waterways. Project received the 2004 Department of the Army's Environmental Restoration, Installation Award given by the National Guard Bureau.

Chlorinated Solvent Soil and Groundwater Cleanup and Hexavalent Chromium Remedial Investigation, Raytheon Corporation, Canoga Park, CA – Project Manager. Managed this $1.1M multi-task project. Responsible for coordination and scheduling of all field activities, reporting, and waste management involved with the operation of a dual-phase remediation system and groundwater monitoring network at a former aerospace manufacturing facility. The remediation system involved over 100 wells, including vapor extraction, air sparge, groundwater monitoring, and groundwater extraction wells.

- Supervised the installation of a remediation system modification involving several additional multi-depth sparge wells. Conducted pilot testing of additional sparge wells and performed data interpretation and produced comprehensive pilot test report evaluating the performance of the remediation system modifications.
- Evaluated site conditions for remedial alternatives and created a workplan for a large-scale pilot test for the remediation of chlorinated hydrocarbon groundwater contamination via enhanced in situ bioremediation (EISB). Coordinated involvement with permitting the injection process and the use of innovative substrates through the Los Angeles Regional Water Quality Control Board. Increased uptime of existing remediation system to more than 95% and reduced O&M costs by 30%.
- Also the lead geologist in an ongoing soil and groundwater assessment of a hexavalent chromium plume located on the former Raytheon facility. The remedial assessment involved installation of several continuously cored; multi-screened groundwater monitoring wells drilled through a complex faulted and folded weathered bedrock/bedrock medium. Performed detailed lithological and hydrogeological data analyses to interpret complex preferential pathways to model the hexavalent chromium plume migration

Electrical Resistance Heating (ERH) System Construction Project, Goleta, CA – Project Manager. Managed a $3M ERH groundwater clean-up project for a large aerospace defense company. The system involved the construction of a 1,200-amp, 480-volt, 3-phase power control unit, multi-phase extraction and treatment system including construction of a treatment compound secondary containment pad and an integrated mechanical system involving liquid ring blowers, centrifugal liquid pumps, rotary screw compressors, heat exchangers, cooling towers with programmable logic control system and telemetry. Additional challenges included coordinating with multiple utility companies because the treatment system encompasses a high-pressure natural gas transmission line, as well as a major fiber-optics and electrical utility corridor.

This project was the first of its kind in the Central Coast Region and, therefore, came under intense scrutiny by permitting authorities and the local community. Permits attained to construct this system included: conditional land use permit (CUP) from the City of Goleta and associated architectural design review board; subsurface installation permits by the County of Santa Barbara Fire Department and County of Santa Barbara Public Health Department, Remedial Action Plan (RAP) approval and Waste Discharge Requirement (WDR) Order from the Central Coast Regional Water Quality Control Board (CCRWQCB); Authority to Construct (ATC) and Authority to Operate (ATO) permits from the County of Santa Barbara Air Pollution Control District (APCD), this was inclusive of numerous Source Testing and Emissions Verification Testing (EVT); Goleta Sanitary District Industrial Wastewater Permit, and Goleta Municipal Water District's additional use permit for cooling towers. Mr. Marcillac coordinated, performed technical QC, and gave several presentations to secure each of these permits within a 9-month timeframe from initial correspondence/applications to physical construction of the project.

Remedial Investigation, Railway Corridor, Trust for Public Land, Maywood, CA – Project Manager. Responsible for project management duties including writing initial proposal, procurement of services, coordination and scheduling of field events, data analysis, report preparation and QA/QC for investigation activities (soil vapor, soil and groundwater sampling) of an approximate ¼-mile long section of an abandoned railway involved in a Brownsfield Project. This project was completed under very rigid time constraints (60 days from contracting to reporting) as it was part of a large property transfer. The project was on time and under budget resulting in several new RFPs from the client.

Risk Assessment, Proposed Maywood Riverfront Park, City of Maywood, Maywood, CA – Project Manager. Coordinated and directed risk assessment team and prepared majority of a large health risk assessment report for a Brownsfield project involving several separately owned and operated industrial properties with extensive histories of environmental impact. Duties involved working with several government agencies to develop defensible health risk scenarios and to compile detailed site histories and evaluation of separate data sets for input parameters to risk calculations. All work was completed within the regulations and guidelines of several regulatory bodies (USEPA, CalEPA, and LARWQCB). Risk assessment was completed on time and under budget.

Site Investigation, Multiple UST and AST Sites, US Army Defense Environmental Restoration Program; Fort McDowell / Angel Island, Marin County, CA – Project Manager. Responsible for coordination and execution of drilling and sampling of soil and groundwater at several sites located on an island in the San Francisco Bay. All sites were associated with historical military activities (1880 – 1940). The location of the sites, being spread out on an island with no automobile access from the mainland, posed several logistical obstacles. The work was completed ahead of schedule in spite of the logistical restraints and unfavorable drilling conditions.

Remedial Investigation, Multiple Fuel Spill Sites, NAS Lemoor, Lemoore, CA – Project Manager. Responsible for coordination, scheduling and performance of all field activities, reporting, and management of investigation-derived waste involved with three fuel spill sites on a large Naval air base in central California. The remedial investigations involved two pipeline leaks of JP-4 jet fuel and an underground storage tank leak of hydraulic oil. The RI included over 40 continuously cored geoprobe borings collecting soil and groundwater samples for analyses by an onsite mobile laboratory. All activities were completed within four weeks. The Central Valley Regional Water Quality Control Board closed one of the sites and the other two sites, considered to be completely assessed, were given a monitoring only status.

Groundwater Remediation of Chlorinated Solvents, Rocketdyne Corporation, Canoga Park, CA – Site Geologist. Responsible for coordination of groundwater sampling events, additional assessment activities, groundwater remediation system operation and performance evaluation, data management and reduction, and waste discharge permitting. Performed permit compliance and quarterly reporting for a groundwater monitoring and remediation network involving more than 100 wells installed through multiple aquifer zones underlying a large aerospace manufacturing facility in Southern California.

Retail Station Remedial Assessments, Feasibility Studies, & Remediation, Chevron USA Inc., Southern and Central California – Project Geologist. Responsible for coordination and execution of RI/FS field assessment activities involving environmental media (soil, groundwater, soil vapor, surface water and sediment) using direct push technology (geoprobe and CPT), hollow stem auger and air rotary drilling technologies, and grab sampling techniques. Supervised UST removals and remedial excavations, installed groundwater monitoring wells, vapor probes (up to 300 feet deep), vapor extraction wells and groundwater extraction wells at more than 15 operating and dormant retail service station sites in Ventura, Santa Barbara and San Luis Obispo counties in California. Several of these stations had operating soil and groundwater remediation systems involving pilot testing, design, and installation of the systems. Also responsible for proposal and work plan writing, data reduction, subsurface interpretation, assessment reporting, risk assessment reporting (Tier I and Tier II) and correspondence and compliance with multiple county and state agencies. Four of the sites received environmental closure from the regulating agency through low-risk closure and reaching clean-up level goals.

RI/FS of Dripolene Contamination, Union Carbide Corporation, Torrance, CA – Project Geologist. Responsible for proposal writing, work plan, and coordination and execution of assessment activities at an operating chemical manufacturing facility under an accelerated time schedule mandated by the DTSC. Activities involved collecting soil and groundwater samples using direct push and hollow stem auger techniques and installing numerous groundwater monitoring wells through multiple aquifers. Initiated the use of a CPT rig equipped with a UV fluorescent probe to rapidly assess monitoring well locations for the presence of hydrocarbons to adhere to the accelerated time schedule. Responsible for all field assessment reporting, subsurface interpretation and quarterly reporting for groundwater monitoring activities.

Crude Oil Pipeline Leak, Unocal Corporation, Avila Beach, CA – Staff Geologist. Responsible for field activities including soil sampling, groundwater monitoring, well installation, large-scale step-drawdown aquifer testing, and quarterly groundwater sampling for a monitoring well network. This project involved a long-term pipeline leak that occurred beneath a small coastal town in central California. Community relations caused a highly political working environment. All fieldwork was performed under direct supervision and scrutiny of multiple agency and community representatives. Involved in creating a database for the site involving 600 boring locations, 50 groundwater monitoring wells and 50 soil vapor extraction wells. Performed extensive subsurface interpretations of the size, depth and shape of the approximately 40-acre crude oil plume. These data were later used for calculations involved in the design of one of the largest remedial excavations in California history.

Environmental Assessments for Proposed School Sites, Ventura Unified School District, Ventura, CA – Project Geologist. Responsible for multiple aspects of approval for two new schools for the Ventura Unified School District. In charge of conducting and reporting for several Phase I historical environmental assessments, Phase II soil and groundwater assessments (involving hydrocarbon and residual pesticide contamination), geotechnical evaluations (including fault trench studies, seismically-induced ground shaking assessments, liquefaction potential assessments, slope stability assessments, and soil expansion/settlement/subsidence assessments. These assessments contributed to environmental impact reports written for several of the potential school sites. Also wrote the geological hazards and risk of upset sections. Two of the potential school sites currently have schools operating on them after receiving DTSC approval and successfully passing through the entire CEQA process.

MEGAN E. DULEY, PE

SENIOR PROGRAM MANAGER/ENGINEER

■ EDUCATION

BS, Chemical Engineering, University of Minnesota, Minneapolis, MN, 2001

■ REGISTRATIONS/CERTIFICATIONS

Professional Engineer (PE), MN, license #44651, 2005

■ SPECIALIZED TRAINING

Naval School Civil Engineering Corps Officers – Geographical Information Systems (ArcGIS) and Applied Geostatistics and Sampling Design 2010

■ COMPUTER SKILLS

ArcGIS

■ PROFESSIONAL AFFILIATIONS

Society of American Military Engineers

■ PROFESSIONAL AWARDS/HONORS

Personal commendation letter from Ms. Ballentine, Assistant Secretary of the Air Force, recognizing significant contribution to investigative and remediation efforts at Kirtland AFB.

Selected as a representative of the Seymour Johnson AFB Environmental Restoration Project Team to receive the General Thomas D. White Award for Environmental Restoration Program (Installations) at the Pentagon.

Ms. Duley is a dedicated, high-energy professional with more than 20 years of progressive experience leading and supporting all project phases in the environmental remediation and restoration sectors including: project management, cost estimating, investigation (CERLA/RCRA), data mining and management, design/execution of remedial and removal actions, GIS and 3D/4D visualization, technical writing and document preparation as well as technical facilitation, consensus building and negotiation with regulatory agencies and stakeholders. She is a high performer with unique skillsets to quickly discern problems, assimilate complex scientific data, develop strategies and solutions, and recognize communication needs and decision styles to bring people to agreement and accelerate progress.

Ms. Duley serves as the Oneida Program Manager across all company per- and polyfluoroalkyl substances (PFAS) projects to provide additional support to Project Managers as well as to confirm and realize programmatic requirements, consistencies, efficiencies, and optimal performance. Ms. Duley's expertise includes investigation, conceptual site model (CSM) development, and development and communication of site strategies for emerging contaminants including PFAS, 1,4-dioxane, and ethylene dibromide (EDB). She is an experienced Program/Contract Manager responsible for project execution, client management, regulatory expertise across multiple federal and state statutes and requirements, direction and optimization of project budget/schedule, direction of project personnel and SB/LB subcontractors' teams, project communications, and tracking performance metrics and project milestones.

Program, project, and contract management | Environmental investigation and remediation services | Technical facilitation and data communication | Development and communication of complex Conceptual Site Models | Site strategy development and implementation | Effective team leader | Regulatory expertise | Data analysis and integration | Environmental and sustainability services | Cost estimating and budget development/tracking | Project and process optimization | Metrics- and Milestone-based performance management | Experience with emerging contaminants | Fluid use of GIS | Federal contract management | Stakeholder/Public outreach and management

ENVIRONMENTAL INVESTIGATIONS AND REMEDIATION

PFAS Remedial Investigation (RI) at Holloman AFB, USACE-SPA Holloman AFB, NM – Alternate Project Manager. Alternate Project Manager directing hydrogeologic evaluations and performance of a PFAS RI for three aqueous film forming foam (AFFF) areas potentially impacted by PFAS constituents at Holloman AFB under a $2.1M FFP contract. The hydrogeologic studies include a dye trace study to evaluate potential hydraulic and transport pathways as well as a water balance evaluation. For the Phase I RI, primary tasks include site characterization including

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Restoration Services

multi-media sampling and delineation in soil, sediment, groundwater, and surface water; source strength evaluation; CSM development, and support for USACE and Holloman AFB for planning and communication with regulatory agencies and stakeholders.

PFAS RI at Travis AFB, USACE-SPA and Travis AFB, Travis AFB, CA – Project Manager. Project Manager directing performance of a PFAS RI for 16 AFFF areas potentially impacted by PFAS constituents at Travis AFB under a $4.8M FFP contract. Primary tasks include site characterization including multi-media sampling and delineation in soil, sediment, groundwater, and surface water; source strength evaluation; CSM development, and support for USACE and Travis AFB for planning and communication with regulatory agencies and stakeholders. Directing high resolution site characterization activities, including use of environmental sequence stratigraphy (ESS) evaluation for the site to inform potential flow pathways and understand fate and transport. Project complexities include off-base impacts to private drinking water wells, complicated hydrogeologic framework, operating remedial systems, and biological requirements for natural resources and endangered species at Travis AFB.

PFAS RI at Edwards AFB, USACE-SPA and Edwards AFB, Edwards AFB, CA – Project Manager. Project Manager leading the PFAS RI for 17 AFFF areas at Edwards AFB under a $6M FFP contract. Primary tasks include site characterization including sampling and delineation in soil, sediment, groundwater, and surface water; source strength evaluation; CSM development, and support for USACE and Edwards AFB for planning and communication with regulatory agencies and stakeholders. Directing high resolution site characterization activities, including use of environmental sequence stratigraphy (ESS) evaluation for the site to inform potential flow pathways and understand fate and transport. Multiple sites are in areas of complex geology (e.g., fractured bedrock), comingled contaminants, operating remedial systems, and other challenging aspects to discern contaminant fate and transport.

Technical Facilitation and GIS/CSM Support, USACE-Tulsa and Edwards AFB, Edwards AFB, CA – Project/Program Manager. Provides technical facilitation, CSM support, and data visualization using GIS tools to internal AF and regulatory stakeholder teams at Edwards AFB. Since 2016, acted as a long-term technical facilitator to guide ongoing decision processes, key site negotiations, stakeholder and public communication, and facilitation of technical working group sessions (20-60+ people) to enhance discussion of compound technical and regulatory issues, promote data-driven decision making, and accelerate resolution and documentation of decision points.

Supported CSM development and site advancement across a multitude of sites at 10 operable units (OUs). Most sites at Edwards AFB are within highly complex geology, including fractured granite, which requires technical understanding of contaminant behavior and fate and transport mechanisms within and across multiple media. Worked with the AFCEC Team to develop a process to address VI, establishing a framework and garnering consensus from regulatory agencies to evaluate VI risk at hundreds of buildings across the installation. To advance specific sites, led data collection and curation activities, development of quantum GIS platform and communication tools, performed technical evaluation of CSMs, provided/reviewed assessment of remedial effectiveness for current systems, developed visualization and communication aids, and facilitates meetings to advance site understanding and determine next steps in a contentious stakeholder environment.

Edwards AFB Basewide Groundwater Monitoring and Operation & Maintenance, USACE-Sacramento and Edwards AFB, Edwards AFB, CA – Project Management Support. Provides senior level project management, engineering, and regulatory support for multitude of environmental restoration program sites requiring groundwater and VI monitoring and remedial system operation base-wide. Contract includes multi-media sampling, data collection and management, CSM development, remedy optimization, and advancing sites through the CERCLA process with oversight and consensus with the USEPA, California DTSC, and Lahontan Regional Water Quality Control Board. Support AFCEC team with the preparation of five year reviews, Community Involvement Plans, and communication with stakeholders.

CSM Development and Support, USACE-Omaha and AFCEC, AF Installations Nationwide – Project Manager. Responsible for program and project management for multiple, simultaneous environmental projects supporting the AFCEC Complex Sites Initiative (CSI) working directly with teams in the Technical Directorate at multiple AF installations nationwide. Expertise in the development and communication of key CSM elements to understand critical geologic and stratigraphic features, contaminant distribution, flow and transport mechanisms, risk factors/receptors, and high-resolution site characterization. Provided GIS visualization and technical facilitation to technical teams and in regulatory/public stakeholder meetings to advance multi-media investigation and remediation needs for sites with emerging contaminants including PFAS, EDB, 1,4-dioxane, and other emerging issues at multiple sites at seven USAF installations including Ellsworth AFB, Davis Monthan AFB, AFP44, AFP42, Kirtland AFB, Edwards AFB, and Peterson AFB.

PFAS EE/CA, USACE-Omaha and Peterson AFB, Peterson AFB, CO – Project Engineer. Served as the project engineer for an EE/CA to address PFAS impacts for an AFFF site at Peterson AFB on accelerated schedule to achieve expedited regulatory approval. The AFFF site included additional investigation and rapid evaluation of site data for soil, sediment, surface water, and groundwater within a stormwater system and retention pond. The EE/CA included evaluation of operation of an in-place groundwater treatment system as well as pilot study technologies in evaluation and cost assessment of remedial alternatives.

Technical Facilitation and GIS/CSM Support for RCRA Facility Investigation (RFI) at Bulk Fuels Facility Site, USACE-SPA and Kirtland AFB, Kirtland AFB, NM – Project/Program Manager. Project/Program Manager providing GIS/CSM development, visualization, and communication support for highly contentious Interim Measure (IM) planning and implementation and compilation of the RFI for the Bulk Fuels Facility (BFF) Site at Kirtland AFB. The RFI provides a curation of all project activities completed over 15+ years, including thousands of multi-media samples, installation and operation of IMs, and a complex CSM with stratigraphic modeling. Specifically, with the team, provided site data, scientific CSM interpretation and review of models/risk assessment, and conclusions, as well as data management and GIS interpretations and figures to support completion of the RFI document.

From 2014-2019, provided live access to historic site data and facilitation for ongoing technical working group meetings, regulatory negotiations, and public meetings/outreach activities with 25-50 stakeholder participants, and worked closely with the USAF, multiple USACE districts, the New Mexico Environment Department, US Geological Survey, City of Albuquerque, and the Albuquerque Bernelillo County Water Utility Authority, as well as appointed government officials during the decision-making process.

USAF Portfolio Risk Management Assessment for Environmental Sites, USACE-Omaha and AFCEC, AF Installations Nationwide – Project Manager. Provided project management and engineering review of DoD and USAF environmental restoration and compliance programs (ERP/CRP) as well as the military munitions response program (MMRP) across the USAF portfolio of 119 CONUS installations. Extensive use of GIS and 3D/4D visualization, geostatistical tools, and probabilistic cost estimating to evaluate environmental concerns, risks, and alternatives at thousands of risk-driving sites in the USAF portfolio across all USEPA regions and a multitude of state environmental regulations. Worked closely with individual project teams (5-30+ people) to facilitate discussions and formulate consensus for exit strategies with base personnel, regulatory agencies, and other key stakeholders. Provided evaluation of technical risk, cost to complete, uncertainties and uncertainty drivers to provide a quadrant plot visualization to understand magnitude and priority of USAF programmatic liabilities.

USAF MMRP Portfolio Risk Management Assessment for MMRP Sites, USACE-Omaha and AFCEC, AF Installation Nationwide – Project /Program Manager. Led development metrics to assess risks at USAF MMRP sites for integration into the nation-wide USAF Portfolio Risk Management Assessment tool to recognize program labilities and enhance asset management. Integrated risk associated with unexploded ordnance, munition constituent impact to site media, complexities in site settings, regulatory and public involvement, and other factors influencing site and programmatic risk. Provided project management and technical analysis across 119 CONUS US AFBs for each installations’ MMRP sites, environmental restoration, and environmental compliance sites.

Post Remedy in Place (Post-RIP), USACE-Omaha, AFCEC, SECAF, AF Installations Nationwide – Project Engineer. Project Manager working directly with AFCEC and the office of the Secretary of the Air Force (SECAF) to develop post-RIP metrics to evaluate and track remediation strategies performance, efficiency, and impact to USAF programmatic liability with respect to cost, schedule, sustainability (carbon emissions), and acres returned to Mission use. Presented and gained consensus with AF Team on individual metrics and programmatic assessment of each metric to develop tool for liability identification and prioritization. Provided analysis of AF base sites nationwide across the USAF environmental portfolio to assess programmatic performance and prioritize funding.

Performance-Based Contract Development, USACE-Omaha and AFCEC, AF Installations Nationwide – Project Manager/Project Engineer. Provided direct engineering and technical support to the AFCEC Performance-Based Management Contracting team as they developed the Performance-Based Restoration (PBR) Strategy. Worked with AFCEC and individual installations to identify sites, establish technical performance objectives, develop contract language, provide cost/ROM estimates, assist with contractor site visits (Hill AFB, Tinker AFB), integrate PBR strategies with Federal Facility Agreement (FFA) requirements for solicitation of the large-scale contracts at multiple installations and groupings of installations.

Sustainable Asset Accounting System Project, USACE-Omaha and AFCEC, Barksdale AFB and AF Installations Nationwide – Project Engineer. Provided technical and engineering supporting for development of the Sustainable Asset Accounting System (SAAS), a triple bottom line accounting tool. Worked with Team to develop an accounting tool, which normalized a multitude of data inputs across a USAF installation to calculate triple bottom line accounting metrics (e.g. – social, environmental, and economic), to evaluate potential decision impacts to holistic asset value. The Team mined and evaluated data for Barksdale AFB as a pilot to demonstrate the SAAS tool.

Shell Crop Protection Program, Shell, European Facilities – Project Engineer. Provided technical site analysis, environmental risk quantification, and liability negotiation support for Shell Crop Protection sites in Germany, Netherlands, and Italy. Evaluation required accelerated understanding of respective regulatory requirements, identification of contributing sources, and evaluation of impacts in multiple media to assess source and liability allocation.

Stormwater Pollution Prevention Project, Multiple Air Carriers at MSP, Minneapolis, MN – Project Manager. Managed stormwater pollution prevention project supporting multiple air carriers at MSP International Airport including on-site inspections, storm water pond sampling, as well as preparation of plans (SWPPP, BMPs, etc.) and documents per Minnesota Pollution Control Agency guidance and requirements.

Fence-to-Fence Environmental Restoration Program Performance Based Contract, USACE-Omaha, Seymour Johnson AFB, Goldsboro, NC – Project Manager. Managed and directed $13M base-wide “fence-to-fence” performance-based contract (PBC) under CERCLA and RCRA regulatory frameworks for investigation, remediation, and/or site closure at 16 ERP sites at Seymour Johnson AFB. Directed and managed investigations, data collection, and field studies, remedial design (in situ chemical oxidation, removal actions, bioremediation, multi-phase extraction) and implementation, remedial action operation/maintenance/optimization, long-term monitoring/optimization, negotiating and consensus building with regulatory agencies and stakeholders, and presenting project information to the public and citizen groups for all sites with contaminants ranging from petroleum and solvents to metals.

Directly managed on-site personnel responsible for daily operations of O&M for groundwater treatment and multi-phase extraction systems. Achieved performance objectives for all program sites on or ahead of schedule. Selected as a representative of the Seymour Johnson AFB Environmental Restoration Project Team to receive the General Thomas D. White Award for Environmental Restoration Program (Installations) at the Pentagon.

MMRP Site Investigations at Multiple Installations Performance-Based Contract, USACE-Omaha, Clear AFS, AK/Boise ANG Base, ID/Nellis AFB, NV/Arnold AFB, TN – Project Manager. Project Manager for site investigations at Clear AFS, Boise ANG, Nellis AFB, and Arnold AFB under the Military Munitions Response Program. Directed investigations (PA/SI, RI, statistical sampling plan design, UXO/MMRP field projects), remedial design (in situ chemical oxidation, removal actions, bioremediation, multi-phase extraction) and implementation, remedial action operation/maintenance/optimization, long-term monitoring/optimization, negotiating and consensus building with regulatory agencies and stakeholders, and presenting project information to the public and citizen groups for 60+ US Air Force (USAF) sites with contaminants ranging from petroleum and solvents to metals and explosives. Directly responsible for simultaneously directing field crews, managing on-site personnel, directing SB and LB subcontractors, and all project activities for ~$20M of task orders in Alaska, California, Idaho, Illinois, Nevada, North Carolina, and Tennessee.

Groundwater Treatment System O&M at Naval Industrial Reserve Ordnance Plant, US NAVY, Minneapolis, MN – Project Engineer. Lead environmental engineer for operation and maintenance (O&M) of an 800-gpm groundwater treatment system at the Naval Industrial Reserve Ordnance Plant (NIROP; formerly #1 on the National Priorities List) in Minneapolis, MN. For four years, worked daily on-site performing and overseeing contractors and teams for system operation/optimization, groundwater and surface water [Mississippi River] sampling, evaluation of the remedy and supporting augmentation with alternatives, and reporting.

KRISTEN CARLYON PEYTON, CHMM

SENIOR CHEMIST

- **EDUCATION**

BS, Chemistry, University of California, Berkeley, CA, 1992

- **REGISTRATIONS/CERTIFICATIONS**

Certified Hazardous Materials Manager (CHMM), #18310 (expires 12/31/2027)

- **SPECIALIZED TRAINING**

OSHA 40-Hour, AT Level 1 Training

- **COMPUTER SKILLS**

eDMS, SQL, Geotracker, NIRIS, ERPIMS, FUDSChem, and ProUCL

Ms. Carlyon Peyton has 16 years experiences as a senior chemist on numerous complex sites involving hazardous, toxic, and radioactive constituents for the DoD and EPA. She is experienced in developing and enforcing program and project-specific quality programs, data quality objectives (DQOs), Quality Assurance Project Plans (QAPPs), and sampling and analysis plants (SAPs) to ensure that the highest quality of data is collected and submitted.

Ms. Carlyon Peyton has 12 years of chemistry laboratory experience, including hands-on experience performing laboratory analyses for organic and inorganic chemicals, serving as the quality assurance officer for the laboratory, and managing the mobile laboratories and field sampling services. She is experienced in providing internal surveillance for project environmental sampling and testing; verifying the appropriateness of sampling procedures, analytical methods, and laboratory quality systems; coordinating field and laboratory quality surveillance; directing data reviews; and monitoring corrective actions. She has served as the primary point of contact for laboratory and government personnel; managed laboratory selection and field sampling; and performed data management, validation, and data quality assessments. She has also provided method development for field methodologies, such as X-ray fluorescence (XRF) and mercury analyzers.

Ms. Carlyon Peyton has served as the Program Chemist for the US Army Corps of Engineers (USACE), Naval Facilities Engineering Command (NAVFAC), Air Force Civil Engineer Center (AFCEC), and the US Environmental Protection Agency (EPA). In her capacity as Program Chemist, she was responsible for preparing the program-specific Quality Management Plan (QMP), preparing/reviewing site-specific QAPPs and SAPs, providing support and oversight of other chemists managing individual projects under the contract, and reviewing chemistry-related work performed for both consistency and compliance with program requirements.

ENVIRONMENTAL INVESTIGATIONS AND REMEDIATION

PFAS Remedial Investigation at Vandenberg SFB, USACE Los Angeles, Vandenberg SFB - Senior Chemist. Senior Chemist supporting the Phase I PFAS RI at Vandenberg SFB from 1/2022 to the present. Supported development of the UFP-QAPP featuring Draft Method 1633 and selection of the laboratory.

PFAS Remedial Investigation at Holloman AFB, USACE Albuquerque, Holloman AFB - Senior Chemist. Senior Chemist supporting the Phase I PFAS RI at Holloman AFB from 11/2021 to the present. Supported development of the UFP-QAPP and selection of the laboratory.

PFAS Remedial Investigation at Travis AFB, USACE Albuquerque, Travis AFB - Senior Chemist. Senior Chemist supporting the Phase I PFAS RI at Travis AFB from 5/2021 to the present. Supported development and implementation of the UFP-QAPP, coordinated with field, lab, and data validators. Provided senior review of validated data packages in preparation for data usability assessment.

PFAS Remedial Investigation at Edwards AFB, USACE Albuquerque, Edwards AFB - Senior Chemist. Senior Chemist supporting the Phase I PFAS RI at Edwards AFB from 5/2021 to the present. Supported development of the UFP-QAPP, coordinated with field, lab, and data validators. Provided senior review of validated data packages in preparation for data usability assessment.

San Fernando Valley Superfund Site, Pollock Operable Unit, US EPA Region 9, CA – Senior Chemist. Senior Chemist supporting the program at the Pollock Operable Unit from 7/2021 to the present. Developed and implemented UFP-QAPP Addenda and coordinated sampling events with the EPA R9RSCC.

MMRP RI/FS at Irvine Park – Army Camp, USACE Los Angeles, Orange County, California - Senior Chemist. Senior Chemist supporting the RI/FS at the Irvine Park formerly used defense site (FUDS) from 7/2021 to the present. Supported development of the MR-QAPP with focus on the MC.

CON/HTRW Site Closure, Former Plattsburgh Atlas S-6 Site, Au Sable Forks, Black Brook, New York – Senior Chemist. Senior Chemist supporting the activities necessary to remove the site from the FUDS program and to obtain regulatory concurrence and approval by NYDSEC for site closure from 6/2021 to the present. Supported development and implementation of the FUDSChem eQAPP and performed event management. Validated project data by reviewing/augmenting FUDSCHem automated data review (ADR) and uploaded geological data from site activities to FUDSChem in electronic and portable document formats.

Travis Nike Battery 10 Containerized/Hazardous, Toxic, and Radioactive Waste CON/HTRW Supplemental Investigation and Remediation Groundwater Monitoring, FUDS J09CA0974-01, USACE Sacramento – Senior Chemist. Senior Chemist supporting the groundwater monitoring at Nike Battery 10 from 8/2021 to the present. Developed and implemented Field Change Request Forms for QAPP revisions, developed the FUDSChem eQAPP, performed FUDSCHem event management, and coordinated with field, lab, and data validators. Provided senior review of validated data packages in preparation for data usability assessment.

San Fernando Valley Superfund Site, Basin-wide Operable Unit, US EPA Region 9, CA – Senior Chemist. Senior Chemist supporting the $2.8 million dollar program at the Basin-wide Operable Unit from 5/2021 to the present. Developed and implemented the Basin-wide UFP-QAPP, performed and/or reviewed data validation of annual groundwater monitoring, coordinated sampling events with the EPA R9RSCC, and lead development of a data management plan.

PRIOR TO SRS

Basewide Groundwater Monitoring Program (BGMP) and Operations Maintenance and Monitoring (OM&M) at Installation Restoration (IR) Site 1, NAVFAC Southwest (SW), Alameda Point, Alameda, California – Senior Chemist. Senior Chemist supporting the BGMP and OM&M at IR Site 1 at Alameda Point. As Program/Project Chemist developed and implemented SAP and various field change requests (FCRs), Coordinated field, laboratory, and third-party data validation, Naval Installation Restoration Information Solution (NIRIS) deliverables, authored Quality Control Summary Reports (QCSRs) and provided input for annual monitoring reports. (2019-2021)

Hot Spot Delineation and Excavation Remedial Action at Parcel E-2, NAVFAC SW, Hunter's Point Naval Shipyard, San Francisco, California – Senior Chemist. Senior Chemist supporting a remedial action to delineate and excavate near-shore and inland soil hot spots (radiological-impacted) at Parcel E-2. Scope included a Remedial Action Work Plan (RAWP), delineation of hot spots, preparation of a pre-excavation characterization, excavation, and preparation of a Remedial Action Closure Report (RACR). As Program/ Project Chemist developed and implemented SAP and coordinated analyses for air monitoring required by the Dust Plan. Coordinated electronic data deliverables (EDDs) and provided input for RACR. (2014-2019)

Palos Verdes Shelf Remedial Action, EPA Region 9, Los Angeles County, California – Senior Chemist. Senior Chemist supporting the RA, which involved performing sediment, water column, and fish tissue monitoring of the Palos Verdes Shelf Superfund site as part of the monitored natural recovery (MNR) component of the remedy, as part of the remedial action selected in the interim Record of Decision (IROD) issued in September 2009. Provided development and implementation of sediment QAPP, laboratory and data validation coordination, and co-authored MNR report. (2013-2019)

Phase II Radiological Remediation and Support, Parcel D-1, NAVFAC SW, Hunter's Point Naval Shipyard, San Francisco, California – Senior Chemist. Senior Chemist supporting the remedial action to delineate and excavate sanitary sewer and storm drain (SS/SD) lines and radiologically impacted ship berths at Parcel D-1. Scope includes removal and free release of 5,500 linear feet of SS/SDs, free release surveys for Ship Berths and the Naval Radiological Defense Laboratory (NRDL) area, and disposal of over 10,000 railroad ties. As the program/project chemist, provided development and implementation of SAP, coordination with laboratories and third-party data validators, data quality assessments, RACR, and electronic deliverable support. (2013-2017)

Klau/Buena Vista Mines Lake Nacimiento, Operable Unit (OU) 3 RI, EPA Region 9, San Luis Obispo, California – Senior Chemist. Senior Chemist supporting the RI, which involved the investigation and study of the mercury and methyl mercury contamination in surface water, porewater, sediment, and tissue in Lake Nacimiento; and the evaluation and their impact to human health and the environment. As Project Chemist, authored EPA-approved QAPP and several QAPP Addendums. Coordinated with laboratories: commercial; EPA Region 9; and Contract Laboratory Program (CLP) through the Regional Sample Control Coordinator (RSCC). Provided sample coordination and field support. Coordinated data uploads, data validation (commercial and through EPA for CLP data), performed S2B validations, and provided data usability assessment reports. (2013-2017)

Geochemistry Background Sediment Study for Morris Reservoir at the Former Naval Center for Combat and Operational Stress Control (NCCOSC) Morris Dam Research and Development (R&D) Facility, NAVFAC SW, Azusa, California – Senior Chemist. Senior Chemist supporting the study to determine whether the presence of metals identified in sediment sampled from Morris Reservoir are: (1) naturally-occurring (from naturally-occurring minerals or mineralization associated with natural geologic processes, including regional mineralization in the San Gabriel Mountains and local mineralization identified in rocks from the peninsula and the northeastern portion of Silver Mountain, the large peak west of the site); (2) anthropogenic (from activities predating historic Navy activities, including hard rock mining and mineral processing and placer mining that occurred from the mid 1800's through the early 1930's along the stretch of the San Gabriel River that is now beneath Morris Reservoir); or (3) from historic Navy activities. As Project Chemist, authored Navy Quality Assurance Office (QAO)-approved SAP; conducted XRF analyses using bench-top instrument; was responsible for sample management; coordinated data validation, and authored data usability report. (2012-2015)

Non-Time-Critical Removal Action (NTCRA) for IR Site 2, Former NCCOSC Morris Dam R&D Facility, NAVFAC SW, Azusa, California – Senior Chemist. Senior Chemist supporting the NTCRA to remove contaminated soils from four areas, referred to as Exposure Units (EUs), and to conduct groundwater monitoring to demonstrate that the removal was protective of groundwater. Chemicals of concern included metals, polychlorinated biphenyls (PCBs), N-nitrosamine (NDMA), and perchlorate. As Project Chemist, authored Navy QAO-approved SAP, revision and addendum; was responsible for sample management; coordinated data validation; authored QCSRs; and coordinated EDDs. (2010-2015)

Site FT005, USACE, Travis Air Force Base, Solano County, California – Senior Chemist. Senior Chemist supporting the performance-based remediation services project from 2010 to 2012 to complete inspection, and monitoring and maintenance of five sites for closure. Implementation of land use control (LUC) remedial action for FT005, following the excavation of contaminated soil. Objective is to achieve no further action (NFA), no further active remediation (NFAR), or site closure to the maximum extent possible to provide lowest long-term inspection and monitoring costs for best value remedy-in-place (RIP) to the Air Force. The site was closed and attained unrestricted site use status. As Project Chemist, implemented the RAWP and the Travis Model QAPP. Through USACE-approved FCRs, improved the silica gel clean up methodology used for the project to achieve better detection limits for matrix-impacted samples. (2010-2012)

ROBERT PRICE, PG, CEG, QSD

SENIOR GEOLOGIST

EDUCATION

M.S., Geology, University of Vermont, Burlington VT, 2005

B.S., Geological Sciences, University of California, Santa Barbara, CA, 2002

REGISTRATIONS/CERTIFICATIONS

Certified Engineering Geologist, CA, No. 2585

Professional Geologist, CA, No. 8588

Qualified SWPPP Developer (QSD), CA

SPECIALIZED TRAINING

40-hour OSHA HAZWOPER training

Construction Quality Management for Contractors (CQM) Certification, February 2022.

Disaster Service Worker Volunteer, Governor's Office of Emergency Services

COMPUTER SKILLS

AutoCAD

PROFESSIONAL AFFILIATIONS

Association of Engineering Geologists

Mr. Price is a Professional Geologist and Certified Engineering Geologist with more than 17 years of experience managing environmental, engineering, and construction projects for a diverse portfolio of clientele that include local public municipalities (City of Santa Barbara Public Works, Housing Authority of the County of Santa Barbara, Santa Barbara County Parks Division, County of San Luis Obispo Public Works, City of Goleta Public Works, City of Malibu) development companies (The Towbes Group, Investec RE), Federal Defense (U.S. Navy – Seal Beach), and California energy providers (Southern California Edison, Southern California Gas Company, Crimson Midstream, Plains All American Pipeline).

His municipal experience includes the management, environmental, quality control, and permitting support of waterline replacement projects, desalination facility construction, bridge reconstruction, landfill, and wastewater treatment plant improvement projects. These professional responsibilities encompass project coordination, site characterization studies including developing work plans, construction monitoring, stormwater and surface water compliance, project planning and implementation, regulatory agency communication and negotiations, systematization of fieldwork, and report submittals as well as other project deliverables.

In addition, his experience includes stormwater management services for SWPPP and long-term stormwater monitoring programs implementing structural BPMs such as silt fencing, fiber rolls, filters, and slope netting for erosion and sediment control, and non-structural controls for site maintenance and sedimentation prevention.

Elings Park Closed Landfill, Santa Barbara, CA

- Responsible for oversight, management, and quality control of the landfill gas mitigation system, stormwater and drainage control system, landfill gas, and groundwater monitoring programs, including monitoring, operation, permit compliance, and mitigation system performance evaluations.
- Stormwater management included routine wet season inspections and reporting and qualifying event monitoring and sampling events.

Charles E Meyer Desalination Plant Reactivation Project, City of Santa Barbara, CA

- Provided comprehensive environmental services including site assessments, construction monitoring, contaminated soil management, air quality permitting and monitoring, SWPPP preparation and compliance monitoring.

Los Osos Closed Landfill, San Luis Obispo County, CA

- Prepared monitoring and compliance reports for surface water, groundwater, and landfill gas extraction system monitoring programs.
- Stormwater compliance reporting included seasonal rainfall summaries and sampling results for qualified events.

Baseline Groundwater Quality Monitoring Project, Malibu Civic Center Wastewater Treatment Facility, CA

- Conducted routine groundwater and surface water monitoring to evaluate baseline water quality conditions prior to operation of the wastewater treatment facility.

Anapamu Bridge Replacement Project, City of Santa Barbara, CA

- Conducted site assessments, construction monitoring, contaminated soil management, air quality permitting and monitoring, and stormwater compliance monitoring.
- A portion of the Old Mission Creek was temporarily diverted to accommodate bridge demolition and reconstruction.

El Estero Wastewater Treatment Plant Secondary Improvement Project, City of Santa Barbara, CA

- Provided comprehensive environmental services including site assessments, construction monitoring, quality control, contaminated soil management, air quality permitting and monitoring, and stormwater monitoring.

Water Main Replacement Project, City of Santa Barbara, CA

- Provided preconstruction site assessment and waste profiling, contaminated soil management, stormwater monitoring, and air quality permitting and monitoring.

Old Town Sidewalk Improvements Project, City of Goleta, CA

- Provided contaminated soil management and stormwater compliance services.

Ammunition Pier and Turning Basin Project, U.S. Navy, Seal Beach, CA

- Conducted Vibracore sampling in Anaheim Bay and evaluated marine sediments for use as fill soil to construct the civilian boating channel.

Emergency Spill Response, Assessment, and Compliance Services, Crimson Midstream, CA

- Performed emergency spill response services including assessment, cleanup recommendations, verification sampling, and post response assessments for multiple project areas.

- Successfully oversaw a 24-hour spill response to obtain emergency response closure within four days and return a state highway to service, greatly reducing the response costs.
- Prepared port-response assessment workplans.

Bohnett Park Project, City of Santa Barbara, CA

- Performed a pre-construction site assessment and provided subsurface data for the stormwater infiltration facility.

Preliminary Endangerment Assessment (PEA), Springville LLC, Camarillo, CA

- Completed a PEA of former agricultural property. The PEA was approved, and the California Department of Toxic Substances Control (DTSC) approved No Further Action status; the property was redeveloped with residential housing.
- The PEA has been provided by the DTSC as an example for other impacted properties in the area.

Hancock Project, The Towbes Group, Santa Maria, CA

- Directed the excavation of over 9,000 tons lead- and petroleum-contaminated soil at a former railroad depot in Santa Maria, California.
- Successfully obtained project closure; the site was redeveloped with multi-unit residential housing without title restrictions or additional monitoring requirements.

Casa de las Flores Project, Peoples Self-Help Housing, Carpinteria, CA

- Performed SWPPP monitoring and compliance services during site redevelopment.

Mineral Remoteness Evaluation, Hyundai Motor Test Track, California City, CA

- Completed a mineral remoteness evaluation for 1,600 undeveloped acres of the testing facility, to obtain a CDFW conservation easement providing required construction offsets.

Geologic Hazards Evaluation, Plains Replacement Pipeline, CA

- Performed a comprehensive geologic hazards evaluation for a proposed 123-mile pipeline corridor from Santa Barbara County to Kern County.

Mineral Remoteness Evaluation, Attiyeh Ranch, San Luis Obispo and Monterey Counties, CA

- Completed a mineral remoteness evaluation of 8,300 acres of ranchland to support the property transfer to the Land Conservancy of San Luis Obispo.

MATTHEW VAN BEEK, PE

DIRECTOR – RISK MANAGEMENT, HEALTH & SAFETY, IT SERVICES

EDUCATION

MS, Engineering Management (emphasis in Project/Program Manager), Milwaukee School of Engineering, Milwaukee, WI, 2011

BS, Mechanical Engineering, Milwaukee School of Engineering, Milwaukee, WI, 2002

REGISTRATIONS/CERTIFICATIONS

Florida Licensed Mechanical Contractor (2020)

Professional Engineer: WI (#39159), 2007

Master's Certificate in Project Management (MSOE)

COMPUTER SKILLS

AutoCAD

Pro-Engineer

Solid Works

Microsoft Project

SPECIALIZED TRAINING

OSHA 10-Hour Construction Safety and Health

US Army Corps of Engineers – Construction Quality Management for Contractors

MISCELLANEOUS

Member of the Oneida Nation of Wisconsin

Matt has 20 years of experience in the areas of engineering, project management, utilities, manufacturing, construction, and operations. He is well versed in project management and mechanical systems.

Matt is the licensed qualifier for General Mechanical Corporation (GMC), which allows them to conduct mechanical contracting operations in the state of Florida. This involves general oversight of all GMC business operations.

Oneida ESC Group – Director Risk Management, Health and Safety, IT Services (January 2021 – Present)

- Serves as Contractor Quality Control Supervisor (CQCS) for several federal PFAS Remedial Investigations. Oversees all Oneida QC activities, performs process reviews, ensures that appropriate resources, training, and lines of authority are established to efficiently support the projects.
- Responsible for overseeing all exposure to the organization related to project performance, health and safety, quality, IT, and project liability.
- Responsible for monitoring the performance of all projects throughout the project lifecycle. Work to resolve and mitigate project performance issues as they arise.
- Overall responsibility of administering the Company's Corporate Health & Safety program.
- Manage the procurement and renewal of all company insurance policies. Act as the liaison between our Company, insurance broker, and insurance carrier. Provide leadership support to Operations for all insurance claim related issues.
- Responsible for all aspects of corporate information technology activities including systems analysis, implementation of new technologies, cybersecurity compliance, website design, programming, hardware/software procurement, device management, and helpdesk support.

Oneida ESC Group – Corporate Risk Management / Quality Control Manager (October 2016 – January 2021) Works under the direction of the Director of Corporate Risk Management to plan, develop, organize, implement, direct, and evaluate the organization's quality function and performance.

- Develop and administer the Company's project management training program.

- Draft and implement Corporate Standard Operating Procedures (SOPs) to ensure consistent business processes across the enterprise.
- Participate in the development of the company's plans and programs; evaluate and advise on the impacts of new programs/strategies or regulatory actions.
- Plan, develop, enhance, and enforce policies and procedures designed to manage and mitigate risks related to quality and project performance including financial performance.
- Contributes to continual improvement in quality and performance management by working with subsidiary company managers.
- Completes project site visits to evaluate project delivery and performance.
- Provides risk management input to decision-making on issues affecting the organization including evaluation of alliances, acquisitions, or mergers; pursuit of business lines, programs, contracts, or projects that present risks to the company.
- Manages the procurement and renewal of all company insurance policies and provide support to Operations for all insurance related issues.
- Manage issues relating to our Corporate Health and Safety Program, quality, risk, and insurance.

Alliant Energy – Manager, Gas Engineering (2014 – 2016) Managed a team of engineering professionals who provided technical and operations support to internal customers throughout Alliant Energy's Wisconsin natural gas service territory. Duties included: budgeting, hiring, performance reviews, coordinating and scheduling work, salary recommendations, discipline, ensure employees report to work fit for duty, leadership, grievance resolution, coaching, counseling, and modeling of company's core values.

- Provided mentorship, training, technical guidance, and oversight to Gas Engineering department staff and field engineering technicians.
- Developed the annual capital budget and associated work plan.
- Monitored gas distribution system condition and performance. Identified and communicated capital improvement initiatives/enhancements to gas distribution systems.
- Oversaw the scoping, engineering, and budgeting of $25M+ in capital improvement/expansion projects annually.
- Provided engineering, project development, and project management support for large natural gas

expansion/replacement projects (individual projects ranged from $10M to $30M+).

- Developed, maintained, and interpreted gas operating work practices/standards/maintenance plans in accordance with the Pipeline & Hazardous Materials Safety Administration (PHMSA) and associated state regulations.
- Assisted with the evaluation, testing, and preparation of specifications for gas materials, tools, and equipment. This includes investigation of material, tool and equipment failures, and identifying corrective actions.
- Supported the preparation of regulatory applications, responding to regulatory audits/inquiries and providing testimony at regulatory hearings.

We Energies, Gas System Operations - Senior Engineer (2008 – 2014)
Project management responsibilities included:

- Managed large capital improvements associated with the construction of natural gas regulation stations and high-pressure pipelines.
- Duties include project scoping, permitting; licensing; construction cost estimating, engineering design; construction management; job close-out, writing and enforcing contracts; ensure on-time and on-budget project performance.
- Ensured successful start-up and commissioning of projects; provide record keeping and ongoing system monitoring in support of operations, maintenance and future planning; provide benchmarking information on engineering and construction services; assist with resource allocation functions.

Operational responsibilities included:

- Developed bid packages to support the execution of maintenance programs company-wide.
- Implemented and managed labor contracts for the inspection and maintenance of natural gas distribution facilities.
- Developed budgets, monitor progress, and control spending for Government regulated O&M activities.
- Researched, developed, and implemented new technologies to improve the efficiency of existing business processes within Gas System Operations and Gas Field Operations.
- Provided training and support to management, supervisors, and field personnel on Company policies and procedures.

Kohler Company, Kohler Power Systems, Operations – Senior Project Engineer (2007 – 2008) Responsibilities included:

- Managed projects of significant scope between KPS facilities worldwide and suppliers to increase manufacturing capacity and promote company growth in new markets.
- Led international project teams to execute capital projects on time and on budget.
- Used technical expertise to conduct project research and identify cost reduction strategies.
- Facilitated the development of manufacturing techniques and implement best practices.
- Researched, developed, and implemented projects to reduce facility energy consumption.

Kohler Company, Technical Services, Facilities Engineering – Mechanical Project Engineer (2002 – 2007) Responsibilities included:

- Supported facility construction, renovations, and expansions worldwide.
- Coordinate with external design firms to obtain local permits and approvals.
- Developed designs / specifications for plumbing, process piping, and fire protection systems.
- Provided technical expertise to resolve machine design, manufacturing, and safety issues.
- Consulted with internal customers to develop project scope.
- Ensured engineering designs comply with NFPA, FM Global, and EH&S policies.
- Led project design efforts, bid package development, procurement, and implementation.
- Performed intermediate and final project reviews to ensure scope and quality goals were met.
- Developed cost estimates to support capital planning and project budgeting.
- Reviewed contractor bids to ensure project costs are reasonable and contractor accounted for all scope items.
- Tracked project costs and schedules against budget and timing commitments.

BRADLEY J. KUNTZ, CIH, CSP, CHMM, SMS

CORPORATE HEALTH & SAFETY MANAGER

EDUCATION

BS, Environmental Science, University of Cincinnati, Cincinnati, Ohio, 1998

REGISTRATIONS/CERTIFICATIONS

Certified Industrial Hygienist (CIH): (#10706), April 2015, exp. Dec. 1, 2025

Certified Safety Professional (CSP): (#31279), May 2016, exp. June 30, 2026

Certified Hazardous Materials Manager (CHMM): (#21145), Nov 2017, exp. Nov. 30, 2027

Safety Management Specialist (SMS): (#SMS-250), June 2017, exp. Dec. 31, 2022

SPECIALIZED TRAINING

40-Hour OSHA Health & Safety Training, 29 CFR 1910.20, January 1999

8-Hour OSHA Health & Safety Refresher, December 2022

8-Hour OSHA Supervisor Course, April 2000

10-hour Construction Industry Safety & Health Outreach Course, February 2007

30-hour OSHA Construction Safety, Oct. 4, 2010, and Jan. 7, 2021

OSHA Trenching & Excavation Competent Person Training, July 21, 2008

First Aid/CPR/AED/BBP Certification, Jan. 29, 2019 (Valid for 2 years)

Construction Quality Management for Contractors (CQM), December 2022

Annual Medical Surveillance, February 2022

PPE Training and Annual Respirator Fit Test

Niton X-Ray Fluorescence (XRF) instrument, 8-hour Training Class, Dec. 7, 2005, technology used for detection of RCRA metals in-situ in soils.

Mr. Kuntz has over 25 years of varied experience in the field of workplace health and safety, environmental health, and OSHA compliance. He has directed multiple environmental site safety and health programs for both private and government clients.

In addition, Mr. Kuntz has directed and enforced effective safety programs for diverse projects that included workplace health and safety at hazardous waste sites; munitions of explosive concern contaminated sites; OSHA compliance at facilities of industrial clients; investigations of indoor air quality concerns; monitoring for air contaminants; and assessment/management of environmental exposures contaminants.

Mr. Kuntz has been responsible for developing and implementing Corporate Safety and Health Programs for all environmental projects involving Levels B, C, and D. Established corporate standard operating procedures (SOPs) and mitigated safety and health procedures (e.g., life support/logistical services, COVID-19 monitoring, reporting, and deployment) for operations occurring at international (Pacific AOR) and/or remote and/or austere locations. Supervises all field personnel, such as Site Safety and Health Officers (SSHOs) and has stop work authority for all projects and programs. Interprets regulations and implements corporate, OSHA, NC DOL, and USACE policies and procedures; trains support personnel; tracks safety and health program performance; develops and approves accident prevention plans (APPs), site safety and health plans (SSHPs) and activity hazard analyses (AHAs); oversees personnel monitoring and personnel protective equipment (PPE) programs; conducts inspections and accident investigations; audits field projects for corporate and subcontractors performance documents issues, accidents, and violations; and ensure corrective actions are implemented. Facilitates training and medical monitoring. Developing Corporate-Level ADP training and an overhaul of the Corporate Safety Program Plan and ARDs/SOPs. His career experience includes:

- Workplace Health and Safety, Environmental Health, OSHA Compliance
- Recognition, Evaluation, and Control of Potential Hazards
- Development, Implementation, and Management of Formal Site Programs
- Development of Educational Programs and Delivery of Training
- Legal, Regulatory, and Technical Research
- Eight years of experience in OSHA compliance; including DoD, installations, general industry, and hazardous waste sites
- 25 years of experience developing and implementing Safety and Health Plans at hazardous waste sites and developing and directing PPE programs, including air monitoring programs, at hazardous waste sites, MMRP sites including recovered chemical

ONEIDA ESC Group

Supervisor's Drug and Alcohol Testing Course #6010, National Ground Water Assoc., 12/14/2005

DoD Environmental Monitoring & Data Quality Workshop, Albuquerque, NM, March 2007

- **PROFESSIONAL AFFILIATIONS**

Member of ASSP; ACGIH; and AIHA

- **PROFESSIONAL AWARDS/HONORS**

NSC 1 Million Hours Worked without a Lost Time Incident 2021

BB&T Lighthouse Beam Award for Excellent Safety 2010-2020

OSHA STAR VPP Program Liaison 2010-2020

warfare material, remedial actions, and in flammable or combustible atmospheres and confined spaces

- 25 years of experience in developing and implementing S&H plans at sites contaminated with Munitions and Explosives of Concern (MEC) under the DoD's Military Munitions Response Program (MMRP)
- Working knowledge of federal, state, and local occupation health and safety regulations available to the scope and geographic area of this contract
- Corporate liaison for NC Dept of Labor STAR program since 2010. Participates in monthly meetings, annual conference, develops annual STAR report. STAR is modeled on the OSHA VPP
- Works with HR on Workman's Compensation insurance cases/claims and employee injuries/mishaps/near misses
- Liaison with Work Care for injury intervention
- Accident investigations
- Worksite audits
- Chair of the Safety Committee

Relevant Manager Roles

COVID Response Team, DAWSON – LEAD. Developed Travel Logistics form with HR; wrote the Environmental Division COVID-19 SOP and the COVID-19 AHA. Mr. Kuntz evaluates travel forms for local and state policy, guidelines, restrictions, testing requirements, and mandatory quarantines. He looks at potential exposure cases and informs employees of needed quarantine periods and testing policy, testing methods, and suggests locations. Ensures corporate office locations and field sites have proper equipment (PPE, masks, thermometers, checklists, and hand sanitizer). Participated in weekly corporate COVID Ops Meetings. [03/2020 – 08/2021]

WorkCare Incident Intervention DAWSON – LEAD. Advocated for implementation of the WorkCare Incident Intervention Program after several recordable incidents likely could have been prevented had Corporate used the service. WorkCare was implemented in December 2020. Mr. Kuntz works with the safety managers and HR to run the program effectively. [03/2020 – 08/2021]

Environmental Division Representative on the Corporate Safety Committee, DAWSON, USA – LEAD. Review all safety incidents monthly and discuss ways to prevent reoccurrence and continuous improvement of metrics, reporting, corporate plans and procedures, give presentation on safety metrics, lagging indicators: recordable vs. reportable cases, case rates, lost-time incidents, DART, EMR, OSHA 300 logs and leading indicators, safety meetings, training, safety audits, near misses, first aid cases, etc. [03/2020 – 08/2021]

Corporate ADP Safety Training, ADP, DAWSON – LEAD. Help recommend new safety training initiatives for ADP, work with developers to come up with video and give feedback on edits. So far, we have a draft video on ADP for accident investigation reporting. Coming soon is emergency response and new employee safety orientation. [03/2020 – 08/21]

Relevant Project Experience

Multiple Award Environmental Services (MAES), FY20 Facility Reduction Program, Demolition of 49 Buildings/Facilities Aberdeen Proving Ground, Maryland – Health and Safety Manager. Responsible for developing the H&S Plan for the complex Asbestos and Hazardous Materials Abatement and Building Demolition. Dust mitigation, Level C, and D PPE, asbestos, and dust sampling methodology. Manages and oversees safety and developed the APP/SSHP/AHAs. Reviewed and approved APP and safety plans for compliance with appropriate regulations, guidelines, and corporate policy. [Contract Number: W912DR-19-D-0007 Delivery Order: W912DR20F0450]

Asbestos and Hazardous Materials Abatement and Building Demolition, Charles Melvin Price Supply Center, Omaha – Health and Safety Manager. Responsible for developing the H&S Plan for the complex Asbestos and Hazardous Materials Abatement and Building Demolition. Dust mitigation, Level C, and D PPE, asbestos, and dust sampling methodology. Manages and oversees safety and developed the APP/SSHP/AHAs. Reviewed and approved APP and safety plans for compliance with appropriate regulations, guidelines, and corporate policy. [10/2020–08/2021]; FFP, 2 year, $2.6Mil.]

Water Compliance, FY20 United States Marine Corps Installations-East, Camp Lejeune, NC – Health and Safety Manager. Responsible for developing, managing, and overseeing safety and developed the APP/SSHP/AHAs. Reviewed and approved APP and safety plans for compliance with appropriate regulations, guidelines, and corporate policy. Large subcontractor component, excavations, confined spaces, heavy equipment to dig trenches and install wet-tap water compliance sampling points at 60 locations on the base. [09/2020 – 08/21; Contract No. W912HN-18-D-1007, Task Order: W91278-20-F-0562]

Environmental Office Clean-Out/Recycle at the Former Joliet Army Ammunition Plant, Wilmington, Will County, IL – Health and Safety Manager. Responsible for developing the H&S Plan for the cleanout of the building and garage, determining PPE requirements including P-100 respirators and Tyvek suits for initial entry and assessment due to concerts of dust and histoplasmosis from bat or bird dropping, and rodent or other animal contamination. [09/2020 – 8/2021; Contract No. W912QR-20-D-0013, Task Order: W912QR-20-F-0381, CELRL, FFP, 1 year]

Robotics Tree Removal at Various Ranges, Fort Stewart, GA; Fort AP Hill, VA; Fort Benning, GA; West Point, NY; Fort Indiantown Gap, PA; and more awarded Task Orders forthcoming, CEHNC – Corporate Health and Safety Program Manager. Responsible for developing the H&S Plan for the complex Robotic Tree and Vegetation Removal. Manages and oversees safety and developed the APP/SSHP/AHAs. Reviewed and approved APP and safety plans for compliance with appropriate regulations, guidelines, and corporate policy. Created an integrated H&S plan for MMRP, GIS, and subcontractors. The project has two recordable safety incidents at the FIG PA site. [10/2019 – 8.2021; FFP, 5 year, $40Mil.]

Demolition Work and Preliminary Repairs at Aliamanu Military Reservation (AMR)-88 Facility, Joint Base Pearl Harbor-Hickam (JBPHH), NAVFAC Oahu, Hawaii – Health and Safety Program Manager. Assisted in reviewing APP and other subcontractor planning documents for demolition of a large tunnel with vast amounts of asbestos, ACM, lead paint, mercury, PCBs, and other hazardous materials, PPE, respirators, and air monitoring/sampling. [Dates 3/2020 – 8/2021; Contract No. N62478-16-D-4014, N6247820F4155; NAVFAC, FFP, $40M]

Closure and Replacement of Monitoring Well 149AMW006, CELRL, Fort Campbell, KY – Health and Safety Manager. Reviewed and approved APP and safety plans for compliance with appropriate regulations, guidelines, and corporate policy. [06/2020 – 08/2021; Contract No. W912QR18D0035, Task Order: W912QR20F0216, CELRL, FFP]

UXO and Soil Investigation and Removal, Joint Base Cape Cod (JBCC), USACE, Barnstable County, MA – Health and Safety Manager. Ensure APP and safety plans are followed, update AHAs as needed, work with UXOSO to ensure safety compliance. [3/2020 – 08/2021]

Indoor Air Quality Assessments for Cousins Properties, Fifth Third Center, Truist (Hearst) Tower, NASCAR Center, formerly Gateway Center, Bank of America Tower, Charlotte, NC – Industrial Hygienist and Project Manager. Manage a team of field technicians to inspect the floors and HVAC system including air intakes and coolers on rooftops. Annually monitor approximately three floors per building for oxygen, relative humidity, carbon monoxide, and carbon dioxide. Ensure parameters are within guidelines set by ASHREE and ACGIH. The project has had zero safety incidents. [03/2005 – 08/2021; FFP, annually ~$30k Project]

Interim Measures for Parcel 21 (Solid Waste Management Unit 1) and Parcel 24 -- Igloo Block A, USACE-Tulsa, Fort Wingate Depot, NM, – Corporate Health and Safety Program Manager. Prepared the accident prevention plan for a large and complex RCRA explosives contaminated soil removal/remedial action (up to 75,500 cubic yards) in former explosives leaching beds at this former Army Depot. Hired and trained a site safety and health officer for this job. These parcels will eventually be turned over to various Native American tribes (Navajo Nation and Pueblo of Zuni). Large excavation (up to 35 feet depth) which requires sloping design and implementation overseen by a competent Person with daily inspections and daily communication with Mr. Kuntz. Contaminants include various explosive constituents as well as metals, specifically lead. [8/12/2014 – 8/11/2021; W9128F-13-D-0025, DS01, FFP, $9.9M]

Sunflower Army Ammunition Plant (SFAAP), MEC Foundations and Inside Sewer Lines Removal Action, USACE, Kansas City District, Omaha MEGA, De Soto, Johnson County, KS – Corporate Health and Safety Program Manager. Project scope is industrial plant demolition, decontamination, and restoration. It includes the removal and disposal of potentially explosive building foundation slabs and walls, sumps, sewers, and underground infrastructure from a former Army Ammunition Plant.

Contamination includes explosives, various metals, ACM, etc. Mr. Kuntz managed CPFF project with two funding sources: DERA and US Army BRAC division. Developed a final APP/SSHP/AHAs and safety related FCRs and SOPs. Designed PPE selection and implementation for team of approximately 30 people. Provided contaminant exposure evaluation and corrective action, excavation safety, fall protection, respiratory protection program and implementation, respirator fit testing, confined space evaluation, ventilation system selection and design, power trucked safety and implementation, air sampling for asbestos and dust and VOCs. Project objectives included mitigating bulk explosive hazards found within and around concrete slabs and sub-foundations, interior drainage/plumbing fixtures, and adjacent shallow soils. Work elements include demolition and recycling of concrete, contaminated soil (metals, ACM) excavation and stockpile management, bulk explosives evaluation and mitigation, analytical testing, hazardous and non-hazardous waste management. To date, 29,950 BCY of soil, 674,424 SF of concrete, 3,708 LF of piping, and 1,959 analytical samples have been processed. Final reconciled quantities at 313 accounts across eight SWMUs and AOCs (from our Master Tracker file) addressed include the following;

- 52,402.06 cubic yards of hazardous/non-hazardous soil removed;
- 40,764 cubic yards of ACM removed and disposed of;
- 52,254 cubic yards of clean fill placed and compacted (with 3,904 truck trips);
- 832,921,18 square feet of concrete handled, investigated, and managed;
- 8,052.76 linear feet of inside sewer line inspected and removed;
- 4,866.69 linear feet of outside sewer line inspected and removed; and
- 1,959 soil and water samples collected and analyzed.

Mr. Kuntz is managing and directing safety at the Interim Corrective Measures (ICM) Implementation at 14 SWMUs or AOCs under a Cost Plus Fixed Fee task order with blended funding from Army Base-Realignment and Closure (BRAC) and Defense Environmental Restoration Account (DERA). The work performed under the Army Installation Restoration Program (IRP) in compliance with the Resource Conservation and Recovery Act (RCRA) includes: 1) MEC and explosives decontamination and remediation on and under foundation slabs, walls, and sumps, and removal of sewer lines and piping associated with former production facilities, and 2) environmental investigation and cleanup of materials (i.e., soil, concrete, piping, etc.) containing various metals, explosives, acids, petroleum-related compounds, and asbestos containing material. Manages project safety personnel and safety of two subcontractors; the multi-year project is supported by approximately five offices and 32 field personnel consisting of SUXOS, UXO SO, UXO QCS, UXO technicians, environmental scientists, heavy equipment operators, administrative staff, and laborers. The project is on schedule and budget with no safety incidents or QC non-conformance. [09/2015 – 08/2021; $30M W9128F-13-D-0025 TO #DH01]

Engine Room Team Trainer (ERTT) Construction Project, NAFAC, Joint Base Charleston (JBC) Goose Creek, SC – Corporate Health and Safety Program Manager. Responsible for overseeing the project's health and safety initiatives and helped develop and approve an APP and AHAs. High security project. Building the ERTT within an existing warehouse building. (SOW: Design Engine Room Team Trainer, Construction Management, Construction and As-Builts.) Involves fall protection, scissor lifts, indoor air quality, heights, welding hazards, eye-protection. [04/2016 – 02/2020; $13.75M, FFP]

Munitions Response and Five-Year Review, USACE Huntsville, Former Fort McClellan (FTMC), Anniston, AL – Corporate Health and Safety Program Manager. Review 11 specified areas in the Charlie Area of the Former Fort McClellan (45,679 acres), and five-year reviews of response actions at specified sites on the former FTMC, disposal of any potential hazardous waste discovered incidental to field operations in the Charlie Area, and removal of the existing Geophysical Prove-Out (GPO) IAW the requirements of the PWS. This includes removal of all discernable munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH). [08/11/2015 – 02/2020; $40,698,753.76]

Robins AFB Former Skeet Range TS882, Remedial Investigation/Feasibility Study (RI/FS), USACE Omaha, Warner Robins, GA – Corporate Health and Safety Manager. The RI was focused on the PAH- and lead-impacted areas within TS882, a Munitions Response Area (MRA) identified as a former skeet range. Today the range includes a golf course and low wetland areas. Soil samples were collected in these areas from a series of hand-augured borings. Groundwater samples (filter/unfiltered), surface water and sediment samples were collected and analyzed for lead. Developed a final APP/SSHP/AHAs and safety-related FCRs and SOPs. Worked with the SSHO from the field on a daily/weekly basis. Safety concerns pertained to project personnel working near potentially contaminated soil and water. Field work was designed to minimize exposure to the chemicals by all pathways—inhalation, ingestion, and skin absorption—and to reduce risks from other possible site hazards. This RI/FS was completed IAW CERCLA and approved by CENWO. [07/2012 – 06/2017; FFP, $418K]

MEC Removal Action, USACE, Various Ranges, Fort McCoy, WI – Corporate Health and Safety Program Manager. Responsible for developing the H&S Plan for the complex MEC and MPPEH Removal Actions at four training ranges. Managed and oversaw safety and developed the APP/SSHP/AHAs for the location, identification, and removal of MEC items, MD, and RRD from four active training ranges. Reviewed and approved APP and safety plans for compliance with appropriate regulations, guidelines, and corporate policy. Created an integrated H&S plan for MMRP, geophysical, GIS, and subcontractors. The project had zero safety incidents. [06/2014 – 07/2016; (TBUDS), CEHNC, FFP, $375K]

Mold Remediation Design, US Penitentiary, Lee, VA – Certified Industrial Hygienist. Reviewed design and sampling results to identify, define, and delineate mold contamination in twin wings of the 450,000SF US

Penitentiary. Reviewed the decontamination approach and safety health review of all project data and resulting plans. [xx/2015 – xx; $500k]

Remedial Investigation/Feasibility Study, Former Avon Park Army Airfield, FL – Project Manager and Safety Manager. As PM: Proposed planning and decision documents and participated in the proposed plan public meeting, conducted monthly calls, revised the schedule, billings, and contract mods. As Safety Manager: Developed the Safety and Health Plan for the complex RI/FS at the 64,580-acre FUDS, which was used for practice bombing, machine gun firing, and other ranges. Avon Park has heavily wooded forests and wetland areas (alligators were a deadly threat), which required the use of underwater DGM and helicopter magnetometer surveys in addition to digital and analog geophysical mapping. Managed and oversaw safety and developed the APP/SSHP/AHAs for the characterization of MEC and MC. Reviewed and approved APP and safety plans for compliance with appropriate regulations, guidance, and corporate policy. Responsible for an integrated S&H plan for MMRP, geophysical, GIS, and scientific staff and various subcontractors. No safety incidents occurred on this project. [(9/2011–Present; 9/30/2021 was the anticipated completion date. $2.5M]

Remedial Investigation/Feasibility Study (RI/FS), USACE Albuquerque District, Leonard Wood, MO – Corporate Health and Safety Program Manager. RI/FS at a former machine gun range at Fort Leonard Wood, MO under the direction of the USACE, Kansas City, and Omaha Districts (contracted by USACE, Albuquerque District). The 425-acre site is partly of low-lying grassland and scrub brush, and partly of a wooded steep bluff; these two areas are bisected by the Big Piney River. ZAPATA performed a surface clearance of a large portion of the site, followed by digital geophysical data collection, and environmental media sampling to determine the nature and extent of possible DoD-contamination. [07/2014 – xx/2018; $1.6M.]

Remedial Investigation/Feasibility Study Lake Bryant Bombing and Gunnery Range, USACE Huntsville District, Marion County, FL – Health and Safety Manager. SHM for Lake Bryant, comprised of eight MRSs totaling 10,520 acres of land within the Ocala National Forest, under the jurisdiction of the US Forest Service. Oversaw the preparation and implementation of the APP/SSHP IAW EM-385-1-1. Developed a Conceptual Site Model (CSM), oversaw MC sampling, and the safety management of the RI effort. Coordinated additional MC sampling fieldwork in conjunction with agreements with the FDEP regulators. Conducted on-site training, established emergency response and medical evacuation protocols, conducted hazard assessments, modified safety plans, and maintained H&S program records. The project was successfully completed with a perfect safety record. [xx/2010 – xx/2022; W912DY-10-D-0028, TO#0007; $2.58M]

Mold Remediation, Buildings B292 and B294, Pope AAF, NC – Industrial Hygienist. Certified Industrial Hygienist. Supported design and implementation of sampling strategy to identify, define, and delineate mold contamination in twin 33,000SF USAF dormitory/barracks buildings. Assisted in determining and designing the decontamination approach and safety health review of all project data and resulting plans. [xx/2001 – xx; $3.5M]

Remedial Investigation (RI)/ Feasibility Study (FS) for Waste Disposal Sites (WDS) 1-6, Environmental Chemical Corporation (ECC) under Huntsville WERS (Performance Based Contract under WERS), Former Turner Air Force Base (FTAFB) Albany, GA – Health and Safety Manager. SHM responsible for overseeing the safety program during installation of new monitoring wells, redevelopment of existing wells, groundwater sample collection and analysis, DPT boring installation, and falling head hydraulic conductivity tests. Oversaw the preparation and implementation of the APP/SSHP IAW EM-385-1-1. Conducted on-site training, established emergency response and medical evacuation protocols, conducted hazard assessments, modified safety plans, and maintained H&S program records. Ensured all field works was conducted in compliance with the approved APP/SSHP. The project was successfully completed with a perfect safety record. [2010–2013; $232,370]

Additional Site Assessments at Former Lake City Naval Air Station (combined contracts under TPMC), Lake City, FL – Health and Safety Manager. Prepared and implemented the APP/SSHP IAW EM-385-1-1. Conducted on-site training, established emergency response and medical evacuation protocols, conducted hazard assessments, modified safety plans, and maintained H&S program records. Conducted safety inspections and audits of the field work associated with the geophysical investigation, supplemental site assessment investigation, monitoring well installation, soil and groundwater sampling, and hydraulic conductivity testing. The project was successfully completed with a perfect safety record. [xx/2008 – xx/2013; $490,943]

Performance Based Remediation, Tripp's Mini-Mart, York, SC – Health and Safety Manager/Quality Manager. SHM responsible for coordinating with the South Carolina Department of Health and Environmental Control for the removal of free product and reduction of petroleum fuel hydrocarbons in groundwater to Site Specific Target Levels. Provided safety oversight for all field activities. Prepared and implemented the APP/SSHP IAW EM-385-1-1. Conducted onsite training, established emergency response and medical evacuation protocols, conducted hazard assessments, modified safety plans, and maintained H&S program records. Conducted safety inspections and audits of the field work. The project was successfully completed with a perfect safety record. [xx/2008 – xx/2013; $264K]

Interim Removal Action (IRA) and RI/FS, USACE Savannah District, Amelia Earhart Park, Opa Locka, FL – Site Safety and Health Officer. Mr. Kuntz served as the Site Safety and Health Officer at a former army airfield, located in Opa Locka, FL on behalf of the US Army Corps of Engineers (USACE) Savannah District. He was responsible for health and safety while the project confirmed the presence or absence of buried drums/contamination along a 4,000-ft sewer-line right-of-way, identifying contaminants above background or action levels of mostly arsenic and PAHs in the soil or groundwater, making recommendations to USACE regarding the need for further investigations, and managing the removal/disposal/remediation effort of buried contaminant materials (mostly heavy metals arsenic and PAHs). Over 2,000 tons of hazardous materials (arsenic) were characterized and excavated; 15 (unexpected) MD items were inspected, certified free of explosive hazard, and properly disposed. Investigation methods included direct-push technology and electromagnetic survey (using EM61). Mr Kuntz was responsible for PPE levels (level B, C, and D), air monitoring of contaminants, heat stress monitoring, dust monitoring, sampling unknown drums, respirators, Tyvek, heavy equipment, and excavation safety. Performed budget preparation and maintenance, subcontract management, field investigation coordination, technical report preparation, and regulatory review and compliance. The project was completed within schedule and budget with no safety incidents or QC non-conformance. [11/2006 – 11/2012; DACA21-02-D-0006; TO #0013, 0024; FFP/PBR, $3.9M.]

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ATTACHMENT B

Checklists for Preparatory and Initial Phases

Attachment B

PREPARATORY PHASE COMPLETION REPORT for___________________________________

(Definable Feature of Work)

Project: PFAS Fingerprinting and Background Study

Date of Report: ___________

Item Number	Applicable?	Item	Completed (initials)
1	YES ☐ NO ☐	Review Contract Documents	
2	YES ☐ NO ☐	Ensure that all materials and/or equipment is on hand, and has been tested, submitted and approved.	
3	YES ☐ NO ☐	Ensure that the required control testing provisions are in place	
4	YES ☐ NO ☐	Examine the work area to ensure that all preliminary work has been accomplished.	
5	YES ☐ NO ☐	Review Activity Hazard Analyses	
6	YES ☐ NO ☐	Review construction permit requirements and verify that all permits have been obtained and are current.	
7	YES ☐ NO ☐	Other:	
8	YES ☐ NO ☐	Other:	
9	YES ☐ NO ☐	Other:	
10	YES ☐ NO ☐	Other:	

Comments on specific items listed above: (attach additional sheets if necessary)

_______________________________ Oneida Site Superintendent

_______________________________ Oneida Project QC Officer

_______________________________ USACE Representative

____

Attachment B

INITIAL PHASE INSPECTION REPORT for___________________________________

(Definable Feature of Work)

Project: PFAS Fingerprinting and Background Study

Date of Report: __________

Item Number	Applicable?	Item	Completed (initials)
1	YES ☐ NO ☐	Check preliminary work	
2	YES ☐ NO ☐	Check new work for compliance with contract documents	
3	YES ☐ NO ☐	Review control testing	
4	YES ☐ NO ☐	Establish level of workmanship	
5	YES ☐ NO ☐	Check for use of defective or damaged materials	
6	YES ☐ NO ☐	Check for omissions and resolve any differences of interpretation with the COR	
7	YES ☐ NO ☐	General check of dimensional requirements	
8	YES ☐ NO ☐	Check safety compliance	
9	YES ☐ NO ☐	Other:	
10	YES ☐ NO ☐	Other:	

Comments on specific items listed above: (attach additional sheets if necessary)

Oneida Site Superintendent

Oneida Project QC Manager

USACE Representative

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ATTACHMENT C

CQC Forms (Daily Contractor Production and QC Report, and Deficiency Reporting)

Attachment C

DAILY QC REPORT AND CONTRACTOR PRODUCTION (ATTACH ADDITIONAL SHEETS IF NECESSARY)	**DATE:**
	PRODUCTION REPORT NO:

CONTRACT NO. W91238-23-D-0023	**PROJECT:** **PFAS Fingerprinting and Background Study** **DFOW:** **LOCATION:** **Multiple Sites**	0000

OTIE REP:

AM WEATHER		**PM WEATHER**		**MAX TEMP(F)**	**MIN TEMP(F)**

WORK PERFORMED TODAY

DEFICIENCY ITEMS TO BE ADDRESSED (see deficiency tracking log for details)

Item#	**Item Description**	**Date Completed**

SAFETY/COMPLIANCE CHECKLIST

Tailgate Meeting and Review of AHA's: ☐ (see daily tailgate form)		Lost Time Accident Today: Yes ☐ No ☐ (if yes, attach OSHA Form)
BMP Inspection: ☐	BMP Repairs Needed:	Date Completed:
Spill kit: ☐	Measurement Instruments Used:	Calibration ☐ (see cal logs)
Permits Onsite: ☐	Housekeeping Acceptable in AM ☐	End of Day Housekeeping ☐

Was Hazardous Material/Waste Released to the Environment? Yes ☐ No ☐
If Yes, describe incident and mitigation measures taken:

Any Trenching, Scaffolding, Craning, HV Electrical, High Work Done Today? Yes ☐ No ☐
If yes, attach inspection checklist as appropriate.

Additional Safety or Compliance Comments:

CONSTRUCTION EQUIPMENT ON JOB SITE TODAY. INDICATE HOURS USED (Attach Inspection Sheet for All Heavy Equipment)

Equipment	**Owner**	**Safety Check Performed By**	**Hours Used**	**Date brought on site**

CHANGED CONDITIONS / DELAY / CONFLICTS ENCOUNTERED / VERBAL INSTRUCTION by USACE or DAF (List any conflicts with the delivery order):

VISITORS TO THE SITE-

TESTING PERFORMED (XRF, other)

Type	**Qty of Tests**	**Results (units)**	**Passing Criteria per Specifications**	**Follow Up Action if**

Attachment C

DAILY QC REPORT AND CONTRACTOR PRODUCTION (ATTACH ADDITIONAL SHEETS IF NECESSARY)

PROJECT: **PFAS Fingerprinting and Background Study**

DFOW:

LOCATION: **Multiple Sites**

	(units)			**Needed**

SAMPLES COLLECTED FOR OFFSITE TESTING				
Matrix (chips, soil, water, etc.)	**Qty of Samples**	**Testing Methods**	**Offsite Laboratory Used**	**Shipping Method (courier or FedEx)**

ONSITE LABOR						
EMPLOYEE	**WORK PERFORMED**	**EMPLOYER**	**NUMBER**	**At Tailgate safety meeting**	**TITLE/TRADE**	**HRS**

Other Remarks or Submittal Actions Required:

Total Work Hours On Job Site, This Date:	
Total of Work Hours From Previous Report	
Total Work Hours From Start of Project	

ANTICIPATED WORK FOR TOMORROW:

LIST OF ATTACHMENTS:

CONTRACTOR/SUPERINTENDENT:

DATE :

Attachment C

PROJECT: **PFAS Fingerprinting and Background Study**
DFOW:
LOCATION: **Multiple Sites**

Deficiency Report

Date ______________________________

USACE/AF Contact:
Project:
Project Number:
Contract Number:

1. NONCONFORMANCE DESCRIPTION

Identified by: ________________________ Date: ________

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES (ATTACH ADDITIONAL DOCUMENTATION IF NECESSARY):

Identified by: ________________________ Date: ________

3. CAUSE:

4. APPROVAL FOR PROPOSED CORRECTIVE ACTION:

Project Manager: ________________________ Date: ________
Project QC Officer: ________________________ Date: ________

5. CORRECTIVE ACTION TAKEN (ATTACH ADDITIONAL DOCUMENTATION IF NECESSARY):

6. CORRECTIVE ACTION COMPLETE:

Project Manager: ________________________ Date: ________
Project QC Officer: ________________________ Date: ________

Attachment C

Contract	Project	Contractor
W91238-23-D-0023	**PFAS Fingerprinting and Background Study Multiple Sites**	**Oneida**

DEFICIENCY TRACKING LOG

DESCRIPTION	**DATE IDENTIFIED**	**DATE CORRECTED**	**CORRECTIVE ACTION**

ATTACHMENT D

Test Report Form

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Attachment D

Test Report Form

Date ________________________________

USACE Rep.:	Technician:
Project: PFAS Fingerprinting and Background Study	Test Methods:
Project Number: S2023037	Material Tested:
Contract Number: W91238-23-D-0023	Weather Conditions:

Location of Test	**Test Results**	**Notes**

Completed By: ____ Title:

ATTACHMENT E

Materials Tracking Log

<table>
<tr><td>Contract</td><td colspan="2">Project</td><td>Contractor</td></tr>
<tr><td>**W91238-23-D-0023**</td><td colspan="2">**PFAS Fingerprinting and Background Study**</td><td>**Oneida**</td></tr>
<tr><td colspan="4">**MATERIALS TRACKING LOG**</td></tr>
<tr><td>**DESCRIPTION**</td><td>**DATE RECEIVED**</td><td>**CORRECT MATERIAL?**</td><td>**Serial/Lot Number/ Product ID**</td></tr>
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ATTACHMENT F

Amendments to the Quality Management Plan

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Appendix D

Field Forms

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Groundwater Well Development/Purge Log

Project Name	Project ID/Phase/Task:	Field Activity:
Site Name/ID	Location ID (Well ID):	Target Purge Volume (gal):
Purging Method/Equipment	Sampling Equipment:	Air Monitoring Equipment:
A. Well Casing Diameter (inches):	**B.** Unit Casing Volume: →	6" Diameter = ~1.5 gal/ft 4" Diameter = ~0.67 gal/ft 3” Diameter = ~0.37 gal/ft 2" Diameter = ~0.17 gal/ft
C. Depth to Well Bottom from TOC:	**D. Static** Depth to Water from TOC:	
E. Length of Static Water Column in Casing **(C – D)**	**F.** Casing Water Volume **(B x E)**	**G.** Casing Volumes (**3 x F**)

Date	**Time** **24hr**	**Recovery Time (min)**	**Purge Rate (gal/min)**	**Dynamic H2O Level (ft)**	Volume Purged (gl)	Temp (C°)	pH	Specific Conductivity (us/cm)	Dissolved oxygen (mg/L)	Redox (mV)	Turbidity (NTU)	**Water Description**
	:											
	:											
	:											
	:											
	:											
	:											
	;											
	;											
	;											
	;											
	;											
	;											
	;											

Recovery Depth* (ft from TOC) : ___________

Final **Recovery Time*** (min) : ____________

* Taken As Final Water Level Reading and Time after sampling is complete and well has recovered.

Prepared By:____

Checked By: ____

Groundwater Well Development/Purge Log

Project Name: ______________________________ Page ___ of ____

LOCATION ID:(Well Number)____

Date	**Time** **24hr**	**Recovery Time (min)**	**Purge Rate (gal/min)**	**Dynamic H2O Level (ft)**	Volume Purged (gl)	Temp (Cº)	pH	Specific Conductivity (us/cm)	Dissolved oxygen (mg/L)	Redox (mV)	Turbidity (NTU)	**Water Description**
	:											
	:											
	:											
	:											
	:											
	:											
	;											
	;											
	;											
	;											
	;											
	;											

Recovery Depth* (ft from TOC) : ___________ Final **Recovery Time*** (min) : ____________ * Taken As Final Water Level Reading and Time after sampling is complete and well has recovered.

Prepared By:____ Checked By: ____

MONITORING WELL PURGE/SAMPLE LOG

Well Inspection Checklist:	Good	Bad	Comments
Well Identification	☐	☐	
Vault Cover	☐	☐	
Vault Seal	☐	☐	
Bolts	☐	☐	
Vault Lock	☐	☐	
Concrete Completion	☐	☐	
Well Lock/Seal	☐	☐	

Project Name: ______________________________

Project Number: ______________________________

Site Sampler(s): ______________________________

Date: ______________________________

WELL DATA

Well Number: ____________________

Depth to Water: ____________________ ft. BTOC

Total Depth of Well: ____________________ ft. BTOC

Water Column in Well: ____________________ ft.

Gauging Time: ____________________

Casing DIA (D): ____________________ in.

Casing Type: ____________________

PID (ppm): ____________________

Screen Interval: __________ to __________ ft. bgs.

Sample Filter Used: Yes No

Sample Filter Size (Microns):

GROUNDWATER PURGE DATA

Purge Method: ☐ **Bladder** ☐ **Peristaltic** ☐ **Monsoon** ☐ **Other:** ____________________

Pump Type: ____________________ **Pump Setting:** ____________________ ft. BTOC

Time	Depth to water (ft. BTOC)	Purge Rate (mL/min)	Volume Removed (mL)	pH (units)	Specific Cond. (µS/cm)	Turbidity (NTU)	Temp (˚C)	DO (mg/L)	ORP (mV)	Notes

SAMPLING DATA

Sample ID. (time): ____________________ (   )

QA/QC Sample: ☐ No QA/QC Sample ☐ Duplicate ☐ Matrix Spike ☐ Equip. Blank

Sample Method: ☐ Pump ☐ Disposable Bailer

QA/QC ID. (time): ____________________ (   )

Anayltical Methods: ____

____

SAMPLER SIGNATURE: ____

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Safety and Operations Tailgate Meeting Form

Rev. 3 01232017

Date/Time: ______________________ **Project Number:** ______________________
Project Name: ______________________ **Contract No:** ______________________
Project Location: ____
Client: ______________________ **Client Phone:** ______________________
Type of Work: ____

OPERATIONS and QUALITY	**Yes**	**No**	**N/A**
Tasks to be performed (include the definable features of work)			
Critical path items (schedule, client interaction, project coordination)			
Subcontractors on site today			
Other visitors expected on site			
Material/Equipment deliveries expected and storage areas			
Applicable information from Base Operations or client (as needed)			
Review of As Builts/Layout Plans, if applicable			
Operational / Quality Deficiencies to discuss (refer to Daily Quality Control Report from day before and other inspection reports)			
Other:			

SAFETY	**Yes**	**No**	**N/A**
Protective Clothing/Equipment Level: D C B A (circle appropriate) As applicable, head, eye, ear, respiratory, other protection			
Contaminants and hazardous materials anticipated			
Chemical exposure issues anticipated			
Work zones and methods of security			
Decontamination procedures (equipment and personnel)			
General safe work practices			
GOOD CATCHES and any safety deficiencies or Near Misses (if yes, provide explanation below)			
Other:			
Other:			
Emergency Procedures:			
Hospital Name: **Hospital Phone:**			

ENVIRONMENTAL COMPLIANCE	**Yes**	**No**	**N/A**
Environmental Protection Plan			
• Preservation of existing conditions in surrounding water and land			
• Dust quality monitoring			
• Spill prevention and response			
• Promote recycling, waste prevention, minimization and energy conservation			
Waste Management Plan			
• Storage, shipping, disposal of general waste			
• Storage, shipping, disposal of hazardous waste			
• Recordkeeping			
• NO Waste should be kept on site for more than 90 Days			
Stormwater Pollution Prevention Plan			
• Periodic BMP Inspection Checklist			
• Post-Rain Inspection			
• Other			

Safety and Operations Tailgate Meeting Form

Rev. 3 01232017

EXPLANATIONS/NOTES

ATTENDEES

The following personnel were present for discussion of the topics listed above and have read and understand the contents of the Site Accident Prevention Plan/AHAs/Site Safety and Health Plan.

NAME	COMPANY	SIGNATURE

Meeting Conducted By:	Date:

DAILY FIELD RECORD

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Page ____ of ____

Project and Task Number:

Date:

TIME	DESCRIPTION OF WORK PERFORMED

CHAIN OF CUSTODY

317 East Main Street
Ventura, CA 93001
Phone: (805) 585-2110
Fax: (805) 585-2111

Report To:

Contact: ______________________________
Company: ______________________________
Address: ______________________________
____
Phone: ______________________________
Fax: ______________________________
E-Mail: ______________________________

Bill To:

Contact: ______________________________
Company: ______________________________
Address: ______________________________
____
Phone: ______________________________
Fax: ______________________________
PO#: ____________ Quote: ____________

Shaded Areas For Internal Use Only ***Page ___ of ___***

Lab Lot

Package Sealed Yes No	Samples Sealed Yes No
Received on Ice Yes No	Samples Intact Yes No
Temperature ºC	of Cooler
Within Hold Time Yes No	Preserv. indicated Yes No NA
pH Check ok Yes No NA	Res. Cl₂ Check ok Yes No NA
Sample Labels and COC Agree Yes No COC not present	

Sampler Name:
Signature:
Project Name:
Project Number:
Project Location:
Lab PM:
Date Required
Hard Copy: _____/_____/_____
Fax: ____/_____/_____

Refrg #										
#/ Cont.										
Volume										
Preserv										

Laboratory ID	MS MSD	Client Sample ID	Sampling Date	Time	Mtx	Grab											*Additional Analyses / Remarks*

RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME
RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME

Matrix Key

WW = Wastewater
W = Water
S = Soil
SL = Sludge
MS = Miscellaneous Solids
OL = Oil
A = Air
SE = Sediment
SO = Solid
DS = Drum Solid
DL = Drum Liquid
L = Leachate
WI = Wipe
O = ______________

Container Key

1. Plastic
2. VOA Vial
3. Sterile Plastic
4. Amber Glass
5. Widemouth Glass
6. Other

____

Preservative Key

1. HCl, Cool to 4°
2. H2SO4, Cool to 4°
3. HNO3, Cool to 4°
4. NaOH, Cool to 4°
5. NaOH/Zn Acetate, Cool to 4°
6. Cool to 4°
7. None

COMMENTS:

Date Received / /
Courier: Hand Delivered ☐
Bill of Lading:

Surface Water Sampling Form

Date __________ Page ____of_____

Project Name:____Sample ID: _______________________________

Team Members: *(list additional names on back)*	Date of last rain:

Observations: *Circle one underlined option:* **Observations Time:** ______________________

Cloud cover	no clouds; partly cloudy; cloudy sky
Precipitation	none ; misty; foggy; drizzle; rain (light, moderate, heavy);
Wind	calm; breezy; windy;
Visible Turbidity	clear water; cloudy water (>4" visibility), murky (<4" visibility). *[this pertains to the water itself, not to scum]*
Sample color	none; amber; yellow; green; brown; gray; clear other:
Sample odor	none; fresh algae smell; chlorine; rotten eggs; sewage; other
Other (presence or % Cover:)	algae or water plants; oily sheen; foam or suds; litter; trash; other

Measurements

Instrument ID	Parameter	Unit	Result	Time	Depth*	Comments
	Turbidity	NTU				
	Dissolved oxygen (DO)	mg/l				
	Temperature, water	°C				
	pH	pHU				
	Salinity	psu				
	Free Chlorine	mg/L				

***Measurement Depth**: *(Select)* surface (<6"); mid-column; near-bottom; *(provide Total Depth if mid-column or near-bottom selected)*

Total Depth (ft): ____________________________

Sampling Device: *(for observations, measurements, and Samples)*: Auto-sampler; bucket; Eckman; other:

Photo #	Photo Time	Comments

Appendix E

Waste Management Plan

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Appendix E

Waste Management Plan

PFAS Fingerprinting and Background Study
Multiple Air Force Bases

Prepared for:

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814

Under Contract No.
W9123823D0023

Prepared by:

Sustainment and Restoration Services, LLC
209 E. Victoria Street
Santa Barbara, California 93101
SRS Project No. S2022008

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
ID	identification
IDW	investigation derived waste
No.	number
OESC	Oneida Engineering, Science, and Construction Group
Oneida	Refers to SRS and OTIE in this UFP-QAPP
PFAS	per- and polyfluoroalkyl substances
QAPP	Quality Assurance Project Plan
SI	Site Inspection
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USAF	United States Air Force
USACE	United States Army Corps of Engineers
WMP	Waste Management Plan

1.0 INTRODUCTION

This document presents the Waste Management Plan (WMP) for per- and polyfluoroalkyl substances (PFAS)-containing investigation-derived waste (IDW) generated during PFAS fingerprinting and background study investigations at multiple Department of the Air Force (DAF) installations.

1.1 AUTHORITY

This WMP was prepared by Sustainment and Restoration Services, LLC (SRS) for the United States Army Corps of Engineers Sacramento District (USACE-SPK), Contract No. W91238-23-D-0023, Task Order No. W91238-23-F-0086.

1.2 PURPOSE AND SCOPE

The purpose of this WMP is to provide a systemic approach to IDW management in order to protect the health and safety of the worker, the public, and the environment. The WMP applies to all IDW generated from the activities performed as part of the PFAS background and fingerprinting investigation, including soil sampling, groundwater sampling, surface water sampling, lysimeter sampling, temporary monitoring well installation and development, and associated secondary waste streams and management of waste during mobilization and demobilization phases of the project. The IDW and subsidiary waste management will be performed in accordance with federal regulations and applicable state regulations. This WMP also covers procedures for recordkeeping, document management, waste characterization, and disposal of IDW. These procedures may be modified during project execution in response to unanticipated or changing conditions or updated guidance. The installations included in this programmatic WMP are as follows:

- Des Moines Air National Guard Base (ANGB), Iowa
- Dover Air Force Base (AFB), Delaware
- Eielson AFB, Alaska
- Stewart ANGB, New York
- Travis AFB, California
- Wright Patterson AFB, Ohio
- Tucson Area Installations (Morris ANGB, Air Force Plant 44, and Tucson International Airport), Arizona

If IDW handling, storage, and disposal procedures for specific installations deviate from this programmatic WMP, they will be documented in installation-specific Uniform Federal Policy – Quality Assurance Project Plan UFP-QAPP addenda (submitted under separate cover).

2.0 TYPES OF INVESTIGATION-DERIVED WASTE

There are several different potential IDW generation activities during the PFAS fingerprinting and background study field activities. A general discussion regarding the generation, sampling, and disposal of IDW is presented in the following sections.

2.1 PERSONAL PROTECTIVE EQUIPMENT

Waste personal protective equipment (PPE) generated during field activities (including used disposable masks, and gloves) will be placed in plastic bags and then disposed of at an approved disposal facility.

2.2 SAMPLING WASTE

For the purposes of this WMP, sample wastes are those materials that are generated during sampling activities. Each waste stream will be sampled to verify compliance with the approved Subtitle D disposal facility waste acceptance requirements. The sampled material will be handled, packaged, stored, and transported in accordance with all applicable regulations. Sampling wastes include, but are not limited to, the following:

- Disposable equipment and items such as plastic single use samplers, tubing, broken or unused sample containers, sample container packaging, gloves, masks, and tape
- Soil cuttings from drilling activities
- Drilling mud or water used for drilling activities
- Groundwater from well purging and well development activities
- Cleaning fluids and decontaminants as well as wash water
- Unused or excess packaging and shipping materials.

3.0 WASTE IDENTIFICATION, SAMPLING, AND CHARACTERIZATION

This section provides instructions for identification, containerizing, labeling, sampling, and characterizing IDW generated during field activities.

3.1 WASTE IDENTIFICATION

This project will include liquid, soil, and other solid IDW media as described in Section 2.

3.2 WASTE COLLECTION AND HANDLING

IDW will be containerized, labeled, and isolated to minimize cross contamination. Liquid IDW will be stored in secure containers (e.g., 55-gallon drum, poly tanks) onsite. Soil IDW will be stored in secure containers (e.g., 55-gallon drum). Other solids (i.e., PPE, construction waste, and sampling equipment) will be placed in trash bags and disposed of as non-hazardous solid waste in an appropriate off-base Subtitle D landfill.

Waste characterization samples will be collected for each IDW media as deemed necessary, following the field sampling SOPs presented in Appendix A of the Programmatic UFP-QAPP. The waste characterization samples will be packaged and shipped to the contract laboratory for analysis.

3.3 WASTE CHARACTERIZATION

Soil and liquid IDW will be analyzed using the methods described in the Programmatic UFP-QAPP and UFP-QAPP addenda as required for characterization. IDW sample results for PFAS will be compared to the screening levels presented in the programmatic QAPP or requirements per the waste disposal facility. Results will be used to determine if the waste includes PFAS results above screening criteria. In addition, IDW samples may additionally be analyzed for non-PFAS waste characterization determination. The analytical parameters required for hazardous waste determination will be presented in the installation-specific UFP-QAPP addenda.

4.0 DOCUMENTATION, TRANSPORTATION, AND DISPOSAL

4.1 SHIPPING DOCUMENTATION

Prior to any offsite waste disposal, characterization information will be documented on a waste profile form provided by the offsite treatment and/or disposal facility as part of the waste acceptance process. The profile will be reviewed and approved by the installation Remedial Project Manager or designee. SRS will coordinate with the Remedial Project Manager to obtain any required generator certification and/or signatures. Signed profile(s) will then be submitted to the disposal facility for acceptance.

The profile typically requires the following information, including but not limited to:

- Generator information, including name, mailing address, contact, and phone number
- Site name, including street address
- Process generating waste (e.g., well development, well water sample collection, etc.)
- Source of contamination
- Historical use for area
- Waste composition
- Physical state of waste
- Applicable hazardous waste codes.

Once the approved profile or approval letter is received from the disposal facility, transportation can be scheduled. Each load of waste will be manifested prior to leaving the site. At a minimum, the manifest form will include the following information:

Generator information including name, address, contact, and phone number, and installation identification (ID):

- Transporter information including name, address, contact and phone number, and installation ID
- Facility information including name, address, phone number, and installation ID
- Site name including street/mailing address
- Department of Transportation proper shipping name
- Type and number of container(s)
- Quantity of waste (volumetric estimate)
- Contract Task Order number or Job number
- Profile number
- 24-hour emergency phone number

The generator and the transporter must sign the manifest before the load of waste leaves the site. The original signed manifest will be returned to the address of the generator. SRS anticipates that the facility will provide a copy of the facility-signed manifest to SRS.

4.2 TRANSPORTATION

A contractor licensed for commercial transportation will transport non-hazardous wastes. If wastes are hazardous, the transporter selected will have the appropriate credentials and licenses to comply with all required regulations and manifest requirements.

4.3 DISPOSAL

Disposal facilities with proper permits and in good standing with the state and federal agencies will be used. IDW will be sent to a facility that is authorized/approved to dispose of PFAS-contaminated waste.

Offsite treatment and disposal facilities will use the waste profile and supporting documentation (e.g., analytical data) to determine whether they will accept the waste. Hazardous and non-hazardous wastes will be disposed of at facilities permitted to receive such wastes.

The treatment and disposal facility will be responsible for providing a copy of the final facility-signed waste manifest and a certificate of treatment or disposal for each load of waste received.

4.4 WASTE MANAGEMENT RECORDKEEPING

The following records and documents shall be maintained in the project files for the duration of the contract:

- Profiles and associated characterization data
- Manifests and bills of lading.

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Appendix F

PFAS Signature ® Brochure

PFAS Signature® Advanced Analytics Tool

Source Discrimination and Establishing Background Using HRMS Analysis

Per- and polyfluoroalkyl substances (PFAS) are a large class of chemicals widely used for many commercial and industrial applications, including aqueous film forming foams (AFFF), metal plating, plastic molds, photographic films, semiconductors and textile manufacturing. Many of these substances end up in the wastewater treatment plants (WWTPs) and landfills, which means these facilities also serve as potential sources of PFAS.

By understanding the specific signature of these analytes in different matrices, we can deduce information about their sources. This chemical forensic approach is not possible using the targeted analysis alone.

PFAS groundwater and soil contamination at impacted sites often cover large areas and may include co-mingled sources. There is a significant need to understand the source attribution and delineations to determine the fate and transport of these chemicals. In addition, at many of these sites, it has become a critical need for source tracking and differentiation of AFFF sources from non-AFFF sources.

Our Solution

The Battelle-developed PFAS Signature® advanced analytical tool offers PFAS source differentiation and tracking using high-resolution mass spectrometry (HRMS) techniques, in combination with PFAS targeted analysis and advanced statistical analysis.

The identification of sources of contamination is based on:

- Chemical signature
- Isomeric profiles
- Manufacturing
- Age of release
- Fate and transport
- Transformation products

Source Differentiation

Battelle has built a mass spectral PFAS source library based on PFAS targeted analysis and HRMS analysis of different known PFAS sources that can be applied to a site investigation to understand the source attribution of the substances. The developed library is used to compare and differentiate PFAS composition and trends seen in field-derived samples during a site investigation.

Our PFAS Signature® tool was applied to the environmental samples collected from different source scenarios. The results show clear delineation of different sources (Figure 1).

Database of Source Specific Signature Library

- AFFF Formulations
  - More than 35 sources of different AFFFs
- AFFF-Impacted Sites (Multiple Matrices)
- Commercial Products
  - More than 15 commercial products
- Waste Sector
  - Landfill Leachates
  - Municipal WWTP
  - Paper Mill related WWTP
  - Compost
- Metal Plating

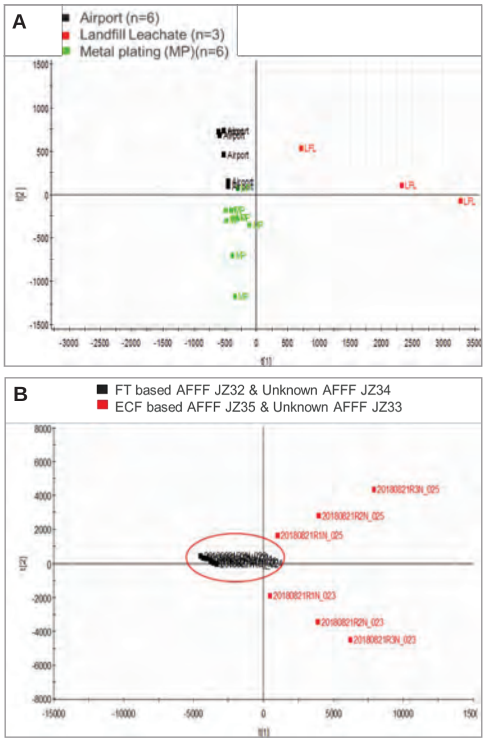

Figure 1. Example of PFAS Signature® Chemical Forensics results showing samples collected from (A) different environmental sources, and (B) AFFFs from known and unknown manufacturing sources.

Source Tracking

Another application of our PFAS Signature® tool is in a higher-level source discrimination screening. An example showing the differentiation of AFFF and non-AFFF sources is shown in Figure 2. The cluster of non-AFFF related samples collected from different locations clearly differentiates from the AFFF-impacted environmental samples collected from different sites. The non-AFFF samples shows sources of WWTP related and the landfill leachate samples collected from different parts of United States.

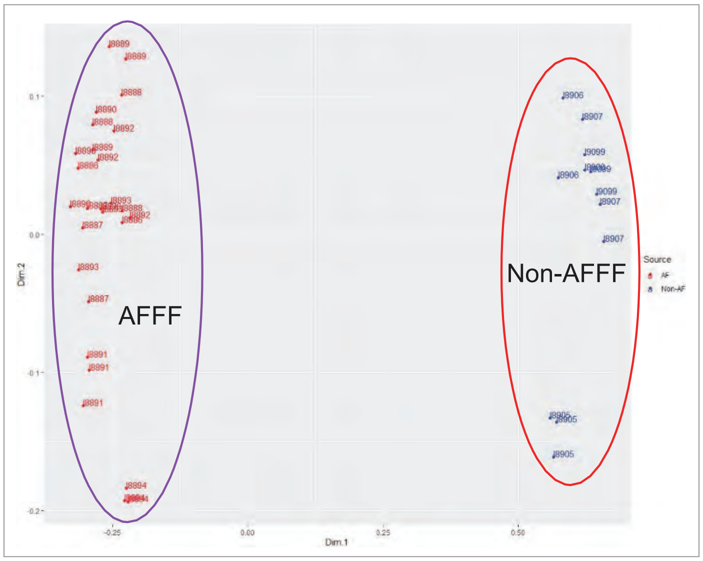

Figure 2. Multi-dimensional scaling plot showing clear differentiation of AFFF and non-AFFF sources. Plot shows HRMS PFAS data collected from different sources of non-AFFF and AFFF-impacted samples.

Establishing Background

In addition to the PFAS targeted analysis quantitative data, PFAS suspect screening analysis can also assist in establishing background levels of broader list of PFAS. As many of the PFAS analytes are not included in the targeted analyte list, suspect screening analysis can help fill gaps in the available data. From EPA Guidance EPA 540-R-01-003, background samples are needed for comparison of site and background concentrations for making risk management decisions concerning appropriate remedial actions.

Suspect Screening Library for up to 520 PFAS

- Identifies chemicals that would not have been identified by the targeted analysis
- Supports development of the conceptual site model to validate assumptions
- Identifies contributing sources that are not the 'known' or expected source(s)

Results

The information obtained from multiple lines of evidence is investigated to understand the PFAS sources and compare them. PFAS Signature® assesses how the unknown sample compares to the trained library to understand the similarities and differences between the unknown and known sources (Figure 3).

The following multiple lines of evidence are assessed to differentiate the sources:

- Targeted analysis
- High resolution mass spectral analysis
- Statistical analysis
- Age of release
- Fate and transport
- Transformation Products

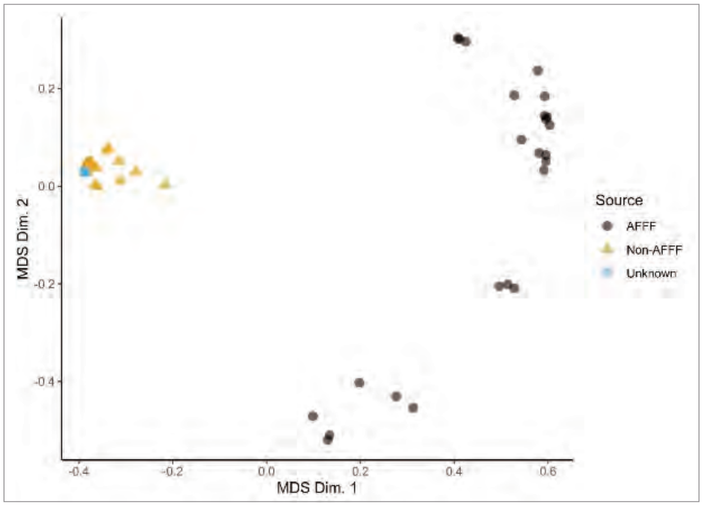

Figure 3. PFAS Signature® Analysis showing visualization of unknown sample compared to the known source samples.

Application of Battelle's PFAS Signature® approach, which is a combination of advanced HRMS tool and statistical analysis, shows great promise in understanding the source delineations and categorizations that are not possible using only targeted PFAS analysis by LC-MS/MS methods.

ID 697 11/23

It can be done

Attachment B

Kickoff and Scoping Meeting Minutes

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Attachment B

Kickoff and Scoping Meeting Minutes

PFAS Fingerprinting and Background Study
Stewart ANGB Kick-Off Meeting Agenda

Contract No. W91238-23-D-0023 / Task Order No. W91238-23-F-0086

Project Name	**PFAS Fingerprinting and Background Study**
Location	**MS Teams (10:00- 11:30 AM PST)** Dial-in number (US): +1 414-662-3620, 182794251#
Date	20 November 2023
Meeting Facilitator/Lead	Megan Duley (Oneida Group – SRS)
Distribution List	All meeting attendees

Invited Attendees:

Name	Association	Role	Participation (X)
Jessica Faragalli	USACE	Project Manager/ TO COR	
Daniel Czech	USACE	Contracting Officer	
Michael Riggle	USACE	Contract COR	
Jolie Higgins	USACE	Technical Lead	
Sitlaly Avelino	USACE	Environmental Engineer	
Cynthia Cash	AFCEC	AF Program Manager	
Alecia George	AFCEC	Deputy PM – AF Installations	
Kathleen Bradley	AFCEC	CZTE Support	
Hunter Anderson	AFCEC	CZTE Support	
Seb Gillette	AFCEC	CZTE Support	
Bill Myer	ANG	Stewart ANGB RPM	
Keith Freihofer	ANG	ANG Program Manager	
Jacques Marcillac	ONEIDA Group	Program Manager	
Megan Duley	ONEIDA Group	Project Manager	
Kevin Engle	ONEIDA Group	Deputy PM – AF Installations	
Lauren Idleman	ONEIDA Group	Deputy PM – ANG Installations	
Kristen Carlyon Peyton	ONEIDA Group	Senior Program Chemist	
Robert (Bob) Mallisee	ONEIDA Group	Senior Hydrogeologist	
Mark Wanek	ONEIDA Group	Project Geologist	
Nicole Cook	ONEIDA Group	Environmental Geologist	
Pam Change	Battelle	Battelle Project Manager	
Kavitha Dasu	Battelle	Battelle Fingerprint Chemist	
Rick Wice	Battelle	Battelle Senior Geologist	
Amy Dindal	Battelle	Battelle Technical	
Allen Davis	Battelle	Battelle Technical	

Meeting Objective:

The purpose of the Kick-Off Meeting is to introduce the project team, discuss roles and responsibilities, establish project communication, discuss project objectives and schedule, and identify next steps for successful project execution.

Agenda Items (see slides for topic content):

I. **Welcome**

II. **Health and Safety Moment**

III. **Introductions / Roles & Responsibilities of Key Personnel**

IV. **Project Overview**

V. **Overview of Fingerprinting and Background Analysis (Battelle Slides)**

VI. **Stewart ANGB PFAS Summary (SRS presentation of summary, Team discussion/learning)**

VII. **Working at Stewart ANGB**

VIII. **Other Discussion Items**

IX. **Action Items**

Action Items

Task	Personnel Responsible	Due Date
Submit Meeting Minutes.	Megan Duley /Kevin Engle / Lauren Idleman	29 Nov 2023

PFAS Fingerprinting and Background Study
Stewart ANGB Scoping Meeting Minutes

Contract No. W91238-23-D-0023 / Task Order No. W91238-23-F-0086

Project Name	**PFAS Fingerprinting and Background Study**
Location	**MS Teams (8:30-10:30 PM EST)** Dial-in number (US): +1 414-662-3620,,67232753#
Date	7 March 2024
Meeting Facilitator/Lead	Megan Duley (Oneida Group – SRS)
Distribution List	All meeting attendees

Invited Attendees:

Name	Association	Role	Participation (X)
Jessica Faragalli	USACE	Project Manager/ TO COR	
Jolie Higgins	USACE	Technical Lead	
Richard Anderson	USACE Omaha	USACE Omaha POC/Technical Support	
Cynthia Cash	AFCEC	AF Program Manager	X
Alecia George	AFCEC	Deputy PM – AF Installations	
Kathleen Bradley	AFCEC	CZTE Support	
Seb Gillette	AFCEC	CZTE Support	X
Keith Freihofer	ANG	ANG Program Manager	
William (Bill) Myer	ANG	Stewart ANGB RPM	X
Mike Oettinger	ANG	Stewart ANGB Environmental Manager	
Alekzander (Alekz) Orby	ANG	Stewart ANGB Environmental Specialist	X
Jeremy Bennett	BB&E	Stewart ANGB Technical Support Contractor	X
Walter (Walt) Howard	AECOM	Stewart ANGB RI Contractor	X
Megan Duley	ONEIDA Group	Project Manager	X
Lauren Idleman	ONEIDA Group	Deputy PM – ANG Installations	X
Kevin Engle	ONEIDA Group	Deputy PM – AF Installations	X
Nicole Cook	ONEIDA Group	Environmental Geologist	X
Kristen Carlyon Peyton	ONEIDA Group	Senior Program Chemist	
Genevieve Vander Velden	ONEIDA Group	Geologist	X

Robert (Bob) Mallisee	ONEIDA Group	Senior Hydrogeologist	
Pam Chang	Battelle	Battelle Project Manager	
Kavitha Dasu	Battelle	Battelle Fingerprint Chemist	X
Steve Verdibello	Battelle	Battelle Technical	X
Rick Wice	Battelle	Battelle Senior Geologist	

Meeting Objective:

The purpose of the scoping meeting is to allow the project team to meet virtually and in person, tour the installation to evaluate potential sampling locations, and refine the proposed sampling approach as part of the planning process. The following minutes capture high level discussion and direction from the presentation of scoping slides (see attached) during the Teams meeting.

Agenda Items (see slides for topic content):

I. Welcome

- Megan Duley welcomed the meeting participants. Project team members provided introductions.

II. Health and Safety Moment

- Megan presented a slide on daylight savings time.

III. Project Approach and Discussion

- Before starting the presentation, the team discussed the active RAB at Stewart ANGB. There is a RAB meeting coming up on 24 April 2024; Bill Myer noted it would be beneficial to have the Oneida Team give a brief presentation. Cindy clarified that it is outside of the scope of this project for Oneida to attend in person, but she is willing to call into the meeting along with the Oneida Team to provide a brief project overview.

- Cindy reminded the team that the objective of these studies is to evaluate AFFF and other PFAS sources at the installation and noted that the purpose of the project is not to search for PRPs.

- Megan noted that the slides and associated preliminary figures of locations were an initial pass based on review of site and CSM information. The initial sample locations are suggested to prompt discussion to refine locations and optimize based on team knowledge and observations in the field during the site visit.

- Bill explained that any sample locations off-base will need ROE coordination. USACE-New York District typically coordinates off-Base and Airport ROE needs for the installation, as well as for the City of Newburgh; the process can take up to one year.

- The team discussed proposed soil sample locations. Alekz noted that the area near BG-13 contains sensitive cultural resources (Revolutionary War-era homestead) and may need additional coordination. The sample location may be adjusted slightly.

- Walt noted that ROE coordination for the BG-5 sample location might include working with the property owner’s attorney (this was clarified in an email from Walt on 3/8/24 which is attached to these minutes; the BG-5 location would not include working with an attorney but the SW-28 location would). The team will consider co-locating BG-5 and SW-28 on the same parcel to streamline the ROE process.

- The team discussed soil sample depth; the RI is proposing to sample from the 0-2 inches bgs and 2-12 inches bgs intervals. For the soil background study, 0.0-0.5 ft bgs will be used.

- Jeremy asked if a sample was proposed near the former pesticide burial pit. A soil boring with two soil samples (shallow and deep) is proposed at this location for the fingerprinting study.

- The team discussed the lagoon area. Walt noted that it has been difficult to collect deep soil samples along the edges of the lagoons, as the soil is very tight and groundwater is shallow.

- Kavitha inquired about potentially collecting additional background samples near BG-1 and BG-9. Megan noted that obtaining access agreements for sampling could be challenging in that area. Walt pointed out that AECOM sampled near the cul-de-sac in that area but was unable to obtain property access and needed to use the road right of way.

- The team discussed the outfalls near the lagoons. Walt noted there are two outfalls/pipes of unknown origin in the area. A surface water sample was added to the pipe that discharged east of the SW-33 location.

- Nicole mentioned the Vails Gate Firehouse, which appears to be an active firehouse according to aerial images. Walt noted that AECOM sampled surface water near the firehouse. The on-site team will look at this area during the site reconnaissance.

- Lauren presented the proposed groundwater sampling plan. If possible, several samples would be collected from VAP points installed during the second RI mobilization (Mob 2). Walt confirmed that these points would likely be available to sample in the fall; the points installed during Mob 1 will also be available (VAP points will remain open until early next year). Some of the VAP locations are slow to recharge. Bedrock monitoring wells installed during Mob 2 will likely be available for sampling by the end of the summer.

- The team discussed FUDS wells located south of Stewart ANGB. Many of these wells are in suitable locations to support the fingerprinting study. The Oneida team will review the well locations, screen depths, and date of last sampling to identify wells that can be sampled without the need for redevelopment; selected locations will be presented in the Stewart ANGB QAPP Addendum.

- The Oneida team requested an excel table or shapefile containing all current and proposed well locations and construction details to aid in project planning. Walt will send over what is available.

- Alekz noted that Base drinking water is supplied by the City of Newburgh. Water used for fire suppression comes from the Town of New Windsor.
- The team discussed an AFFF spill from Atlantic Aviation. The AFFF was released into a tributary to Silver Steam and was reportedly cleaned up.
- The Team discussed that the Health Department previously conducted residential sampling and that all results were less than the 70 ppt LHA. Bill noted that the data may be available from the health department but the installation did not have the data and that there are no residential wells near the installation.
- Bill confirmed that the regulators for Stewart ANGB included Justin Starr with NYSDEC as well as the NY Department of Health.

IV. Action Items

Action Items

Task	Personnel Responsible	Due Date
Submit Meeting Minutes.	Oneida Team	14 March 2024
Provide shapefile or excel table containing coordinates and construction details for existing and planned wells at Sewart ANGB	Walt Howard	22 March 2024

PFAS Fingerprinting and Background Study for Stewart ANGB Scoping Meeting

Contract No. W91238-23-D-0023
Task Order No. W91238-23-F-0086

7 March 2024

Meeting Agenda

- Welcome
- Health and Safety Moment
- Project Summary and Overall Approach
- Stewart ANGB PFAS Background Study Sampling Approach
- Stewart ANGB PFAS Fingerprinting Study Sampling Approach
- Other Discussion Items
- Installation Tour
- Debrief/Discussion

Health and Safety Moment

Daylight Saving Time starts Sunday, March 10th

- Spring forward, we “lose” an hour
- 2009 study in Journal of Psychology said “the springtime change is associated with an increase in the number and severity of workplace accidents, especially for those engaged in jobs requiring a high level of attention to detail.”
- To prepare, follow these tips:
  - *Head to bed earlier so you can get your usual amount of sleep*
  - *Postpone any more hazardous work until later in the week next week*
  - *Give yourself extra time to drive to work so you can take your time and avoid potential accidents*

https://www.worksafeforlife.ca/safetymattersblog/spring-ahead-with-caution

Project Overview

Study Objectives from PWS

- **Background Study**

  The goal of the background study is to evaluate the anthropogenic background concentrations at each installation.

- **Fingerprint Study**

  The goal of the fingerprint study is to potentially discriminate among potential AFFF sources.

Overall Study Approach

- Sample locations (soil, surface water, and groundwater) were chosen considering the following data and data sources:
  - *Known distribution of PFAS impacts including concentrations / relative proportions of PFAS constituents (PA/SI/ESI/RI QAPP)*
  - *Installation-wide CSM including groundwater flow, GW-SW interactions, lithology, stratigraphy, etc. (PA/SI/ESI/RI QAPP/CPA)*
  - *PFAS source area types (PA/SI/ESI)*
  - *Suspected/potential PFAS source areas not investigated in RI (PA/SI; Stewart ANGB communications)*

Analytical Approach

Analytical Tool	Analytical Methods Included	PFAS Analytes
PFAS Signature®	EPA 1633 Targeted analysis – Quantitative Analysis	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis -Qualitative	520 Suspect screening analytes
	Machine Learning Analysis using Suspect screening data	520 Suspect screening analytes
PFAS Background Study	EPA 1633 Targeted analysis – Quantitative Analysis	40 target analytes
	High Resolution Mass Spectral Method – Suspect Screening Analysis – Semi-quantitative	520 Suspect screening analytes

Background Study Approach (Soil)

- 50-65% of total available soil samples allocated for background study (20-25)
- Surface Soil (0-2 ft bgs)
- Samples collected from areas believed to be free of PFAS impacts
- Sample locations will provide:
  - *Good spatial coverage on- and off-installation*
  - *Sample points up-, down-, and side-gradient of known PFAS impacts*
  - *To the extent possible, a representative distribution of land use types (industrial, residential, undeveloped, etc.)*
- Consideration given to accessibility, sensitive natural resources, and other factors. Where possible, samples will not be collected from existing ERP sites.

Background Study Approach - Soil

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Restoration Services

Team to discuss using GIS

Fingerprinting Study Approach - Soil

- 35-50% of total available soil samples allocated for fingerprinting study (15-20)
- Sample locations target PFAS source areas including those with highest known PFAS concentrations
  - *Investigation areas selected considering degree of PFAS contamination, potential for co-mingling, proximity to installation boundaries, accessibility, source type (to ensure diverse selection of PFAS sources evaluated), lysimeter data, and number of available soil samples*
- Surface soil (0-2 ft bgs) and subsurface samples (up to 6 ft bgs) collected; subsurface samples target locations where contamination at depth is known or suspected
- Consideration given to accessibility, sensitive natural resources, and other factors.

Fingerprinting Study Approach - Soil

Fingerprinting Study Approach - Surface Water

- Surface water samples will be strategically placed to obtain information from as many potential sources contributing to surface water impacts as possible
- Surface water sampling considerations:
  - *Samples taken at outfalls and culverts*
  - *Upstream and downstream of base and investigation locations*
  - *Wetlands, lakes, and ponds also targeted for sampling*
- Consideration given to accessibility, sensitive natural resources, and other factors.

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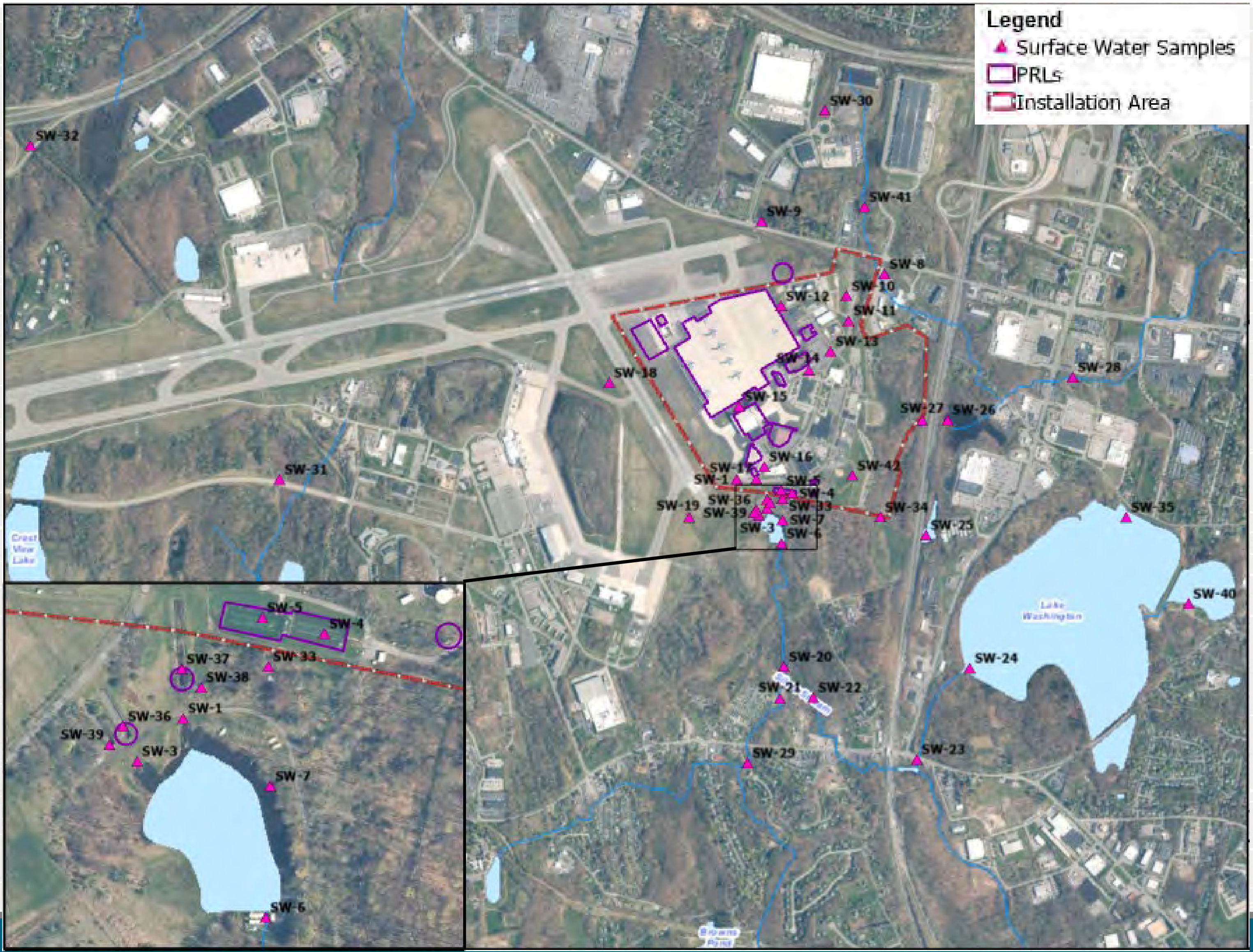
Restoration Services

Fingerprinting Study Approach–Surface Water



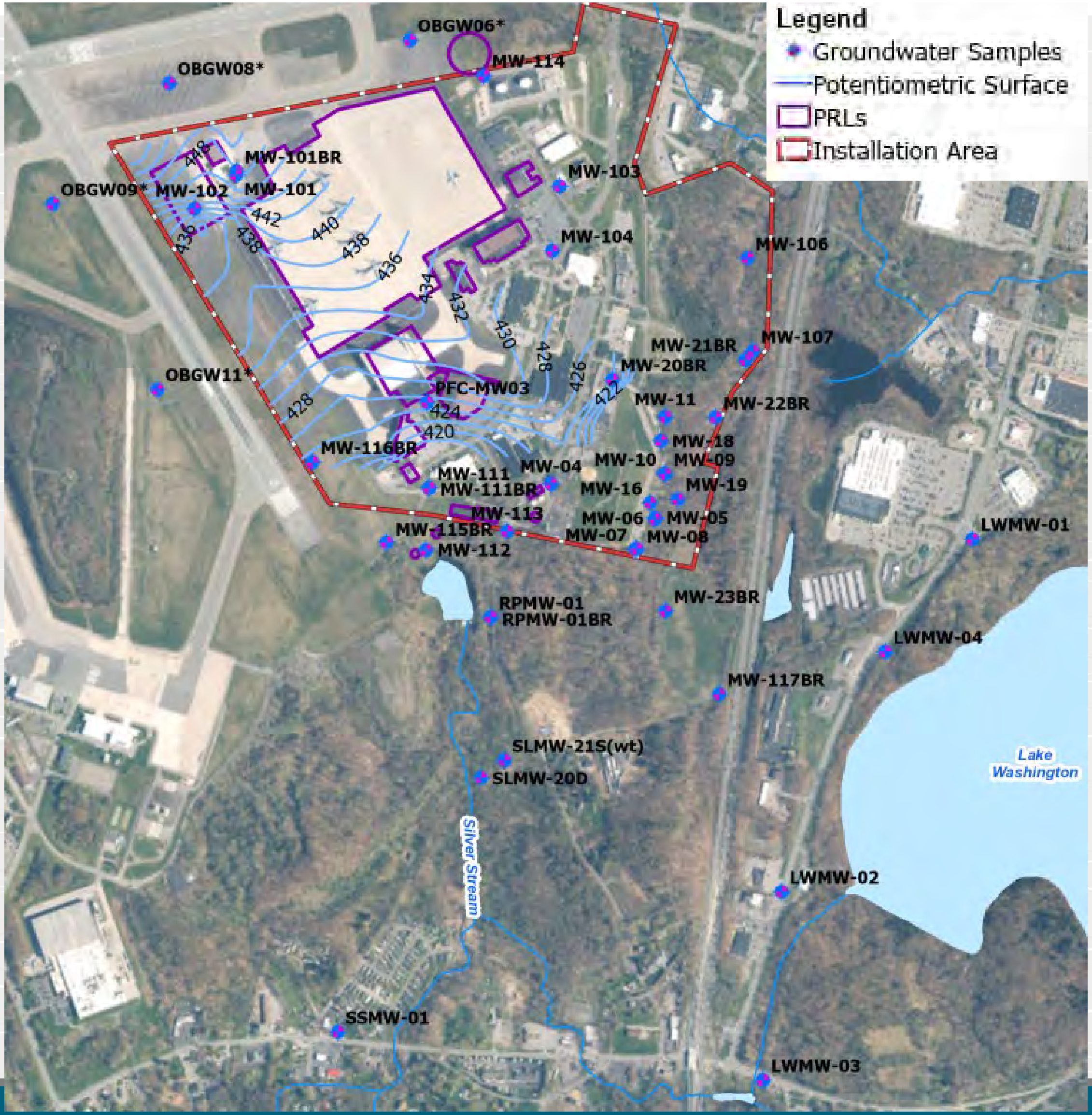
Fingerprinting Study Approach–Groundwater

- Groundwater fingerprinting samples will be placed to assess:
  - *On-installation groundwater:*
    - PFAS source areas (as many source types as possible)
    - Areas of suspected co-mingling of different PFAS sources
    - Areas of maximum PFAS concentrations
      - SI, ESI, and RI Mob 1 Results
    - Areas of potential GW/SW interaction
  - *Off-installation groundwater:*
    - Up-, down-, and side-gradient (sample locations may be off-installation or along boundaries)
    - Locations where observed PFAS signature may vary due to multiple sources
    - Perceived data gaps
    - Potential sampling at off-base drinking water wells (private wells, municipal well fields, etc.)

Fingerprinting Study Approach - Groundwater

- Stewart ANGB groundwater sampling considerations:
  - *Off-base property access*
    - Existing/previously secured access agreements
    - Potential for new access agreements
  - *Existing MW network*
  - *Consideration given to accessibility, sensitive natural resources, and other factors.*

Fingerprinting Study Approach - Groundwater



Discussion

- Group Discussion
- Review of sites with GIS
- In-Person Site Tour and Scoping
- Thanks Stewart ANGB Team!

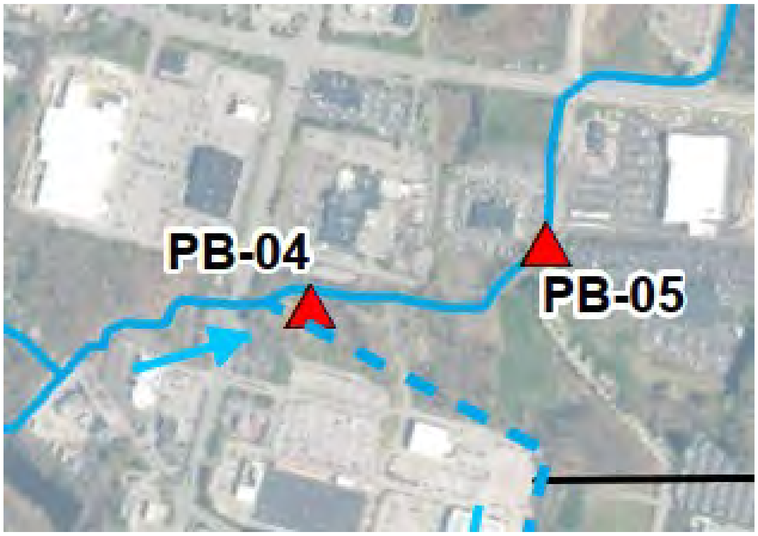
Lauren Idleman

From:	Howard, Walter <Walter.Howard@aecom.com>
Sent:	Friday, March 8, 2024 8:07 AM
To:	Megan Duley
Cc:	MYER, WILLIAM M GS-13 USAF ANGRC ANGRC/A4; Lauren Idleman; Nicole Cook
Subject:	RE: Stewart Data Request/Clarification
Attachments:	Stewart Well Construction.xlsx; Stewart Airport - USACE FUDS wells.xlsx
Follow Up Flag:	Follow up
Flag Status:	Flagged

Megan,

Please find attached the coordinates and screen intervals for our Mobe1 PFAS RI temp and bedrock wells, and those for the USACE FUDS wells.

Hope your site walk went well yesterday. I'd like to correct a statement I made on the call. I stated that the proposed BG-5 location was on a parcel where an attorney previously requested USACE to provide our RI SW sample results. After looking at your figure more closely I see that wasn't correct. The parcel I was thinking of when I said that is where you plan to collect surface water sample SW-28 (our Mobe 1 SW location PB-04). If it would still satisfy your need, consider that we were able to collect sample PB-05 further downstream (see below) from the public ROW with no permissions required.



Walt Howard
AECOM
518-791-4234

From: Megan Duley <MDuley@oescgroup.com>
Sent: Tuesday, March 05, 2024 2:17 PM
To: Howard, Walter <Walter.Howard@aecom.com>
Cc: MYER, WILLIAM M GS-13 USAF ANGRC ANGRC/A4 <william.myer.2@us.af.mil>; Lauren Idleman

<LIdleman@oescgroup.com>; Nicole Cook <NCook@oescgroup.com>
Subject: Stewart Data Request/Clarification

Hi Bill and Walt –

Do you have available a monitoring well inventory list as spreadsheet (with coordinates) and/or GIS shapefile. We have some information from ERPIMS on wells but it is not complete. It is hard to tell what the full well network is. We have also found figures but then those locations are not often labeled so hard to tell; and also have seen a PDF in QAPP of Mob 1/Mob 2 well construction info. We do have the well data from Mob 1 and a figure of locations planned for Mob 2 but would be helpful to have any well construction information for those and ALL ERP wells as spreadsheet and/or GIS shapefile, if available.

Secondly, do you know when you think the Mob 2 wells will be installed (we are trying to understand if they will be available for sampling)?

Would appreciate any insight or info you can send over quickly – it will make our group discussion easier on Thursday. Our goal is to understand available wells for potential sampling.

Big Thanks,
Megan

Megan Duley, PE
C: 651.775.7870
mduley@oescgroup.com

From: Howard, Walter <Walter.Howard@aecom.com>
Sent: Friday, March 1, 2024 3:24 PM
To: Megan Duley <MDuley@oescgroup.com>
Cc: MYER, WILLIAM M GS-13 USAF ANGRC ANGRC/A4 <william.myer.2@us.af.mil>
Subject: FW: CPA Out brief Stewart

You don't often get email from walter.howard@aecom.com. Learn why this is important

Hi Megan,

Attached is an excel flat file with the RI Mobe 1 analytical results and location coordinates. The SI/ESI analytical data is also included in a second tab in this file.
The zip file is our geodatabase file which includes the potentiometric surface map from the ESI (the RI scope does not include MW installation and synoptic WLs until Mobilization 3), as well as other layers.

Have a nice weekend.

Walter O. Howard, PG
Project Manager
M: 518.791.4234
walter.howard@aecom.com

From: Megan Duley <MDuley@oescgroup.com>
Sent: Thursday, February 29, 2024 12:49 PM
To: MYER, WILLIAM M CIV USAF ANGRC ANGRC/A4VR <william.myer.2@us.af.mil>

Cc: Nicole Cook <NCook@oescgroup.com>; Lauren Idleman <LIdleman@oescgroup.com>
Subject: [Non-DoD Source] RE: CPA Out brief Stewart

Hi Bill,

Thanks for sending – super helpful. Lots of pieces to this puzzle!

Also wondering if you may have 2 other things that would be helpful to our review and development of initial recommendations –

1) The RI results from mob 1 – they can be preliminary and we can flag them as such. Results in spreadsheet (with coordinates great), results in prelim figures you all presented at RAB/other, any results though shapefile easiest if can send a layer package or GIS file.
2) A shapefile of the potentiometric surface you use out there – it is best if we should the same interpretation your teams (regulatory/etc) are used to seeing so if we could get this shapefile for use in our figures, that would be great!

Thank you!
Megan

Megan Duley, PE
C: 651.775.7870
mduley@oescgroup.com

From: MYER, WILLIAM M CIV USAF ANGRC ANGRC/A4VR <william.myer.2@us.af.mil>
Sent: Wednesday, February 28, 2024 3:37 PM
To: Megan Duley <MDuley@oescgroup.com>
Subject: CPA Out brief Stewart

William Myer (COL Ret), PG
ANG Environmental Restoration Program Manager
NGB-A4VR
Cell 774-994-7265
Remote Work

Attachment C

Installation-Specific Site Safety and Health Plan

FINAL

Site Safety and Health Plan

Per- and Polyfluoroalkyl Substances (PFAS) Fingerprinting and Background Study

Stewart Air National Guard Base

May 2024

Prepared for:

Air Force Civil Engineer Center

Under Contract No.

W91238-23-D-0023 / W91238-23-F-0086

Prepared by:

Sustainment and Restoration Services
207 E. Victoria Street
Santa Barbara, California 93101

Approval of the Site Safety and Health Plan

Plan Prepared by:

Competent/Qualified Person
David Berthene, GIT
Project Geologist

31 May 2024
Signature and Date

Plan Approved by:

Corporate Safety and Health Manager, Certified Industrial Hygienist
Bradley Kuntz, CIH, CSP, CHMM, SMS

Bradley J. Kuntz 31 May 2024
Signature and Date

Effective Dates: 06 March 2024 to 25 September 2026 (with annual updates as necessary)

CONTENTS

TABLES

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

AF	Air Force
AHA	Activity Hazard Analysis
amsl	above mean sea level
ANGB	Air National Guard Base
ANSI	American National Standards Institute
APP	Accident Prevention Plan
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CPR	Cardiopulmonary Resuscitation
COPC	contaminant of potential concern
COR	Contracting Officer’s Representative
CSP	Certified Safety Professional
CRZ	contaminant reduction zone
dBA	decibel
eV	electron volt
EZ	Exclusion Zone
°F	Fahrenheit
FTL	Field Team Lead
GIT	Geologist In Training
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation derived waste
N/A	Not Applicable
NRR	noise reduction rating
OASD	Office of the Assistant Secretary of Defense
OESC	Oneida Engineering, Science, Construction Group
OSHA	Occupational Safety and Health Administration
PE	Professional Engineer
PEL	Permissible Exposure Limit
PFAS	Per- and polyfluoroalkyl substances
PG	Professional Geologist

PID	Photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
RAC	Risk Assessment Code
SHM	Safety and Health Manager
SRS	Sustainment and Restoration Services
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SZ	support zone
TWA	time-weighted average
USACE	United States Army Corps of Engineers
VOCs	volatile organic compounds

1.0 INTRODUCTION

Sustainment and Restoration Services, LLC (SRS) a subsidiary of Oneida Engineering, Science, and Construction Group (Oneida) has been awarded Contract W91238-23-D-0023, task order number W91238-23-F-0086 by the U.S. Army Corps of Engineers (USACE) Sacramento District to complete a Fingerprinting and Background Study of per-and polyfluoroalkyl substances (PFAS) in soil, groundwater, and surface water at Stewart Air National Guard Base (ANGB) (Figure 4, Tab 3 of the Accident Prevention Plan [APP]). The goal of the PFAS fingerprint study is to potentially discriminate among PFAS sources, including aqueous film forming foam and various wastes and products. The goal of the background study is to evaluate the anthropogenic background concentrations at each installation.

1.1 PURPOSE

Work tasks under this contract will be performed in Newburgh, New York. The Site is subject to the written plan requirements of United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual EM-385-1-1, 30 November 2014, Section 33, and Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) standard in 29 Code of Federal Regulations (CFR) 1910.120. This Site Safety and Health Plan (SSHP) has been prepared according to these requirements and describes the procedures to be followed in order to reduce worker exposure to hazardous substances and other potential health and safety hazards that are present at the site.

1.2 SCOPE OF THE SSHP

The SSHP addresses all phases of field operations at the site and includes the following information:

- Site description and contaminant characterization
- Hazard identification and assessment (Activity Hazard Analysis)
- Staff organization, qualifications, and responsibilities
- Training requirements
- Personal protective equipment
- Medical surveillance
- Exposure monitoring procedures
- Standard operating procedures
- Site control measures
- Decontamination procedures
- Emergency response

2.0 SITE DESCRIPTION AND CONTAMINANT CHARACTERIZATION

2.1 SITE DESCRIPTION AND LOCATION

Stewart ANGB is located in Newburgh, New York, and is the base of the 105th Airlift Wing. The ANGB shares an airfield with Stewart International Airport. Stewart ANGB is approximately 60 miles north of New York City. (Figure 4, Tab 3 of the APP). The air base encompasses approximately 267 acres of land. There is no family or transient military housing on base (AECOM, 2015).

The climate in Newburgh is defined as humid continental and characterized by four highly variable seasons, warm summers, and no extended dry season. The temperature typically varies from 17 Fahrenheit (°F) to 86 °F and is rarely below 10 degrees °F or above 88 °F. The average cold season (1 December to 9 March) temperature is approximately 30 °F, and the average warm season (29 May to 16 September) temperature is 80 °F. The average annual precipitation is 51 inches with an average annual snowfall of 36 inches. The typical number of days with measurable precipitation is 121 (AECOM, 2015).

The installation is in the Hudson-Champlain Lowland of the Valley and Ridge Province. The topography is relatively flat with significant downward slopes to the south and east. Surface elevations range from 440 to 450 feet (ft) above mean sea level (amsl) throughout most of the installation, to a low of 340 ft amsl along the eastern property line, and 400 ft amsl along the southern property line (Air Force Center for Environmental Excellence, 2002).

2.2 CONTAMINANT CHARACTERIZATION

The main contaminants of potential concern (COPCs) at the site are PFAS constituents in soil and groundwater (Wood, 2020). Other contaminants that may be present in some areas to be investigated include volatile organic compounds (VOCs) and pesticides in groundwater (TEC-Weston JV, 2017; WSP, 2023). Exposure to these COPCs may be possible via inhalation during the initial opening of the well before gauging, and absorption through dermal contact while sampling soils, drilling and installing monitoring wells, and groundwater sampling.

3.0 HAZARD IDENTIFICATION AND ASSESSMENT

3.1 TYPES OF HAZARDS AND ASSESSMENT

Workers may be exposed to the COPCs at the site during soil sampling, groundwater gauging, monitoring well installations and groundwater sampling activities. In addition, there will be biological risks (bees, spiders, etc.) and physical risks (pinch points, struck-by hazards) when installing monitoring wells, during pick-up of waste for disposal, or other site activities. To determine the hazards and associated risk with planned work activities on this project, detailed Activity Hazard Analysis (AHA) will be conducted for each work activity. Each hazard in the individual AHA will be assigned a Risk Assessment Code (RAC).

The AHA includes breaking down each phase of work into its distinct job steps and assigning a RAC to each job step and corresponding hazard in the AHA. The assigned RAC will be one of the following, based on the anticipated or known probability and severity of the hazards that can cause an accident after controls are implemented:

E = Extremely High Risk

H = High Risk

M = Moderate Risk

L = Low Risk

Table 3-1 Activity Hazard Analyses

AHA Number	Description
01	Mobilization/Demobilization
02	Land Survey, Biological Survey, and Utility Clearance
03	Vegetation Removal
04	Direct Push Technology (DPT) Drilling
05	Hollow Stem Auger and Sonic Drilling
06	Well Installation
07	Groundwater Monitoring and Sampling
08	Subsurface Soil Sampling
09	Surface Water Sampling
10	Concrete/Wet Saw Cutting
11	Investigation Derived Waste Handling and Disposal
12	Airfield Safety

Specified controls to minimize and/or eliminate the risk of injury from identified hazards are described in this SSHP, AHAs (Appendix A, Tab 4 of the APP) and additional safety plans (Appendix H, Tab 4 of the APP). With implemented controls, the risk of injury ranges is anticipated to be Low Risk to Moderate

Risk. If an emergency situation were to happen, emergency response contacts are included in Attachment 1 of this SSHP.

3.1.1 Chemical Hazards

Potential significant chemical hazards associated with this site include PFAS constituents and VOC constituents associated with other restoration sites listed in Table 3-2. There is a potential for exposure to one or more of these contaminants through inhalation and/or dermal contact while investigation activities are being conducted. However, the risk of exposure to concentrations of these COPCs above any occupational exposure levels is low, provided that controls described in this SSHP and AHAs are implemented. This is based on an exposure assessment of the known concentrations of these contaminants at the site.

Site constituents are those that exist at the site and are the cause for conducting site activities. The chemicals that are brought on site in order to conduct the work may be hazardous and subject to regulation under the OSHA Hazard Communication Standard (29 CFR 1910.1200).

3.1.2 Biological Hazards

The Site Safety and Health Officer (SSHO) will identify all personnel with known insect or arachnid allergies or sensitivities before fieldwork begins. Personnel with known allergies should take appropriate medication and should notify the SSHO of this medication’s location. All insect/arachnid bites are to be reported to the SSHO as soon as practicable.

3.1.3 Insects and Arachnids

During fieldwork, personnel may encounter a wide variety of insects and arachnids including mosquitoes, ticks, spiders, bees, and wasps. Field personnel are encouraged to use appropriate insect repellent. Stings from bees, wasps, and harvester ants may cause serious allergic reactions in certain individuals. Apply any repellents in accordance with manufacturers' recommendations.

3.1.3.1 Ticks

Tick bites can spread deadly diseases. The deer tick, wood tick, and the lone star tick are the most encountered species in New York. This species resides in warm places and mainly feeds on dogs, although it can also feed on people if many ticks are present. Tick checks are important in avoiding any health problems. Tick checks are important in avoiding any health problems. Common species of ticks that carry diseases in New York include the American Dog Tick, Deer Tick, and Lone Star Tick (New York State Department of Health).

While Lyme disease is the most common result of a tick bite, the animal may also carry other serious diseases.

Report a tick bite to the SSHO within 4 hours.

3.1.3.2 Mosquitoes

Mosquitoes occur anywhere standing water occurs and may transmit the Zika virus, West Nile virus, and other serious diseases.

Zika is spread mostly by the bite of an infected Aedes species mosquito (Ae. aegypti and Ae. albopictus). These mosquitoes bite during the day and night. Prevent Zika by avoiding mosquito bites. Since 2018, no local mosquito borne Zika virus transmission has been reported in the continental United States. However, the mosquitoes that can spread Zika are found throughout the United States. The use of mosquito repellent can drastically reduce the chance of being bitten by a mosquito.

3.1.3.3 Spiders

Spider bites can be extremely serious (e.g., those of the black widow and brown recluse). Black widow venom affects the nervous system; symptoms can include local reaction, muscle cramps, belly pain, weakness, tremor, nausea and vomiting, faintness, dizziness, chest pain, and trouble breathing.

A brown recluse spider bite primarily affects the skin and surrounding tissue at the site of the bite. Brown recluse spider venom contains enzymes that can cause tissue damage, leading to a condition called necrosis, where the skin and underlying tissue can break down and die. The bite area might initially appear red and swollen and could develop into a blister or an open sore. In severe cases, the bite might lead to a deep, ulcerating wound that can take weeks or even months to heal.

All spider bites can cause rashes, itching, and possible infection. The possibility of allergies greatly increases the danger since people are not usually aware of such allergies until bitten. Therefore, spiders should be regarded as a serious potential hazard.

Workers can take the following preventative steps to avoid bites:

- Inspect or shake out any clothing, shoes, towels, or equipment before use.
- Wear protective clothing such as a long-sleeved shirt and long pants, hat, gloves, and boots when handling stacked or undisturbed piles of materials.
- Minimize the empty spaces between stacked materials.
- Remove and reduce debris and rubble from around the outdoor work areas.
- Trim or eliminate tall grasses from around outdoor work areas.
- Store apparel and outdoor equipment in tightly closed plastic bags.
- Keep your tetanus boosters up-to-date (every 10 years). Spider bites can become infected with tetanus spores.

3.1.3.4 Bees and Wasps

If field personnel have been stung by a bee, the stinger should be removed immediately. Use something to scrape across the affected area (e.g., credit card) to remove the stinger. Once the stinger is removed, wash the area with soap and water and apply ice. Monitor affected area for allergic reaction. If field personnel are allergic to bee stings or if an allergic reaction is noticed after a sting, administer a doctor prescribed epinephrine (colloquially known as an Epi-pen) shot after sting occurs and seek medical attention immediately. The epinephrine can only be administered to the field personnel in a manner prescribed by a doctor.

If field personnel have been stung by a wasp, the treatment is similar to a bee string. The majority of people without sting allergies will show only minor symptoms during and after a wasp sting. Personnel likely to develop a raised welt around the sting site. A tiny white mark may be visible in the middle of the welt where the stinger punctured the skin. Usually, the pain and swelling recedes within several hours of being stung. Clean the area with soap and water to prevent infection and apply a cold compress to reduce swelling. Avoid scratching the sting area to prevent further irritation. If field personnel are allergic to wasp stings or if an allergic reaction is noticed after a sting, administer a doctor prescribed epinephrine shot and seek medical attention immediately.

3.1.4 Venomous Snakes


Timber Rattlesnake


Eastern Copperhead Rattlesnake


Eastern Massasauga Rattlesnake

New York is home to three species of venomous snakes: the Eastern Copperhead Rattlesnake, Timber Rattlesnake, and Massasauga Rattlesnake. The Eastern Copperhead Rattlesnake has a copper-colored head and cat-like vertical pupils and dark hourglass shaped crossbands. They commonly live in deciduous forest and mixed woodlands. Eastern Massasauga Rattlesnakes are gray or grayish-brown in color with dark bands or blotches down the back. Timber rattlesnakes can be yellow, gray, or brown in color, with or without a rusty orange stripe down the center of the back, and commonly live in steep bluffs and rocky outcrops.

In areas with potential exposure to venomous snakes, employees shall be required to wear snake chaps or knee-high snake boots. However, in the event of a snake bite, report to the SSHO as soon as possible. Medical attention may need to be sought immediately.

3.1.5 Microorganisms and Worms

To prevent fungal and parasitic infections, personnel should keep their feet clean and dry, especially in areas where animals may have defecated. Hookworm, ascaris, and whipworm are known as soil-transmitted helminths (parasitic worms). Hookworm fertilized eggs release immature worms into the soil; these larvae mature into a form that can penetrate the skin of humans. Hookworm infection is mainly acquired by walking barefoot on contaminated soil however, any direct skin contact (including digging) can allow passage of the larvae through the skin. Hookworm, Ascaris, and Whipworm can be transmitted through ingestion of worm eggs (deposited by infected animals).

3.1.6 Other Animals

To avoid animal bites and diseases, including rabies and plague, do not handle or pet animals, especially dogs and cats. Any animal encountered should be considered a wild animal. If an employee is bitten or scratched, wash the wound immediately with soap and water and seek medical attention to determine if medication or anti-rabies vaccine is needed. Bats are known reservoirs for several viruses that can be transmitted to humans including rabies, Nipah Virus and Hendra Virus. Ground squirrels, rock squirrels, various rats, mice, and other mammals may harbor fleas carrying bubonic plague. Their bites can also transmit rabies and other infections. Field personnel should avoid wildlife whenever possible. Report all animal bites to the SSHO as soon as possible.

3.1.6.1 Hantavirus

The hantavirus is a type of virus that is primarily transmitted to humans from rodents, particularly deer mice, white-footed mice, rice rats, and cotton rats. These rodents carry the virus and shed it in their urine, droppings, and saliva. People can become infected with the hantavirus when they come into contact with contaminated rodent urine, droppings, or nesting materials, or by inhaling tiny particles of these materials that are stirred into the air.

Avoiding contact with rodents and their droppings is key. Wearing PPE when working in areas where rodents might be present and ensure good ventilation in enclosed areas where rodents may have been present to reduce the risk of inhaling particles. If you suspect that you've been exposed to the virus or if you experience symptoms such as fever, muscle aches, and respiratory issues after potential exposure, seek medical attention. Early detection and medical care can improve outcomes in case of hantavirus infection.

3.1.7 Poisonous Plants

Poison Sumac

Poison Ivy

Poison ivy and sumac are plants that contain oils called urushiol, which can cause allergic reactions in many people who come into contact with them. These plants are found in various regions and can cause itchy rash, redness, swelling and blisters on the skin.

Before beginning work in an area where there is potential for poisonous plants, the SSHO should familiarize the employees with the distinctive features of the plants, such as leaves, stems, and berries, to minimize the risk of exposure. If permitted or practical, the removal or destruction of the poisonous plants shall be done, given proper PPE is utilized. It is recommended that workers wear gloves, long sleeves, and long pants to reduce skin exposure. Before entering an area that may contain poisonous plants, employees with severe allergies should notify the SSHO.

If exposed to poison ivy or sumac, wash the exposed areas thoroughly and gently within 10 minutes of contact. Most cases of the rash can be treated with calamine lotion. Clean clothing, tools, or any gear that was exposed to the plants as the plants' toxic oil can remain on clothing and other items for extended periods of time. Refrain from scratching the affected areas as it can worsen the irritation and increase the risk of infection. If the allergic reaction is severe, covers a large area of the body, or if blisters appear infected, seek medical attention.

3.2 EXPOSURE TO HAZARDOUS SUBSTANCES (CONTAMINANTS OF POTENTIAL CONCERN)

Workers may be exposed to COPCs present at the site via dermal contact or inhalation. Exposure to these COPCs at concentrations above any occupational exposure levels is a Low Risk, provided that controls described in this SSHP and AHAs are implemented.

In addition to the AHAs, the SSHO will review the characteristics, potential and known exposure level and health effects of the COPCs at the site with site personnel, as described in SSHP Attachment 2.

Table 3-2 outlines the maximum concentrations of the COPC analytes detected at the site during previous investigations (TEC-Weston JV, 2017; WSP, 2023).

Table 3-2 Contaminants of Potential Concern

Analyte	Soil			Groundwater		
	Units	Concentration	Screening Level[1]	Units	Concentration	Screening Level[1]
PFOS	µg/kg	14.2	13	ng/L	3,790	4.0
PFOA	µg/kg	1.53 J	19	ng/L	264	6.0
PFBS	µg/kg	ND	1,900	ng/L	130	600
Cis-1,2-Dichloroethene	--	--		µg/L	41	70
4,4'-DDD	--	--		µg/L	1.1 J	NE
4,4'-DDE	--	--		µg/L	0.21	NE
Vinyl Chloride	--	--		µg/L	32	2.0

NOTES:

Note 1: Screening levels for PFAS are from the 24 August 2023 Memorandum issued by the Office of the Assistant Secretary of Defense, Energy, Installations and Environment: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program (OASD, 2023)

Screening levels for all other listed analytes are the United States Environmental Protection Agency Regional Screening Levels (RSLs) – Summary Table, November 2023.

J	estimated concentration
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ng/L	nanograms per liter
--	no data

Table 3-3 contains a list of potentially present site chemicals showing their composition and what they may be used for.

Table 3-3 Summary of Potentially Present Site Chemicals

Chemical	Concentration Composition (% Weight)	Usage
Unleaded gasoline and diesel	Gasoline (80-100%) Diesel, Number (No.) 2 (85-100%)	Equipment Fuel
Alconox	Sodium tripolyphosphate (12-28%) Sodium Alkylbenzene Sulfonate (8-22%) Tetrasodium Pyrophosphate (2-16%)	Decontamination
Isobutylene	Isobutylene (100%)	Span calibration gas
Liquinox	Sodium Alkylbenzene Sulfonate (10-25%) Sodium Xylenesulphonate (2.5-10%) Alcohol Ethoxylate (2.5-10%) Lauramine oxide (1-2%)	Decontamination

Chemical	Concentration Composition (% Weight)	Usage
Sunscreen	Homosalate (10%) Octocrylene (8%) Octyl Salicylate (5%) Butyl Methoxydibenzoylmethane (4%) Hydroxybenzoates (<1%) Phenoxyethanol (<1%) Benzyl Alcohol (<1%)	Personal Protection Applications
Silica Dust (Grout Mix)	Silica (100%)	Temporary Well abandonment

4.0 STAFF ORGANIZATION, QUALIFICATIONS, RESPONSIBILITIES

This section describes the personnel responsibilities for implementation of the SSHP. This includes field supervision, enforcing safe work practices, ensuring proper use of personal protective equipment (PPE), and communicating modified safety requirements to site personnel. Key personnel and their roles and responsibilities are discussed in detail in Section 4.0 of the APP.

Oneida has tasked the following individuals with safety and health responsibilities for this SSHP.

Primary and alternative health and safety personnel are delegated as such:

Table 4-1 List of Primary and Alternate Safety Team Personnel

Name	Team Management	SSHO	Quality Control Manager	Field Team Lead (FTL)
Megan Duley, PE	Project Manager (PM)	N/A	N/A	N/A
Bradley Kuntz, CIH, CSP, CHMM, SMS	Safety and Health Manager (SHM) Certified Industrial Hygienist (CIH)	N/A	N/A	N/A
Mark Wanek, PG	N/A	**Primary**	Alternate	**Primary**
Kevin Engle, PG	N/A	Alternate	**Primary**	Alternate
Richard Klamm	NA	Alternate	Alternate	Alternate
Brandon Womack	NA	Alternate	Alternate	Alternate
John Kelley	NA	Alternate	Alternate	Alternate
Matthew Van Beek, PE	Corporate Quality Control	N/A	N/A	N/A

NOTES:

CHMM	Certified Hazardous Materials Manager
CSP	Certified Safety Professional
N/A	Not applicable
PE	Professional Engineer
PG	Professional Geologist
SMS	Safety Management Specialist

4.1 PROJECT MANAGER

Megan Duley, PE is the PM for this project. In addition to the responsibilities listed in Section 4.2.1 of the APP, the PM is responsible for preparation and communication of this SSHP. The PM will make available proper PPE and other safety equipment to control exposure to hazards identified in the SSHP and ensure that the SSHP is provided and communicated to site personnel, including subcontractors.

4.2 SAFETY AND HEALTH MANAGER

Bradley Kuntz, CIH, CSP, CHMM, SMS is the SHM for the project. In addition to the responsibilities listed in Section 4.2.4 of the APP, the SHM is responsible for review and approval of this SSHP. The SHM is available to provide consultation and support on health and safety issues that may arise during implementation of this SSHP.

4.3 FIELD TEAM LEAD/SITE SAFETY AND HEALTH OFFICER

Mark Wanek, PG is the FTL/SSHO and Kevin Engle is the alternate FTL/SSHO for the project. Additional alternates are listed on Table 4-1. In addition to the responsibilities listed in Section 4.2.2 of the APP, the FTL/SSHO will set up the work zone(s), restrict and control entry of personnel in and out of the work zone(s), and direct site personnel to perform assigned tasks with the proper controls, PPE and procedures described in this SSHP. The FTL/SSHO will perform the following duties as they pertain to the SSHP.

- Check that site personnel have the prerequisite training prior to entry in the work zone(s) and keep records of training at the site.
- Review the SSHP with site personnel in conjunction with the APP and AHAs, as they relate to assigned tasks.
- Perform air monitoring in potential and/or known areas of exposure to hazardous substances, including calibration of air monitoring equipment and keeping records of air monitoring data

4.4 SITE PERSONNEL PERFORMING HAZWOPER OPERATIONS (INCLUDING SUBCONTRACTORS)

All current training certificates and medical surveillance clearances must be on file with the SSHO before each worker can commence work on-site. Oneida employee’s safety responsibilities are summarized in Section 4.2 of the APP.

4.5 VISITORS

Visitors are required to follow the direction of the SSHO and be escorted by the SSHO at all times when visiting the work site. The SSHO has the right to restrict access from visitors at the work site. Safety requirements for site visitors are summarized in Section 5.3 of the APP.

4.6 WORK STOPPAGE AUTHORITY

The FTL, SSHO, and PM will have the authority to order a cessation of the activity if hazards present an unsafe risk to injury or if there is a violation.

5.0 TRAINING

All personnel involved with hazardous waste operations must be trained according to the HAZWOPER requirements in 29 CFR 1910.120(e). The training requirements are specified in Section 6.0 of the APP.

5.1 HAZWOPER PREREQUISITE TRAINING

Prerequisite HAZWOPER training is listed below.

Table 5-1 Training Requirements

HAZWOPER Training Requirements	Personnel that Require this Training
Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour initial training HAZWOPER 3 days of supervised training HAZWOPER 8-hour Refresher training (annual)	Personnel who may be exposed or potentially exposed to hazardous substances and health hazards at the site during the project.
HAZWOPER 8-hour Supervisor training	SSHO
Other Training Requirements	**Personnel that Require this Training**
APP/SSHP orientation training	Personnel entering the site, prior to beginning work tasks
Onsite safety meeting (tailgate)	Personnel entering and working at the site (ongoing)
30-hour OSHA Construction or General Industry Outreach Safety training	SSHO
First Aid, CPR, bloodborne pathogen training	Site Supervisor, SSHO

NOTES

CPR: Cardiopulmonary Resuscitation

5.2 SITE-SPECIFIC HAZWOPER TRAINING

Personnel performing work activities will be provided initial orientation training on this SSHP and AHAs corresponding to work tasks that personnel will perform. The PM, in coordination with the Site Supervisor and SSHO, will ensure all personnel receive this training prior to beginning work for the project for the first time. The SSHO will document that all personnel have received this training.

The SSHO will provide and document site-specific orientation training prior to the start of any field activities and whenever new workers arrive on-site. No site workers will be allowed to begin work until the site-specific training is completed and documented. The training will address the requirements of this SSHP, including:

- Site description
- Responsibilities and lines of authority
- Site contaminants – health effects, exposure, monitoring, decontamination
- Established work zones
- Selection, use, and limitation of PPE, including respirators (if needed)
- Potential site hazards (chemical, physical, and biological)
- Hazard communication
- Emergency procedures and points-of-contact

6.0 PERSONAL PROTECTIVE EQUIPMENT

This section of the SSHP describes how PPE is selected and used to protect workers from exposure to COPCs and hazardous conditions on the site. Selection of appropriate PPE is based on the contaminant type(s), concentration(s), and routes of exposure and other physical hazards that may be encountered for each work task.

6.1 PPE EVALUATION AND DETERMINATION

Appropriate PPE is specified in Table 6-1. Based on the potential presence of COPCs at the site, Level D, and/or Modified Level D PPE will be required to minimize exposure to site contaminants via inhalation and dermal contact when gauging, drilling and sampling activities are performed. Contaminants used to determine the PPE level are provided in Table 3-2.

6.2 PPE REQUIREMENTS

The following lists the equipment required for Level D, Modified Level D.

Level D PPE

- High visibility safety vest (American National Standards Institute [ANSI] Class II); or high visibility shirt with reflective striping (ANSI Class II rating).
- Nitrile gloves when gauging groundwater.
- Cut-resistant gloves when opening/closing flush mount well caps or performing maintenance on equipment that has the potential to cause a hand injury.
- ANSI Z87.1 rated safety glasses and bear a legible and permanent “Z87” logo to indicate compliance with the standard.
- If a person’s vision requires the use of corrective lenses, they shall be protected by prescription safety glasses, protective glasses with side shields or goggles designed to fit over the corrective lenses.
- Hard hat when overhead hazards are present. All protective headgear shall meet the requirements of ANSI Z89.1.
- Sturdy safety-toed work boots meeting ASTM Standard F2413 will be worn as a minimum. Footwear providing protection against impact and compression hazards shall be rated as I/75 and C/75.
- Hearing protection devices with minimum noise reduction rating of 26 decibels (dBA) (if excessive noise is present).

Modified Level D PPE

Equipment specified for Level D, *plus* the following:

- Coveralls, (long trousers and shirt) and/or disposable coveralls.
- Nitrile inner gloves.
- Nitrile outer glove.

Required PPE and site-related activity are summarized in Table 6-1. In addition, to the PPE specified in Table 6-1, all levels require a hard hat, steel-toed boots, safety vest, safety glasses, and hearing protection (if excessive noise is present), as described above.

Table 6-1 Personal Protective Equipment by Task

Task	Hazard	Level	Body	Skin
Mobilization/ Demobilization	No exposure	D	Normal work clothes	N/A
Surveying/Utility Clearance	No exposure	D	Normal work clothes	Work gloves
Vegetation Removal	No exposure	D	Normal Work clothes, long pants	Work gloves
Groundwater Gauging	Low to Moderate potential for chemical exposure	D	Normal work clothes, long pants	Nitrile gloves
DPT, HSA and Sonic Drilling and Well Installation	Low to Moderate potential for chemical exposure; high potential to excessive noise exposure.	D	Normal work clothes, long pants	Nitrile gloves
Surface Soil Sampling	Low potential for chemical exposure	D	Normal work clothes, long pants	Nitrile gloves
Surface Water Sampling	Low to Moderate potential for chemical exposure	D	Normal work clothes, long pants	Nitrile gloves
Groundwater Sampling	Low to Moderate potential for chemical exposure	D	Normal work clothes, long pants	Nitrile gloves
Concrete/Wet Saw Cutting	Low potential for chemical exposure	D	Normal work clothes, long pants	Work and Nitrile gloves
Investigation Derived Waste Handling and Disposal	Low to Moderate potential for chemical exposure	D	Normal work clothes, long pants	Nitrile gloves
Airfield Safety	Potential for exposure to hazardous noise levels.	D	Normal work clothes, long pants. Hearing protection such as earplugs and/or muffs.	N/A

6.3 RESPIRATORY PROTECTION

Upgrade to respirator use (Level C PPE) is not anticipated for this project and will require stop work procedures and discussion with the SHM and PM if action levels are exceeded (please refer to Section 8.8) to make sure the training and procedures for these upgrades are implemented or present. If PPE upgrades are made, then the APP/SSHP will be amended accordingly. The amendment will include but not be limited to a written Respiratory Protection Program specifying standard operating procedures to protect each SRS and construction-site employee from respiratory hazards, according to the requirements of 29 CFR 1910.134 (and 29 CFR 1926.103).

Upgrades to respirators are to be used only after concurrence with the SHM and PM, and where administrative and/or engineering control of respirator hazards is not feasible, while engineering controls are being installed, or in emergencies.

6.4 PPE TRAINING

HAZWOPER training and medical clearance requirements will be verified for all on-site personnel. The SSHO will review PPE requirements as part of the daily safety tailgate meetings and ensure all personnel are using PPE properly.

6.5 PPE INSPECTION

The SSHO will instruct site personnel in the daily tailgate safety meetings the requirements for PPE hygiene, including daily inspection and cleaning. The SSHO will also periodically visually inspect PPE in use by Site personnel. The SSHO will visually inspect stored stand-by safety equipment and PPE at least weekly during fieldwork. PPE and equipment shall be properly decontaminated prior to exiting the exclusion zone/contaminant reduction zone.

7.0 MEDICAL SURVEILLANCE

This section describes the medical surveillance requirements for personnel performing HAZWOPER operations at the site. The purpose of medical surveillance is to provide uniform medical care, certify employees are physically able to safely perform the work assigned, monitor employee health on a regular basis, and provide medical care for occupational injury or illness. This program applies to Oneida employees and subcontractors.

7.1 MEDICAL EVALUATION

All personnel involved in on-site operations must participate in an ongoing medical surveillance program meeting the requirements of OSHA 29 CFR 1910.95, 1910.120 and 1910.134. The first examination will be conducted before personnel begin working at the site. The medical surveillance protocols and examination results will be overseen by a licensed physician certified in Occupational Medicine by the American Board of Preventive Medicine or who, because of necessary training and experience, is Board-eligible.

7.2 ANNUAL EXAMINATION

Each employee who may be potentially exposed to hazardous chemicals, or who may require wearing a respirator for more than 30 days per year will receive an annual examination consistent with the baseline examination aforementioned. Those employees who wear a respirator for less than 30-days per year will receive a bi-annual examination.

7.3 EMPLOYEE NOTIFICATION OF MEDICAL EXAMINATION RESULTS

The physician at WorkCare (a national medical surveillance program) will review the results of the medical evaluation. If the examination uncovers a serious health problem, the employee is contacted and notified in writing by the nurse. WorkCare also recommends that the employee see his/her personal medical provider. If the condition is more serious WorkCare will notify the SRS Human Resources Department. If the health condition is pertaining to the job, Health Resources will conduct follow-up monitoring.

7.4 RECORDS

Accurate medical records will be maintained by the occupational physician in accordance with 29 CFR 1910.120. Employees will be permitted access to all medical records following the procedures outlined in 29 CFR 1910.20 and Oneida’s Safety and Health Procedures, which have been adopted for this project.

8.0 EXPOSURE MONITORING

This Exposure Monitoring section describes the procedures for the monitoring of hazardous conditions that may generate an inhalation risk (gas, vapor, particulates), in compliance with 29 CFR 1910.120(b)(4)(ii)(E) and 29 CFR 1910.120(h)).

Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

8.1 NOISE MONITORING

The SSHO will evaluate the project sites for noise hazards. Field work near the flightline and drilling activities may produce noise hazards equal to or exceeding an 8-hour time-weighted average (TWA) sound limit of 85 dBA measured on the A scale of a sound level meter. Where 8-hour TWAs are 85 dBA on an A-rated scale or greater, a hearing conservation program is required. A Hearing Conservation Program will be implemented for workers exposed to noise at or above 85 decibels, 8-hour TWA.

As the time duration of noise exposure decreases, a higher allowable dBA is allowed (Table 8-1 a reproduction of Table 5-4 of Section 5.C.04 (b) [USACE, 2014]).

Table 8-1 Continuous Noise Exposure (ACGIH and USACE Standard)

Duration per day (hours)	Measurement (dBA)
12	83
10	84
8	85
4	88
2	91
1	94

Requirements for the hearing conservation program are detailed in Section 9.10 of the APP (Tab 2).

Feasible administrative or engineering controls shall be used when employees are subject to sound that exceeds the permissible exposure limit (PEL). If controls fail to reduce sound exposure to within the PEL, PPE must be provided and used to decrease sound levels to within the PEL. Use of PPE, such as earplugs or muffs, will be implemented immediately if sound levels, measured using a dosimeter with data logging capabilities, are calculated to be above the action level. Exposure to impact noise should not exceed the 140 dBA peak sound level. Expandable foam earplugs or earmuffs with a minimum noise reduction rating of 25 dBA will be worn during activities with the potential for loud noise, including various construction activities that may involve drill rigs, power tools, and field work near aircraft operations and flightlines.

Drill rigs and other ancillary equipment will include proper warning signs indicating the use of hearing protection devices within 25 feet of operating equipment. Sonic and Geoprobe drilling may produce continuous noise greater than 103 dBA and up to 108 dBA; therefore, double hearing protection is required when working near a sonic or Geoprobe rig. Double hearing protection is the combination of earplugs with earmuffs. Double hearing protection may not sufficiently attenuate the noise above 108 dBA, therefore, more control measures are required (Section 5-8 d.C (c-2) [USACE, 2024]). Contact the SHHO for additional guidance.

Hand signals will be used when noisy conditions exist and/or when hearing protection devices are used. Hand signals will be discussed and agreed upon by site personnel prior to use of hearing protection.

8.2 REQUIREMENT, LOCATION, FREQUENCY

Air monitoring will consist of ambient air monitoring for VOCs while conducting gauging, drilling, and sampling activities that may expose personnel to COPCs. The location and frequency of air monitoring is shown below.

Table 8-2 Air Monitoring Requirement, Location, Frequency

Air Monitoring Locations	Air Monitoring Requirements and Frequency
Around wells during well gauging and sampling.	Monitor breathing zone when for 15 minutes continuously or until PID reading reaches below 1 part per million (ppm) and maintains a consistent concentration at that level.
Around borehole/new monitoring wells during drilling and installation.	
Around drums of investigation derived waste (IDW; during IDW handling)	Monitor breathing zone around drums of IDW before handling by personnel.

NOTES

PID	Photoionization detector

If measurements indicate a need to change work practices and/or PPE level, this decision will be documented via memoranda, and the SSHP amended accordingly.

8.3 MONITORING EQUIPMENT AND TYPE

Monitoring will be conducted using a PID with a 10.6 electron volt (eV) lamp that will detect the ionization potentials for VOCs. No personal monitoring will be required. The PID model will be a MiniRAE 3000.

8.4 AIR MONITOR CALIBRATION PROCEDURES

The SSHO or someone designated by the SSHO will calibrate the PID on a daily basis. The PID will be powered using either rechargeable batteries or alkaline battery packs. Data will be recorded on a field sheet daily. In addition, background levels for total organic vapors will be measured and recorded in the field logbook. Bump checks will be conducted following very high readings to ensure calibration of equipment.

8.5 MINIRAE 3000 CALIBRATION PROTOCOL

Monitoring equipment calibration will follow manufacturer’s procedures as listed in the operations manuals (Attachment 3). A standard calibration gas of 100 ppm isobutylene, a flow regulator, and polyethylene tubing will be employed for calibration of the PID. The instrument’s calibration will be in accordance with the instrument manufacturer’s direction.

All calibration readings will be recorded in the Air Monitor Calibration Log in Appendix F (Tab 4 of the APP).

8.6 DUST MONITORING

Respirable crystalline silica may be generated during tasks such as well installation and grouting, and concrete and wet saw cutting.

Crystalline silica will be mitigated using engineering controls (e.g., water suppression). A Crystalline Silica Exposure Control Plan is provided in Appendix H.5, Tab 4 of the APP outlining the controls to eliminate and/or minimize exposure to crystalline silica. The engineering and work practice controls will be in accordance with Table 1 in CFR 1926.1153.

8.7 MONITORING DATA RECORD KEEPING

The Air Monitoring Field Data Log included in Appendix F, Tab 4 of the APP will be used to document air monitoring activities. Direct reading VOC measurements will be recorded in an air monitoring log consisting of the date, location, result, and the initial/signature of the person collecting the measurements.

8.8 ACTION LEVELS RATIONALE AND DETERMINATION

Background air concentrations must be established prior to starting work to provide a baseline for comparison against the action levels provided in Table 8-2. The baseline study will consist of a minimum of 5 minutes of real-time monitoring for organic vapors in each work location prior to initiation of gauging work.

Table 8-3 Air Monitoring Action Levels for Site Activities

PID Reading for Sustained Period of 15 Minutes in the Breathing Zone	Response Actions
Less than 1 ppm based on Vinyl Chloride	Level D
Greater than or equal to 1 ppm	Pause work and allow borehole or monitoring well to ventilate. Repeat measurement of breathing zone. If concentrations have not dissipated, then stop work and contact PM and SHM. Work will not resume until: • The SRS PM and Corporate SHM are notified, and the situation is evaluated to determine the next course of action., and • Appropriate corrective measures are implemented which may include administrative and engineering controls, and/or PPE upgrade.
Greater than or equal to 50 ppm	Stop work and secure the area. Work will not resume until: • The SRS PM and Corporate SHM are notified, and the situation is evaluated to determine the next course of action, and

	• Applicable corrective measures are implemented which may include administrative and engineering controls, and/or PPE update.

8.9 MITIGATION PLAN

Air near the boreholes, wellheads and drums will be monitored using a PID to reduce potential worker exposure during these field activities (Table 8-2).

If air monitoring shows concentrations greater than action levels, stand back from the bore wellhead. Allow to ventilate and measure the concentrations of VOCs in the breathing zone again after 15 minutes. If concentrations have not reduced to below the designated action levels, continue to allow the breathing zone to ventilate for an additional 15 minutes and repeat the measurement of atmospheric contaminants. If concentrations of VOCs have not dissipated, notify the SSHO, PM, SHM, AFCEC PM and Contracting Officer's Representative (COR). Work may not resume until the SRS PM and Corporate SHM have been notified and the situation evaluated to determine the next course of action.

8.10 NOTIFICATION

The PM, SSHO, USACE and AFCEC PM, and USACE COR, as well as the activity point of contact will be notified if wells continue to exhibit concentrations above the designated action levels.

9.0 STANDARD OPERATING SAFETY PROCEDURES AND CONTROLS

All Site personnel shall follow these procedures and operational requirements. These precautionary measures are designed to reduce the risks of inadvertent or accidental chemical exposure or injury during on-site operations.

9.1 PERSONAL PROCEDURES

- Utilize the buddy system when two or more workers are at the site. Workers will monitor themselves and be alert to changes and safety of others.
- Eat, drink, or smoke only in designated areas.
- Do not take prescribed drugs during operations where the potential for absorption, inhalation, or ingestion of toxic substances exists, unless specifically approved by a qualified physician.
- Do not work when ill.
- Conduct work during daylight hours only.
- Minimize personnel and equipment in the work area.
- Handle materials and containers in accordance with the APP/SSHP/AHAs. Do not disturb drums and containers unless required for project work.
- Confirm with SSHO the required level of PPE protection required for each task.
- Protect the public by delineating work areas using cones, barriers and/or fencing to restrict access to Site operations. Employ traffic control devices and communication as necessary to inform and protect the public from Site activities.

9.2 OPERATIONAL REQUIREMENTS

- All work shall be in Level D or Modified Level D when working in the control zones.
- The SSHO shall conduct daily tailgate meetings, safety and health inspections to determine if operations are being performed in accordance with this APP/SSHP, OSHA, and any other pertinent regulations and contract requirements.
- Obtain work permits as required and understand permit requirements for safe operations, such as traffic control, public encroachment, excavation.
- All personnel working at the site shall be adequately trained and thoroughly briefed on potential hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications. The SSHP shall conduct daily health and safety meeting prior to work at the site.
- In event of an accident, the supervisor or SSHO shall notify the PM and the PM will notify the USACEPM as required by the contract. The SRS PM will immediately notify the SHM.
- Report all injuries or work-related illnesses to the SSHO or supervisor as soon as possible.
- Personnel and equipment will remain outside the work area unless required for the task currently being performed.

10.0 SITE CONTROL MEASURES

This section details the setup of the site into the various work zones to minimize the possibility of exposing unprotected personnel, prevent translocation of contaminants, and prevent unauthorized entry to the site. Site control is described below, in accordance with the requirements of 29 CFR 1910.120(b)(4)(ii)(F) and 29 CFR 1910.120(d).

10.1 SITE ACCESS AND SECURITY

Work areas will be clearly delineated within the secure perimeter using cones, delineators, and/or caution tape. The FTL and SSHO will supervise work activities and prevent unauthorized entry into areas where work is being performed.

10.2 SITE MAP

A site map showing the site areas where tasks will be performed is located is provided as (Figure 4, Tab 3 of the APP). The site map will be updated as site conditions change over the duration of the project.

10.3 SITE ACCESS

All work locations are accessible. Entry and exit into the work zones will be monitored by the Field Team Leader and SSHO.

10.4 SITE WORK ZONES

As long as the level of protection required is Level D or modified Level D, only one work zone will be established. However, if the level of protection is upgraded, an exclusion zone, contamination reduction zone, and support zone will be established, as determined by a Site Layout Plan that will be developed and approved by the USACE PM. These zone designations are defined as follows:

Exclusion Zone (EZ) is defined as the area where contamination is either known or likely to be present, or because of activity, will provide a potential to cause harm to personnel. Entry into the exclusion zone requires the use of PPE. All personnel entering the exclusion zone must check with the SSHO prior to entry. Upon exiting the exclusion zone, personal protective clothing should be removed as directed by the SSHO. The worker(s) should thoroughly wash their face, hands, and forearms prior any other action, especially eating, drinking, smoking or performing any other hand to mouth function.

Contaminant Reduction Zone (CRZ) is the area where personnel conduct personal and equipment decontamination. It is essentially a buffer zone between contaminated areas and clean areas. Activities to be conducted in this zone will require personal protection as defined in the decontamination procedures.

Support Zone (SZ) is situated in clean areas where the chance of encountering hazardous materials or conditions is minimal. PPE is not required in the support zone but should be available in case of emergency.

If these zone designations are required, they will be established using yellow caution tape and/or orange cones or delineators. When these zone designations are not required, all personnel who are potentially exposed to contaminants are still required to log-in/log-out from the work site each day.

10.5 SITE COMMUNICATION

Personnel will communicate through verbal communication, including the use of cell phones.

11.0 DECONTAMINATION

This section describes how personnel and equipment are decontaminated when exiting the work zones and are designed to achieve an orderly, controlled removal or neutralization of contaminants that may accumulate on personnel or equipment, minimize worker contact with contaminants and protect against the transfer of contaminants outside designated work zones.

11.1 TASK REQUIRING DECONTAMINATION

Decontamination of personnel, PPE, and equipment is required at the site for all workers exiting a contaminated area whenever intrusive (subsurface) activities and/or sample collection activities are performed where there is a potential or known exposure to soil and groundwater. Decontamination is required for these work tasks on this site:

- DPT/HSA/Sonic drilling
- Groundwater monitoring well development
- Groundwater sampling
- Groundwater gauging
- IDW handling and disposal

The potential for contaminants to be accumulated or transferred outside the work zones is low, provided that contact with groundwater is minimized and contained, if present aboveground.

11.2 GENERAL DECONTAMINATION PROCEDURES

All personnel performing work activities in the work zone(s) must follow these general decontamination procedures:

- An EZ, CRZ and defined SZ will be established and delineated unless it can be demonstrated that workers, their PPE and clothing, and equipment will not come into physical contact with hazardous substances at the site.
- PPE and equipment will be removed and stored in the CRZ upon exiting the EZ or will be decontaminated or stored in a sealed bag in the CRZ if being removed from the CRZ and EZ and if it has come into contact with subsurface soil or groundwater.
- Equipment removed from the EZ and CRZ will be decontaminated using an Alconox rinse process (Table 11-1), or completely sealed/bagged prior to offsite decontamination.
- PPE and other small items (e.g., nitrile gloves, wet wipes, rags) can be disposed of as general trash, provided there is minimal contact with soil, sediment, surface water, or groundwater.
- Deionized water will be used for decontaminating PPE or equipment at the site must be containerized, labeled, and profiled according to project-specific waste management procedures.
- Upon exiting the EZ, the worker(s) should thoroughly wash their face, hands, and forearms prior any other action, especially eating, drinking, smoking, or performing any other hand to mouth function.
- No eating, drinking, smoking, applying cosmetics (e.g., lip balm) is allowed within the EZ.

All employees will follow the rules established for the site. Employees found to be disregarding the rules will be barred from the site.

11.3 SPECIFIC DECONTAMINATION AND STORAGE/DISPOSAL PROCEDURES

Specific decontamination and storage/disposal procedures are provided in Table 11-1. The SSHO will coordinate with the SHM to confirm if these procedures need to be modified if warranted by unanticipated site conditions.

Table 11-1 Decontamination Procedures

Tasks	Types of Equipment	Decontamination Procedures	Storage and/or Disposal Procedures
DPT/HSA/Sonic Drilling Groundwater Sampling Characterization and Handling of IDW	PPE (hard hat if overhead hazards are present), safety glasses, steel-toed boots, safety vest, work gloves)	Wet wipe PPE with hard surfaces prior to exiting the Site; dispose or place reusable PPE in a sealed bag if contacted with subsurface soil or groundwater.	Dispose disposable PPE as general trash or leave reusable PPE in a sealed bag.
	Coveralls, disposable nitrile gloves and disposable boot covers	Remove and place in dedicated trash bags for subsequent removal/disposal.	Used PPE will be managed and disposed in accordance with the project-specific waste management procedures.
	Work trucks	Dry brush gross contamination from trucks and ancillary components, containerize all gross debris in dedicated container for removal to the CRZ.	If gross removal of contaminants is impractical for some equipment, these items will be wrapped in plastic prior to transport to the CRZ. In the CRZ these components will be thoroughly wet-wiped and washed with wash water collected and containerized; or fully sealed for offsite decontamination.
	Sampling Equipment	Decontaminate sampling equipment and ancillary components using a quadruple wash and rinse of potable Alconox/Liquinox-water mixture, followed by potable water rinse, de-ionized water rinse, and final rinse with PFAS-free water.	Liquid generated from decontamination of sampling equipment will be containerized and managed and disposed in accordance with the project-specific IDW procedures.

NOTE:

During field activities, a variety of vehicles and small equipment is anticipated. The level of potential contamination for vehicles and equipment is “low” for support vehicles used in uncontaminated areas and/or for non-intrusive field activities, and “medium” for intrusive activities in potentially contaminated areas.

11.4 EFFECTIVENESS OF DECONTAMINATION

SSHO will perform a daily visual inspection of the Site to ensure that no media are being transferred outside of the work zone area.

12.0 EMERGENCY RESPONSE

This section describes the emergency action plan to address potential emergencies at this site, procedures for responding to those emergencies, roles, and responsibilities during emergency response, and training that workers must receive in order to follow the emergency action plan. This section also describes the provisions this site has made to coordinate its emergency response planning in the event of a spill.

Emergency Response procedures, emergency contact information, and route maps to medical facilities are provided in Attachment 1 and Figures 1 and 2 of this SSHP, and Section 9.2 of the APP (Tab 2).

13.0 REFERENCES

AECOM. 2015. Final Regional Compliance Restoration Program Preliminary Assessment/Site Inspection, Stewart Air National Guard Base, Newburgh, New York. July 2015.

AMEC Environment and Infrastructure, Inc. (AMEC). 2012. Final Annual 2011 Long Term Monitoring Program Report Site 1 Former Base Landfill, 105th Airlift Wing, New York Air National Guard, Stewart Air National Guard Base, Newburgh, New York. May.

Air Force Center for Environmental Excellence (AFCEE). 2002. Environmental Baseline Survey 105th Airlift Wing, New York Air National Guard, Stewart International Airport, Newburgh, New York. November 2002.

MiniRAE 3000 VOC Monitor. http://www.raesystems.com/products/minirae-3000-wireless-handheld-voc-monitor

New York State Department of Health. https://www.health.ny.gov/diseases/communicable/lyme/index.htm

Office of the Assistant Secretary of Defense (OASD), Energy, Installations and Environment. 2023. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. 24 August.

Occupational Safety and Health Administration (OSHA). Hazardous Waste Site Operations and Emergency Response Standard (OSHA 29 CFR 1910.120).

TEC-Weston Joint Venture (TEC-Weston JV). 2017. Final Remedial Investigation Report, Pesticides in Monitoring Well-01 (SS005), Stewart Air National Guard Base, Newburgh, New York. April.

United States Army Corps of Engineers (USACE). 2014. Safety and Health Requirements Manual, EM 385-1-1, 15. 30 November.

Wood. 2020. Final Expanded Site Inspection Report for Per- and Polyfluoroalkyl Substances, 105th Airlift Wing, New York Air National Guard, Stewart Air National Guard Base, Newburgh, New York. September.

WSP. 2023. Final 2022 Annual Long Term Monitoring Report Site 3: Former Base Landfill, 105th Airlift Wing, New York Air National Guard, Stewart Air National Guard Base, Newburgh, New York. March.

FIGURES

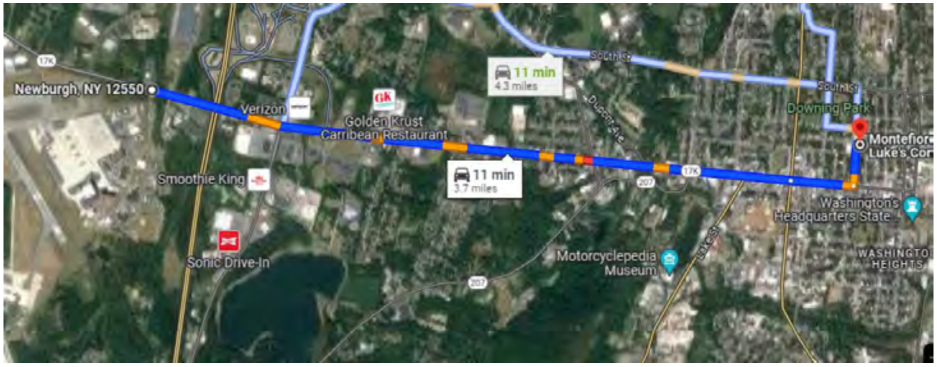
FIGURE 2

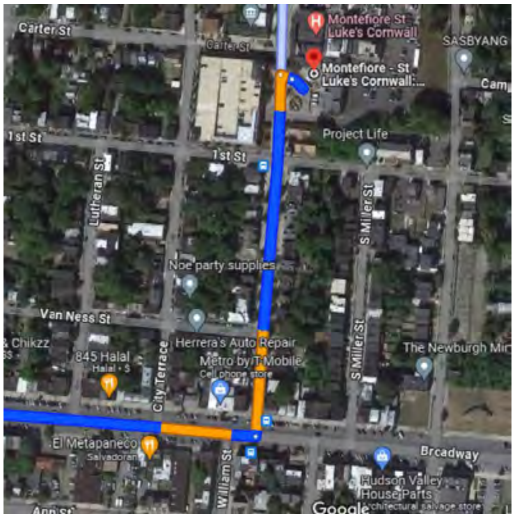
HOSPITAL MAP AND DIRECTIONS – Stewart Air National Guard Base

Route to Emergency Room Facility

From: **Stewart Air National Guard Base**

To: **Montefiore - St Luke's Cornwall: Emergency Room**
70 Dubois St, Newburgh, NY 12550
Phone: 845-568-2305
Open 24 Hours





Depart from: **Stewart Air National Guard Base Vistors Center**

1.	Turn right and head east on NY-17K	3.5 mi.
2.	Turn left onto Dubois Street	0.2 mi.
3.	Destination will be on the right	

Arrive at: **Montefiore - St Luke's Cornwall: Emergency Room**
70 Dubois St, Newburgh, NY 12550

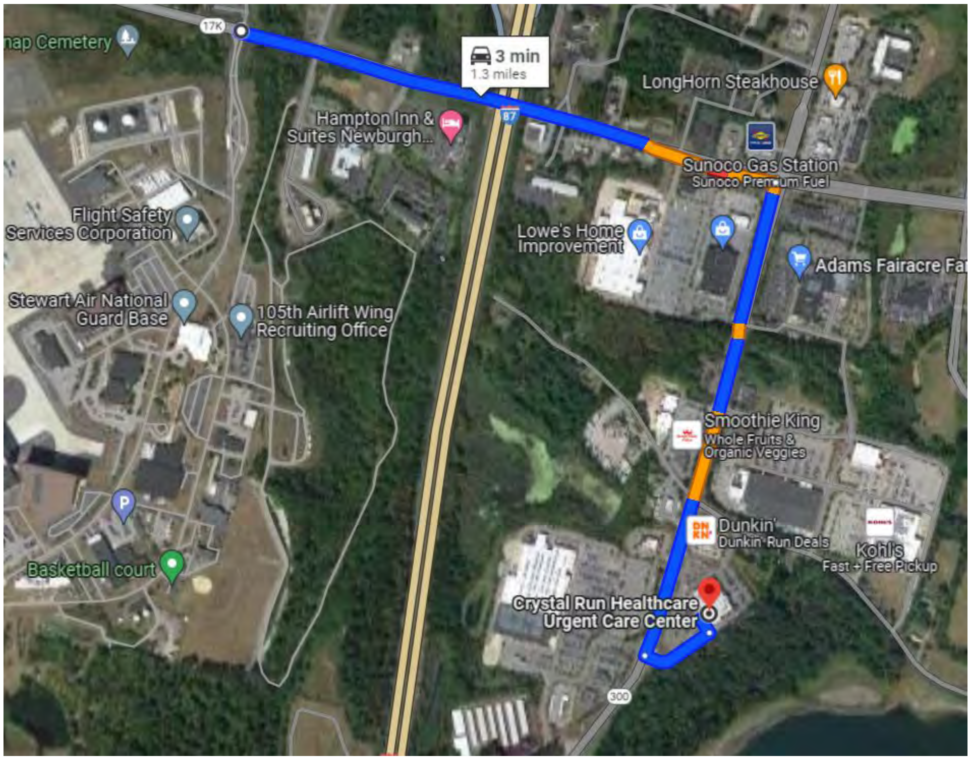
FIGURE 3

HOSPITAL MAP AND DIRECTIONS – Stewart Air National Guard Base

Route to Urgent Care Facility

From: **Stewart Air National Guard Base**

To: **Crystal Run Healthcare Urgent Care Center**
1200 NY-300 1st Floor, Newburgh, NY 12550
Phone: 845-787-0863
Mon to Sat 8am to 730pm; Sun 8am to 530pm



Depart from: **Stewart Air National Guard Base Vistors Center**

1.	Turn right and head east on NY-17K	0.6 mi.
2.	Turn right onto NY-300 S	0.6 mi.
3.	Destination will be on the left	

Arrive at: **Crystal Run Healthcare Urgent Care Center**
1200 NY-300 1st Floor, Newburgh, NY 12550

ATTACHMENT 1

EMERGENCY RESPONSE CONTACTS

EMERGENCY RESPONSE CONTACTS

EMERGENCY CONTACTS	
Emergency (fire, paramedic, security forces)	**911 –** Stewart ANGB Fire, Medical, and Security Forces will respond to 911.
National Response Center (Chemical and Oil Spills)	(800) 424-8802
Poison Control Center	(800) 222-1222
Agency for Toxic Substances and Disease Registry	(800) 232-4636
Oneida Team (PRIME CONTRACTOR) CONTACT	
SRS SSHO/FTL: Mark Wanek	Cell: (805) 705-8017 E-mail: mwanek@oescgroup.com
SRS SSHO Alternate: Kevin Engle	Cell: (720) 390-9747 E-mail: kengle@oescgroup.com
SRS Project Manager: Megan Duley	Cell: (651) 775-7870 E-mail: mduley@oescgroup.com
SRS SSHO/FTL Alternate: Richard Klamm	Cell: (210) 394-0744 E-mail: rklamm@oescgroup.com
SRS SSHO/FTL Alternate: Brandon Womack	Cell: (801) 200-4561 E-mail: bwomack@oescgroup.com
SRS SSHO/FTL Alternate: John Kelley	Cell: (925) 906-9698 E-mail: jckelley@oescgroup.com
OESC Corporate SHM: Bradley Kuntz, CIH, CSP, CHMM	Cell: (704) 907-5115 E-mail: bkuntz@oescgroup.com
OESC Incident Intervention Hotline: WorkCare For OESC employees to report injuries, receive treatment guidance and follow-up care from a medical professional.	(888) 449-7787
USACE PROJECT CONTACTS	
Jessica Faragalli (Senior Project Manager)	(916) 557-7620
AFCEC PROJECT CONTACTS	
Cynthia Cash (AF Program Manager)	(210) 367-1511
Bill Myer (Stewart ANGB RPM)	(240) 612-8473
Stewart ANGB	
Hospital Montefiore - St Luke's Cornwall: Emergency Room 70 Dubois St, Newburgh, NY 12550	(845) 568-2305 Open 24 Hours
Urgent Care Crystal Run Healthcare Urgent Care Center 1200 NY-300 1st Floor, Newburgh, NY 12550	(845) 787-0863 8am-730pm Monday to Saturday 8am to 530Pm Sunday

IF AN ACCIDENT HAPPENS

1. Assess the scene, keep yourself safe
2. Call for help
3. Assist with keeping the scene secure, help further if safe to do so
4. Notify Site Safety and Health Officer
5. Notify Site Supervisor
6. Follow Accident Reporting Procedures in Section 8 of the APP.

"ALL STOP" SCENARIOS INCLUDE

- SRS Safety Stand-down
- Earthquake
- Local Community Emergency
- Severe Storm
- Wind Conditions above safe levels, e.g., >25 mph

ATTACHMENT 2

EXPOSURE AND HEALTH EFFECTS OF CONTAMINANT OF CONCERNS

DDT, DDE, and DDD - ToxFAQs™

What are DDT, DDE, and DDD?

DDT (dichlorodiphenyltrichloroethane) is a man-made chemical that does not occur naturally in the environment. It is a white, crystalline solid with no odor or taste. DDE (dichlorodiphenyldichloroethylene) and DDD (dichlorodiphenyldichloroethane) are chemicals similar to DDT that can form when DDT breaks down.

DDT is a pesticide that was once widely used to control insects in agriculture and insects that carry diseases such as malaria. Its use was banned in 1972 because of damage to wildlife but is still used in a limited number of countries where diseases such as malaria are a major health problem. DDE has no commercial use. DDD was also used to kill pests, but its use has also been banned. One form of DDD has been used to treat cancer of the adrenal gland.

What happens to DDT, DDE, and DDD in the environment?

DDT can get into the environment when it is used as a pesticide. DDE and DDD form when DDT breaks down. These chemicals can evaporate into the air from water and moist soil and may then be carried to locations very far from the original source. They can be removed from the air by rain and snow or be broken down by sunlight. DDT, DDE, and DDD stick strongly to the soil and are not likely to move into the groundwater. Microorganisms in the soil slowly break down DDT (it can take anywhere from 2 to 15 years to break down half of the DDT). DDT does not dissolve easily in water and is mostly found in the sediment on the bottom of bodies of water. DDT, DDE, and DDD can build up in plants and animals.

How can I be exposed to DDT, DDE, and DDD?

Most people are not likely to be exposed to DDT, DDE, or DDD. The most common way to be exposed to small amounts of these chemicals is from eating contaminated food such as meat, fish, poultry, and dairy products. If you live near a hazardous waste site, you might be exposed to DDT, DDE, and DDD from contaminated air, dirt, or water.

Since DDT was banned in 1972, exposure to DDT, DDE, and DDD has decreased dramatically. Small amounts may still be found in some food.

How can DDT, DDE, and DDD affect my health?

People who accidentally swallowed large amounts of DDT had tremors, headaches, nausea, and seizures. These effects went away after the exposure stopped. No effects were seen in volunteers who took a small daily dose of DDT by capsule for 18 months. Studies have shown that women with high amounts of DDE in their blood were more likely to have a premature baby or a baby with a wheeze. Exposure to DDT may also increase chances of developing Type II diabetes mellitus in some groups of people.

Animal studies generally used higher amounts of DDT, DDE, and DDD than you would likely be exposed to in the United States. In studies where animals were fed DDT, DDE, or DDD, harmful effects were seen on their nervous system, liver, and reproductive system (including decreased fertility).

DDT, DDE, and DDD

Can DDT, DDE, and DDD cause cancer?

Studies have shown that people with higher levels of DDT in their blood have an increased risk of developing liver cancer. Liver cancer was also seen in animals that were fed DDT over a long period of time.

The U.S. Department of Health and Human Services (DHHS) has determined that DDT may reasonably be anticipated to be a human carcinogen (causing cancer in people).

The U.S. Environmental Protection Agency (EPA) has classified DDT, DDE, and DDD as probable human carcinogens.

The International Agency for Research on Cancer (IARC) determined DDT may possibly cause cancer in humans.

Can I get a medical test to check for DDT, DDE, and DDD?

Tests are available to measure levels of DDT, DDE, and DDD in the blood, hair, and breast milk.

These tests cannot predict whether you will have health problems from the exposure to DDT, DDE, and DDD. Doctor's offices do not routinely offer these tests.

How can I protect myself and my family from DDT, DDE, and DDD?

Most people don't need to take any special steps to avoid DDT, DDE, and DDD in their daily lives. Washing fruits and vegetable that come from foreign countries will remove most DDT if any is present. Children should avoid playing in dirt or water near hazardous waste sites to avoid coming in contact with these chemicals.

Follow health advisories that tell you about consumption of fish and wildlife caught in contaminated areas.

For more information:

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at https://wwwn.cdc.gov/dcs/ContactUs/Form

Go to ATSDR's Toxicological Profile for DDT, DDE, and DDD: https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=81&tid=20

Go to ATSDR's Toxic Substances Portal: https://wwwn.cdc.gov/TSP/index.aspx

Find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

Perfluoroalkyls - ToxFAQs™

What are perfluoroalkyls?

Perfluoroalkyls are a group of man-made chemicals that are not found naturally in the environment. Some chemicals that are in this group include: perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), and perfluorodecanoic acid (PFDA).

The two perfluoroalkyls made in the largest amounts in the United States were PFOA and PFOS. Perfluoroalkyls were used to protect products like carpet and fabric, and as a coating for paper and cardboard packaging. They can also be found in some firefighting foams.

Where are perfluoroalkyls found in the environment?

Perfluoroalkyls can be found in air, soil, and water as a result of manufacture and use. They do not break down in the environment very easily. Perfluoroalkyls can seep through the soil into groundwater.

How can I be exposed to perfluoroalkyls?

You may be exposed to perfluoroalkyls in the air; in indoor dust, food, and water; and in some home products. However, the main sources of exposure to perfluoroalkyls, such as PFOA and PFOS, are usually from eating food and drinking water that are contaminated with these chemicals. Because exposure is widespread, blood tests can find PFOA, PFOS, PFNA, and PFHxS in most people. However, in general, human blood levels of these chemicals are going down as exposures in the environment goes down.

Babies born to mothers exposed to PFAS can be exposed during pregnancy and while breastfeeding. However, nursing mothers should continue to breastfeed. Based on current science, the benefits of breastfeeding appear to outweigh the risks for infants exposed to PFAS in breast milk. To weigh the risks and benefits of breastfeeding, mothers should contact their doctors. Children can be exposed to perfluoroalkyls in carpet since they are closer to the ground and play on the floor.

Exposure to perfluoroalkyls is widespread. The main sources in the environment is contaminated food and water.

Workers in facilities that make or use perfluoroalkyls can be exposed to higher amounts of these chemicals and may have higher levels in their blood. Some communities near factories that made PFOA and PFOS were exposed to high levels of these substances in drinking water.

How can perfluoroalkyls affect my health?

A large number of studies have examined possible relationships between levels of perfluoroalkyls in blood and harmful health effects in people. However, not all of these studies involved the same groups of people, the same type of exposure, or the same perfluoroalkyls, resulting in a variety of observed health outcomes. Research in humans suggests that high levels of certain perfluoroalkyls **may** lead to:

- increased cholesterol levels (PFOA, PFOS, PFNA, PFDA);
- changes in liver enzymes (PFOA, PFOS, PFHxS)
- decreased vaccine response in children (PFOA, PFOS, PFHxS, PFDA);
- increased risk of high blood pressure or pre-eclampsia in pregnant women (PFOA, PFOS);
- small decreases in infant birth weights (<20 grams (0.7 ounces) decrease in birth weight per 1 ng/mL increase in PFOA or PFOS in blood).

Perfluoroalkyls

One way to learn about whether perfluoroalkyls will harm people is to do studies on lab animals. Most of these studies have tested doses of PFOA and PFOS that are higher than levels found in the environment. These animal studies have found that PFOA and PFOS can cause damage to the liver and the immune system. PFOA and PFOS have also caused birth defects, delayed development, and newborn deaths in lab animals.

Humans and animals react differently to perfluoroalkyls, and not all effects observed in animals may occur in humans. Scientists have ways to estimate how the exposure and effects in animals compare to what they would be in humans. What they learn from this process helps them decide how to protect people from chemical exposures.

Can perfluoroalkyls cause cancer?

Studies do not clearly show whether perfluoroalkyls cause cancer in people. People exposed to high levels may have increased risk of kidney cancer or testicular cancer. However, these studies are not consistent and may not have looked at other factors like smoking.

Studies in animals have shown that PFOA and PFOS can cause cancer in the liver, testes, pancreas, and thyroid. However, some scientists believe that humans may not develop the same cancers as animals.

The Environmental Protection Agency (EPA) has classified PFOA and PFOS as having suggestive evidence of carcinogenic potential in humans. The International Agency for Research on Cancer has classified PFOA as possibly carcinogenic (causing cancer) to humans, but it has not evaluated whether other perfluoroalkyls may also cause cancer. The Department of Health and Human Services has not yet evaluated whether PFOA and other perfluoroalkyls can cause cancer.

Can I get a medical test to check for perfluoroalkyls?

A blood test can measure perfluoroalkyls in your blood, but this is not a test routinely done in a doctor's office. If you have perfluoroalkyls in your blood, you have been exposed to these chemicals and absorbed them into your body at some time. Most people have some level of perfluoroalkyls in their blood. The blood test can't predict if you will have health problems from exposure to perfluoroalkyls.

How can I protect myself and my family from perfluoroalkyls?

If you do not know about perfluoroalkyls levels in your water, ask your local health department. Do not use consumer products that contain perfluoroalkyls. Drink or cook with bottled water or install activated carbon water filters if your tap or well water contains perfluoroalkyls.

For more information:

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at https://wwwn.cdc.gov/dcs/ContactUs/Form

Go to ATSDR's Toxicological Profile for perfluoroalkyls: https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=1117&tid=237

Go to ATSDR's Toxic Substances Portal: https://wwwn.cdc.gov/TSP/index.aspx

Find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

Vinyl Chloride - ToxFAQs™

What is vinyl chloride?

Vinyl chloride is a colorless gas with a mild, sweet odor. It burns easily and it is not stable at high temperatures. Vinyl chloride is a manufactured substance that does not occur naturally. It can be formed when other substances such as trichloroethane, trichloroethylene, and tetrachloroethylene are broken down.

Vinyl chloride is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and packaging materials.

What happens to vinyl chloride in the environment?

Liquid vinyl chloride evaporates easily. Vinyl chloride in water or soil evaporates rapidly if it is near the surface. Vinyl chloride in the air breaks down in a few days to other substances, some of which can be harmful. Small amounts of vinyl chloride can dissolve in water. Vinyl chloride is unlikely to build up in plants or animals that you might eat.

How can I be exposed to vinyl chloride?

You can be exposed by breathing vinyl chloride that has been released from plastic manufacturing facilities, hazardous waste sites, and landfills. You can also be exposed from cigarette and cigar smoke. You can be exposed to very low levels of vinyl chloride in drinking water.

Workers can be exposed by breathing vinyl chloride in air or during contact with skin or eyes in the workplace.

How can vinyl chloride affect my health?

Breathing high levels of vinyl chloride can cause you to feel dizzy or sleepy. Breathing very high levels can cause you to pass out, and breathing extremely high levels can cause death. Some people who have breathed vinyl chloride for several years have changes in the structure of their livers. People are more likely to develop these changes if they breathe high levels of vinyl chloride. Some people who work with vinyl chloride have nerve damage and develop alterations in immunity. The lowest levels that produce liver changes, nerve damage, and alterations in immunity in people are not known. Some workers exposed to very high levels of vinyl chloride have problems with the blood flow in their hands. Their fingers turn white and hurt when they go into the cold. Highly exposed workers have also developed a specific type of cancer known as angiosarcoma of the liver. The effects of drinking high levels of vinyl chloride are unknown. If you spill vinyl chloride on your skin, it will cause numbness, redness, and blisters.

The levels of vinyl chloride typically found in the environment are lower than levels known to cause health problems.

Animal studies have shown that exposure to vinyl chloride during pregnancy can affect the growth and development of the fetus.

Vinyl Chloride

Can vinyl chloride cause cancer?

The U.S. Department of Health and Human Services (DHHS) has classified vinyl chloride as known to be a human carcinogen (cause cancer).

The U.S. Environmental Protection Agency (EPA) has classified vinyl chloride as a known human carcinogen by the inhalation route of exposure. It has also classified it as carcinogenic by the oral route and likely to be carcinogenic by the dermal route.

The International Agency for Research on Cancer (IARC) determined that vinyl chloride is carcinogenic to humans.

Can I get a medical test to check for vinyl chloride?

The results of several tests can sometimes show if you have been exposed to vinyl chloride. Vinyl chloride can be measured in your breath, but the test must be done shortly after exposure. This is not helpful for measuring very low levels of vinyl chloride.

The amount of the major breakdown product of vinyl chloride, thiodiglycolic acid, in the urine may give some information about exposure. However, this test must be done shortly after exposure and may also indicate exposure to other chemicals in addition to or besides vinyl chloride.

How can I protect myself and my family from vinyl chloride?

Tobacco smoke contains low levels of vinyl chloride, so limiting your family's exposure to cigarette or cigar smoke may help reduce their exposure to vinyl chloride.

Workers using or making vinyl chloride should wear protective eye wear, clothing, gloves, and when needed, respiratory protection.

For more information:

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at https://wwwn.cdc.gov/dcs/ContactUs/Form

Go to ATSDR’s Toxicological Profile for Vinyl Chloride: https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=282&tid=51

Go to ATSDR’s Toxic Substances Portal: https://wwwn.cdc.gov/TSP/index.aspx

Find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

Silica - ToxFAQs™

What is silica?

Silica is found naturally in the environment. It is a compound made from silicon and oxygen and can come in different forms. All silica forms are made from the same chemicals but can have different structures. Silica is divided into two main groups, crystalline silica and amorphous silica (non-crystalline silica). The most common type of crystalline silica is quartz. Other types also exist, but they are less common.

Silica compounds are found throughout the environment in rocks, sand, clay, soil, air, and water. Silica is used in many commercial products, such as bricks, glass and ceramics, plaster, granite, concrete, cleansers, skin care products, and talcum powder. Some forms of amorphous silica are used as food additives, food wrappings, toothpaste and cosmetics.

How could I be exposed to silica?

The general population is exposed to silica through air, certain types of indoor dust (such as from concrete), food, water, soil, and some consumer products. The exposure of greatest concern is through air. However, most silica particles encountered by the general population in air are too big (non-respirable) to breathe into the lungs and cause problems.

Workers in certain industries are exposed to much higher levels of silica than the general population. For example, activities like blasting, cutting, drilling or grinding materials that contain silica can cause workers to breathe air containing *small particles* (respirable) of silica dust. This is a serious health concern for workers in occupations involving materials containing crystalline silica, such as construction, mining, sandblasting, and porcelain manufacturing. **Exposure of workers to crystalline silica is recognized as an important occupational (job) hazard.**

How can *crystalline* silica affect my health?

No known health effects are found from exposure to crystalline silica at the levels normally found in the environment.

Many studies in **workers** have looked into possible relationships between crystalline silica exposure and harmful health effects. These studies show that **workers breathing small crystalline silica particles for a long time (typically years) can develop silicosis, a serious lung disease.** Crystalline silica is the only compound that causes silicosis. Studies in workers have also documented that silica can cause **chronic obstructive pulmonary disease (COPD), lung cancer, kidney failure, autoimmune diseases, and increased susceptibility to tuberculosis**.

Health problems from crystalline or amorphous silica are extremely rare in the general public; health problems occur to *workers* breathing in silica dust.

How can *amorphous* silica affect my health?

There are no known health effects from exposure to amorphous silica at the levels found in the environment or in commercial products (food additives and wrapping, toothpaste and cosmetics).

A few reports suggest that amorphous silica can cause respiratory dieases (but no silicosis) in workers. Studies in lab animals suggest that although breathing amorphous can cause lung inflammation and injury, it is less hazardous than crystalline silica.

Silica

How can silica affect children?

It is unlikely that children in developed countries would have sufficient exposure to crystalline silica to be at risk for silica-related disease. If children were exposed to large amounts of small crystalline silica particles, as might occur during child labor in developing countries, they would likely be at risk for similar health effects as adults. If you think your child has had this type of exposure, talk to your child's doctor or nurse.

Can *crystalline* silica cause cancer?

Federal and international agencies have concluded that exposure to crystalline silica particles that are small enough to reach the lungs can cause lung cancer. The Department of Health and Human Services and the International Agency for Research on Cancer classify crystalline silica (respirable size) as a known human carcinogen (causes cancer).

These conclusions are based on studies in workers showing that **prolonged (long-term) inhalation of crystalline silica particles that are small enough to reach the lungs increase the risk for getting lung cancer. However, levels of these small particles are much higher than what is usually found in the general environment.**

Can *amorphous* silica cause cancer?

Studies of amorphous silica in workers and lab animals have not found cancer. Federal and international agencies have not made any conclusions on whether amorphous silica can cause cancer.

Can I get a medical test to check for silica exposure?

There are no medical tests to find out if you have been exposed to silica.

How can I protect myself and my family from silica?

Usual exposures of the general public to large particles of crystalline or amorphous silica are not known to cause any health effects in people without lung diseases like asthma. Therefore, **people don't need to take any special steps to avoid silica in their daily lives or avoid products containing silica. However, you should wear protective equipment (e.g. particle mask) if you engage in a hobby or activity that creates small dust particles by grinding or cutting materials that contain silica. Workers exposed to silica should avoid bringing dust home on their clothes.**

Workers who may be exposed for longer periods of time to respirable crystalline silica should talk to their supervisor or employer. The National Institute for Occupational Safety and Health (NIOSH) also has information: https://www.cdc.gov/niosh/topics/silica/.

For more information:

Call **CDC-INFO** at 1-800-232-4636, or submit your question online at https://wwwn.cdc.gov/dcs/ContactUs/Form

Go to ATSDR's Toxicological Profile for Silica: https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=1483&tid=290

Go to ATSDR's Toxic Substances Portal: http://www.atsdr.cdc.gov/substances/index.asp

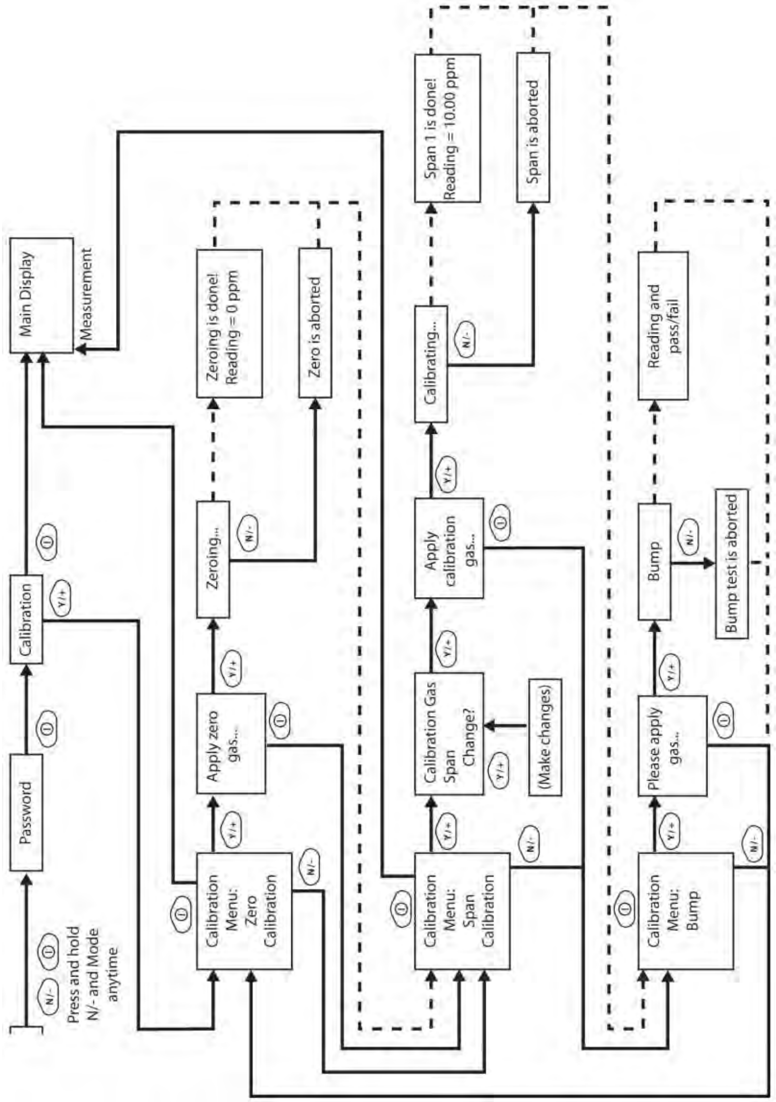
Find & contact your ATSDR Regional Representative at http://www.atsdr.cdc.gov/DRO/dro_org.html

ATTACHMENT 3

AIR MONITOR CALIBRATION PROCEDURES (MINIRAE 3000 PID)

Standard Two-Point Calibration (Zero & Span, Optional Bump)

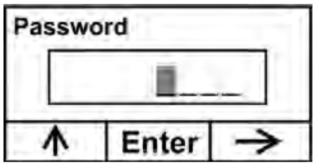
The following diagram shows the instrument's calibrations in Basic/Hygiene mode.



Note: Dashed line indicates automatic progression.

Entering Calibration

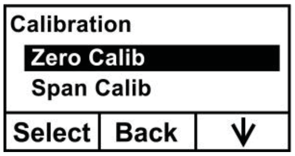
1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. In Basic User Level, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

   Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

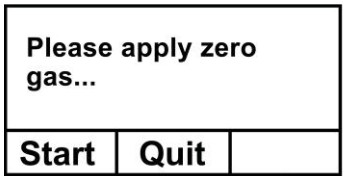
Zero (Fresh Air) Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a "fresh" air source such as from a cylinder or Tedlar bag (optional accessory). The "fresh" air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:



Please apply zero gas...

1. Turn on your Zero calibration gas.
2. Press [Y/+] to start calibration.

   Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts a 30-second countdown and displays this message:

   Zeroing...

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any action on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says "Zero aborted!" and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

Zeroing is done!
Reading = 0.0 ppm

The instrument will then show the Calibration menu on its display, with Span Calib highlighted.

Span Calibration

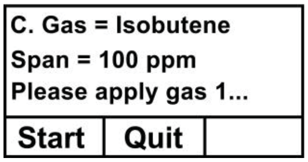
This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:



C. Gas = Isobutene
Span = 100 ppm
Please apply gas 1...

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you see a message similar to this (the value is an example only):

Span 1 is done!
Reading = 100.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Two-Point Calibration In Basic User Level

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display. You will see the following message:

Updating settings…

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

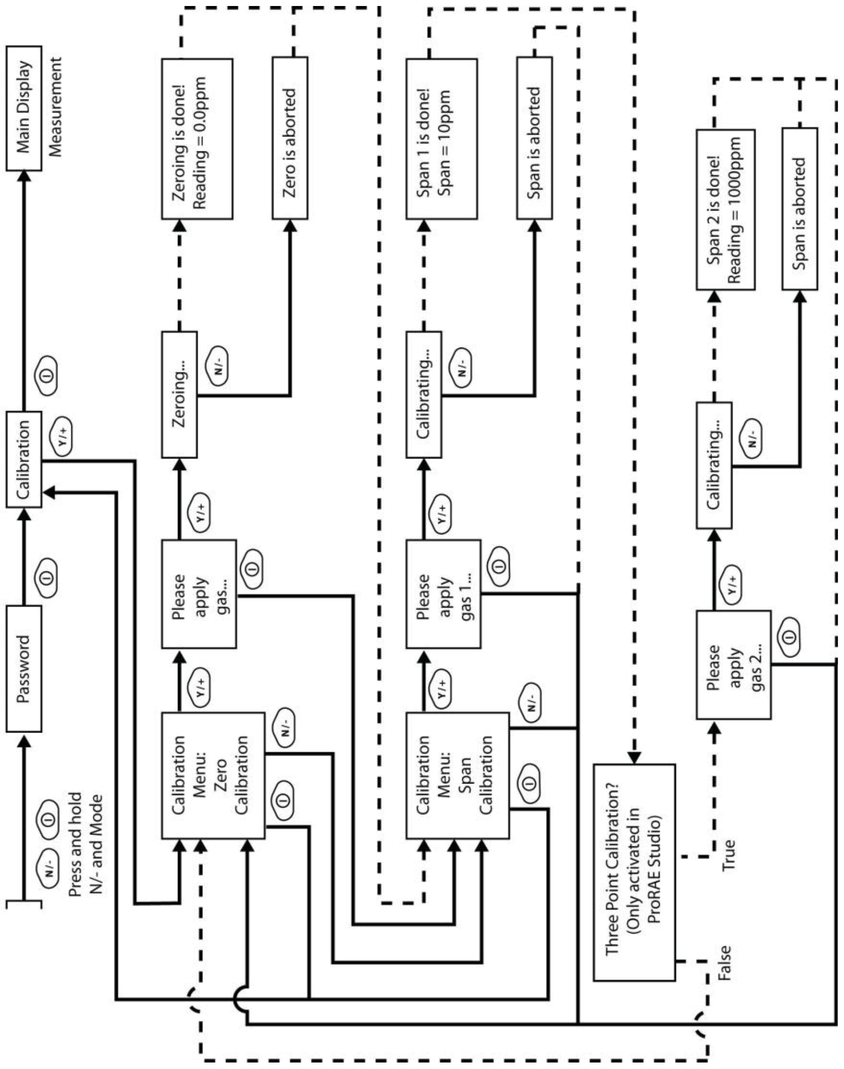
Three-Point Calibration

For enhanced accuracy, it is possible to perform a second Span calibration in addition to the Zero and Span calibrations outlined in the previous section. Your instrument first must be set to allow this third calibration. This requires using ProRAE Studio software and a PC, as well as a higher concentration of calibration gas.

Note: Once the third calibration is set, you do not need to use ProRAE Studio to allow future 3-point calibrations. Also, you can only disable 3-point calibration capability by using ProRAE Studio again.

Perform the Zero and Span calibrations. After the first Span calibration (Span 1) is completed, the display a second Span calibration (Span 2) can be performed. The process is identical to the first calibration. As in the Span 1 calibration, you may exit and return to the Zero calibration screen if you choose not to perform this calibration or to abort it.

Note: If a bump test is available, it appears after the last calibration in the menu. See "Two-Point Calibration," page 38, for details. Also, refer to page 53 for details on how to perform a bump test.



Note: Dashed line indicates automatic progression.

Span 2 Calibration

A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure.

Note: This gas should be of a higher concentration than the gas used for Span 1 calibration.

Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span 2 calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

Please apply gas...

4. Turn on your span calibration gas.
5. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu for Zero calibration.

6. Span calibration starts a 30-second countdown and displays this message:

Calibrating...

During the Span calibration process, the instrument performs the Span calibration automatically and does not require any action on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu will appear. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you will see a message similar to this (the value shown here is for example only):

Span 2 is done!
Reading = 1000 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Three-Point Calibration

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display. You will see the following message:

Updating settings…

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Bump Test

RAE Systems recommends that a bump test be conducted prior to each day's use. The purpose of a bump test is to ensure that the instrument's sensors respond to gas and all the alarms are enabled and functional.

- The MiniRAE 3000 must be calibrated if it does not pass a bump test when a new sensor is installed, after sensor maintenance has been performed, or at least once every 180 days, depending on use and sensor exposure to poisons and contaminants.
- Calibration and bump test intervals and procedures may vary due to national legislation and company policy.

To perform a bump test (functional challenge), follow these steps:

1. Select "Bump."
2. Install the calibration adapter and connect it to a source of calibration gas.
3. Verify that the displayed calibration value meets the concentration specified on the gas cylinder.
4. Start the flow of calibration gas.
5. Press [Y/+] to start the bump test.
6. You can abort the calibration at any time during the countdown by pressing [N/-].

7. If the calibration is not aborted, the display shows reading and then tells you whether the bump test passed or failed. If the bump test failed, then it automatically advances to the Calibration screen.

Important!

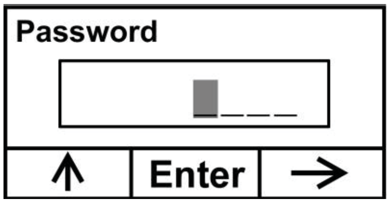
Anytime a bump test fails, you should perform a full calibration of the instrument.

Programming Mode

Programming Mode can be entered from either Hygiene Mode or Search Mode. If the current user mode is Basic, you must provide a 4-digit password to enter.

Entering Programming Mode

1. Press and hold [MODE] and [N/-] until you see the Password screen.



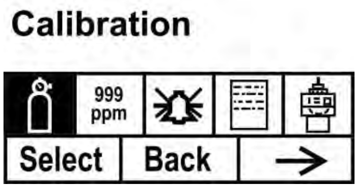
2. Input the 4-digit password:

- Increase the number from 0 through 9 by pressing [Y/+].
- Step from digit to digit using [N/-].
- Press [MODE] when you are done.

If you make a mistake, you can cycle through the digits by pressing [N/-] and then using [Y/+] to change the number in each position.

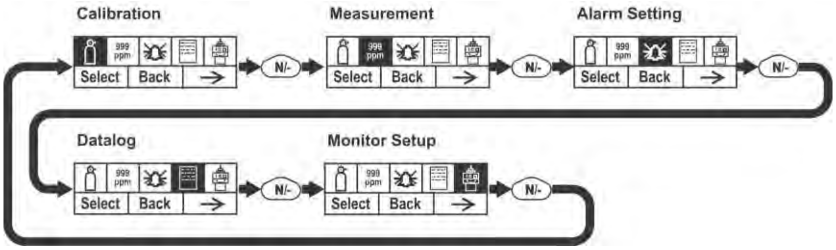
Note: The default password is 0000.

When you have successfully entered Programming Mode, you see this screen:



Note: The password can only be changed by connecting the instrument to a PC running ProRAE Studio software. Follow the instructions in ProRAE Studio to change it.

The Calibration label is shown and its icon is highlighted, but you can press [N/-] to step from one programming menu to the next, with the name of the menu shown at the top of the display and the corresponding icon highlighted. As you repeatedly press [N/-], the selection moves from left to right, and you see these screens:



Note: When you reach Monitor Setup and press [N/-], the menu cycles back to Calibration.

Programming Mode Menus

The Programming Mode allows anyone with the password to change the instrument's settings, calibrate the instrument, modify the sensor configuration, enter user information, etc. Programming Mode has five menus. Each menu includes several sub-menus to perform additional programming functions.

This table shows the menus and sub-menus:

	999 ppm			
Calibration	**Measurement**	**Alarm Setting**	**Datalog**	**Monitor Setup**
Zero Calibration	Meas. Gas	High Alarm	Clear Datalog	Radio Power
Span Calibration	Meas. Unit	Low Alarm	Interval	Op Mode
Bump		STEL Alarm	Data Selection	Site ID
		TWA Alarm	Datalog Type	User ID
		Alarm Mode		User Mode
		Buzzer & Light		Date
				Time
				Pump Duty Cycle
				Pump Speed
				Temperature Unit
				Language
				Real Time Protocol
				Power On Zero
				Unit ID
				LCD Contrast
				Lamp ID
				PAN ID
				Mesh Channel
				Mesh Interval

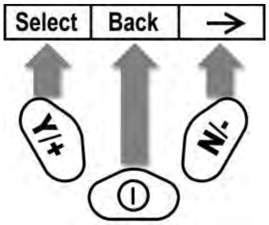
Once you enter Programming Mode, the LCD displays the first menu, Calibration. Each subsequent menu is accessed by pressing [N/-] repeatedly until the desired menu is displayed. To enter a sub-menu of a menu, press [Y/+].

Exiting Programming Mode

To exit Programming Mode and return to normal operation, press [MODE] once at any of the programming menu displays. You will see "Updating Settings…" as changes are registered and the mode changes.

Navigating Programming Mode Menus

Navigating through the Programming Mode menus is easy and consistent, using a single interface format of "Select," "Back" and "Next" at the top level. The three control buttons correspond to these choices as shown:



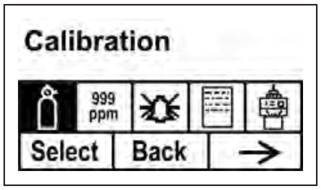
Note: Pressing [MODE] in the Programming Mode's top level causes the instrument to exit Programming Mode and return to monitoring.

The three keys perform the following functions in Programming Mode:

Key	Function in Programming Mode
[MODE]:	Exit menu when pressed momentarily or exit data entry mode
[Y/+]:	Increase alphanumerical value for data entry or confirm (yes) for a question
[N/-]:	Provides a "no" response to a question

Calibration

Two types of calibration are available: Zero (fresh air) and Span.



Select Zero or Span Calibration by pressing [N/+]. Once your choice is highlighted, press [Y/+].

Zero Calibration

The procedure for performing a zero calibration is covered on page 41.

Span Calibration

The procedure for performing a basic span calibration is covered on page 41.

Bump

The procedure for performing a bump calibration is covered on page 53.

A bump test can be performed either manually or using the AutoRAE 2 Automatic Test and Calibration System. When a bump test is done manually, the instrument makes a pass/fail decision based on sensor performance, but the user still has the responsibility to make sure all the alarms are enabled and functional.

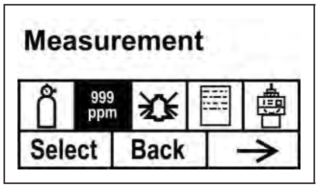
Note: Bump testing and calibration can be performed using an AutoRAE 2 Automatic Test & Calibration System. An AutoRAE 2 bump test takes care of both the sensor and alarm tests. Consult the AutoRAE 2 User's guide for details.

IMPORTANT!

If the instrument does not pass a bump test, perform a full calibration. If calibration also fails, the PID sensor or lamp may require cleaning or replacement. If the instrument repeatedly fails to calibrate, turn it off and refer it for servicing.

Measurement

The sub-menus for Measurement are Measurement Gas and Measurement Unit.



Meas. Gas

Measurement gases are organized in four lists:

- My List is a customized list of gases that you create. It contains a maximum of 10 gases and can only be built in ProRAE Studio on a PC and transferred to the instrument. **Note:** The first gas in the list is always isobutylene (it cannot be removed from the list).
- Last Ten is a list of the last ten gases used by your instrument. The list is built automatically and is only updated if the gas selected from Custom Gases or Library is not already in the Last Ten. This ensures that there is no repetition.
- Gas Library is a library that consists of all the gases found in RAE Systems' Technical Note TN-106 (available online at www.raesystems.com).
- Custom Gases are gases with user-modified parameters. Using ProRAE Studio, all parameters defining a gas can be modified,

Attachment D

Responses to Regulatory Comments

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Response to Comments Matrix
Draft Final Stewart ANGB QAPP Addendum
PFAS Fingerprinting and Background Study

Comment Number	Reviewer (agency/initials)	Line	Section	Page (pdf)	Comment	AF Response[1]	Reviewer Response[1]
NYSDEC Comments							
1	NYSDEC /Justin Starr	131-132	Introduction		This section describes the final project deliverable as a combined fingerprinting and background study report for the Stewart ANGB site, but there is no discussion on timing of potential regulatory review. Please clarify whether there will be a draft-final version made available to regulatory agencies for review and comment prior to report finalization.	Concur, explanation. A Draft Final copy of the PFAS Fingerprinting and Background Study Report will be provided for regulatory review.	Reviewer concurrence provided 10/09/24.
2	NYSDEC /Justin Starr	--	Worksheet #6 Communications Pathways		This section describes the various organizations and points-of-contact that need to be informed under different scenarios (e.g., stop work issues, daily field reports). In the event of a significant incident, DEC and NYSDOH should be informed as well. Please revise as appropriate.	Concur. Worksheet #6 was revised to include NYSDEC.	Reviewer concurrence provided 10/09/24.
3	NYSDEC /Justin Starr	--	Worksheet #10.2 Expanded Conceptual Site Model and Site Profiles, Section 10.4		In describing the surface water in the vicinity of Stewart ANGB, this section states, "surface water at the base consists of Recreation Pond". This omits a separate surface water pathway that exists along the eastern boundary of the base. Stormwater along this boundary discharge into a receiving stream known as "Murphy's Gulch." This stream continues under Interstate 87 into wetlands that discharge to Patton Brook and eventually Quassaick Creek. Please revise accordingly.	Concur. Section 10.4 was revised as follows: Surface water in the vicinity of Stewart ANGB generally flows in the direction of Lake Washington, located 0.5 miles southeast of the base. Surface water at the base includes Recreation Pond, located just south of the base's southern border. Recreation Pond is the catchment for Stewart ANGB stormwater outfall discharges; Recreation pond discharges to Silver Stream, which flows into Lake Washington. Surface water along the eastern boundary of Stewart ANGB flows into a ditch known as Murphy's Gulch, which flows east under Interstate 87 to wetlands that discharge to Patton Brook and eventually into Quassaick Creek.	Reviewer concurrence provided 10/09/24.
4	NYSDEC /Justin Starr	--	Worksheet #17 Sampling Design and Rationale, second paragraph		This section describes the collection of a sample of AFFF currently stored at Stewart ANGB to support machine learning analysis involved in the PFAS fingerprinting method. However, there is no discussion on how precisely this would help particularly since multiple formulations of AFFF have been used at Stewart ANGB, and the chemistry of current stores may not reflect the chemistry of historical AFFF that caused PFAS contamination observed in on-site soils and water. Please provide additional clarification and revise accordingly.	Explanation. We acknowledge that the current formulation of AFFF stored at Stewart ANGB likely does not match historic formulations used at the installation. However, this is still a potentially useful data point that provides a marker of a known AFFF formulation. We understand that the PFAS contamination at the ANGB is from legacy contamination and the current AFFF stock pile might not represent the legacy contamination. However, for instances where there are mixed sources of new and legacy AFFF, we will be able to differentiate the new AFFF from the base compared to other non-Base AFFF contaminations.	Reviewer concurrence provided 10/09/24.
5	NYSDEC /Justin Starr	--	Worksheet #17 Sampling Design and Rationale, Section 17.1 Groundwater		This section describes collection of total organic carbon and total metals at half of the groundwater sampling locations. Please elaborate on why these samples would assist the overall analysis, and why they are only needed at half of the sampling locations.	Explanation. This is a preliminary study with limited scope. Hence, TOC and total metals data is collected only for select samples. The data collected will be evalutated to determine if it will help clarify other PFAS sources or transport processes, as TOC and total metals concentrations may provide evidence of source area migration and can potentially be used as an additional line of evidence in source area discrimination. For example, thge presence of high concentrations of chromium in the samples in addition to PFOS/ 6:2 FTS potentially indicates a metal plating source, and the presence of high TOC in samples may provide information about the retardation of longer chain PFAS due to partitioning and help understand/evaluate the sources of any high detections of PFAS in downgradient samples potentially caused by other PFAS sources.	Reviewer concurrence provided 10/09/24.
6	NYSDEC /Justin Starr	--	Worksheet #18 Sampling Locations and Methods, Table 18.2a Groundwater Sample Rationale		The programmatic UFP QAPP Worksheet #11 Project/Data Quality Objectives, Step 2, states each installation team is to "evaluate potential AFFF- and non-AFFF PFAS sources on-installation as well as those nearby ." A former fire training area / rifle range exists upgradient and nearby to Stewart ANGB. This area, currently known as the former Demolition & Burning Facility (DBF), was used by Stewart Air Force Base, and by later entities, until sometime between 1978-1980 when its utilization was reportedly ceased. In 2016, NYSDOT contractor HDR Inc. conducted groundwater sampling for PFAS with results indicating higher PFOA concentrations relative to PFOS. This ratio contrasts with other samples collected at both the airport and the base, which generally show higher concentrations of PFOS relative to PFOA. Since there is a potential AFFF source area (with a notably different chemical signature from other known source areas) located upgradient and near Stewart ANGB, thus meeting the criteria stated in programmatic UFP QAPP Worksheet #11, DEC requests selected monitoring wells in the DBF be included as part of this Work Plan, with Table 18.2a and associated figures revised accordingly. HDR Inc. 2016 Sampling Results: https://extapps.dec.ny.gov/data/DecDocs/336088/Report.HW.336088.2016-10-14.Stewart%20Airport%20Sampling%20Letter%20Report.pdf	Concur, explanation. We agree there is value in collecting a groundwater sample from the DBF area. Property access coordination with NYSDOT is underway and a groundwater sample will be collected if property access can be secured ahead of the planned fieldwork start date. The UFP-QAPP Addendum has been revised throughout to add detail regarding the DBF and potential groundwater sample.	Reviewer concurrence provided 10/09/24.

Response to Comments Matrix
Draft Final Stewart ANGB QAPP Addendum
PFAS Fingerprinting and Background Study

Comment Number	Reviewer (agency/initials)	Line	Section	Page (pdf)	Comment	AF Response[1]	Reviewer Response[1]
NYSDEC Comments							
7	NYSDEC /Justin Starr	--	Worksheet #29 Project Documents and Record		This section defers discussion of project documents and reports to the programmatic UFP-QAPP thereby omitting site-specific discussion of electronic data deliverable submittals to each site's respective regulatory agencies. Please confirm whether DEC- formatted EDDs (preferred) or ERPIMS export files containing this data can be provided to DEC for Stewart ANGB. If yes, please revise this section accordingly.	Concur. An export file will be provided with submittal of the Draft Final PFAS Background and Fingerprinting Study Report.	Reviewer concurrence provided 10/09/24.
8	NYSDEC /Justin Starr	--	Appendix F		While the high-level overview of the PFAS Signature® Advanced Analytics tool described in this appendix and programmatic UFP-QAPP Worksheet #14, section 14.6, clarifies the tools capabilities, it lacks the information necessary to inform the reviewer on how precisely the output is generated. The scarcity of information is exacerbated by the heavily redacted Battelle PFAS Standard Operating Procedure (SOP) document, provided as part of the Work Plan, which provides very little useful information due to the redaction. Please ensure the final report will describe, in detail, the step-by-step process to show how the tool reached its conclusions with emphasis on which supervised machine learning techniques, additional lines of evidence, and site-specific information was utilized and how they factored into the output. Furthermore, given the novel use of the PFAS Signature® Advanced Analytics tool within DEC remedial programs and our own unfamiliarity with this tool, DEC requests a conference call with a Battelle technical representative to discuss, in general, how the tool works so that we may better understand the results.	Concur. A meeting to present Battelle's PFAS Signature SOP was provided on 19 August 2024.	Reviewer concurrence provided 10/09/24.