Final

Site Inspection
Uniform Federal Policy Quality Assurance Project Plan Addendum
Army Aviation Support Facility #2
Rochester, New York

Per- and Polyfluoroalkyl Substances Impacted Sites
ARNG Installations, Nationwide

Prepared for

Army National Guard Headquarters
111 S. George Mason Drive Arlington, VA 22204
Contract No. W912DR-19-D-0005

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UNCLASSIFIED

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
<	Less than
>	Greater than
%	Percent
AASF	Army Aviation Support Facility
AECOM	AECOM Technical Services, Inc.
AFFF	Aqueous film forming foam
amsl	Above mean sea level
amu	Atomic mass unit(s)
AOI	Area of Interest
APP	Accident Prevention Plan
ARNG	Army National Guard
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Materials
B.A.	Bachelor of Arts
bgs	Below ground surface
B.S.	Bachelor of Science
C	Carbon
CA	Corrective Action
CAS	Chemical Abstracts Service
CCB	Continuing calibration blank
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CMQ/OE	Manager of Quality/ Organizational Excellence
CoC	Chain of custody
CPR	Cardiopulmonary Resuscitation
CQCS	Contractor Quality Control Supervisor
CSM	Conceptual site model
CSP	Certified Safety Professional
DL	Detection Limit
DO	Dissolved Oxygen
DoD	Department of Defense
DPT	Direct-Push Technology
DQI	Data Quality Indicator

DQO	Data Quality Objectives
DUA	Data Usability Assessment
EA	EA Engineering, P.C. and its affiliate EA Science and Technology
EDR™	Environmental Data Resources Inc.™
ELAP	Environmental Laboratory Accreditation Program
EMS	Emergency Medical Services
FB	Field blank
ft	Foot (feet)
gal	Gallon(s)
GC	Gas chromatography
GC/MS	Gas chromatography/mass spectrometry
GIS	Geographic information system
GPS	Global Positioning System
GRO	Gasoline range organics
HA	Health Advisory
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	High-density polyethylene
HEF	High Expansion Foam
HPLC	High-performance liquid chromatography
HQ	Hazard quotient
HTRW	Hazardous, toxic, and radioactive waste
ICAL	Initial calibration
ICB	Initial calibration blank
ICP	Inductively coupled plasma
ICV	Initial calibration verification
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation-derived waste
IS	Internal standards
ISC	Instrument Sensitivity Check
ISO	International Organization for Standardization
LC/MS/MS	Liquid Chromatography Tandem Mass Spectrometry
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LFB	Laboratory fortified blank
LFBD	Laboratory fortified blank duplicate
LFSM	Laboratory fortified sample matrix
LFSMD	Laboratory fortified sample matrix duplicate
LOD	Limit of Detection
LOQ	Limit of quantification
LRB	Laboratory reagent blank

MDL	Method detection limit
mg	Milligram(s)
mg/kg	Milligram(s) per kilogram
mL	Milliliter(s)
MMRP	Military Munitions Response Program
MPC	Measurement performance criteria
M.S.	Master of Science
MS	Matrix spike
MSD	Matrix spike duplicate
NA	Not applicable
ND	Non-detect
NELAP	National Environmental Laboratory Accreditation Program
ng/L	Nanogram(s) per liter
No.	Number
NYARNG	New York Army National Guard
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PCB	Polychlorinated biphenyl
PE	Professional Engineer
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutanesulfonic acid
PFC	Perfluorinated compound
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PG	Professional Geologist
PhD	Doctor of Philosophy
PID	Photoionization detector
PM	Project Manager
PMP	Project Management Professional
POC	Point-of-Contact
PPE	Personal protective equipment
ppm RMS	millimeters per 1,000 meters root mean square
ppt	Part(s) per trillion
PQAPP	Programmatic UFP-QAPP
PVC	Polyvinyl chloride
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
QSM	Quality Systems Manual
RF	Response Factor

RI	Remedial Investigation
RPD	Relative percent difference
RPM	Remedial Project Manager
RSD	Relative standard deviation
RSL	Regional Screening Level
SI	Site Inspection
SL	Screening level
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
su	Standard unit(s)
SVOC	Semivolatile organic compound
TBD	To be determined
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time Critical Removal Action
TO	Task Order
TOC	Total organic carbon
TPP	Technical Project Planning
UCMR3	Unregulated Contaminant Monitoring Rule 3
UFP	Uniform Federal Policy
URL	Uniform Resource Locator
U.S.	United States
USACE	U.S. Army of Corps of Engineers
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	Volatile organic compound

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INTRODUCTION

1.1 PROJECT AUTHORIZATION

This is the Army National Guard (ARNG) Installation-Specific Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) addendum to the Site Inspection (SI) Programmatic UFP-QAPP (PQAPP) (EA 2020). This UFP-QAPP Addendum addresses SI activities to be completed at the Rochester Army Aviation Support Facility (AASF) #2 Rochester, New York.

The ARNG is the lead agency in performing *Preliminary Assessments (PAs) and SIs for Per- and Polyfluoroalkyl Substances (PFAS) Impacted Sites at ARNG Facilities Nationwide*. This work is supported by the U.S. Army Corps of Engineers (USACE) Baltimore District and their contractor EA Engineering, P.C. and its affiliate EA Science and Technology (EA)[1] under Contract Number (No.) W912DR-19-D-0005, Task Order (TO) No. W912DR20F0383. Programmatically, the ARNG is assessing the potential environmental impacts primarily from aqueous film forming foam (AFFF) and similar chemical releases suspected at their properties related to processes that used PFAS (e.g., fire training, firefighting, and metal plating).

The SI project elements will be performed by EA in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; US Environmental Protection Agency [USEPA], 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations [CFR] Part 300; USEPA, 1994), and in compliance with the U.S. Department of the Army (DA) requirements and guidance for field investigations, including specific requirements for sampling for perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorobutanesulfonic acid (PFBS), and the group of related compounds known in the industry as PFAS. The term PFAS will be used throughout this plan to encompass all PFAS chemicals being evaluated, including PFOS, PFOA, and PFBS, which are the key components of the suspected releases being evaluated, and the other PFAS related compounds listed in the TO. This UFP-QAPP Addendum focuses on the SI phase of work specific to the Rochester AASF #2 (also referred to as the “site” or “facility”).

1.2 SI PURPOSE

The main purpose of this SI effort is to identify whether there has been a release to the environment from the Areas of Interest (AOIs) identified in the PA (AECOM Technical Services, Inc. [AECOM] 2020) and determine the presence or absence of PFOA, PFOS, and PFBS at or above the 2019 Office of the Secretary of Defense (OSD) screening levels (SLs) (Deputy Assistant Secretary of Defense, 2019). AOIs may also be screened against the USEPA Lifetime Health Advisory (HA) where groundwater is used as a proxy for drinking water.

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

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[1] EA Engineering, P.C. is affiliated with EA Engineering, Science, and Technology, Inc., PBC who does business as EA Science and Technology in State of New York.

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

2) Determine the potential need for a removal action (i.e., Time Critical Removal Action [TCRA]; applies to drinking water only).

3) Collect or develop data to evaluate the release.

4) Collect additional data to develop the conceptual site model (CSM) in preparation for an effective Remedial Investigation (RI).

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

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

1.3 QAPP ADDENDUM ORGANIZATION

Elements of every ARNG PFAS SI are addressed in the SI PQAPP (EA, 2020). The PQAPP is comprehensive and is consistent with the USEPA's intent that the UFP-QAPP be the primary planning document for an entire project (Intergovernmental Data Quality Task Force [IDQTF], 2005a-c). This UFP-QAPP Addendum, in combination with the PQAPP elements, meets the requirements set forth in the UFP for QAPPs (IDQTF, 2005a-c) and *USEPA Requirements for Quality Assurance Project Plans* (USEPA, 2001).

This UFP-QAPP Addendum was prepared to include the detailed information specific to the SI at the Rochester AASF #2. For ease of review, material from the PQAPP is included in this deliverable alongside the Rochester AASF #2-specific worksheets. **Table 1-1** below describes the components that are covered under the PQAPP, and those that are covered under this UFP-QAPP Addendum:

Table 1-1: Comparison of PQAPP to UFP-QAPP Addendum

QAPP Addendum Worksheets	Applicable Document
Worksheets #1 and #2 - Title and Approval Page and QAPP Identifying Information	Programmatic/Site-Specific
Worksheets #3 and #5 - Project Organization and QAPP Distribution	Programmatic/Site-Specific
Worksheets #4, #7, #8 - Personnel Qualifications and Sign-off Sheet	Programmatic/Site-Specific
Worksheet #6 - Communication Pathways	Programmatic/Site Specific
Worksheet #9 - Project Planning Session Summary	Site-Specific
Worksheet #10 - Conceptual Site Model	Site-Specific

QAPP Addendum Worksheets	Applicable Document
Worksheet #11 - Project/ Data Quality Objectives	Site-Specific
Worksheet #12 - Measurement Performance Criteria	Programmatic
Worksheet #13 - Secondary Data Uses and Limitations	Programmatic
Worksheets #14 and #16 - Project Tasks and Schedule	Site-Specific
Worksheet #15 - Screening Limits and Laboratory- Specific Detection/ Quantitation Limits	Programmatic
Worksheet #17 - Sampling Design and Rationale	Site-Specific
Worksheet #18 - Sampling Locations and Methods	Site-Specific
Worksheets #19 and #30 - Sample Containers, Preservation and Hold Times	Programmatic
Worksheet #20 - Field Quality Control Summary	Programmatic/Site-Specific
Worksheet #21 - Field Standard Operating Procedures	Programmatic
Worksheet #22 - Field Equipment Calibration, Maintenance, Testing and Inspection	Programmatic
Worksheet #23 - Analytical Standard Operating Procedures	Programmatic
Worksheet #24 - Analytical Instrument Calibration	Programmatic
Worksheet #25 - Analytical Instrument and Equipment Maintenance, Testing and Inspection	Programmatic
Worksheets #26 and #27 - Sample Handling, Custody and Disposal	Programmatic
Worksheet #28 - Analytical Quality Control and Corrective Actions	Programmatic
Worksheet #29 - Project Documents and Records	Programmatic
Worksheets #31, #32 and #33 - Assessments and Corrective Action	Programmatic
Worksheet #34 - Data Verification and Validation Input	Programmatic
Worksheet #35 - Data Verification Procedures	Programmatic
Worksheet #36 - Data Validation Procedures	Programmatic
Worksheet #37 - Data Usability Assessment	Programmatic

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QAPP Worksheets #1 and 2: Title and Approval Page

Site Name/Project Name: Rochester Army Aviation Support Facility #2 / Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites, Army National Guard Sites, Nationwide

Site Location: Rochester, New York

Contractor Name: EA Engineering, P.C. and its affiliate EA Science and Technology (EA)

Contract Number: W912DR-19-D-0005

Work Assignment Number: Task Order W912DR20F0383

Project Lead: Army National Guard

Preparation Date: October 2021

Approval Signatures:
Investigative Organization Signature/Date: Michael O'Neill
Printed Name/Title: Michael O'Neill / EA Project Manager

Investigative Organization Quality Manager Signature/Date:
Printed Name/Title: Frank Barranco / EA Director of Quality Control

Army National Guard Program Lead Signature/Date: CONNOLLY.DAVID.M.1292853633 Digitally signed by CONNOLLY.DAVID.M.1292853633 Date: 2021.10.07 09:50:36 -04'00'
Printed Name/Title: David Connolly / ARNG Program Manager

Contracting Organization Project Manager Signature/Date: PECK.TIMOTHY.JOSEPH.1252325553 Digitally signed by PECK.TIMOTHY.JOSEPH.1252325553 Date: 2021.10.07 09:43:52 -04'00'
Printed Name/Title: Tim Peck / USACE Baltimore District Project Manager

New York Army National Guard Signature/Date: FREEHART.JAMES.PATRICK.1020134450 Digitally signed by FREEHART.JAMES.PATRICK.1020134450 Date: 2021.10.07 14:11:34 -04'00'
Printed Name/Title: James Freehart / Environmental Branch Chief

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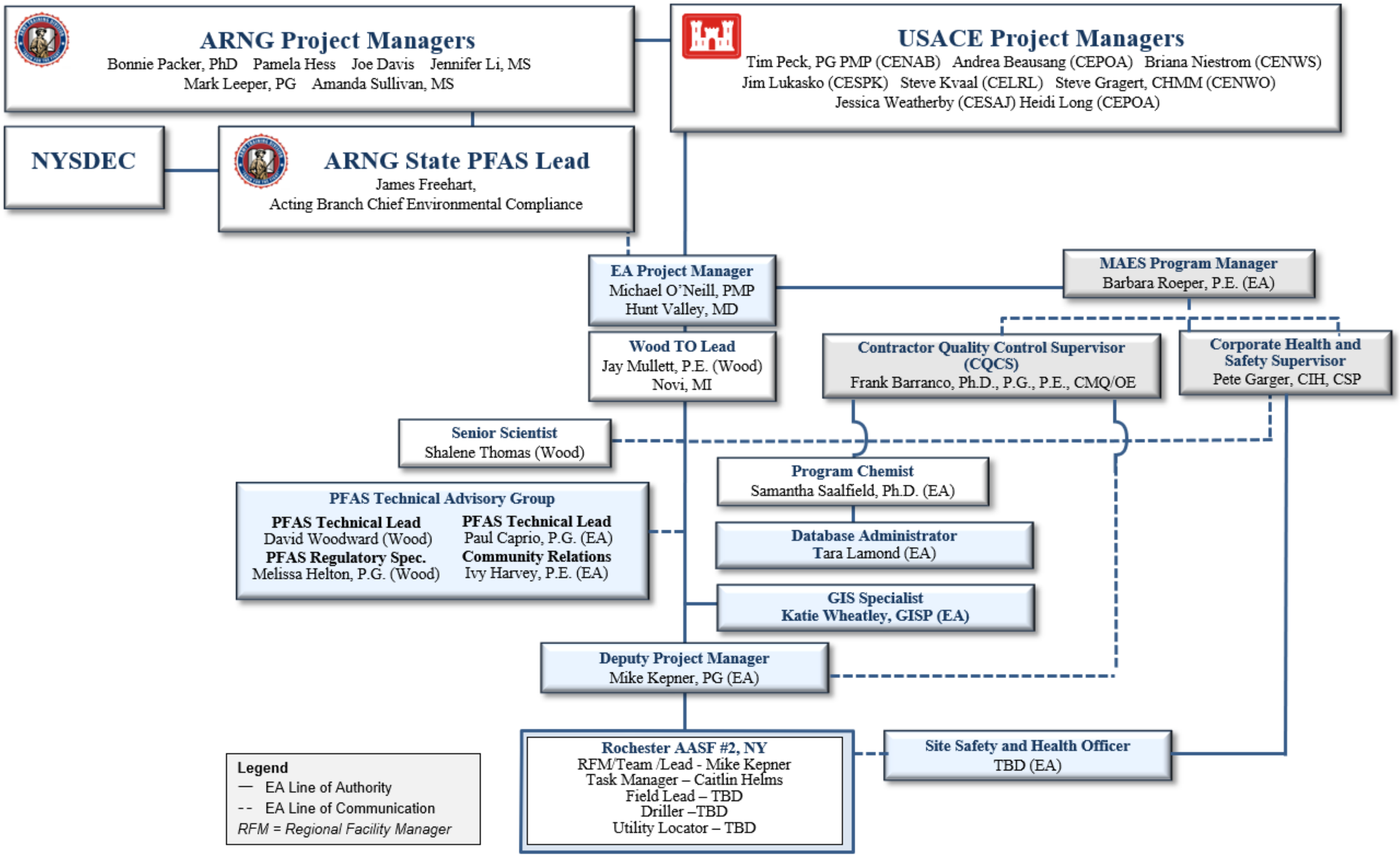
QAPP Worksheets #3 and 5: Project Organization and Quality Assurance Project Plan Distribution

Figure 3-1: Project Organizational Chart



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

This worksheet contains a list of the key project personnel who are identified as performing the tasks that are defined in this QAPP Addendum for the Rochester AASF #2 and includes the personnel's organization, project role, education/experience, and specialized training/certifications. The personnel have signed and dated the worksheet to signify that they agree with the information in this QAPP Addendum and agree to implement it.

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature
Organization: EA				
Barbara Roeper	EA Program Manager	Master of Science (M.S.)/ Environmental Engineering; Bachelor of Science (B.S.)/ Chemical Engineering; 30+ years of experience; Experienced Program Manager for multi-task programs, including firm-fixed-price and performance-based contracting tasks; Experienced managing project execution, construction oversight projects, field studies, cost estimation, site safety management, quality management, subcontractor management, and regulatory negotiations	Professional Engineer (PE), Project Management Professional (PMP)	Signature available upon request.
Michael O'Neill	Project Manager	B.S./Engineering Sciences; 22+ years of project management experience and has overseen work on 100+ DoD installations. Managed more than 40 Military Munitions Response Program (MMRP), Hazardous, Toxic, and Radioactive Waste (HTRW), and remediation TOs; 25+years of experience supporting USACE Baltimore	PMP (EA)/PM	Signature available upon request.
Michael Kepner	Deputy Project Manager	B.S. Geoenvironmental Studies; 16 years of experience in environmental consulting and project management, including planning, field supervision and logistics, data analysis and reporting, and regulatory/stakeholder involvement and coordination at multiple ARNG installations.	Professional Geologist (PG)	Signature available upon request.

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature
Frank Barranco	EA Contractor Quality Control Supervisor (CQCS)	B.S. Geology, Doctor of Philosophy (PhD) Environmental Science and Engineering; 24 years of experience in environmental site investigation, providing technical and quality direction on contaminated groundwater/soil/ sediment projects. 11 years as Corporate QC Officer for $600 million of federal contracts, including remediation activities at HTRW and emerging contaminants (PFAS) sites. Directed quality program for implementation of remedial cleanup technologies including water treatment, excavation, in situ chemical oxidation, capping, slurry walls, in situ chemical and biological reduction, enhanced aerobic and anaerobic bioremediation, bioventing, biosparging, vacuum-enhanced recovery, multiphase extraction, surfactant-enhanced aquifer remediation, and in situ and ex situ thermal treatment. 2,000+ hours of training in quality management, HTRW and MMRP field sampling protocol, sustainability, DQO development, contaminant transport, and environmental engineering.	PhD, PG, PE, Manager of Quality/ Organizational Excellence (CMQ/OE)	Signature available upon request.
Samantha Saalfield	EA Program Chemist	PhD Earth Sciences, Bachelor of Arts (B.A.) Geology-Chemistry; 14 years of environmental chemistry experience. Supported chemistry needs on 50+ project sites with environmental contamination, including PFAS at 5 sites. Ensures laboratories used have proper DoD Environmental Laboratory Accreditation Program (ELAP) method/lab specific accreditations. Oversees analytical method selection, laboratories, and data validators.	PhD	Signature available upon request.

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature
Robert Marcase	EA Corporate Health and Safety Officer	B.S. Environmental Science; 25 years of experience in a wide range of environmental, safety and health, and industrial hygiene projects. His experience includes regulatory compliance strategy, industrial hygiene investigation and process analysis, occupational exposure assessment, facility-wide health and safety auditing, and air quality permitting and compliance. His experience also includes environmental assessments, building inspections, industrial air pollution testing, and water quality analysis. Oversees development of: APP /SSHP; identification/evaluation of chemical, physical, radiological, and biological hazards; medical surveillance programs; personal protective equipment; employee training requirements; environmental monitoring; and proper reporting.	Certified Industrial Hygienist (CIH), Certified Safety Professional (CSP) Certified Hazardous Materials Manager (CHMM) OSHA 30-Hour Construction Safety Training; 2020 NIOSH 582 Certification, Collecting and Analyzing Asbestos Air Samples; 1998 Asbestos Building Inspector Certification, Maryland and Pennsylvania; 1999	Signature available upon request.
Organization: Wood				
Marie Bevier	Data Validator	B.S. Liberal Arts with Chemistry Emphasis, 27 years' experience as an environmental analytical chemist.	Environmental Analytical Chemist/ National Registry of Certified Chemists	Signature available upon request.
Organization: Eurofins Lancaster Laboratories Environmental LLC Pennsylvania (Primary Analytical Laboratory)				
Darlene Bandy	Project Manager	Associate Degree; over 17 years of experience in the environmental field, as an analyst in the laboratory and in project management.	Not applicable	Signature available upon request.
Dorothy Love	Director, Quality Assurance	B.S. Environmental Health; 30 years of experience in laboratory analyses and quality control.	Not applicable	Signature available upon request.
Organization: Eurofins TestAmerica Sacramento California (Secondary Analytical Laboratory)				
David Alltucker	Project Manager	B.A. Chemistry, 13 years of experience in laboratory project management.	Not applicable	Signature available upon request.
Lisa Stafford	Quality Assurance Manager	B.S. Chemistry, 13 years of experience in the analytical industry to her current role in the Quality Assurance department.	Not applicable	Signature available upon request.
NOTE: Signatures indicate personnel have read and agree to implement this QAPP as written.				

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QAPP Worksheet #6: Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure (Timing, pathways, etc.)
Program Manager decisions and modification	USACE, Baltimore District Project Manager	Tim Peck, PG, PMP	410-962-3416 Timothy.J.Peck@usace.army.mil	Initiate award of work and options. Track project progress through monthly reporting and daily field reporting. Stop work for quality or performance concerns. Communication by email or phone as needed.
	USACE, Omaha District Project Manager	Steve Gragert, CHMM	402-995-2743 steve.p.gragert@usace.army.mil	
	USACE, Sacramento District Project Manager	James Lukasko	916-557-5392 james.j.lukasko@usace.army.mil	
	USACE, Seattle District Project Manager	Briana Niestrom	206-764-3498 Briana.C.Niestrom@usace.army.mil	
	USACE, Louisville District Project Manager	Steve Kvaal, PMP	502-315-6316 Steven.Kvaal@usace.army.mil	
	USACE, Alaska District Project Manager	Heidi Long, PhD	907-361-1175 heidi.l.long@usace.army.mil	
		Andrea Beausang, MS	907-753-2557 Andrea.L.Beausang@usace.army.mil	
	USACE, Jacksonville District Project Manger	Jessica Weatherby, PE	904-232-2178 Jessica.A.Weatherby@usace.army.mil	

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure (Timing, pathways, etc.)
Program Technical Review	ARNG Project Manager	Bonnie Packer, PhD Pam Hess Joe Davis Mark Leeper, PG Amanda Sullivan, MS Jennifer Li, MS	703-607-7977 bonnie.m.packer.ctr@mail.mil 208-880-9734 pamela.s.hess.mil@mail.mil 615-791-1139 joe.b.davis36.ctr@mail.mil 804-516-3529 mark.s.leeper.civ@mail.mil 304-642-6000 amanda.d.sullivan7.ctr@mail.mil 301-717-6939 jennifer.j.li2.ctr@mail.mil	Communicate project scope/schedule and coordinate logistics between project team and installation personnel on an as-needed basis, documented via phone records and emails. Facilitate information transfer between contractor and installation and support contractor acquisition of site-specific information (i.e., geographic information system [GIS] Layers, access information, utility maps, etc.) as needed to conduct the SI. Coordination and resolution of logistical issues and technical issues between ARNG/State Regulatory Agencies/Installation RPMs. By mail or phone as needed. The EA PM will obtain ARNG technical review and concurrence of the QAPP and project documents and any field modifications/QAPP changes as necessary. All approved modifications will be included in QAPP revisions (prior to field work). ARNG technical review and comments will be incorporated into the QAPP and project documents and a record of ARNG comments saved in project files for documentation.
Contractual modification and/or program performance	EA Program Manager	Barb Roeper	410-329-5150 broeper@eaest.com	Communicates with USACE Contracting Officer and other USACE personnel at the programmatic level regarding overall performance.
Manage all project phases/overall technical lead	EA Project Manager EA Deputy Project Manager	Michael O'Neill Michael Kepner	410-329-5142 moneill@eaest.com 410-329-5123 mkepner@eaest.com	Responsible for overall management and execution of the project. Maintains lines of communication with USACE and ARNG. Communicates field changes to the USACE/ARNG and discusses options prior to implementation. Receives direction from the USACE regarding communications with other stakeholders. Deputy PM serves as secondary POC.
Project Safety	EA Health & Safety Supervisor	Rob Marcase	410-329-5192 rmarcase@eaest.com	Communicates with EA PM regarding safety issues. Reviews and approves safety plans, conducts audits, and exercises stop-work authority, if needed.
Project QA/QC and Corrective Actions	EA CQCS	Frank Barranco, PhD, PG, PE, CMQ/OE	410-584-7000 fbarranco@eaest.com	Communicates with EA PM regarding QC/QA issues. Reviews and approves corrective action plans.

Communication Drivers	Responsible Entity	Name	Phone Number	Role/Procedure (Timing, pathways, etc.)
Modifications to Analytical Corrective Actions	EA Program Chemist	Samantha Saalfield, PhD	410-584-7000 ssaalfield@eaest.com	Reports on the adequacy, status, and effectiveness of the QA program by phone or email during weekly progress calls and as needed.
Laboratory Corrective Actions and QA Modifications	Laboratory QA Manager	Dorothy Love or Lisa Stafford	717-556-7327 Dorothy.Love@eurofinset.com 916-373-5600 LisaStafford@eurofinset.com	Reports project nonconformance issues within 1 week to the Laboratory Project Manager in person or by phone, or email.
Modifications to Eurofins analytical responsibilities	Laboratory Project Manager	Darlene Bundy or David Alltucker	717-556-7327 Darlene.Bandy@eurofinset.com 916-373-5600 David.Alltucker@eurofinset.com	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email
Modification to data validation responsibilities	Data Validation Project Manager	Marie Bevier	503-639-3400 marie.bevier@woodplc.com	Report project nonconformance issues within 1 week to the Program Chemist by phone, or email.
Regulatory Agency Interface	New York Army National Guard (NYARNG)	James Freehart	(518) 605-9280 James.p.freehart.civ@mail.mil	Communicate technical approaches, schedule, and decisions directly to regulatory agencies' representative(s) on an as-needed basis, documented via phone records and emails. Facilitate/support setup of technical project planning (TPP) meeting(s) with regulator, USACE and ARNG, document distribution and comment/response process.

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QAPP Worksheet #9: Technical Project Planning Session Summaries

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

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

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

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[1] Due to the COVID-19 pandemic, all meetings will be conducted via teleconferences. Additionally, TPP Meeting 1 and 2, will be combined into one meeting to compress the schedule and meet ARNG program completion deadlines.

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QAPP Worksheet #10: Conceptual Site Model

The information presented in this section was gathered during the PA at the Rochester AASF #2. The PA process included the following tasks:

- Reviewed available administrative record documents and Environmental Data Resources Inc. (EDR)^{TM} report packages to obtain information relevant to potential PFAS releases, such as: drinking water well locations, historical aerial photographs, Sanborn maps, and environmental compliance actions in the area surrounding the facility;
- Conducted a site visit on 11 October 2018 and completed visual inspections at locations where PFAS-containing materials were suspected of being stored, used or disposed;
- Interviewed current and former New York Army National Guard (NYARNG) Rochester AASF #2 personnel during the site visit;
- Identified AOIs and developed a preliminary CSM to summarize potential source-pathway-receptor linkages of potential PFAS in soil, groundwater, surface water and sediment for each AOI.

The findings of the PA are summarized in this worksheet. The text within this worksheet is directly from the PA report. Additional details about the Rochester AASF #2 can be found in the PA Report (AECOM, 2020).

FACILITY LOCATION AND DESCRIPTION

Rochester AASF #2 is located in Monroe County, western New York, in the city of Rochester. Since the facility's establishment in 1991, it has been located on the Greater Rochester International Airport and is leased to the National Guard for land use of the facility. The facility is approximately 4 miles southwest from the Rochester city center and 0.75 miles south of the airport terminal. Interstate 390 borders airport property directly to the northeast (AECOM 2020).

Prior to 1991, the property was undeveloped. A small airplane hangar was built in 1991, which the NYARNG began operating shortly after. In 2008, a second hangar connected to the original hangar was constructed, with each hangar covering roughly 32,600 square feet (ft). A separate detached storage building was also constructed (**Figure 10-1**). The second hangar is located on the western side of the hangar constructed in 1991. The Rochester AASF #2 hangars are located 0.70 miles northeast from the end of the southern runway (AECOM 2020).

The property that is now the Greater Rochester International Airport was used for aviation purposes in the early 20th century. The first development occurred in 1927 with the construction of a hangar and aviation field, formerly known as Britton Field. By 1948, the Monroe County took possession of the property and began making improvements on the existing runways, building a new runway and building a terminal complex. The Greater Rochester International airport now covers 1,136 acres and has three runways (AECOM 2020).

FACILITY ENVIRONMENTAL SETTING

Monroe County is a predominately suburban area largely consisting of plateaus in the Lake Ontario Lowlands of western New York. The terrain of the facility is consistent with the majority of Monroe County. Monroe County has a total of 1,367 square miles, 52 percent of which are water. Rochester AASF #2 is located less than 5 miles south from the city of Rochester. Approximately 500 ft to the east of the facility is the Genesee River. Several industries are less than 1 mile to the south, west, and southwest of the facility. Westgate community plaza is 2 miles to the west of the facility (AECOM 2020).

Geology

Rochester AASF #2 is located west of the Genesee River, within the northwestern geological region of the Ontario Lowlands, which is a segment of the Erie and Ontario lowlands physiographic province. This region forms part of the plains that border the Great Lakes. The Ontario lowlands are an area of generally subdued topography shaped over multiple periods of extensive glacial advancement and recession (deglaciation) (AECOM 2020).

Deglaciation is responsible for thick deposits of fluvial sand, gravel, and lacustrine clay, silt, and fine sand found throughout the region. As a result, glacially-derived landforms are present near the Rochester AASF #2, including eskers, kettles, and massive deposits of sand and gravel, known as kame, laid down at the periphery of ice sheets during glacial drainage. The Rochester AASF #2 lies at the southwestern edge of the Rochester Kame-Moraine, which is a part of the Brighton-division of the Pinnacle Hills; a system of three different kame-moraine divisions that create sporadic and unusual topographic highs for Rochester and the surrounding 4 miles. The “Pinnacle”, where these divisions intersect, rises approximately 740 ft above mean sea level (amsl), compared to the Rochester average mean sea level of 475 ft (AECOM 2020).

The majority of both the surface and underlying material of Rochester AASF #2 are Pleistocene age unconsolidated glacial deposits, recent floodplain deposits, and lacustrine delta. These sediments consist of silts and clays underlain by fine sands and gravels of variable thicknesses ranging between 20 to nearly 300 ft. A previous subsurface investigation by the US Department of Agriculture Soil Conservation Service, who perform the National Cooperative Soil Survey, indicated that the majority of the upper 10 ft of the Rochester AASF #2 facility subsurface material are various types of till plain (ground moraines) and silt loam. This silt loam consists of low permeability, somewhat-poorly to poorly drained, fine grained silts and clays with very slow infiltration rates. These soil layers can also impede the downward movement of water, suggesting there is high runoff from the Rochester AASF #2 facility to the Genesee River to the southeast (AECOM 2020).

Underneath the silt loam and fine-grained sands and gravel is limestone and Precambrian crystalline bedrock. Many of the drinking water wells in the Genesee River basin come from bedrock; however, they do not yield as much as unconsolidated sediments (AECOM 2020).

Hydrogeology

Based on review of USEPA's map of Sole Source Aquifers, Rochester AASF #2 is not located over a sole source aquifer. Based on review of the New York State Department of Environmental Conservation's Map of Principal and Primary Aquifers in New York State, the Rochester AASF #2 facility cantonment area is not located over a principal or primary aquifer. The principal preglacial buried-valley aquifer system underlies the Irondequoit and Genesee River Valleys. This unconsolidated aquifer spans the entire Rochester AASF #2 facility, with precipitation and runoff being the sole source of recharge (AECOM 2020).

The glacio-lacustrine silt and very fine sand, as well as kame deposits, create unique hydrogeological conditions; the unconsolidated glacial deposits of thick, permeable sand and gravel underlie flood plains and terraces of the less permeable silt loam. These deposits can cause different zones of infiltration, or scenarios where there is a high water table and low drainage potential, making the prediction of local groundwater flow direction challenging. The unconsolidated deposits yield the largest supply to wells in Monroe County, with yields as much as 10 million gallons (gal) per day across the entire aquifer. Recharge by infiltration and precipitation occurs just south of and on the Rochester AASF #2, as the more permeable material sits on the surface in these locations (AECOM 2020).

Groundwater flow direction in the cantonment area is generally from west to east, towards the Genesee River (**Figure 10-2**), which flows into Lake Ontario. An EDR^{TM} Report conducted a well search for a 1-mile radius surrounding the facility. Using additional online resources, such as state and local GIS databases, wells were researched to a 4-mile radius of the facility. Data from the United States Geological Survey (USGS) National Water Information System Mapper indicated there are no active USGS monitoring wells and 418 inactive monitoring wells within a 4-mile radius of the facility. Well data from New York State indicate there are six potable water wells within a 4-mile radius of the facility, one to the northwest (upgradient), one to the southwest (side gradient), and four to the southeast beyond the Genessee River. Information regarding well screen depths was not available, but the total well depths of the six wells range between 53 and 400 ft below ground surface (bgs) (AECOM 2020).

There are several bedrock wells located side-gradient within 1.5 miles to the south-southeast and to the northwest of Rochester AASF #2 (**Figure 10-2**). The average depth to groundwater in the Rochester area is between 16 and 37 ft bgs, with average well depths of 28 to 101 ft, and yield anywhere from 8 to 287 gal per minute (AECOM 2020).

Based on the USEPA Unregulated Contaminant Monitoring Rule 3 (UCMR3) data, no PFAS were detected in a public water system above the HA within 20 miles of the facility. PFAS analyses performed in 2016 had method detection limits that were higher than currently achievable. The Health Advisory (HA) is 70 ppt for PFOS and PFOA, individually or combined. Thus, it is possible that low concentrations of PFAS were not detected during the UCMR3 but might be detected if analyzed today. The facility receives water from the Monroe County Water Authority. The majority of drinking water supplied within Monroe County and the city of Rochester comes from Lake Ontario and Hemlock Lake, though there are 4,500 privately-owned drinking water wells within the county. Hemlock Lake is located approximately 25 miles south of Rochester AASF #2. Lake Ontario is located approximately 12 miles north of Rochester AASF #2 (AECOM 2020).

Hydrology

Rochester AASF #2 is located in the Lower Genesee Watershed, which is a part of the 2,500 square miles Genesee River Watershed in the Great Lakes Basin. The Lower Genesee Watershed covers 1,100 square miles, drains over 8,000 square miles of streams, and covers Genesee, Livingston, Monroe, Ontario, and Wyoming Counties. Little Black Creek, Red Creek, Allen Creek, Black Creek, and Town of Gates-Genesee River Watersheds are all a part of the Lower Genesee Watershed (**Figure 10-3**). The main channel of the Genesee River is located approximately 0.35 miles southeast of Rochester AASF #2's eastern and southern boundaries. Surface water resources at Rochester AASF #2 include natural streams, rivers, and open water features. All surface runoff from the Rochester AASF #2 area eventually drains into the Genesee River (AECOM 2020).

Approximately 0.75 miles north-northeast across from Interstate 390 is the Erie Canal. The Genesee River converges with the Erie Canal under Interstate 390 before continuing on to Lake Ontario. On the western side of the Rochester AASF #2 is Little Black Creek, which runs south and connects to a drainage ditch below the southern runway (runway 4) and travels east along Paul Road 252 before converging into the Genesee River. Another drainage ditch at the end of Runway 10 travels south and connects to Little Black Creek. Black Creek is 0.5 miles south of the facility, which is less than 300 ft away from Little Black Creek near Paul Road 252, where it also converges into the Genesee River (AECOM 2020).

Both the Genesee River and Lake Ontario are popular for recreational use. Some recreational uses include boating, swimming, and fishing (AECOM 2020).

Climate

The climate in the Rochester AASF #2 area and surrounding Greater Rochester International Airport is predominately continental, with an average annual temperature of 48.2 degrees Fahrenheit (°F). Seasonally, temperatures vary from an average summer high of 68.9°F, to average winter lows of 27°F. The total mean annual precipitation is 34.27 inches. February is the driest month, with 1.95 inches of precipitation, while August is the wettest month, with 3.47 inches of precipitation (AECOM 2020).

Current and Future Land Use

Rochester AASF #2 is a private facility with access only through a guarded security gate off Old Beahan Road. The property is a NYARNG installation that is used for training, maintenance, and unit administration. There are no current expansion plans for the facility and, in general, the future use of the facility is not expected to change.

AREAS OF INTEREST

There are no known releases of AFFF to the environment at Rochester AASF #2; however, PFAS have the potential to be released to soil and groundwater based on AFFF storage and use at the facility. One AOI, consisting of the Old Hangar, New Hangar, and Hazardous Waste Storage Shed, was identified based on preliminary data and inferred groundwater flow direction. This AOI is described below and presented on **Figure 10-4**.

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

AOI 1:

Old Hangar

The Old Hangar is located in the southeastern portion of the Greater Rochester International Airport and was built in 1991, in a roughly 32,600 square ft area; it is still active at the time of reporting. The Old Hangar has a boiler room on the eastern side containing two 500-gal 3% AFFF storage tanks connected to a deluge system. This system was previously connected to an underground storage tank that was removed in 2007, at which point a 25,000-gal aboveground storage tank (AST) was installed. While no initial test of the deluge system after its installation was reported, it has been common practice at the other AASF locations in the State of New York. Additionally, no AFFF release events were documented in connection with the underground storage tank removal. There are also three 36-gal 3% AFFF mobile storage tanks set up within the Old Hangar that are reported to have never had releases (AECOM 2020).

A 2018 September Record of Release notes a release of AFFF and water that occurred on 20 June 2017. The bladders on the two 500-gal 3% AFFF storage tanks in the boiler room malfunctioned, causing a release in the boiler room that flowed into the Old Hangar. Interviews with Rochester AASF #2 staff said it is unclear as to how much AFFF was released from the tanks. Interviews and documented reports state the spill was contained by the deluge system, and AFFF went into the drains and was completely contained by the 25,000-gal AST. Due to general hydraulics, the floor drains have a system (pump room) that pumps floor drainage into the AST. A retrofitting event occurred shortly after, during which, the 500-gal AFFF storage tanks were refilled with 3% AFFF. The 25,000-gal AST was later emptied and disposed of by a contractor without incident (AECOM 2020).

New Hangar

A New Hangar was established in 2008. The New Hangar has a fire pump room containing one 300 gal 1.5% AFFF storage tank connected to a deluge system. This system is hooked to the same 25,000-gal AST as the Old Hangar. A storage room contains seven 5-gal buckets of 3% AFFF left over from the 2007 retrofitting event. Two 36-gal 3% AFFF mobile tanks are also set up within the New Hangar. Similar to the Old Hangar, no initial deluge system test was reported to have been conducted when the New Hangar was constructed. Testing of the hangar deluge system occurs annually but bypasses the AFFF storage tanks, using only water to conduct the tests. There have been no documented reports of AFFF releases at the New Hangar since its installation in 2008; however, due to the storage of AFFF and presence of a deluge system within the New Hangar, this location is considered a potential PFAS release area (AECOM 2020).

Hazardous Waste Storage Shed

A Hazardous Waste Storage Shed is located roughly 300 ft to the west, adjacent to the New Hangar. One 55-gal drum of 3% AFFF was found inside the Hazardous Waste Storage Shed. This drum is part of the extra material from the 2007 retrofitting event. There is no evidence to suggest any spills, leaks, or releases have occurred inside the storage shed; however, due to the storage of AFFF within the Hazardous Waste Storage Shed, this location is considered potential PFAS release area (AECOM 2020).

POTENTIAL OFF-FACILITY SOURCE AREAS

Four off-facility potential PFAS sources were identified adjacent to the Rochester AASF #2 during the PA interviews and during review of the EDR^{TM} Report.

Greater Rochester International Airport

The first development at what is now the Greater Rochester International Airport occurred in 1927 with the construction of a hangar and aviation field, formerly known as Britton Field. Over the years, operations at the airport have included passenger flights, cadet flight school, and civilian pilot training. Monroe County took over airport property ownership in 1948. Operations within private hangars located at the Greater Rochester International Airport include aircraft maintenance, air cargo handling, ground service equipment maintenance, private aircraft rentals, and a flight school. The Rochester AASF #2 is located on the southeastern side of the airport property. Although information was not available during the PA interviews regarding AFFF usage or storage at the airport, there could have been potential use of AFFF in association with typical airport operations at the airport terminal, along the flight lines, or within the associated hangars. Additionally, as it is unknown whether there are fire suppression systems in any of the private hangars, or if AFFF has been used for training or as a fire suppressant at any time, these hangars have been included as potential adjacent sources at the airport. Therefore, the Greater Rochester International Airport is considered a potential adjacent off-facility source of PFAS (AECOM 2020). The Greater Rochester International Airport is located up and cross-gradient to the facility.

Greater Rochester international Airport Fire Department

The greater Rochester International Airport Fire Department is located less than 0.25 miles north of Rochester AASF #2. Although information was not available during the PA interviews regarding AFFF usage or storage, according to current Federal Aviation Administration regulations, since commercial aviation activities occur at this facility, AFFF is required to be stored and used for any potential firefighting activities and firefighting training. Therefore, the

Greater Rochester International Airport Fire Department is considered a potential adjacent off-facility source of PFAS (AECOM 2020). The Greater Rochester International Airport Fire Department is located cross-gradient to the facility.

Gates Fire District

The closest local fire department, Gate Fire District, is located 1.5 miles northwest of Rochester AASF #2. This fire department would respond to emergencies at Rochester AASF #2. Information was not available during the PA interviews regarding AFFF usage or storage at this location. Because the presence or absence of AFFF cannot be confirmed, the Gates Fire District is considered a potential adjacent off-facility source of PFAS (AECOM 2020). The gates Fire District is located cross-gradient to the facility.

Rochester Fire Academy

The Rochester Fire Academy is located approximately 1-mile east northeast of Rochester AASF #2. Since 1954, the Rochester Fire Academy has been owned and operated by the city of Rochester as a training facility used by the city’s Fire and Police Departments. During the period of 1954 to 1980, various chemicals from local hazardous waste generators were burned and/or disposed of during training exercises. It is unknown whether or not AFFF were used at this facility. Because the presence or absence of AFFF cannot be confirmed, the Rochester Fire Academy is considered a potential adjacent off-facility source of PFAS (AECOM 2020). The Rochester Fire Academy is located downgradient from the facility.

EXPOSURE PROFILE

AOI 1

AOI 1 encompasses the AFFF release at the Old Hangar and the potential AFFF releases at the New Hangar and the Hazardous Waste Storage Shed. The area surrounding the AOI is predominantly paved with a few grassy areas between paved areas (AECOM 2020).

The known AFFF release at AOI 1 occurred within the confines of the Old Hangar building. The quantity of AFFF released is unknown, though interviews and documented reports state the spill flowed from the boiler room and into the Old Hangar, where the foam went into the drains, was pumped through the pump room,and was completely contained by the AST. A retrofitting event occurred shortly after, during which, the tanks were refilled with 3% AFFF. The AST was later emptied and disposed of by a contractor without incident. Due to the storage of AFFF within the New Hangar and the Hazardous Waste Storage Shed, these locations are considered potential PFAS release locations. No known or documented release of AFFF has occurred within either location (AECOM 2020).

While known releases of AFFF occurred and were contained within the Old Hangar, it is possible that unknown or undocumented releases of AFFF occurred at AOI 1 on paved areas and grassy surfaces. AFFF releases could have occurred directly onto surface soil but may also have infiltrated subsurface soil via cracks in pavement or joints between areas that are paved with different materials. Therefore, ground-disturbing activities in these areas could result in site worker, construction worker, and trespasser exposure to potential PFAS contamination via inhalation of dust or ingestion of surface soil. Additionally, ground-disturbing activities to subsurface soil could result in construction worker exposure via ingestion. Therefore, the exposure pathways for inhalation of soil particles and ingestion of soil are considered potentially complete for these receptors (AECOM 2020).

Because potential PFAS releases to surface soil at AOI 1 could have occurred, PFAS may migrate from the surface soil to the groundwater via leaching. Groundwater at the facility generally flows in an eastern direction towards the Genesee River. The facility receives water from the Monroe County Water Authority, and there were no identified private drinking water wells located immediately downgradient of the facility (**Figure 10-2**) between the Rochester AASF #2 and the Genesee River, which likely represents a groundwater divide. However, due to the potential for unidentified residential wells downgradient of the facility and before Genessee River, the ingestion exposure pathway for groundwater is potentially complete for off-facility residents that are located downgradient of AOI 1. Six potable water wells were identified within 4 miles of the facility with one to the east and two southeast of the facility (New York State, 2016). These wells are beyond the Genessee River and are not likely to be impacted by potential contaminants originating west of the river. Additionally, the anticipated depth to groundwater is shallow: between 16 and 37 ft bgs. Due to the shallow depth to groundwater, trenching activities could result in construction worker exposure via accidental ingestion, therefore this pathway is also considered potentially complete (AECOM 2020).

Although no surface water features flow through the AOI, the facility is within close proximity to the Genesee River, which flows into Lake Ontario, which is the largest water body supply for drinking water in the county; therefore, surface water and sediment exposure pathways are potentially complete for off-facility residents via ingestion. Additionally, both the Genesee River and Lake Ontario are popular for recreational use, including fishing, swimming, and boating. Therefore, the surface water and sediment exposure pathways are potentially complete for off facility recreational users. Human consumption of fish potentially affected by PFAS from the river and lake is also possible (AECOM 2020).

POTENTIAL OFF-FACILITY SOURCE AREAS

There are potential adjacent sources of PFAS to the west, north, and east of Rochester AASF #2. Several are up and cross-gradient of the facility and can potentially impact PFAS concentrations in groundwater within the facility.

CONCEPTUAL SITE MODEL SUMMARY

No PFAS remediation activities have occurred at the identified AOI. In general, the potential PFAS exposure routes are ingestion and inhalation. Dermal contact is not considered to be a potential exposure route, as studies have shown very limited absorption of PFAS through the skin. Receptors at Rochester AASF #2 include site workers, construction workers, trespassers, recreational users, and off-facility residents.

Ground-disturbing activities could result in site worker, construction worker, trespasser exposure to potential PFAS contamination via inhalation or ingestion of surface soil. Additionally, ground-disturbing activities to subsurface soil could result in construction worker exposure via ingestion.

PFAS are water soluble and can migrate readily from soil to groundwater. Therefore, potential PFAS releases to soil at the identified AOIs may migrate from the subsurface soil to the groundwater via leaching. Although there were no private drinking water wells identified immediately downgradient of the facility, there is potential for unidentified residential wells making the exposure pathway for groundwater potentially complete for off-facility residents. Wells located downgradient beyond the Genesee River are not likely to be impacted. Shallow groundwater depth creates the potential for construction worker exposure during trenching activities via accidental ingestion. Groundwater flow at Rochester AASF #2 is generally to the east.

Surface water and sediment exposure pathways are potentially complete for off-facility residents and off-facility recreational users.

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Army National Guard Site Inspections
Site-Specific Quality Assurance Project Plan
Rochester AASF#2, New York

Figure 10-1
Facility Location

Facility Data

🟩 Facility Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:.........................October 2021
Prepared By:.............................EA
Prepared For:....................USACE
Projection:........WGS 84 UTM 18N

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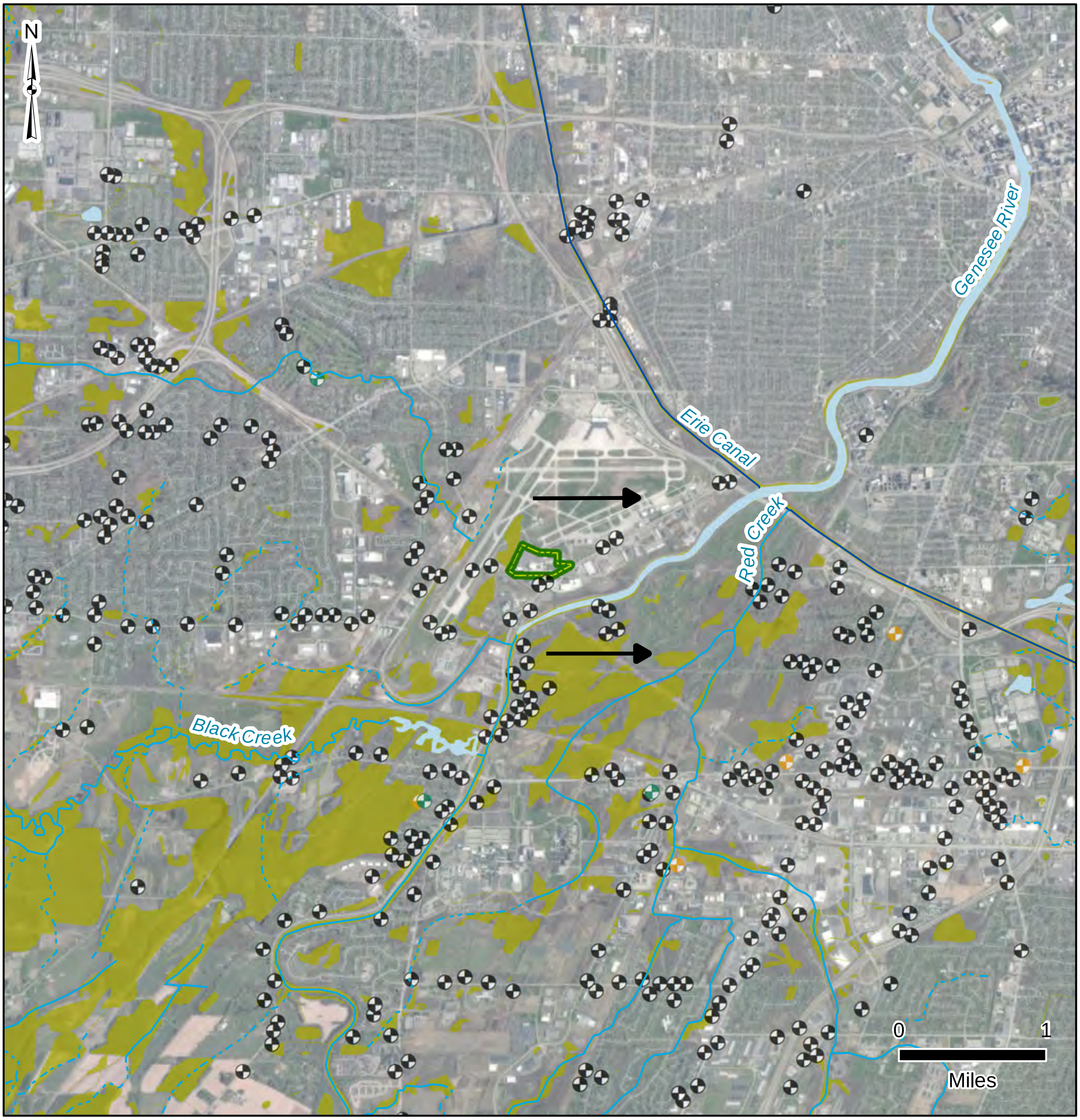
Army National Guard Site Inspections
Site-Specific Quality Assurance Project Plan
Rochester AASF, New York

Figure 10-2
Groundwater Features



Facility Data

🟩 Facility Boundary

Well Type

◐ Potable

◐ Potential Private Well

◐ USGS Inactive Monitoring Well

Hydrology/Hydrogeology

➡ Groundwater Flow Direction

〰 Perennial Creek/Stream

〰 Intermittent Creek/Stream

〰 Canal/Ditch

▨ Waterbody

▨ Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:...................... October 2021
Prepared By:.............................EA
Prepared For:....................USACE
Projection:........WGS 84 UTM 18N

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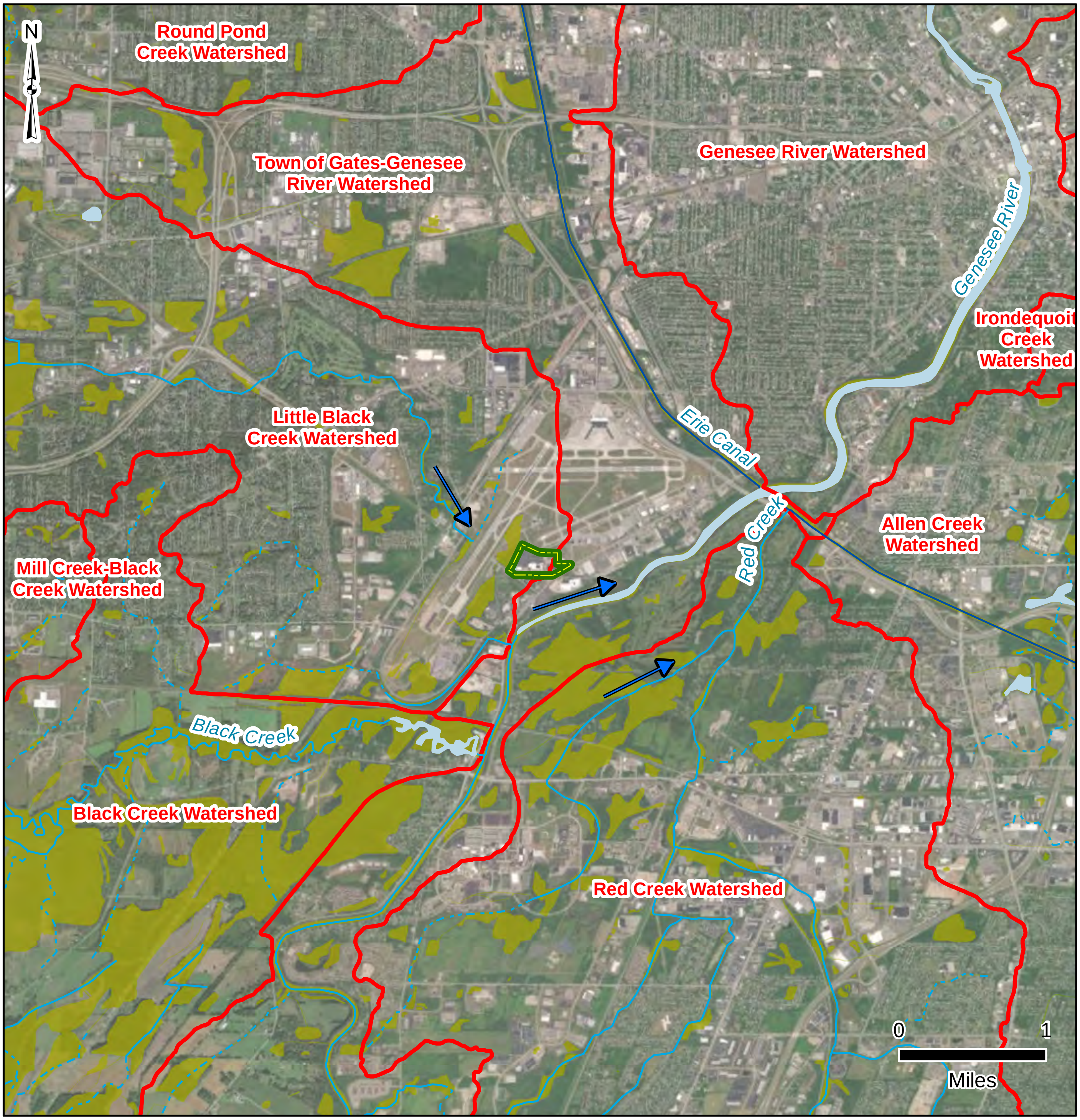
Army National Guard Site Inspections
Site-Specific Quality Assurance Project Plan
Rochester AASF #2, New York

Figure 10-3
Surface Water Features



Facility Data

🟩 Facility Boundary

Hydrology

➡ Surface Water Flow Direction

~ Perennial Creek/Stream

-·- Intermittent Creek/Stream

~ Canal/Ditch

● Waterbody

● Wetlands

🟥 Watersheds

Data Sources:
ESRI 2020
AECOM 2020

Date:.................... October 2021
Prepared By:..............................EA
Prepared For:...................USACE
Projection:........WGS 84 UTM 18N

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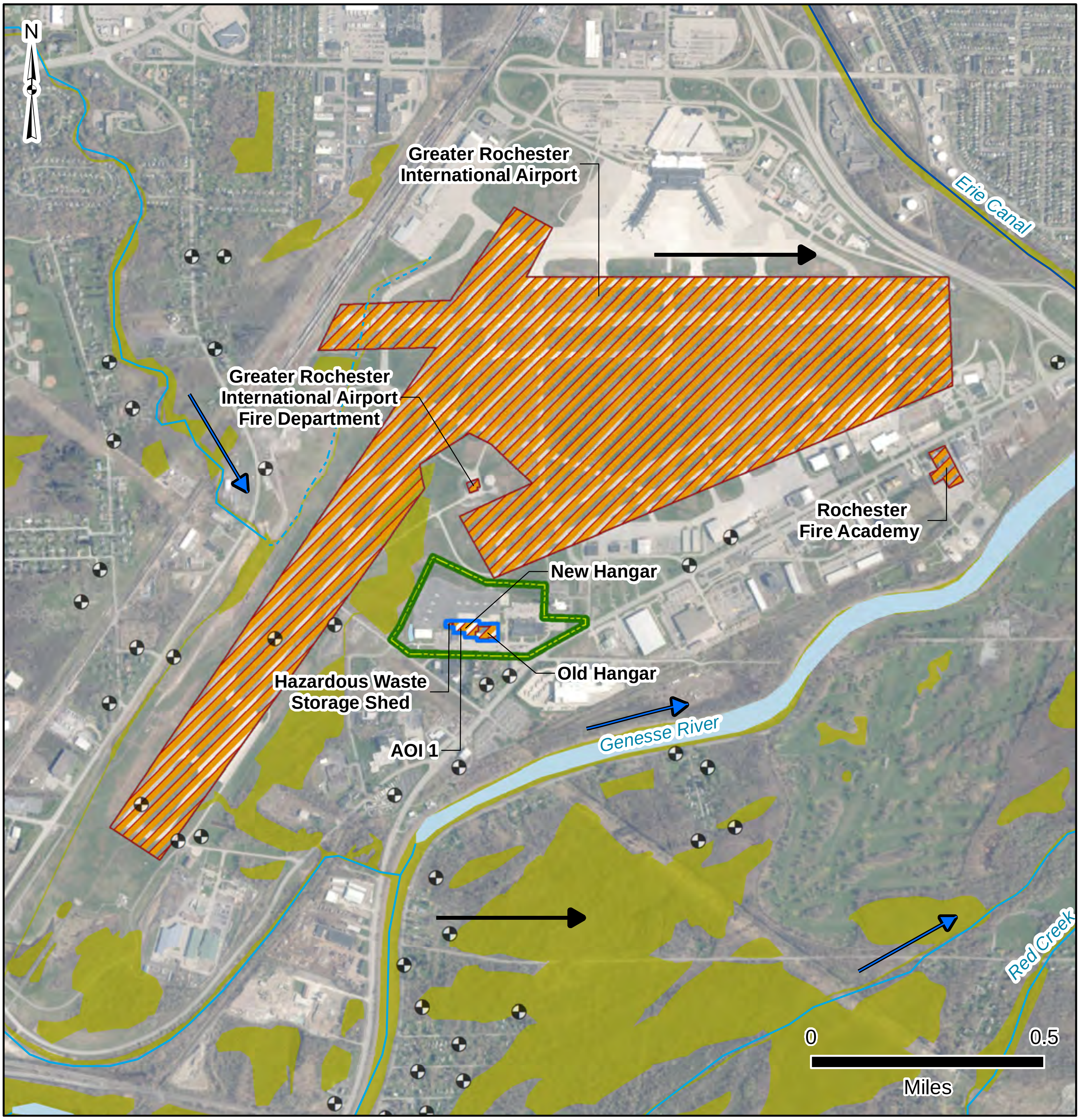
Army National Guard Site Inspections
Site-Specific Quality Assurance Project Plan
Rochester AASF, New York

Figure 10-4
Areas of Interest



Facility Data

🟩 Facility Boundary
🟦 Area of Interest
▨ Potential PFAS Release

Well Type

◐ Potable
◐ USGS Inactive Monitoring Well

Hydrology/Hydrogeology

➔ Surface Water Flow Direction
➔ Groundwater Flow Direction

〜 Perennial Creek/Stream
〜 Intermittent Creek/Stream
〜 Canal/Ditch
Waterbody
Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:.................... .October 2021
Prepared By:..............................EA
Prepared For:....................USACE
Projection:........WGS 84 UTM 18N

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QAPP Worksheet #11: Project/Data Quality Objectives

The Project/Data Quality Objectives (DQOs) for the TO are outlined below. These DQOs will follow the USEPA's seven-step iterative process for DQO development (USEPA 2006). DQOs are influenced by the ongoing project planning discussions with stakeholders and will be updated if new consensus decisions materialize.

1. State the Problem

The presence of PFAS, which may pose a risk to human health or the environment, in environmental media at the facility is currently unknown. PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. The regulatory framework for managing PFAS at both the federal and state level continues to evolve.

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the OSD dated 15 September 2021 (Deputy Assistant Secretary of Defense, 2021). The ARNG program under which this SI will be performed follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, the site will proceed to the next phase under CERCLA. The OSD SLs apply to three compounds: PFOS, PFOA, and PFBS. The SLs are presented in **Worksheet #15** of this QAPP Addendum. Additionally, the USEPA issued drinking water lifetime HAs for PFOA and PFOS in May 2016 (USEPA 2016a; USEPA, 2016b). The USEPA HAs may also be used as SLs for groundwater samples collected at the facility boundary where off-facility drinking water wells are present downgradient. This determination will be based on localized groundwater flow direction established during the SI.

The following quotes from Army policy documents form the basis for this project:

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

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

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

2. Identify the Goals of the Study

The goals of the SI include the following:

- Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs at the Rochester AASF #2.
- Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.
- Determine the potential need for a TCRA (applies to drinking water only). The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.
- Collect or develop data to evaluate the release.
- Collect data to better characterize the release for more effective and rapid initiation of an RI (if determined necessary).
- If PFOA, PFOS, and PFBS are determined to be present, aim to evaluate whether the concentrations can be attributed to on-facility or off-facility sources that were identified within 4 miles of the installation as part of the PA (e.g., fire stations, major manufacturers, other DoD facilities).

3. Identify Information Inputs

Primary information inputs include:

- The PA Report for the Rochester AASF #2
- Analytical data collected during other environmental sampling efforts at the Rochester AASF #2;
- Ground water, surface water, soil and/or sediment sample data collected in accordance with this installation-specific UFP-QAPP Addendum; and
- Field data collected including groundwater elevation and water quality parameters measured using a multi-parameter water quality meter.

4. Define Boundaries of the Study

The scope of the SI is horizontally bounded by the property limits of the Rochester AASF #2. Off-facility sampling is not included in the scope of this SI; however, if future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with the property owner(s). The scope of the SI is vertically bounded as follows: groundwater (37 ft bgs) and soil from direct-push technology (DPT) borings (37 ft bgs).

The temporal boundaries of the study are limited by seasonal conditions; the field work for the scope will be performed Summer 2021.

5. Develop the Analytic Approach

All samples will be analyzed by a DoD Environmental Laboratory Accreditation Program (ELAP) and National Environmental Laboratory Accreditation Program (NELAP) certified laboratory (i.e., Eurofins Lancaster Laboratories Environmental LLC Pennsylvania [primary] or Eurofins TestAmerica Sacramento California [secondary])[3]. Data will be compared to SLs (**Worksheet #15**), and decision rules for groundwater and soil as defined in the PQAPP (listed below) will be applied concerning actions to be taken based on any SL exceedances. These rules will govern response actions based on the results of the SI sampling effort.

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

Groundwater/Surface Water:

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

Soil:

1. What is the concentration of PFOA, PFOS, and PFBS constituents in shallow surface soil (0-2 ft bgs)?
2. What is the concentration of PFOA, PFOS, and PFBS constituents in soil (i.e., capillary fringe and bedrock interface) (2-37 ft bgs)?
3. What does the CSM suggest in terms of source, pathway, and receptor?

Soil and groundwater samples will be collected (if applicable) from potential source areas identified in the PA. Based on previous nearby investigations, groundwater is expected to be encountered within the unconfined surficial aquifer no deeper than 37 ft bgs.

6. Specify Performance/Acceptance Criteria

See **Worksheet #37.**

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[3] Laboratories also hold NYSDOH ELAP certification for applicable methods and are able to achieve reporting limits of 2 ng/l and 0.5 ug/kg for PFOA and PFOS in aqueous and solid samples.

7. Develop the Detailed Plan for Obtaining Data

See **Worksheets #17** and **#18.**

Table 11-1: Groundwater Decision Rules

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

Notes:
< = less than.
> = greater than.
ARNG = Army National Guard.
CSM = conceptual site model.
ND = non-detect.
PFAS = per- and polyfluoroalkyl substances.
RI = Remedial Investigation.
SI = Site Inspection.
SL = Screening level SLs taken from OSD memorandum titled “Investigating PFAS Substances within the DoD Cleanup Program” and dated 15 September 2021 (Deputy Assistant Secretary of Defense, 2021) and Regional Screening Levels for Chemical Contaminants at Superfund Sites On-Line Calculator. USEPA Office of Superfund. https://www.epa.gov/risk/regional-screening-levels-rsls. HQ = 0.1. Accessed April 9, 2021.

Table 11-2: Soil Decision Rules

Scenario	PFAS Concentration Range	Response (Off-facility human receptor within 4 miles)
Scenario 1	ND	No further action during SI phase.
Scenario 2	>ND (any positive detection) and < SLs	1) Assess CSM including: • Potential for particulate runoff (i.e., transport via surface water) • Nearby receptors and land use (residential or industrial/commercial worker) at the source location (i.e., potential for incidental ingestion) • Depth to groundwater; distance to nearby surface water body • Comparison of soil concentrations to groundwater concentrations at the source or nearby surface water body • Data reliability and bias 2) No further action for soil during SI Phase at this time. ARNG may consider need for additional evaluation in the future.
Scenario 3	> SLs	1) Assess CSM as above and: • Comparison of soil concentrations to groundwater concentrations at the source and downgradient at the boundary • Comparison of soil concentrations to surface water concentrations at or near the source and downstream at the boundary 2) Proceed to RI.

Notes:

< = less than.
> = greater than.
ARNG = Army National Guard.
CSM = conceptual site model.
ND = non-detect.
PFAS = per- and polyfluoroalkyl substances.
RI = Remedial Investigation.
SI = Site Inspection.
SL = Screening level SLs taken from OSD memorandum titled “Investigating PFAS Substances within the DoD Cleanup Program” and dated 15 September 2021 (Deputy Assistant Secretary of Defense, 2021) and Regional Screening Levels for Chemical Contaminants at Superfund Sites On-Line Calculator. USEPA Office of Superfund. https://www.epa.gov/risk/regional-screening-levels-rsls. HQ = 0.1. Accessed April 9, 2021.

QAPP Worksheet #12-1: Measurement Performance Criteria

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

Matrix: Water
Analytical Group: PFAS
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP$^{(a)}$	Data Quality Indicators	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Groundwater and Surface Water sampling (SOPs 07, 13, 51, 73)	LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15; extraction by SPE (SOP T-PFAS-WI22030 or WS-LC-0025)	Bias Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤ 30%	Field Duplicate	S&A
		Accuracy	Recovery limits per QSM Version 5.3.	Isotope Extracted Labeled Standards	A
		Accuracy/Bias/Precision	DoD QSM Appendix C limits	Laboratory Control Spike/Matrix Spike and Duplicates	S & A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank	A
		Accuracy	70-130% recovery	Post Spike Sample	A
		Sensitivity	LOD ≤ SLs for non-detections and LOQs < SLs for detections	Detection limits	S
		Completeness	100%	Reported Sample Data	S & A

Notes: Analytical methods for IDW characterization are not included because data generated using these methods will not be subject to validation.

Sampling Procedure	Analytical Method/SOP[(a)]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)

DoD = Department of Defense.
FTS = Fluorotelomer sulfonate.
IDW = Investigation-derived waste.
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
LOD = Limit of detection.
LOQ = Limit of quantification.
QC = quality control
QSM = Quality Systems Manual.
RPD = Relative Percent Difference.
SL = Screening Level.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-2: Measurement Performance Criteria

Matrix: Soil/Sediment
Analytical Group: PFAS
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil and Sediment sampling (SOPs 21 and 47)	LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15; extraction by SPE (SOP T-PFAS-WI22030 or WS-LC-0025)	Bias Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤ 50%	Field Duplicate	S&A
		Accuracy	Recovery limits per QSM Version 5.3 or higher	Isotope Extracted Labeled Standards	A
		Accuracy/Bias/Precision	DoD QSM Appendix C limits	Laboratory Control Spike/Matrix Spike and Duplicates	S & A
		Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank	A
		Sensitivity	LOD ≤ SLs for non-detections and LOQs < SLs for detections	Detection limits	S
		Completeness	100%	Reported Sample Data	S & A

Notes: Note: Analytical methods for IDW characterization are not included because data generated using these methods will not be subject to validation.

DoD = Department of Defense.
FTS = Fluorotelomer sulfonate.
IDW = Investigation-derived waste.
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
LOD = Limit of detection.
LOQ = Limit of quantification.
QC = quality control.
QSM = Quality Systems Manual.
RPD = Relative Percent Difference.
SL = Screening Level.
SPE = Solid-phase extraction.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-3: Measurement Performance Criteria

Matrix: Soil
Analytical Group: TOC
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 47)	SW9060A (SOP T-WC-WI11627 or DV-WC-0048)	Bias Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤ 50%	Field Duplicate	S&A
		Accuracy/Bias	Laboratory statistical limits	Laboratory Control Spike/Matrix Spike	A
		Accuracy/Laboratory Contamination	No analytes detected > LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank	A
		Precision	Laboratory statistical RPD	Lab Duplicate	S & A
		Sensitivity	LOD ≤ SLs for non-detections and LOQs < SLs for detections	Detection limits	S
		Completeness	100%	Reported Sample Data	S & A

LOD = limit of detection.
LOQ = Limit of quantification.
QC = Quality control.
RPD = Relative Percent Difference.
SL = Screening Level.
SOP = Standard Operating Procedure.
TOC = Total Organic Carbon.

QAPP Worksheet #12-4: Measurement Performance Criteria

Matrix: Soil
Analytical Group: pH
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 47)	SW9045C (SOP T-WC-WI11518 or WS-WC-0028)	Bias Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Field Blank/ Equipment Blank	S&A
		Precision – Overall	RPD ≤ 50%	Field Duplicate	S&A
		Precision	Laboratory statistical RPD	Duplicates	S & A
		Accuracy/Bias	Laboratory statistical window	LCS	A
		Completeness	100%	Reported Sample Data	S & A

Note:
ASTM = American Society for Testing and Materials.
LCS = Laboratory control sample.
QC = quality control.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #12-5: Measurement Performance Criteria

Matrix: Soil
Analytical Group: Grain Size
Concentration Level: Low

Sampling Procedure	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil sampling (SOP 47)	ASTM D422 (SOP T-WC-WI11514 or BR-GT-006)	Precision – Overall	RPD ≤ 50%	Field Duplicate	S&A
		Precision	Laboratory statistical RPD	Lab Duplicate	S & A
		Completeness	100%	Reported Sample Data	S & A

ASTM = American Society for Testing and Materials.
QC = quality control.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

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QAPP Worksheet #13: Secondary Data Uses and Limitations

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

Notes:
* No historical site reports with soil and groundwater chemistry were available for review when developing this UFP-QAPP.
USGS = United States Geological Survey

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QAPP Worksheets #14 and 16: Project Tasks and Schedule

Task	Date
Pre-Mobilization	February 2021 thru May 2021
Mobilization	August 2021[1]
Fieldwork	Augsut 2021[1]
Demobilization	August 2021[1]
Data Review/Validation	September 2021
Reporting (Draft)	October 2021- November 2021

Note;

1. Dates may be adjusted to accommodate the facility schedule.

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QAPP Worksheet #15-1: Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater/Surface Water
Analytical Group: PFAS
Method: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental (Primary) and Eurofins TestAmerica Sacramento (Secondary)

Analyte	Acronym	CAS	SL Level (ng/L)	Eurofins Lancaster– Laboratory Limits (ng/L)			Eurofins TestAmerica Sacramento – Laboratory Limits (ng/L)		
				LOQ	LOD	DL	LOQ	LOD	DL
4:2 Fluorotelomer sulfonate	4:2 FTS	75124-72-4	--	2.00	1.00	0.50	20.00	15.00	5.2
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	--	5.00	4.00	2.00	40.00	20.00	7.00
8:2 Fluorotelomer sulfonate	8.2 FTS	39108-34-4	--	3.00	2.00	1.00	20.00	10.00	3.00
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	3.00	1.00	0.50	20.00	10.00	2.80
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	2.00	1.20	0.60	20.00	10.00	3.00
Perfluorobutane sulfonate	PFBS	375-73-5	600[1]	2.00	1.00	0.50	2.00	1.00	0.46
Perfluorobutanoic acid	PFBA	375-22-4	--	5.00	4.00	2.00	2.00	1.50	0.59
Perfluorodecane sulfonate	PFDS	335-77-3	--	2.00	1.00	0.50	2.00	1.50	0.56
Perfluorodecanoic acid	PFDA	335-76-2	--	2.00	1.00	0.50	2.00	1.00	0.48
Perfluorododecanoic acid	PFDoA	307-55-1	--	2.00	1.00	0.50	2.00	1.50	0.52
Perfluoroheptane sulfonate	PFHpS	375-92-8	--	2.00	1.00	0.50	2.00	1.00	0.37
Perfluoroheptanoic acid	PFHpA	375-85-9	--	2.00	1.00	0.50	2.00	1.50	0.61
Perfluorohexane sulfonate	PFHxS	355-46-4	--	2.00	1.00	0.50	2.00	1.00	0.38
Perfluorohexanoic acid	PFHxA	307-24-4	--	2.00	1.00	0.50	2.00	1.00	0.47
Perfluorononane sulfonate	PFNS	68259-12-1	--	2.00	1.00	0.50	2.00	1.00	0.4
Perfluorononanoic acid	PFNA	375-95-1	--	2.00	1.00	0.50	2.00	1.50	0.52
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	2.00	1.00	0.50	4.00	3.00	1.30
Perfluorooctane sulfonate	PFOS	1763-23-1	40[2]	2.00	1.00	0.50	4.00	3.00	1.10
Perfluorooctanoic acid	PFOA	335-67-1	40[2]	2.00	1.00	0.50	2.00	1.50	0.54
Perfluoropentane sulfonate	PFPS	2706-91-4	--	2.00	1.00	0.50	2.00	1.00	0.30
Perfluoropentanoic acid	PFPeA	2706-90-3	--	2.00	1.00	0.50	2.00	1.00	0.43
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	2.00	1.00	0.50	4.00	3.00	0.83
Perfluorotridecanoic acid	PFTrDA	72629-94-8	--	2.00	1.00	0.50	4.00	3.00	0.76
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	2.00	1.00	0.50	2.00	1.50	0.72

<table>
<tr><th rowspan="2">Analyte</th><th rowspan="2">Acronym</th><th rowspan="2">CAS</th><th rowspan="2">SL Level (ng/L)</th><th colspan="3">Eurofins Lancaster– Laboratory Limits (ng/L)</th><th colspan="3">Eurofins TestAmerica Sacramento – Laboratory Limits (ng/L)</th></tr>
<tr><th>LOQ</th><th>LOD</th><th>DL</th><th>LOQ</th><th>LOD</th><th>DL</th></tr>
<tr><td colspan="4">Acronyms:
CAS = Chemical Abstracts Service Registry Number.
DL = Detection Limit.
HA = Health Advisory.
HQ = Hazard Quotient.
LOD = Limit of Detection.
LOQ = Limit of Quantification.
ng/L = Nanogram(s) per liter.
RSL = Regional Screening Level.
SL = Screening Level.</td><td colspan="6">Notes:
[1]USEPA. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-Line Calculator. USEPA Office of Superfund. https://www.epa.gov/risk/regional-screening-levels-rsls. Accessed April 9, 2021
[2] Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense, 2019).</td></tr>
</table>

QAPP Worksheet #15-2: Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil/Sediment
Analytical Group: PFAS compounds
Method: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental (Primary) and Eurofins TestAmerica Sacramento (Secondary)

Analyte	Acronym	CAS	SL (µg/kg) 0-2 ft bgs	SL (µg/kg) >2 ft bgs	Eurofins Lancaster– Laboratory Limits (µg/kg)			Eurofins TestAmerica Sacramento – Laboratory Limits (µg/kg)		
					LOQ	LOD	DL	LOQ	LOD	DL
4:2 Fluorotelomer sulfonate	4:2 FTS	75124-72-4	--	--	2.00	1.60	0.60	2.00	1.00	0.37
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	--	--	2.00	1.60	0.60	4.00	2.00	0.66
8:2 Fluorotelomer sulfonate	8.2 FTS	39108-34-4	--	--	3.00	1.60	0.60	2.00	1.00	0.30
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	--	2.00	0.400	0.20	2.00	1.00	0.30
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	--	2.00	0.40	0.20	2.00	1.00	0.30
Perfluorobutane sulfonate	PFBS	375-73-5	1,900[1,3]	25,000[1,3]	2.00	1.60	0.40	0.40	0.18	0.059
Perfluorobutanoic acid	PFBA	375-22-4	--	--	2.00	1.60	0.60	0.30	0.20	0.098
Perfluorodecane sulfonate	PFDS	335-77-3	--	--	0.60	0.40	0.20	0.30	0.20	0.082
Perfluorodecanoic acid	PFDA	335-76-2	--	--	0.60	0.40	0.20	0.30	0.20	0.089
Perfluorododecanoic acid	PFDoA	307-55-1	--	--	0.60	0.40	0.20	0.30	0.20	0.10
Perfluoroheptane sulfonate	PFHpS	375-92-8	--	--	0.60	0.40	0.20	0.30	0.20	0.073
Perfluoroheptanoic acid	PFHpA	375-85-9	--	--	0.60	0.40	0.20	0.30	0.20	0.078
Perfluorohexane sulfonate	PFHxS	355-46-4	--	--	0.60	0.40	0.20	0.30	0.20	0.062
Perfluorohexanoic acid	PFHxA	307-24-4	--	--	0.60	0.40	0.20	0.30	0.20	0.071
Perfluorononane sulfonate	PFNS	68259-12-1	--	--	0.60	0.40	0.20	0.30	0.10	0.04
Perfluorononanoic acid	PFNA	375-95-1	--	--	0.60	0.40	0.20	0.30	0.20	0.081
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	--	0.60	0.40	0.20	0.40	0.30	0.12
Perfluorooctane sulfonate	PFOS	1763-23-1	130[2,3]	1,600[2,3]	0.60	0.40	0.20	1.00	0.50	0.24

Analyte	Acronym	CAS	SL (µg/kg) 0-2 ft bgs	SL (µg/kg) >2 ft bgs	Eurofins Lancaster– Laboratory Limits (µg/kg)			Eurofins TestAmerica Sacramento – Laboratory Limits (µg/kg)		
					LOQ	**LOD**	**DL**	**LOQ**	**LOD**	**DL**
Perfluorooctanoic acid	PFOA	335-67-1	130[2,3]	1,600[2,3]	0.60	0.40	0.20	0.30	0.20	0.10
Perfluoropentane sulfonate	PFPS	2706-91-4	--	--	3.00	0.40	0.20	0.30	0.10	0.04
Perfluoropentanoic acid	PFPeA	2706-90-3	--	--	0.60	0.40	0.20	0.30	0.20	0.066
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	--	0.60	0.40	0.20	0.40	0.30	0.11
Perfluorotridecanoic acid	PFTrDA	72629-94-8	--	--	0.60	0.40	0.20	0.30	0.20	0.10
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	--	0.60	0.40	0.20	0.30	0.20	0.10

Acronyms:
µg/kg = Microgram(s) per kilogram.
bgs = below ground surface.
CAS = Chemical Abstracts Service Registry Number.
DL = Detection Limit.
ft = feet.
HQ = Hazard quotient.
LOD = Limit of Detection.
LOQ = Limit of Quantification.
RSL = Regional Screening Level.
SL = Screening Level.

Notes:

[1] USEPA. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-Line Calculator. USEPA Office of Superfund. https://www.epa.gov/risk/regional-screening-levels-rsls. Accessed April 9, 2021

[2] Deputy Assistant Secretary of Defense. 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater using USEPA's RSL Calculator with HQ=0.1 (Deputy Assistant Secretary of Defense, 2019).

[3] The SL for soil is based on incidental ingestion of soil for two scenarios: residential 0-2 ft and industrial/commercial worker >2 ft. These SLs will be applied to the soil intervals reasonably anticipated to be encountered in these scenarios. The industrial/commercial worker screening levels are valid between 2-15 ft, no comparison will be made beyond 15 ft.

QAPP Worksheet #15-3: Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil/Sediment
Analytical Group: Total Organic Carbon
Method: SW9060A compliant with DoD QSM Version 5.3, Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental (Primary) and Eurofins TestAmerica Sacramento (Secondary)

Analyte	CAS	Eurofins Lancaster– Laboratory Limits (mg/kg)			Eurofins TestAmerica Sacramento – Laboratory Limits (mg/kg)		
		LOQ	LOD	DL	LOQ	LOD	DL
Total Organic Carbon	7440-44-0	300	200	100	4,000	2,000	902

Notes:
DL = Detection limit.
LOD = Limit of detection.
LOQ = Limit of quantitation.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.

QAPP Worksheet #15-4: Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil/Sediment
Analytical Group: pH
Method: SW9045C compliant with DoD QSM Version 5.3 or higher Table B-15
Laboratory: Eurofins Lancaster Laboratories Environmental (Primary) and Eurofins TestAmerica Sacramento (Secondary)

Analyte	**CAS**	**Eurofins Lancaster– Laboratory Limits (su)**			**Eurofins TestAmerica Sacramento – Laboratory Limits (su)**		
		LOQ	**LOD**	**DL**	**LOQ**	**LOD**	**DL**
pH	NA	0.01	0.01	0.01	0.1	0.1	0.1

Notes:
DL = Detection limit.
LOD = Limit of detection.
LOQ = Limit of quantitation.
su = Standard unit(s).
NA = Not applicable.

SLs for Soil and Groundwater

The DoD has adopted a policy to retain facilities in the CERCLA process based on conservative SLs for soil and groundwater, as described in a memorandum from the OSD dated 15 September 2021 (Assistant Secretary of Defense, 2021). The ARNG program under

which this SI will be performed follows this DoD policy and should the maximum concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to three compounds: PFOS, PFOA, and PFBS. Additionally, the USEPA issued drinking water lifetime Health Advisories (HAs) for PFOA and PFOS in May 2016 (USEPA 2016a; USEPA, 2016b). The USEPA HAs may also be used as SLs for groundwater samples collected at the facility boundary where off-facility drinking water wells are present downgradient. This determination will be based on localized groundwater flow direction established during the SI.

Analyte	Acronym	CAS	Residential (Soil) (µg/kg)[b] 0-2 ft bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[b] 2-15 ft bgs	Tap Water (Groundwater) (ng/L)	USEPA HA (Groundwater as Drinking Water) (ng/L)[d,e]
4:2 Fluorotelomer sulfonate	4:2 FTS	75124-72-4	--	--	--	--
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	--	--	--	--
8:2 Fluorotelomer sulfonate	8.2 FTS	39108-34-4	--	--	--	--
N-ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6	--	--	--	--
N-methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9	--	--	--	--
Perfluorobutane sulfonate	PFBS	375-73-5	1,900 [c]	25,000 [c]	600 [c]	--
Perfluorobutanoic acid	PFBA	375-22-4	--	--	--	--
Perfluorodecane sulfonate	PFDS	335-77-3	--	--	--	--
Perfluorodecanoic acid	PFDA	335-76-2	--	--	--	--
Perfluorododecanoic acid	PFDoA	307-55-1	--	--	--	--
Perfluoroheptane sulfonate	PFHpS	375-92-8	--	--	--	--
Perfluoroheptanoic acid	PFHpA	375-85-9	--	--	--	--
Perfluorohexane sulfonate	PFHxS	355-46-4	--	--	--	--
Perfluorohexanoic acid	PFHxA	307-24-4	--	--	--	--
Perfluorononane sulfonate	PFNS	68259-12-1	--	--	--	--
Perfluorononanoic acid	PFNA	375-95-1	--	--	--	--

Analyte	Acronym	CAS	Residential (Soil) (µg/kg)[b] 0-2 ft bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[b] 2-15 ft bgs	Tap Water (Groundwater) (ng/L)	USEPA HA (Groundwater as Drinking Water) (ng/L)[d,e]
Perfluorooctanesulfonamide	PFOSA	754-91-6	--	--	--	--
Perfluorooctane sulfonate	PFOS	1763-23-1	130 [a]	1,600 [a]	40 [a]	70[d]
Perfluorooctanoic acid	PFOA	335-67-1	130 [a]	1,600 [a]	40 [a]	70[d]
Perfluoropentane sulfonate	PFPS	2706-91-4	--	--	--	--
Perfluoropentanoic acid	PFPeA	2706-90-3	--	--	--	--
Perfluorotetradecanoic acid	PFTeDA	376-06-7	--	--	--	--
Perfluorotridecanoic acid	PFTrDA	72629-94-8	--	--	--	--
Perfluoroundecanoic acid	PFUnA	2058-94-8	--	--	--	--

Notes:

a.) Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019.

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

c.) Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-Line Calculator. USEPA Office of Superfund. https://www.epa.gov/risk/regional-screening-levels-rsls. Accessed April 9, 2021.

d.) USEPA. 2016a. Drinking Water HA for Perfluorooctanoic Acid (PFOA). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. USEPA Document Number: 822-R-16-005. May 2016. / USEPA. 2016b. Drinking Water HA for Perfluorooctane Sulfonate (PFOS). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. USEPA Document Number: 822-R-16-004. May 2016.

e.) USEPA HAs apply to the PFOS and PFOA concentrations individually or combined.

bgs = below ground surface.
CAS = Chemical Abstracts Service.
ft = feet.
HA= Health Advisory.
ng/L = nanograms per liter.
OSD= Office of the Secretary of Defense.
µg/kg = micrograms per kilogram.

QAPP Worksheet #17: Sampling Design and Rationale

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

The objective of the SI is to identify whether there has been a release to soil and groundwater (if present) at each AOI and determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs. As discussed in **Worksheet #10**, one potential source areas/AOIs were identified at the Rochester AASF #2. Regional shallow groundwater flow at the Rochester AASF #2 is predominantly to the east towards the Genesee River.

- AOI 1 Old Hangar / New Hangar / Hazardous Waste Storage Shed: The Old Hangar, New Hangar, and Hazardous Waste Storage Shed are located in the southeastern portion of the Greater Rochester International Airport.
  - The Old Hangar houses two 500-gal 3% AFFF storage tanks connected to a deluge system within the boiler room, which was previously connected to an underground storage tank before the tank was removed in 2007 and replaced with a 25,000-gal AST. Three 36-gal 3% AFFF mobile storage tanks are also located within the Old Hangar.

    In 2017, there was a release of AFFF and water within the boiler room caused by the malfunction of the bladders on the two 500-gal 3% AFFF storage tanks. Documented reports state the release, which flowed into the Old Hangar, was contained by the deluge system within the 25,000-gal AST. Due to general hydraulics, the floor drains within the hangar have a pump room to force the liquids into the above ground storage tank, which could also be a potential release point. Following the event, the 500-gal AFFF storage tanks were refilled with 3% AFFF. The contents of the 25,000-gal AST were later emptied and disposed of by a contractor.
  - The New Hangar was established in 2008 and contains a fire pump room containing one 300 gal 1.5% AFFF storage tank that connects to a deluge system that is hooked to the same 25,000-gal AST as the Old Hangar. Seven 5-gal buckets of 3% AFFF left over from the 2007 retrofitting event. Two 36-gal 3% AFFF mobile tanks are also located within the New Hangar.
  - The Hazardous Waste Storage Shed is located adjacent to the New Hangar. One 55-gal drum of 3% AFFF, also left over from the 2007 retrofitting event, was observed inside the shed.
- Facility Boundary: Sample locations are located at the facility boundaries in order to assess potential PFAS contamination migrating on-site from off-facility adjacent source areas as well as potential PFAS contamination migrating off-site from the AOI.

Environmental media samples will be collected from the AOIs in accordance with the applicable CSM, as summarized in **Table 17-1**. Temporary monitoring wells will be installed where PFAS were potentially released and downgradient of the potential source areas.

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

SAMPLING TASKS

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

- Worksheet #17a – Mobilization/Utility Clearance
- Worksheet #17b – Direct Push Boring Installation with Soil Sampling
- Worksheet #17c – Temporary Groundwater Monitoring Well Installation and Grab Groundwater Samples
- Worksheet #17d – Synoptic Water Level Measurements
- Worksheet #17e – Location and Elevation Mapping
- Worksheet #17f – Investigation-Derived Waste Management

Table 17-1: Site Inspection Sample Count

AOI	Potential PFAS Release Area	# of DPT Borings	Approximate Depth (ft bgs)	Groundwater Samples	Soil Samples
1	Old Hangar/ New Hangar/ Hazardous Waste Storage Shed	4	42 ft bgs, DPT	4	12
Facility Boundary	Up-gradient	7	42 ft bgs DPT	7	21
Total (not including QC)		11	--	11	33

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

AOI = area of interest.
Bgs = below ground surface.
DPT = direct push technology.
ft = feet.
NA = not applicable.
QC = quality control.

QAPP Worksheet #17a
Sampling Design and Rationale
Mobilization/Utility Clearance

SITE PREPARATION

The site preparation activities for the SI field investigation operations include mobilization of field team personnel and equipment. Additionally, an access roster will be submitted to the NYARNG one week in advance of scheduled field activities. No vegetation clearance is planned during field investigation activities.

PFAS SITE WATER SUPPLY SAMPLING AND SAMPLING EQUIPMENT ACCEPTABILITY

Water used in the initial rinse step of the decontamination process will be confirmed to be less than or equal to 1/5 the screening levels based on analytical testing of the water. This water may be provided from an onsite source or an offsite source (with approval from ARNG). If water testing results are not available or acceptable to ARNG, early mobilization will be conducted to collect a local water sample to determine if the local water meets the criteria for the initial rinse decontamination water (</= to 1/5 SLs). If rinse water is determined to be greater than 1/5 the screening level and/or it is anticipated that large volumes of water will be introduced as part of the drilling process, the ARNG project manager should be consulted prior to using the water for decontamination. Laboratory certified PFAS-free water[4] will be brought onsite to perform final rinse decontamination procedures on equipment.

All materials being purchased or rented for field work will be confirmed as acceptable for use in the PFAS sampling environment. A summary of acceptability of materials for use in the PFAS sampling environment is provided in SOP No. 073 (**Appendix B**).

PERSONNEL QUALIFICATIONS

All personnel mobilized to the site will meet applicable Occupational Safety and Health Administration training requirements including hazardous waste operations and emergency response (HAZWOPER) training and medical surveillance requirements as specified in the Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). Personnel will be required to complete the DoD's *Operations Security Awareness for Military Members, DoD Employees, and Contractors* and *Level 1 Antiterrorism Awareness Training*. Additionally, all employees that will be performing field work will review SOPs to ensure they follow proper PFAS-specific procedures.

PERMITS AND NOTIFICATIONS

Utility clearance will be conducted by NYARNG with input from the EA field team. A minimum of 2 weeks to coordinate the clearance will be required. EA must ensure that a thorough mark-

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[4] "PFAS-free" indicates that the water is certified by the lab as "ND" when compared to the laboratory LODs for PFOA/PFOS/PFBS.

out at the site is completed to locate electrical, gas, telephone, water, sewer, low voltage electric lines, product delivery pipelines, fiber optic, and all other subsurface utilities/services. EA or its drilling subcontractor will contact the local one-call utility location system to mark public utilities after proposed drilling locations are marked. EA and the drilling subcontractor will participate in a Rochester AASF #2 orientation prior to initiating work, if required. The determination of the orientation requirement will be made after final intrusive investigation locations are determined. The EA Project Manager or his/her designee must complete the Subsurface Utility Clearance Checklist found in SOP No. 003. A site walk will be scheduled with the appropriate state ARNG personnel to mark out locations of the subsurface utilities. All field work will be coordinated with the state ARNG Environmental Manager and/or his/her designee. In addition, hand or “soft” digging (e.g., hand auger) to a depth of 5 ft bgs will be completed at all boring locations prior to drilling with mechanical drill tools.

HEALTH AND SAFETY REQUIREMENTS

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

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

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

Community Air Monitoring

Community air monitoring will be performed in accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP), Attachment 1A of the NYSDEC Division of Environmental Remediation-10 Technical Guidance for Site Investigation and Remediation (Appendix C). Air monitoring activities will be implemented to protect the community from any potential airborne releases that could result from field activities associated with the SI (NYSDEC, 2010).

Continuous air monitoring will be performed in the vicinity of the drill rig when intrusive activities are underway. Air monitoring will consist of a dust monitor placed on a tripod adjacent to the work areas, in a downwind location. Background (upwind) levels will be measured each day prior to start-up of site activities and periodically throughout the day. If particulate levels (PM10) are greater than 100 micrograms per cubic meter (µg/m3) above background for a 15-minute period, or if airborne dust is observed leaving the work area, dust suppression techniques will be employed. Work will continue with these suppression techniques provided that PM10 levels do not exceed 150 µg/m3 above background and no visible dust is migrating from the work area. If PM10 exceeds 150 µg/m3 over background, work will be stopped, and a re-evaluation of activities will be initiated.

QAPP Worksheet #17b
Sampling Design and Rationale
Direct-Push Boring Installation and Soil Sampling

Borings will be advanced via DPT drilling methods at locations designated for soil sample collection (SOP Nos. 025 and 047). Surface soil samples (approximately 0-2 ft bgs) will be collected from a decontaminated hand auger used to clear the boring locations to 5 ft bgs. Two subsurface soil samples will be collected at each boring location using a decontaminated GeoProbe® sampling system, if possible: one midpoint subsurface soil sample between the surface and groundwater table (not to exceed 15 ft bgs), and one sample approximately 1 ft above the groundwater table (at approximately 37 ft bgs). If refusal is encountered before the desired depth of sample location, two additional attempts will be made adjacent to the original location. The first step-off attempt will be within 5-10 ft of the original boring, and the second attempt at a location further downgradient to be determined by the project team. If refusal is encountered at 6 ft bgs or shallower, only two samples will be collected per boring: one surface soil sample (0 to 2 ft bgs) and one sample approximately 1 ft above refusal with no groundwater sample. All drilling materials will be PFAS-free. During intrusive activities a Community Health and Safety Plan (CAMP) will be implemented.

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

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

Area of Interest	Number of Borings	Sample Collection Method	Target Depth (ft bgs)	Rationale
AOI 1	4	Hand Auger	0-5	3 borings surrounding AOI 1, located adjacent to the hazardous waste storage shed, the old hangar, and the pump room. Additionally, one sample is located immediately downgradient of AOI 1 to assess potential migration from all locations. The depth was determined by the likelihood of encountering the shallow aquifer.
		DPT	5-36	
Facility Boundary	7	Hand Auger	0-5	7 borings located along the facility boundary in order to assess potential PFAS contamination migrating on-site from potential off-facility sources as well as migration of potential contamination associated with the AOI to off-site locations. The depth was determined by the likelihood of encountering the shallow aquifer.
		DPT	5-36	

Area of Interest	Number of Borings	Sample Collection Method	Target Depth (ft bgs)	Rationale
Notes: AOI = area of interest. bgs = below ground surface. DPT = direct push technology. ft = foot/feet.				

The soil cores will be continuously logged for lithological descriptions by a field geologist using the Unified Soil Classification System (USCS) per SOP No. 016. A photoionization detector (PID) will be used to screen the breathing zone during boring activities. Observations and measurements will be recorded on field forms and in a non-treated field logbook. Photographs will also be taken of the boring cores. At a minimum, depth interval, recovery thickness, PID concentrations, moisture, relative density, color (using a Munsell soil color chart), and texture (using the USCS) will be recorded. Additional observations to be recorded may include groundwater or perched water depth, organic material, or cultural debris. If a continuous, competent clay layer is observed in a boring, measures will be taken to avoid completely penetrating a potential confining unit.

DPT borings will be abandoned using bentonite chips and hydrated at the completion of sampling activities. It is anticipated that all borings will be advanced in areas without surface cover; however, if a boring is required in asphalt, it will be abandoned by backfilling with bentonite chips to approximately 6 inches bgs, and the remainder of the borehole will be patched with an asphalt cold patch. Borings into concrete will be avoided, if possible; however, if borings are advanced into concrete, the borings will be abandoned by backfilling with bentonite chips to approximately 6 inches bgs, and the remainder of the borehole will be filled with concrete to provide as flush a surface as possible[5]. The surface at each location will be restored to match the surrounding area.

Quality Control (QC) samples will be collected in accordance with **Worksheet #20**. Field duplicate samples will be collected at a rate of 10 percent and analyzed for the same parameters as the accompanying samples. Matrix spikes/matrix spike duplicates (MS/MSDs) will be collected at the rate of 5 percent and analyzed for the same parameters as the accompanying samples. One Field Blank (FB) and one Equipment Blank (EB) will be collected per day and will be analyzed for PFAS. A temperature blank will be placed in each cooler to ensure that samples are preserved at or below 6 degrees Celsius (˚C) during shipment.

Each sample will be collected into laboratory-supplied bottleware and submitted to the laboratory for analysis of selected parameters. Samples will be analyzed for PFAS by liquid chromatography tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) Version 5.3 Table B-15. Additionally, one soil sample per AOI from a location in the source area will be analyzed for total organic carbon (TOC) (USEPA Method 9060A) and pH

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[5] EA is not responsible for restoring concrete areas to meet any structural integrity requirements.

(USEPA Method 9045D). Additionally, up to one soil sample[6] per AOI will be submitted for grain size analysis (American Society for Testing and Materials [ASTM] D-422) (i.e., clay content). The grain size analysis will be performed where extensive horizontal and vertical clay units are identified by the field geologist if these conditions are encountered in the field. All sample containers will be PFAS-free. The laboratory method detection limits (DLs) for these analytes are presented in **Worksheet #15** and a sampling summary is provided in **Worksheet #18**. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard chain of custody (CoC) procedures to the laboratory (see SOP No. 002).

QAPP Worksheet #17c
Sampling Design and Rationale
Temporary Groundwater Monitoring Well Installation and Grab Groundwater Samples

Boreholes for temporary wells will be created using Geoprobe® or Hydropunch® sampling equipment. Once the borehole has been advanced to the specified depth, the temporary well will be constructed of a 5-ft section of 1-inch Schedule 40 poly-vinyl chloride (PVC) screen with sufficient casing to reach ground surface. New PVC pipe will be used for each sampling location.

The target screen interval for each location will be the top of the groundwater table, which is expected to be encountered no deeper than 37 ft bgs. The boring will likely be advanced to 42 ft bgs and the screen will be installed from 37 to 42 ft bgs to ensure it adequately penetrates the water table.

The target screen intervals and rationale for the sampling locations are described in **Table 17-3**. The proposed sample locations are provided in **Figure 17-1** and described in **Worksheet #18**.

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

Area of Interest	# Temporary wells	Target Screen Interval (ft bgs)	Rationale
AOI 1	4	Top of groundwater table[1], (est 37-42 ft)	Determine PFAS presence/absence in the shallow aquifer.
Facility Boundary	7	Top of groundwater table[1], (est 37-42 ft)	Determine PFAS presence/absence in the shallow aquifer.

Notes:
1. Actual groundwater depth will be determined in the field.
AOI = area of interest.
bgs = below ground surface.
ft = feet.

A grab groundwater sample will be collected at each temporary well using a peristaltic pump with tubing that has been determined to be PFAS-free (i.e. high-density polyethylene [HDPE] or other PFAS-free material). If the peristaltic pump cannot generate enough hydraulic lift to bring

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[6] Based on regional geologic information, it is anticipated that borings will not be advanced deeper than the natural surficial formation and TOC, pH, and grain size analysis will be performed for samples collected within the same depth interval as samples collected for PFAS analysis. However, if a noticeable variation in geology is noted during boring advancement, an additional sample may be added for TOC, pH, and grain size analysis for a given AOI.

the groundwater to the surface, groundwater samples will be collected using a PFAS-free 0.85-inch Geotech Bladder pump or other sampling device such as a PFAS-free disposable bailer.

An attempt will be made to purge each well to remove sediment and meet the water quality indicator parameter values detailed on pages 3 and 4 of SOP No. 051. Purging will be dependent on groundwater recharge within the well. If sufficient groundwater recharge is observed, the well will be purged until a turbidity reading of ≤ 25 nephelometric turbidity units (NTU) is achieved. However, if turbidity is not < 25 NTU following three 20-minute purge cycles, a sample will be collected regardless, and the lab will be notified of elevated turbidity. In wells with limited groundwater recharge, the sample will be collected using the available groundwater.

Any non-dedicated sampling materials will be decontaminated between boring locations. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen [DO], oxidation-reduction potential [ORP]) will be measured and recorded, once every 5 minutes per SOP 014, on the field sampling form during the collection of the grab sample. Water quality parameters will be measured using a water quality meter and flow-through cell or dedicated PFAS free container.

Each sample will be collected into laboratory-supplied bottleware and submitted to the laboratory for analysis of selected parameters (PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15) (DoD, 2018) as per SOP No. 039. In addition, a subsample of each groundwater sample will be collected in a separate container and undergo a shaker test to identify if there is any foaming. If foaming is observed, the observation will be noted on the CoC to notify the laboratory prior to analysis. All sample containers will be PFAS-free, and the aqueous samples will not be filtered. The laboratory method detection limits for these analytes are presented in PQAPP Worksheet #15. QC samples will be collected in accordance with **Worksheet #20**. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard CoC procedures to the laboratory (SOP No. 002).

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

Groundwater levels will be used to monitor site-wide groundwater elevations and assess groundwater flow. Synoptic water level elevation measurements will be collected from the newly installed temporary monitoring wells (as shown on **Worksheet #18**). The temporary monitoring wells will have each water level measurement taken from the survey mark on the northern side of the well casing.

QAPP Worksheet #17e
Sampling Design and Rationale
Location and Elevation Mapping

A small notch will be cut on the northern side of the well casing which will be surveyed to a vertical accuracy of 0.01 ft. The top of casing and ground surface elevation will be surveyed for each newly installed temporary monitoring well. Survey data will be collected in the applicable

Universal Transverse Mercator zone projection with WGS84 datum (horizontal) and north American Vertical Datum 1988 (vertical).

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

Waste containing PFAS is not currently classified as a characteristic or listed hazardous waste based solely on the presence of PFAS. PFAS IDW is considered a non-hazardous waste and will be managed in accordance with USEPA management of IDW, ARNG guidance, and applicable state regulations (DA 2018).

Non-hazardous solid IDW (i.e., soil cuttings) generated during SI activities will be left in place at the point of the source, unless grossly contaminated (e.g., sheens, odors). The soil cuttings will be distributed on the downgradient side of the borehole. This IDW will not be sampled and will assume the PFAS characteristics of the associated soil samples collected from that source location.

Liquid IDW (i.e., purge water, decontamination water) generated during SI activities will be containerized in properly labeled 55-gal drums (see SOP No. 042) in accordance with the Army Guidance for Addressing Releases of PFAS and as discussed with USACE, NYARNG, and ARNG personnel during a teleconference conducted on 19 February 2021. The IDW will be stored at a location designated by the NYARNG Environmental Office. ARNG will coordinate waste profiling, transportation, and disposal of the solid and liquid IDW.

Coordinates of the selected IDW disposal area will be collected with a GPS unit and reported in the SI Report. Other solids such as spent PPE, plastic sheeting, tubing, rope, unused monitoring well construction materials, and other environmental media generated during the field activities will be disposed of off-site as municipal waste.

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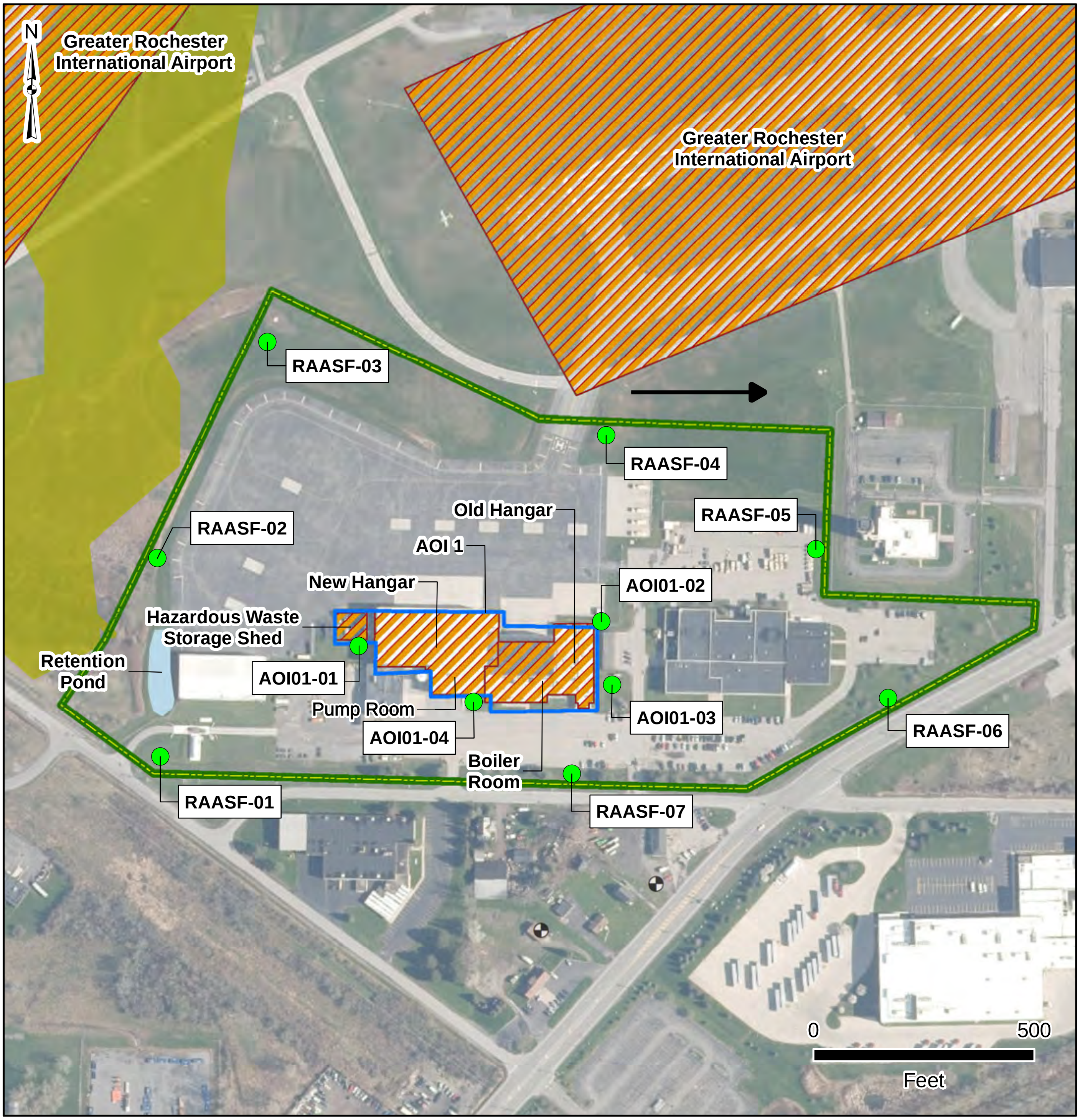
Army National Guard Site Inspections
Site-Specific Quality Assurance Project Plan
Rochester AASF, New York

Figure 17-1
Site Inspection Sample Locations



Facility Data

🟩 Facility Boundary
▭ Area of Interest
▨ Potential PFAS Release

Sample Locations

● DPT

Well Type

◐ USGS Inactive Monitoring Well

Hydrology/Hydrogeology

➔ Groundwater Flow Direction
Waterbody
Wetlands

Data Sources:
ESRI 2020
AECOM 2020

Date:................... .October 2021
Prepared By:..............................EA
Prepared For:....................USACE
Projection:........WGS 84 UTM 18N

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QAPP Worksheet #18: Sampling Locations and Methods

The table below describes the samples that will be collected during the Rochester AASF #1 SI. Note: Sampling SOPs can be found in Appendix A of the PQAPP.

AOI	Location Identifier	Sample Identifier	Matrix	Depth (ft bgs)	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
Soil Samples							
All	AOI01-01 AOI01-02 AOI01-03 AOI01-04 RAASF-01 RAASF-02 RAASF-03 RAASF-04 RAASF-05 RAASF-06 RAASF-07	AOI01-01-SB-[Depth] AOI01-02-SB-[Depth] AOI01-03-SB-[Depth] AOI01-04-SB-[Depth] RAASF-01-SB-[Depth] RAASF-02-SB-[Depth] RAASF-03-SB-[Depth] RAASF-04-SB-[Depth] RAASF-05-SB-[Depth] RAASF-06-SB-[Depth] RAASF-07-SB-[Depth]	Surface Soil	0-2	Hand Auger	PFAS (LC/MS/MS compliant with QSM Version 5.3, Table B-15) Limited Sample Selection (one sample per AOI[1]): TOC (USEPA Method 9060A) pH (USEPA Method 9045D) Limited Sample Selection (up to one sample per AOI): Grain Size/Clay Content (ASTM D-422)	No. 025 and 047
All	AOI01-01 AOI01-02 AOI01-03 AOI01-04 RAASF-01 RAASF-02 RAASF-03 RAASF-04 RAASF-05 RAASF-06 RAASF-07	AOI01-01-SB-[Depth] AOI01-02-SB-[Depth] AOI01-03-SB-[Depth] AOI01-04-SB-[Depth] RAASF-01-SB-[Depth] RAASF-02-SB-[Depth] RAASF-03-SB-[Depth] RAASF-04-SB-[Depth] RAASF-05-SB-[Depth] RAASF-06-SB-[Depth] RAASF-07-SB-[Depth]	Subsurface Soil	13-15	Geoprobe Dual-tube Sampling System	See Above	No. 025 and 047

AOI	Location Identifier	Sample Identifier	Matrix	Depth (ft bgs)	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
All	AOI01-01 AOI01-02 AOI01-03 AOI01-04 RAASF-01 RAASF-02 RAASF-03 RAASF-04 RAASF-05 RAASF-06 RAASF-07	AOI01-01-SB-[Depth] AOI01-02-SB-[Depth] AOI01-03-SB-[Depth] AOI01-04-SB-[Depth] RAASF-01-SB-[Depth] RAASF-02-SB-[Depth] RAASF-03-SB-[Depth] RAASF-04-SB-[Depth] RAASF-05-SB-[Depth] RAASF-06-SB-[Depth] RAASF-07-SB-[Depth]	Subsurface Soil	~1 ft above groundwater table (likely 36)	See Above	See Above	No. 025 and 047
Groundwater Samples							
All	AOI01-01 AOI01-02 AOI01-03 AOI01-04 RAASF-01 RAASF-02 RAASF-03 RAASF-04 RAASF-05 RAASF-06 RAASF-07	AOI01-01-GW AOI01-02-GW AOI01-03-GW AOI01-04-GW RAASF-01-GW RAASF-02-GW RAASF-03-GW RAASF-04-GW RAASF-05-GW RAASF-06-GW RAASF-07-GW	Groundwater	Mid-screen	Peristaltic pump or PFAS-free bailer	PFAS (LC/MS/MS compliant with QSM Version 5.3, Table B-15)	No. 013
Quality Control Samples							
NA	NA	RAASF-FB-01	Water Quality	NA	NA (Pour PFAS-free water)	PFAS (LC/MS/MS compliant with QSM Version 5.3, Table B-15)	NA

AOI	Location Identifier	Sample Identifier	Matrix	Depth (ft bgs)	Type (Sampling Tool)	Analyte/Analytical Group	Sampling SOP
NA	NA	RAASF-EB-01	Water Quality	NA	NA (Pour PFAS-free water)	PFAS (LC/MS/MS compliant with QSM Version 5.3, Table B-15)	NA
NA	NA	RAASF-PW-01	Decontamination Water Source (if needed)[2]	NA	NA (collect from tap or hose)	PFAS (LC/MS/MS compliant with QSM Version 5.3, Table B-15)	NA

Notes:

1. Based on regional geologic information, it is anticipated that borings will not be advanced deeper than the natural surficial formation and TOC, pH, and grain size analysis will be performed for samples collected within the same depth interval as samples collected for PFAS analysis. However, if a noticeable variation in geology is noted during boring advancement, an additional sample may be added for TOC, pH, and grain size analysis for a given AOI.
2. Laboratory certified PFAS-Free water will be brought onsite to be used for decontamination and equipment blanks. Alternatively, a sample from a nearby potable water source (onsite) will be collected prior to mobilization to confirm that the water is < or = to 1/5 the OSD SLs and it can be used for decontamination and equipment blanks.

AOI = area of interest.
ASTM = American Society for Testing and Materials.
bgs = below ground surface.
DPT = Direct-Push Technology.
ft = foot/feet.
GW = groundwater.
LC/MS/MS = liquid chromatography-tandem mass spectrometry.
NA = not applicable.
PFAS = perfluoroalkyl substances.
QSM = Quality Systems Manual.
SB = soil boring.
SOP = standard operating procedure.
TOC = total organic carbon.
USEPA = United States Environmental Protection Agency.

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QAPP Worksheets #19 and 30: Sample Containers, Preservation, and Hold Time

Laboratories:
Eurofins Lancaster Laboratories Environmental LLC (Primary)
2425 New Holland Pike
Lancaster, PA 17601
Phone: (717) 556-7327
Contact: Darlene Bandy, Darlene.Bandy@eurofinset.com
Accreditation/Expiration Date: DoD ELAP QSM Version 5.3 Certificate Number 0001.01/ November 30, 2022

Eurofins TestAmerica Sacramento (Secondary)
880 Riverside Parkway
West Sacramento, CA 95605
Phone: (916) 373-5600
Contact: David Alltucker, David.Alltucker@Eurofinset.com
Accreditation/Expiration Date: DoD ELAP QSM Version 5.3 Certificate Number L2468/ November 30, 2022

Sample Delivery Method: Laboratory Courier/Overnight Shipping

Analyte/ Analyte Group	Matrix	Method	Container(s) (number, size & type per sample)	Preservation	Maximum Holding Time (Preparation/ Analysis)	Data Package Turnaround
PFAS (Eurofins Lancaster)	Aqueous	LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15.	HDPE w/ HDPE screw cap 2 x 250mL	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14/28 days	28 business days
PFAS (Eurofins TestAmerica)	Aqueous	LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15.	HDPE w/ HDPE screw cap 2 x 250mL	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14/40 days	28 business days
PFAS (Eurofins Lancaster)	Solid	LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15.	2, 4.5-ounce HDPE	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14/28 days	28 business days

Analyte/ Analyte Group	Matrix	Method	Container(s) (number, size & type per sample)	Preservation	Maximum Holding Time (Preparation/ Analysis)	Data Package Turnaround
PFAS (Eurofins TestAmerica)	Solid	LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15.	2, 4-ounce HDPE jar	Chilled to 2-6 ºC for shipping, stored at ≤6 ºC	14/28 days	28 business days
Total Organic Carbon	Solid	SW9060A	1, 4-ounce glass jar (20 grams)	Cool ≤ 6 ºC	28 days	28 business days
pH	Solid	SW9045C	1, 4-ounce glass jar with Teflon lined lid (50 grams)	Cool ≤ 6 ºC	Analyze as soon as possible [1]	28 business days
pH	Water (IDW)	SW9040C	1, 250-mL	Cool ≤ 6 ºC	Analyze as soon as possible [1]	28 business days
Grain Size	Solid	ASTM D422	1, 16-ounce glass or plastic (500 grams)	None	None	28 business days

Notes:
1. Report sample temperature with pH.
°C = Degrees Celsius.
DoD = Department of Defense.
HDPE = High-density polyethylene.
LC/MS/MS = liquid chromatography-tandem mass spectrometry.
mL = milliliter.
PFAS = per- and polyfluoroalkyl substances.
QSM = Quality Systems Manual.
USEPA = United States Environmental Protection Agency.

QAPP Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Field Blanks	Equipment Blanks	Total Samples[1]
Groundwater	PFAS	11	2	1	1	1 per day	1 per day[1]	17
Soil	PFAS	33	4	2	2	NA	1 per day[1]	42
	pH, TOC[2]	1	NA	0	0	NA	NA	1
	Grain Size[2]	1	NA	NA	NA	NA	NA	TBD
Decontamination Water (if needed)[3]	PFAS	1	0	0	0	0	0	1

Notes:

1. Current total includes samples collected for one day of work and may increase depending on length of the sampling event.
2. Equipment blanks will be collected for all soil and water samples involving reusable equipment. No equipment blanks will be collected with samples that are collected directly from a tap/faucet.
3. Based on regional geologic information, it is anticipated that borings will not be advanced deeper than the natural surficial formation and TOC, pH, and grain size analysis will be performed for samples collected within the same depth interval as samples collected for PFAS analysis. However, if a noticeable variation in geology is noted during boring advancement, an additional sample may be added for TOC, pH, and grain size analysis for a given AOI.
4. Laboratory certified PFAS-Free water will be brought onsite to be used for decontamination and equipment blanks. Alternatively, a sample from a nearby potable water source (onsite) will be collected prior to mobilization to confirm that the water is < or = to 1/5 the OSD SLs and it can be used for decontamination and equipment blanks.

NA = not applicable.
PFAS = per- and polyfluoroalkyl substances.
TBD = to be determined.
TOC = total organic carbon.

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QAPP Worksheet #21: Project Field Standard Operating Procedure Reference Table

SOP Reference Number	Responsible Organization	Title	Equipment Type or Instrument	Comments
01	EA	Sample Labels	NA	Delineates protocols for the use of sample labels.
02	EA	Chain-of-Custody Form	NA	Delineates protocols for use of chain-of-custody forms.
03	EA	Subsurface Utility Clearance	NA	Delineates protocols for subsurface utility clearance.
04	EA	Sample Packing and Shipping	NA	Delineates protocols for packing and shipping of environmental samples for laboratory for analysis. Note: vermiculite will not be used in packing coolers.
05*	EA	Field Decontamination	NA	Describes procedures for decontamination of sampling equipment and site personnel.
07*	EA	Surface Water Sampling	NA	Delineates protocols for surface water sampling.
13*	EA	Collection of Monitoring Well Samples	NA	Delineates protocols for the collection of groundwater samples from monitoring wells.
14	EA	Collection of Production Well Samples	NA	Delineates protocols for the collection of groundwater samples from production wells.
16*	EA	Surface Water, Groundwater, and Soil/Sediment Field Logbooks	NA	Delineates protocols for filling out field logbooks.
19*	EA	Monitoring Well Installation	NA	Delineates protocol for installing monitoring wells
21*	EA	Sediment Sampling	NA	Delineates protocols for sediment sampling.
25*	EA	Soil Sampling	NA	Delineates protocols for soil sampling.
28	EA	Well and Boring Abandonment	NA	Defines protocols for well and boring abandonment.
42	EA	Disposal of Investigation-Derived Material	NA	Defines the required steps for disposing of investigation-derived waste (IDW) generated during field activities.
43	EA	Multi-Probe Water Quality Monitoring Instruments	NA	Defines the calibration and operation of a meter used during low flow sampling techniques
47	EA	Direct-Push Technology Sampling	NA	Defines field procedures for sampling using direct push technology
51*	EA	Low Flow Purge and Sampling with Dedicated Pumps	NA	Defines field procedures for purging and sampling using low flow sampling techniques
59	EA	Field Logbook	NA	Delineates protocols for recording field survey and sampling information in the Field Logbook.
73	EA	Sampling for Per- and Polyfluorinated Alkyl Substances	NA	Delineates protocols for collecting environmental samples for analysis of per- and polyfluorinated alkyl substances (PFAS), also known generally as perfluoroalkyl compounds or chemicals (PFCs).

SOP Reference Number	Responsible Organization	Title	Equipment Type or Instrument	Comments
75	EA	Collection of Water Samples from Faucets and Sample Ports	NA	Defines field procedures for collecting samples from wells used for drinking water and from Point of Use Treatment Systems and Point of Entry Treatment Systems.

Notes:
*SOP has been modified to meet the requirements associated with PFAS sampling.
IDW = investigation-derived waste.
NA = not applicable.
PFAS = per- and polyfluoroalkyl substances.
SOP = Standard Operating Procedure.

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

This worksheet documents 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 (CA).

Measurement Quality Objective	Activity/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response
Water Level Meter	Inspection, testing/ operator's manual	Daily	Team Lead/ Logbook	Functioning properly	Clean probe; replace battery; return to supplier/ manufacturer for repair
Multi-probe Water Quality Meter	Inspection and calibration/operator's manual	Daily	Team Lead/ Logbook	Functions and calibrates to standards	Clean probe; recalibrate; restart, replace battery
Turbidity Meter	Inspection and calibration/operator's manual	Daily	Team lead/ Logbook	Functions and calibrates to standards	Clean sample vial, recalibrate, restart, replace battery
Sampling Pump	Inspection, testing/ operator's manual	Daily	Team Lead/ Logbook	Functioning properly	Clean pump and/or trouble shoot or return to supplier/ manufacturer for repair
Handheld Global Positioning System (GPS) Unit	Inspection testing/ operator's manual	Daily	Team Lead/ Logbook	Positional error for the GPS less than ±1 meter	Reposition, replace battery
PID	Inspection, testing/ operator's manual	Daily	Team Lead/ Logbook	Functioning properly	Recalibrate; restart, replace battery

Measurement Quality Objective	Activity/ SOP Reference	Frequency	Responsible Person/ Report Method/ Verified by	Acceptance Criteria	Failure Response

Notes:
GPS = Global Positioning System.
PID = Photoionization Detector.
SOP = Standard Operating Procedure.

QAPP Worksheet #23: Analytical Standard Operating Procedures

The analytical and data validation SOPs summarized below are provided in Appendix D of the PQAPP. 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.

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania					
WI11572	Reactive Sulfide (titration) by SW-846 9034 (1996) or Chapter 7.3 (1996) in Solid or Liquid Waste, Rev 10, effective 3/8/19	Definitive	Solid or Water/ Reactive Sulfide	Flow Analyzer	N
WI11629	Total, Amenable, and Weak Acid Dissociable Cyanide in Water and Soils, Free Cyanide in Water, Reactive Cyanide of Solids, by SW-846 Method 9012A/B, EPA 335.4/3, and SM 4500-CN G/E-1999/2011, Rev 19, effective 11/27/18	Definitive	Solid or Water/ Cyanide	Flow Analyzer	N
WI11574	Reactivity of Waste, Rev 14, effective 8/7/14	Definitive	Solid or Water/ Reactivity	NA	N
WI10612	Flash Point for Liquids and Solids by ASTM D93 or EPA 1010A, Rev 10, effective 07/30/18	Definitive	Water/ Flash Point	Pensky Marten Closed Cup Tester	N
WI11880	Balances, Syringe, Pipette Verification, Rev 11, effective 8/31/2020	NA	Maintenance	Balance	N
WI11514	Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D-422-63, Rev 10, effective 1/24/19	Definitive	Soil/ Particle Size	Sieve	N
WI11931	Metals by ICP for Methods SW-846 6010/B/C/D (aqueous, solid, tissue) and EPA 200.7(aqueous) Rev 13, effective 07/17/2019	Definitive	Solid, liquid/ Metals	ICP	N
WI7965	Mercury in Aqueous, Solid, and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA, Rev 18, effective 08/12/2019	Definitive	Solid, liquid/ Metals	ICP	N

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania					
WI11924	Digestion of Aqueous Samples by SW-846 Method 7470A, Rev 21, effective 08/12/2019	NA	Liquid Inorganic Preparation SW-846 7470A	NA	N
WI10697	% Moisture Calculation and % Solids Calculation (Gravimetric) by SM 2540 G-1997 and SM 2540 G-2011, Rev 18; effective 06/08/20	Definitive	Solid/% Moisture	Analytical Balance/over 103-105 degrees	N
WI9238	Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD, Rev 6, effective 03/29/2018	Definitive	Water/ PCBs	GC	N
WI9999	Pesticides in Water by Method 8081B using GC-ECD, Rev 7, effective 03/29/2018	Definitive	Water/ Pesticides	GC	N
WI10920	Separatory Funnel Extraction by Method 3510C, 608, 608.3 or 622 for Pesticides and PCBs in Wastewater, Rev 21, effective 12/16/2019	NA	Organic Preparation Method 3510C	NA	N
WI10004	Polychlorinated Biphenyls (PCBs) in Solid Samples by 8082A using GC-ECD, Rev 9, effective 03/29/2018	Definitive	Solid/PCBs	GC	N
WI10927	Microwave Extraction Method 3546 for PCBs in a Solid Matrix, Rev 9, effective 10/31/2019	NA	Organic Preparation Method 3546	NA	N
WI9954	Interpretation of Chromatographic Data, Rev 14, effective 07/22/2019	NA	Data interpretation	GC & HPLC	N
WI9202	Analysis of Chlorinated Herbicides by 8151A in Water, Rev 17, effective 06/28/2019	Definitive	Water/Herbicides	GC	N
WI10919	Extraction of Chlorinated Herbicides in Water by SW-846 8151A, Rev 19, effective 03/11/2020	NA	Organic Preparation Method 8151A	NA	N
WI22030	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by Method 537 Revision 1.1 Modified QSM Version 5.3, Table B-15 Using LC/MS/MS, Rev 8.1, effective 1/28/2021	Definitive	Water/PFCs	LC/MS/MS	N

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania					
WI122283	Polyfluorinated Alkyl Substances (PFASs) in Solids by Method 537 Version 1.1 Modified QSM Version 5.3, Table B-15 Using LC/MS/MS Rev. 1.1 effective 1/28/2021	Definitive	Solids/PFCs	LC/MS/MS	N
WI25232	Perfluorinated Alkyl Substances (PFASs) in Drinking Water by Method 537.1, Rev 5, effective 09/08/20	Definitive	Drinking Water/PFCs	LC/MS/MS	N
WI12019	Maintenance and Tuning for Thermo Scientific TSQ Quantum Access Tandem Mass Spectrometer with a Thermo Electron Acella HPLC System (LC/MS/MS), Rev 1, effective 1/28/2010	NA	PFCs Maintenance	LC/MS/MS	N
WI11518	pH by EPA 9045C, 9045D and Corrosivity by SW-846 Chap 7 of Solids, Soils, and Solvents using Electrometric Methods, Rev 13, effective 07/08/2019	Definitive	Solid/pH	pH meter	N
WI11475	Multi-Parameters in Solids and Waters by Man-Tech Multi-Parameter System Rev 14; effective 3/20/2020	Definitive	Water	Man-Tech Multi-Parameter System	N
WI9617	Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS, Rev 12, effective 6/10/2020	Definitive	Water, solid, leachate/ GC/MS SVOCs	GC/MS	N
WI10935	Separatory Funnel Extraction (Method 3510C) or Waste Dilution (Method 3580A) of Base Neutrals and Acid Extractables in Leachates. Rev 14, effective 01/10/2020	Definitive	SVOC Prep	Prep	N
WI11627	Total Organic Carbon and Total Carbon in Solids and Sludges by Combustion by SM 5310B, EPA 415.1, SW-846 9060/9060A, Lloyd Kahn, Rev 17, effective 7/9/19	Definitive	Solids/TOC[7]	TOC Analyzer	N

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[7] Solids will be prepared by acid extraction prior to analysis using method 9060A.

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania					
WI8194	VOCs and GRO by GC/MS in Waters and Wastewaters by Method 8260C/D, Rev 9, effective 3/25/2020	Definitive	Water GC/MS VOCs	GC/MS	N
WI7258	Volatiles by Zero Headspace Extractor (ZHE) - Toxicity Characteristic Leaching Procedure (TCLP) by EPA 1311 and Synthetic Precipitate Leaching Procedure (SPLP) by EPA 1312, Rev 13, effective 07/17/19	NA	TCLP Extraction SW-846 1311	NA	N
WI7151	Nonvolatile- Toxicity Characteristic Leaching Procedure (TCLP) by EPA 1311 and Synthetic Precipitate Leaching Procedure (SPLP) by EPA 1312	Definitive	TCLP Extraction SW-846 1311	NA	N
Eurofins TestAmerica Sacramento, West Sacramento, California					
BR-GT-006	Particle Size Analysis (ASTM D422-63, D6913-17, and D7928-17)	Definitive	Solid / Sediments	NA	N
DV-WC-0048	Carbon in Soil (TOC, TC, TIC) [SW846 9060, 9060A]	Definitive	TOC, soil	TOC Analyzer	N
WS-WC-0028	Determination of Alkalinity, Conductivity, and pH, Rev 4.8, effective 11/18/2019	Definitive	Soil and water/pH	Man-Tech PC-Titration	N
WS-LC-0025	Per- and Polyfluorinated Alkyl Substances (PFASs) in Water, Soils, Sediments, and Tissue, [Method 537 (Modified), Method PFAS by LMSMS Compliant with QSM Table B-15, Rev. 5.3]. effective 1/27/2021	Definitive	Soil and Water/PFCs	LC/MS/MS	N
WS-DW-0004	Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Analysis by Liquid Chromatography/ Tandem Mass Spectrometry, Methods 537 and 537.1, Rev. 2.8, effective 6/17/2020	Definitive	Drinking Water/PFCs	LC/MS/MS	N

SOP No.	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania					

Notes:
GC = Gas chromatography.
GC/MS = Gas chromatography/mass spectrometry.
GRO = gas range organic.
HPLC = High-performance liquid chromatography.
ICP = Inductively coupled plasma.
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
N = No.
NA = not applicable.
PFC = perfluorinated Chemical.
QSM = Quality Systems Manual.
SOP = Standard Operating Procedure.
SPLP = Synthetic Precipitate Leaching Procedure.
TCLP = Toxicity Characteristic Leaching Procedure.
TOC = Total organic carbon.
URL = Uniform Resource Locator.
Y = Yes.

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QAPP Worksheet #24: Analytical Instrument Calibration Table

The calibration procedures, criteria, and corrective actions specified in this worksheet are in compliance with Table B-15 of the DoD QSM Version 5.3. The analytical SOPs referenced below are provided in Appendix D of the PQAPP. 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 (CA)	Person Responsible for CA	SOP Reference
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania						
LC/MS/MS	Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis. Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL).	Per manufacturer specifications. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	If the mass calibration fails, then recalibrate. If it fails again, consult manufacturer instructions on corrective maintenance.	Analyst	WI22030
LC/MS/MS	Tuning of LC/MS/MS	When masses fall outside ± 0.5 amu of true masses	Within 0.5 amu of true value	Retune and verify. If tuning fails acceptance criteria, perform a mass calibration, and repeat the tune check.	Analyst	WI22030, WI25232
LC/MS/MS	Mass Spectral Acquisition Rate	Each analyte and extracted internal standard analyte	A minimum of 10 spectra scans are acquired across each chromatographic peak	NA	Analyst	WI22030

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Initial calibration with a minimum 5 points	At instrument set-up and after initial or continuing calibration verification fails, prior to sample analysis	Analytes must be within 70-130% of their true value for each calibration standard. (Note: Per Method 537.1, low calibration standard must be within 50-150% of true value.) Per DoD QSM Table B-15, ICAL must meet one of the two options below: Option 1: The RSD of the RFs for all analytes must be ≤ 20%. Option 2: Linear or nonlinear calibrations must have r2 ≥ 0.99	Correct problem, then repeat ICAL.	Analyst	WI22030, WI25232
LC/MS/MS	LOD check standard	After each initial calibration	All compounds must be detected	Repeat ICAL procedure prior to analyzing samples. Repeat maintenance if needed.	Analyst	WI22030, WI25232
LC/MS/MS	Instrument Sensitivity Check	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at the LOQ. Analyte concentrations must be within ±30% of their true value	Correct problem and rerun ISC. If problem persists, repeat ICAL	Analyst	WI22030
LC/MS/MS	ICV Standard	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value	Correct problem, rerun the ICV and samples associated with the non-compliant ICV. If problem persists, repeat ICAL.	Analyst	WI22030, WI25232
LC/MS/MS	LOD standard	Quarterly	All compounds must be detected	Re-prep and reanalyze LOD.	Analyst	WI22030
LC/MS/MS	LOQ Verification	Quarterly	Within 50% of true value	Re-prep and reanalyze LOQ.	Analyst	WI22030

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	CCV Standard	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Per DoD QSM Table B-15: Concentrations of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value Per Method 537.1: The absolute areas of the quantitation ions for the internal standards (IS) must be within 70%-140% of the areas measured in the most recent CCV and within 50%-150% of the average areas measured during the most recent ICAL. The calculated amount for each target analyte and surrogate must be within ±30% of the true value for all CCVs except the low concentration CCV. For the low concentration CCV, each target compound must be within ±50% of the true value and each surrogate must be within ±30% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	Analyst	WI22030, WI25232

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis	Concentration of each analyte must be ≤1/2 LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed	Analyst	WI22030
pH	Calibration using at least 3 points, sloped with pH 4, 7, and 10 buffers	Daily	percent slope between 92% and 102%	Correct the problem and recalibrate	Analyst	WI11518, WI11475
pH	CCV Standard	After each calibration, every 10 samples, and end of batch	±10% D	Correct the problem, recalibrate, and reanalyze affected samples	Analyst	WI11518, WI11475
TOC Analyzer	Initial calibration with a minimum 4 points ranging from 0.3 mg C to 6 mg C	Monthly or after continuing calibration fails	$r^2 \geq 0.995$	Perform more aggressive instrument maintenance and recalibrate	Analyst	WI11627
TOC Analyzer	ICB Standard	After each initial calibration	No analytes detected > LOQ	Perform more aggressive instrument maintenance and recalibrate	Analyst	WI11627
TOC Analyzer	ICV Standard	After each initial calibration	Within +/- 10% of the nominal concentration	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.	Analyst	WI11627

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
TOC Analyzer	MDL Standard	Yearly	All compounds must be detected	Repeat ICAL procedure prior to analyzing samples. Repeat maintenance if needed.	Analyst	WI11627
TOC Analyzer	CCV Standard	If instrument is idle >4 hours, after every 10 field samples, and at the end of the sequence	Within +/- 10% of the nominal concentration	All affected samples are reanalyzed	Analyst	WI11627
TOC Analyzer	CCB Standard	If instrument is idle >4 hours, after every 10 field samples, and at the end of the sequence	No analytes detected > LOQ	All affected samples are reanalyzed	Analyst	WI11627
Eurofins TestAmerica Sacramento, West Sacramento, California						
Sieves ASTM D422	Sieve Calibration	Once every 6 months	Tolerances per Table 1 in SOP	Remove from service	Analyst	BR-QA-012
TOC Analyzer	Initial Calibration (ICAL) – Minimum 5-point calibration	Initial calibration. Perform instrument re-calibration once per year minimum.	r ≥ 0.995 (r2 ≥ 0.99)	Recalibrate	Analyst	DV-WC-0048
TOC Analyzer	Initial Calibration verification (ICV)	Second source standard, immediately following initial calibration	± 10%	Recalibrate	Analyst	DV-WC-0048

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
TOC Analyzer	Continuing calibration verification (CCV)	Each use, beginning, every 10 samples, end of batch	± 10%	Evaluate failure and impact on samples. If samples non-detect for analytes which have a high bias, report non-detect results with case narrative comment with written approval from the client. or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s), and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst	DV-WC-0048
pH Meter	Minimum three-point calibration with buffers of known pH.	Initial calibration prior to sample analysis	r ≥ 0.995	Evaluate buffers and instrument response. If problem found with above, correct as appropriate, then repeat initial calibration.	Analyst	WS-WC-0028
pH Meter	Initial calibration verification (ICV, Second Source)	Immediately following ICAL.	pH within 0.1 pH unit.	Evaluate data. If problem (e.g., concentrated standard, plugged lines) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Analyst	WS-WC-0028
Autotitrator	Daily calibration verification	After every 10 field samples, and at the end of the sequence.	All pH within 0.1 pH unit	Evaluate standard and response. If problem found with above, correct as appropriate, then repeat CCV. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification	Analyst	WS-WC-0028

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Mass Calibration	Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL).	Per manufacturer specifications. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	If the mass calibration fails, then recalibrate. If it fails again, consult manufacturer instructions on corrective maintenance.	Analyst	WS-LC-0025
LC/MS/MS	Minimum five-point initial calibration for target analytes, lowest concentration standard at or below the LOQ.	At instrument set-up and after initial or continuing calibration verification fails, prior to sample analysis	Each analyte must be within 70-130% of its true value for each calibration standard. (Note: Per Method 537.1, low calibration standard must be within 50-150% of true value.) Per DoD QSM Table B-15, ICAL must meet one of the two options below: Option 1: The RSD of the RFs for all analytes must be ≤ 20%. Option 2: Linear or nonlinear calibrations must have r2 ≥ 0.99	Correct problem, then repeat ICAL.	Analyst	WS-LC-0025, WS-DW-0004

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Instrument blanks	Immediately following the highest standard analyzed and daily prior to sample analysis	Concentration of each analyte must be ≤1/2 LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed	Analyst	WS-LC-0025
LC/MS/MS	Second-source or initial calibration verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value	Correct problem, rerun the ICV and samples associated with the non-compliant ICV. If problem persists, repeat ICAL.	Analyst	WS-LC-0025, , WS-DW-0004
LC/MS/MS	Instrument sensitivity check (ISC)	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at the LOQ. Analyte concentrations must be within ± 30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Analyst	WS-LC-0025

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Per DoD QSM Table B-15: Concentrations of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value Per Method 537.1: The absolute areas of the quantitation ions for the internal standards (IS) must be within 70%-140% of the areas measured in the most recent CCV and within 50%-150% of the average areas measured during the most recent ICAL. The calculated amount for each target analyte and surrogate must be within ±30% of the true value for all CCVs except the low concentration CCV. For the low concentration CCV, each target compound must be within ±50% of the true value and each surrogate must be within ±30% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	Analyst	WS-LC-0025, , WS-DW-0004

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference

Notes:
amu = Atomic mass unit(s).
C = Carbon.
CCB = Continuing calibration blank.
CCV = Continuing calibration verification.
DoD = Department of Defense.
EIS = Extracted internal standard.
ICAL = Initial calibration.
ICV = Initial calibration verification.
IS = internal standards.
ISC = Instrument sensitivity check.
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.
LOD = Limit of Detection.
LOQ = Limit of Quantitation.
MDL = Method detection limit.
mg = milligram(s).
NA = not applicable.
PFAS = per- and polyfluoroalkyl substances.
QSM = Quality Systems Manual.
RF = Response Factor.
RSD = Relative Standard Deviation.
SOP = Standard Operating Procedure.
TOC = Total Organic Carbon.

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania								
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 ±0.5 mg, 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	Analyst	SOP11880
Analytical balance	Annual calibration and maintenance	Annual calibration and maintenance	Annual calibration and maintenance	Annual	As per vendor's specifications in compliance with ISO certification	As per vendor's specifications in compliance with ISO certification	Analyst	SOP11880
pH/ion selective electrode (ISE) Meter	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	Analyst	WI11518
TOC Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	Analyst	WI10038

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS/MS	Backflush of column, injection port and pre-columns, cleaning of ion spray cone, adjustment of collision energies, others as needed	Calibration Check	Visual	As Needed	Initial calibration or calibration verification passes method specifications	Perform additional maintenance prior to instrument calibration or calibration verification	Analyst	WI12019

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Eurofins TestAmerica Sacramento, West Sacramento, California								
Sieves	Sieve Calibration	Sieve Calibration	Sieve Calibration	Once every 6 months	Tolerances per Table 1 in SOP	Remove from service	Analyst	BR-QA-012
TOC Analyzer	Replace disposables, check for leaks, change copper and tin as needed, clean purging cell	Analytical standards	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	DV-WC-0048
Pensky-Martens Closed Cup Apparatus	Replace Disposables, check for cracks and leaks, check waste	Analytical standards	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	DV-WC-0048

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	receptacles, wipe down instrument and any spills.							
pH meter	Inspect and clean electrode.	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	WS-WC-0028
LC/MS/MS	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	WS-LC-0025

Notes:
CCV = continuing calibration verification.
ISO = International Organization for Standardization.
TOC = Total Organic Carbon.
SOP = Standard Operating Procedure.
mg = milligram.
LC/MS/MS = Liquid Chromatography Tandem Mass Spectrometry.

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QAPP Worksheets #26 and 27: Sample Handling, Custody, and Disposal

Sampling Organization: EA Engineering, P.C. and its affiliate EA Science and Technology (EA)

Laboratory: Eurofins Lancaster Laboratories Environmental LLC, Lancaster, Pennsylvania and Eurofins TestAmerica Sacramento, West Sacramento, California

Method of sample delivery (shipper/carrier): Express Overnight or Next Day Air

Number of days from reporting until sample disposal: Minimum 30 days after final report sent to client (EA); unless there is a written request to hold them longer.

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample Collection	EA, Field Personnel	EA SOP 01
Chain-of-custody form completion	EA, Field Personnel	EA SOP 02
Packaging	EA, Field Personnel	EA SOP 04
Shipping coordination	EA, Field Personnel Laboratory Sample Receipt	NA
Sample receipt, inspection, & log-in	Laboratory, Sample Receipt	QA-QM11872; BR-QAMrev9.0; ETA Denver QAM; ETA WS-QAM
Sample custody and storage	Laboratory, Sample Receipt	QA-QM11872; BR-QAMrev9.0; ETA Denver QAM; ETA WS-QAM
Sample disposal	Laboratory, Sample Receipt	QA-QM11872; BR-QAMrev9.0; ETA Denver QAM; ETA WS-QAM

Activity	Organization and title or position of person responsible for the activity	SOP reference

Notes:
EA = EA Engineering, P.C. and its affiliate EA Science and Technology.
SOP = Standard Operating Procedure.
NA = not applicable.

QAPP Worksheet #28-1: Analytical Quality Control and Corrective Action

Matrix: Groundwater/ Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15/SOP WI22030 or WS-LC-0025

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected >1/2 LOQ 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 contaminated blank. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/ Laboratory Contamination	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Version 5.3, Table B-15 Appendix C Limits for batch control.	Flag outliers. Examine the project- specific requirements. Contact the client as to additional measures to be taken.	Analyst	Accuracy/ Bias/Precision	Results within acceptance limits

Matrix: Groundwater/ Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15/SOP WI22030 or WS-LC-0025

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Project-Specific MPC
LCS/LCSD	1 per prep batch of up to 20 samples	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Version 5.3, Table B-15 Appendix C Limits for batch control.	Correct problem, then re-extract and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/Bias /Precision	Results within acceptance limits
Isotopically Labeled Extraction Standards	Every sample (including MS/MSD, LCS, and blanks) prior to preparation	Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	Correct problem. If required, re-extract and reanalyze associated field and QC samples. If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-extracted and analyzed (greater dilution may be needed). Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure..	Analyst	Accuracy	Results within acceptance limits

Matrix: Groundwater/ Surface Water
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15/SOP WI22030 or WS-LC-0025

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Project-Specific MPC
Isotopically Labeled Injection Standards	Per sample (including MS/MSD, LCS, and blanks) prior to analysis	Absolute area must be -50% to +50% of the ICAL midpoint standard. On days when an ICAL is not performed the first CCV of the day is used.	Analyze a second aliquot of the extract. If none remains, reanalyze first aliquot and/or consult a supervisor to determine course of action	Analyst	Accuracy	Results within acceptance limits
Post Spike Sample	Aqueous samples prepared by serial dilution instead of SPE that have reported values <LOQ	70-130% recovery	Reanalyze sample, sample duplicate and post spike sample at higher dilutions until criteria is met	Analyst	Accuracy	Results within acceptance limits

Notes:
CCV = Continuing calibration verification.
DoD = Department of Defense.
ICAL = Initial calibration.
LCS = Laboratory control sample.
LCSD = Laboratory control sample duplicate.
LOQ = Limit of Quantitation.
MPC = Measurement performance criteria.
MS = Matrix spike.
MSD = Matrix spike duplicate.
QC = Quality control.
QSM = Quality Systems Manual.
SOP = Standard Operating Procedure.

QAPP Worksheet #28-2: Analytical Quality Control and Corrective Action

Matrix: Soil/Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15/SOP WI22283 or WS-LC-0025

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected >1/2 LOQ 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 contaminated blank. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/Laboratory Contamination	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Version 5.3, Table B-15 Appendix C Limits for batch control.	Flag outliers. Examine the project- specific requirements. Contact the client as to additional measures to be taken.	Analyst	Accuracy/Bias /Precision	Results within acceptance limits

Matrix: Soil/Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15/SOP WI22283 or WS-LC-0025

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Project-Specific MPC
LCS/LCSD	1 per prep batch of up to 20 samples	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. DoD QSM Version 5.3, Table B-15 Appendix C Limits for batch control.	Correct problem, then re-extract and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available. Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure.	Analyst	Accuracy/Bias /Precision	Results within acceptance limits
Isotopically Labeled Extraction Standards	Every sample (including MS/MSD, LCS, and blanks) prior to preparation	Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.	Correct problem. If required, re-extract and reanalyze associated field and QC samples. If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-extracted and analyzed (greater dilution may be needed). Samples may be re-extracted and analyzed outside of hold times, as necessary for corrective action associated with QC failure..	Analyst	Accuracy	Results within acceptance limits

Matrix: Soil/Sediment
Analytical Group: PFAS
Analytical Method/SOP: LC/MS/MS compliant with DoD QSM Version 5.3, Table B-15/SOP WI22283 or WS-LC-0025

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Project-Specific MPC
Isotopically Labeled Injection Standards	Per sample (including MS/MSD, LCS, and blanks) prior to analysis	Absolute area must be -50% to +50% of the ICAL midpoint standard. On days when an ICAL is not performed the first CCV of the day is used.	Analyze a second aliquot of the extract. If none remains, reanalyze first aliquot and/or consult a supervisor to determine course of action	Analyst	Accuracy	Results within acceptance limits

CCV = Continuing calibration verification.
DoD = Department of Defense.
ICAL = Initial calibration.
LCS = Laboratory Control Sample.
LCSD = Laboratory Control Sample Duplicate.
LOQ = Limit of Quantitation.
MPC = Measurement performance criteria.
MS = Matrix spike.
MSD = Matrix spike duplicate.
PFAS = per- and polyfluoroalkyl substances.
QC = Quality control.
QSM = Quality Systems Manual.
SOP = Standard Operating Procedure.

QAPP Worksheet #28-3: Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: Grain Size
Analytical Method/SOP: ASTM D422 SOP WI11514 or BR-GT-006

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Data Quality Indicator (DQI)	Project-Specific MPC
Duplicate	1 per batch	Laboratory statistical RPD	No corrective action, matrix related	Analyst	Analytical Precision	Results within acceptance limits

Notes:
MPC = Measurement performance criteria.
QC = Quality control.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #28-4: Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: pH
Analytical Method/SOP: SW9245C SOP WI11518 or WS-WC-0028

QC Sample	Number/ Frequency	Method/ SOP Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Project-Specific MPC
LCS	1 per batch	Laboratory statistical window	Correct problem, reprepare and reanalyze the LCS and all sample associated	Analyst	Accuracy/Bias	Results within acceptance limits
Duplicate	1 per 10 samples	Laboratory statistical RPD	No corrective action, matrix related	Analyst	Precision	Results within acceptance limits

Notes:
LCS = Laboratory Control Sample.
MPC = Measurement performance criteria.
QC = Quality control.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

QAPP Worksheet #28-5: Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: TOC
Analytical Method/SOP: SW9060 SOP WI11627 or DV-WC-0048

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

Notes:
LCS = Laboratory Control Sample.
LOQ = Limit of Quantitation.
MPC = Measurement performance criteria.
MS = Matrix spike.
ND = Non-detect.
QC = Quality control.
RPD = Relative Percent Difference.
SOP = Standard Operating Procedure.

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QAPP Worksheet #29: Project Documents and Records

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage location**
Field logbook or data collection sheets	Field Personnel	Task Manager	Project File
Chain-of-Custody Forms	Field Personnel	Task Manager	Project File
Shipping Records	Field Personnel	Task Manager	Project File
Daily Quality Control Reports	EA Task Manager	EA Project Manager, CQCS	Project File
Log of Daily Notice Field Activity	EA Task Manager	EA Project Manager, CQCS	Project File
Deviations/Field Change Request Forms or notifications[8]	Field Personnel	Task Manager with concurrence from project team	Project File
Corrective Action Reports	Project Manager	CQCS	Project File/Reports
Correspondence	Field Personnel	Task/Project Manager	Project File

Laboratory Records			
Record	**Generation**	**Verification**	**Storage Location**
Laboratory sample receipt logs	Laboratory check-in staff	EA Database Administrator	Laboratory Files
Chain-of-Custody Forms	Laboratory check-in staff	EA Database Administrator/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	Lab QA Manager/EA Project Chemist	Project File/Reports
Correspondence	Laboratory Staff	EA Project Chemist	Project File

Project Assessments			
Record	**Generation**	**Verification**	**Storage Location**
Stage 2b Data Validation Checklist (groundwater, surface water, soil, sediment)	EA Project Chemist	EA Database Administrator	Project File/Reports
Stage 4 Data Validation Checklist (drinking water)	EA Project Chemist	EA Database Administrator	Project File/Reports
Data Validation Report	Data Validator	EA Project Chemist	Project File/Reports
Corrective Action Documentation	EA Task Manager/ Project Chemist	EA Project Manager, CQCS	Project File
Independent Technical Review Certification	Technical Reviewer	EA Task Manager	Project File
Inspection Checklists	EA Task Manager	EA Project Manager	Project File

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[8] Deviations/Field Change Requests may be caused by utilities, changes to site conditions, or accessibility issues and these changes may be required without advance warning while the sampling team is in the field sampling. The EA/Wood Team will discuss Deviations/Field Change Requests with the ARNG installation personnel and make every effort to discuss with USACE and ARNG POCs prior to implementing changes in the field.

Project Assessments			
Record	**Generation**	**Verification**	**Storage Location**
Non-Conformance Form	EA Project Manager	EA Program Manager	Project File

Laboratory Data Deliverable					
Record	**Drinking Water**	**Groundwater**	**Surface Water**	**Soil**	**Sediment**
Narrative	X	X	X	X	X
Chain-of-Custody Forms	X	X	X	X	X
Summary Results	X	X	X	X	X
QC Results	X	X	X	X	X
Level IV Data Package	X	X	X	X	X
EQuIS Electronic Data Deliverables	X	X	X	X	X

Notes:
CQCS = Contractor Quality Control Supervisor.
QA = Quality assurance.
QC = Quality control.

QAPP Worksheets #31, 32, and 33: Assessments and Corrective Action

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

Assessments:

Assessment Type	Responsible Party and Organization	Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Project Manager Review	Project Manager/ EA	Monthly (for field efforts that are longer than 1 month)	TBD	Email documenting findings	7 days after assessment
Review of Chain-of-Custody forms	Data Manager / EA	Daily	TBD	Email documenting findings	Within 24 hours
Laboratory Data Assessment (validation)	Data Validator	Once	TBD	Validation report	Within 1 month after receipt of data
Daily Quality Control Audits	Field Sampling Team Leader/ EA	Daily	TBD	Daily QC Report	Within 24 hours
Field Technical System Audits (TSA)	Field Sampling Team Leader/ EA	Daily	TBD	Email/ Daily QC Report	7 days after assessment
Field Performance Audits	Project Manager/ EA or representative	Weekly	TBD	Email/ Daily QC Report	7 days after assessment
Laboratory	Laboratory QA Manager	Per QA Manual	TBD	Email	Determined internally

Notes:
QA = Quality assurance.
QC = Quality control.
TBD = to be determined.

Assessment Response and Corrective Action:

Assessment Type	Person(s) Responsible for Responding to Assessment Findings	Nature of Corrective Action Response Documentation	Timeframe for Response	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
PM Review	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	Project Manager/ EA
Review of chain-of-custody forms	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	Project Chemist/ EA
Laboratory Data Assessment (validation)	Project Chemist/ EA	Email	Up to 1 Week after notification	Laboratory QA Manager	Project Chemist/ EA
Daily Quality Control Audits	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	QA Officer/ EA
Field Technical System Audits	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	QA Officer/ EA
Field Performance Audits	Field Sampling Team Leader/ EA	Daily QC Report/ Email	24 hours after notification	Field Sampling Team Leader/ EA	Project Manager/ EA
Laboratory	Laboratory Analysts	Email to file	Immediate correction – written documentation due within 1 week	Laboratory QA Manager	Laboratory PM

Notes:
CQCS = Contractor Quality Control Supervisor.
PM = Project Manager.
QA = Quality assurance.
QC = Quality control.
TBD = to be determined.

QAPP Worksheet #34: Data Verification and Validation Inputs

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 documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements.

Data Verification and Validation Inputs for Sampling

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved planning documents (i.e., QAPP)	**X**	
2	Contract	**X**	
3	Field SOPs	**X**	
4	Laboratory SOPs	**X**	
Field Records			
5	Field Logbooks/Field Forms	**X**	**X**
6	Equipment Calibration Records	**X**	**X**
7	Chain-of-Custody Forms	**X**	**X**
8	Sampling Diagrams/Surveys	**X**	**X**
9	Daily Field Log	**X**	**X**
10	Relevant Correspondence	**X**	**X**
11	Change Orders/Deviations	**X**	**X**
12	Field Corrective Action Reports	**X**	**X**
Analytical Data Package			
13	Cover Sheet (laboratory identifying information)	**X**	**X**
14	Case Narrative	**X**	**X**
15	Internal Laboratory Chain-of-Custody Records	**X**	**X**
16	Sample Receipt Records	**X**	**X**
17	Sample Chronology (i.e., dates and times of receipt, preparation, and analysis)	**X**	**X**
18	Communication Records	**X**	**X**
19	Project-Specific Proficiency Test Sample Results (if required)	**X**	**X**
20	LOD/LOQ Establishment and Verification	**X**	**X**
21	Standards Traceability	**X**	**X**
22	Instrument Calibration Records	**X**	**X**
23	Definition of Laboratory Qualifiers	**X**	**X**
24	Results Reporting Forms	**X**	**X**
25	QC Sample Results	**X**	**X**
26	Corrective Action Reports	**X**	**As Necessary**
27	Raw Data	**X**	**X**
28	Electronic Data Deliverable	**X**	**X**

Notes:
LOD = Limit of Detection.
SOP = Standard Operating Procedure.
LOQ = Limit of Quantitation.
QAPP = Quality Assurance Project Plan.
QC = Quality control.

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QAPP Worksheet #35: Data Verification Procedures

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 EA SOPs are provided in **Appendix B**.

Records Reviewed	Requirement Documents	Process Description	Frequency	Responsible Person
Field logbooks	EA SOP 05	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 documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed, and results are documented.	Daily End of Activity	EA Task Manager EA PM
Chain-of-custody forms	EA SOP 12	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. 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 for transcription errors.	Daily End of Activity	EA Field Team EA Program Chemist or designee

Records Reviewed	Requirement Documents	Process Description	Frequency	Responsible Person
Laboratory Deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. 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 QAPP. Verify that necessary signatures and dates are present.	Before release Upon receipt	Lab QA Manager EA Program Chemist or designee
Electronic data	QAPP	Electronic laboratory data and field data.	Daily	EA Database Administrator/EA PM
Daily and Weekly QC Report	QAPP, Quality Control Plan	All QC reports are complete for each field day/week.	Daily/Weekly	EA Task Manager
Audit Reports, CA Reports	QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that CA was implemented according to plan.	As required	CQCS

Notes:
CA = Corrective Action.
CQCS = Contractor Quality Control Supervisor.
EA = EA Engineering, P.C. and its affiliate EA Science and TechnologyPM = Project Manager.
QA = Quality assurance.
QAPP = Quality Assurance Project Plan.
QC = Quality control.
SOP = Standard Operating Procedure.

QAPP Worksheet #36: Data Validation Procedures

The PFAS data for groundwater, surface water, soil, and sediment will be validated to a Stage 2B and drinking water will be validated to a Stage 4 standard, including DoD QSM Version 5.3, Table B-15 requirements. TOC, pH, and grain size data collected for the soil samples and data collected for IDW characterization will not undergo data validation.

Data Validator: Wood

Analytical Group/Method:	PFAS
Data deliverable requirements:	EQUIS Electronic Data Deliverables and Level 4 Type PDF Data Package
Analytical specifications:	Worksheet #28, SOPs (Worksheet #23)
Measurement performance criteria:	Worksheet #12
Percent of data packages to be validated:	100 percent
Percent of raw data reviewed:	Drinking Water Only (S4VM validation)
Percent of results to be recalculated:	Drinking Water Only (S4VM validation)
Validation procedure:	DoD *General Data Validation Guidelines Revision 1*; DoD Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Version 5.3, Table B-15 (DoD, 2019a) (DoD, 2019b) (DoD 2020)
Validation code:	S2bVM, and S4VM (Drinking Water Only)
Electronic validation program/version:	NA

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 customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

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QAPP Worksheet #37: Data Usability Assessment

This worksheet documents procedures that will be used to perform the data usability assessment (DUA). Third-party data validation will be performed on the data set by Wood. The data validation team is separate from the Wood Team conducting the SIs. The Data Validation Report will follow the procedures given in Worksheet #36. The DUA is performed at the conclusion of data collection activities, using the outputs from data verification and data validation (Worksheets #35 and #36). The DUA will be documented as a discussion within the SI report and refer to the Data Validation Report that will appear in an appendix of the SI Report.

Identify personnel (organization and position/title) responsible for participating in the data usability assessment:

- Project Manager: Mike O'Neill
- CQCS: Frank Barranco
- Program Chemist: Samantha Saalfield
- SI Task Lead: Mike Kepner

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., Project Quality Objectives or DQOs and MPC) to 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 deviations from planned activities (e.g., number and locations of samples, damaged samples, and SOP deviations) and determine their impacts on the data usability. Assess data quality indicators including precision, accuracy, representativeness, completeness, comparability, and sensitivity, as described in detail below. Evaluate implications of unacceptable QC sample results.
- Step 3
  - Verify the assumptions of the selected statistical method.
    - Verify whether underlying assumptions for selected statistical methods (if documented in the QAPP) 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, then another statistical method may need to be selected.
- Step 4
  - Implement the statistical method.

    - Implement the specified statistical procedures for analyzing the data and review underlying assumptions. For decision projects that involve hypothesis testing (e.g., "concentrations of lead in soil are below the action level") consider the consequences for selecting the incorrect alternative; for estimation projects (e.g., establishing a boundary for surface soil contamination), consider the tolerance for uncertainty in measurements.
- Step 5
  - Document data usability and draw conclusions.
    - Determine if the data can be used as intended, considering implications of deviations and corrective actions. Discuss data quality indicators. Assess the performance of the sampling design and Identify limitations on data use. Update the conceptual site model and document conclusions. Prepare the data usability summary report which can be in the form of text and/or a table.

Summary of Data Quality Indicators

The data usability assessment will include a summary of whether the data achieved the project DQOs, as well as a data quality and usability statement. A description of each data quality indicator is found under each parameter heading below. Precision, accuracy/bias, representativeness, comparability, and completeness, as well as sensitivity, are the data quality indicators used to validate and assess the data produced during the project. Each data quality indicator is described below including a definition of the terminology, the referenced process for calculating the indicator, and the referenced measurement performance criteria for this project. Specific data quality indicators and their specific measurement performance criteria to be evaluated for data usability are presented on Worksheet #12 and Worksheet #28.

To measure and control the quality of analyses, certain QA parameters are defined and utilized in data analysis activities. These QA parameters are defined below. The assigned subcontract laboratory will generally follow the QA/QC criteria specified in the applicable EPA method.

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms. QC measures for precision include field duplicates, laboratory duplicates, MSDs, and analytical replicates.

To meet the needs of the data users, project data must meet the measurement performance criteria for precision specified in UFP-QAPP Worksheets #12 and #28 and supporting worksheets. Precision may be the result of one or more of the following: field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or spatial variation (heterogeneous sample matrices). To identify the cause of imprecision, the field sampling design rationale and sampling techniques will be evaluated by the reviewer, and both field and analytical duplicate/replicate sample results will be reviewed. The process for calculating precision will be in accordance with the UFP-QAPP Manual, Section 2.6.2.1 (EPA 2005a).

Duplicate precision is stated in terms of RPD or absolute difference between two measurements. Measurement of precision is dependent upon sampling technique and analytical method. Field duplicate and laboratory duplicate samples will be used to measure precision for project samples. Both sampling and analysis will be as consistent as possible. For a pair of measurements, RPD (or absolute difference) will be used, as presented below:

$$\text{RPD}\ (\%) = \frac{|D_1 - D_2|}{\frac{(D_1 + D_2)}{2}} \times 100$$

where: D_1 and D_2 = the two replicate values.

RPD will meet QA requirements listed in this UFP-QAPP and the DoD QSM.

If poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the sampling technique, field instrument variation, sample transport, and/or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular data set or sample delivery group, then the impact of that imprecision on usability will be considered prior to use.

Analytical Accuracy/Bias

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) that are due to sampling and analytical operations. Examples of QC measures for accuracy include MS, LCS, equipment blanks, and surrogates. In order to meet the needs of the data users, project data must meet the measurement performance criteria for accuracy/bias specified in UFP-QAPP Worksheets #12 and #28. The process for calculating accuracy/bias will be in accordance with the UFP-QAPP Manual, Section 2.6.2.2.

Sources of error include the sampling process, field contamination, preservation, handling, shipping, sample matrix, sample preparation, and analysis technique. Analytical accuracy will be assessed through surrogate spike, MS, laboratory control and/or quality check samples, where applicable. In general, accuracy is measured in terms of percent recovery (%R):

$$\%\text{R} = \frac{(\text{SSR} - \text{SR})}{\text{SA}} \times 100$$

where:
SSR = spike sample result
SR = sample result
SA = spike added to spiking matrix

Percent recoveries will meet the QA requirements listed in the RPD will meet QA requirements listed in this UFP-QAPP and the DoD QSM.

Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the proper design and implementation of the sampling program and proper laboratory protocol. The process for calculation representativeness will be in accordance with the UFP-QAPP Manual, Section 2.6.2.4.

The sampling protocol created for this project was designed to provide data from biased sampling locations to assess presence or absence. During the development of the sampling protocol, consideration was given to the past history of the site, existing analytical data, physical setting, and processes. Representativeness will be satisfied by determining that the UFP-QAPP is followed, proper sampling techniques, preservation, and handling are used, proper analytical procedures are followed, and holding times for the samples are not exceeded in the laboratory.

This UFP-QAPP discusses how the QA/QC activities (review of sampling design and SOPs, field sampling technical systems audits, split sampling, and analysis audits, etc.) and QC sample data will be reviewed to assess sample representativeness. For samples collected, if field duplicate precision checks indicate potential spatial variability, additional scoping meetings and subsequent sampling may be needed in order to collect data that are more representative of the site.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was planned to be obtained. In order to meet the needs of the data users, project data must meet the measurement performance criteria for data completeness specified in UFP-QAPP Worksheets #12.

A completeness check will be done on the data generated by the laboratory. The completeness criterion for this project is 100% for each DU/analyte/data use. Completeness will be calculated for each analyte as follows (UFP-QAPP Manual Section 2.6.2.6). For each analyte, completeness will be calculated as the number of valid (usable) data points for each analyte, divided by the total number of data points for each analyte.

Following the completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness (\%)} = \frac{\text{number of usable data}}{\text{number of samples collected for each parameter analyzed}} \times 100$$

The completeness acceptance criterion for samples collected in the field will be 100% of the quantity of samples planned for collection in the UFP-QAPP. Corrective action may be implemented to re-collect samples where necessary and possible (e.g., modifying a planned sample location, sample jars broken during shipment). Laboratory notification of sample receipt and conditions will be used to evaluate, as soon as possible, whether any problems during sample shipment would necessitate recollection of samples.

Comparability

Comparability is the degree to which different methods, data sets, and decisions agree or can be represented as similar. Comparability describes the confidence (expressed qualitatively or quantitatively) that two data sets can contribute to a common analysis and interpolation.

The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data are expected to provide comparable data. The procedures used will be EPA methodologies or other standard test methods, which are well recognized and commonly used for environmental investigations.

Desired Method Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a method detection limit study, and calibration standards at the quantitation limit. To meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity specified in Worksheet #12 and SLs specified in Worksheet #15 of this UFP-QAPP.

Depending upon the use of the data and the type of test parameter, specific QLs will be required. Worksheet #15 lists the SLs for the chemical parameters of interest for this work. The analytical methods used for this project should have sensitivities below these criteria.

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REFERENCES

AECOM. 2020. *Final Preliminary Assessment Report, Rochester Army Aviation Support Facility #2, Rochester, New York*. July.

Department of the Army (DA). 2016a. *EM-200-1-2, Environmental Quality, Technical Project Planning Process*. 29 February.

———. 2016b. Memorandum, *Perfluorinated Compound (PFC) Contamination Assessment*. June.

———. 2016c. *Army Guidance to Address Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) Contamination*. August.

———. 2018. *Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances*. September.

Deputy Assistant Secretary of Defense. 2019. *Investigation Per- and Polyfluoroalkyl Substances within The Department of Defense Cleanup Program*. United States Department of Defense. 19 October.

DoD. 2018. *Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1.1*. September.

———. 2019a. *Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3*. May.

———. 2019. *General Data Validation Guidelines Revision 1*. November.

———. 2020. *Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15*. May.

EA, Engineering, Science, and Technology, PBC (EA). 2020. *Final Programmatic Uniform Federal Policy Quality Assurance Project Plan, Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide*. December.

Intergovernmental Data Quality Task Force (IDQTF). 2005a. *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual.*

———. 2005b. *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP); Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 2: FP-QAPP Workbook. Version 1.*

———. 2005c. *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP); Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 2B: Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities*.

———. 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets*.

U.S. Army Corps of Engineers (USACE). 2016. *Environmental Quality: Technical Project Planning Process.* Engineer Manual EM 200-1-2. 29 February.

United States Environmental Protection Agency (USEPA). 1980. *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*. 11 December.

———. 1994. *National Oil and Hazardous Substances Pollution Contingency Plan (Final Rule)*. 40 CFR Part 300; 59 Federal Register 47384. September.

———. 2001. *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5.* EPA/240/B-01/003. Office of Environmental Information, Washington, D.C. March.

———. 2005. *Federal Facilities Remedial Site Inspection Summary Guide.* 21 July.

———. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process* USEPA/240/B-06/001. February.

——— . 2014. *Management of Investigation Derived Waste. SESD Operating Procedure*. SESDPROC-202-R3. July.

——— . 2016a. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). Office of Water, EPA 822-R-16-005. May.

———. 2016b. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). Office of Water, EPA 822-R-16-004. May.

Appendix A

Technical Project Planning Meeting Minutes

Meeting Minutes
Rochester Army Aviation Support Facility (AASF) #2 – Site Inspection (SI) Technical Project Planning (TPP) – Meeting 1/Meeting 2
SI for Per- and Polyfluoroalkyl Substances (PFAS) Impacted Sites, Army National Guard (ARNG) Installations, Nationwide
Contract Number (No.) W912DR-19-D-0005, Task Order No. W912DR20F0383
Day, 11 August 2021
0900 to 1015 hrs

Participants			
Name	Affiliation*	Phone	E-Mail
David Pratt	NYSDEC	--	David.pratt@dec.ny.gov
Brittany O'Brien-Drake	NYSDEC	518-402-9676	Brittany.OBrien-Drake@dec.ny.gov
Sarita Wagh	NYSDOH	--	Sarita.wagh@health.ny.gov
Justin Deming	NYSDOH	--	Justin.deming@health.ny.gov
Jim Freehart	NYARNG	--	James.p.freehart.civ@mail.mil
Jennifer Li	ARNG G9	301-717-6939	jennifer.j.li2.ctr@mail.mil
Tim Peck	USACE - Baltimore	410-320-9506	timothy.j.peck@usace.army.mil
Michael Kepner	EA	410-329-5132	mkepner@eaest.com
*ARNG G9 – Army National Guard; NYARNG – New York Army National Guard; NYSDEC – New York State Department of Environmental Conservation; NYSDOH – New York State Department of Health; USACE – United States Army Corps of Engineers; and EA – EA Engineering, Sciences, and Technology, Inc., PBC			

Mr. Michael Kepner (EA Deputy Project Manager/SI Task Manager/Site Lead) welcomed participants and began the meeting with an overview of the agenda and a roll call with introductions. He noted the purpose of the meeting is to discuss the SI sampling for PFAS to determine presence/absence of releases at the Rochester AASF #2. The meeting was held virtually so there is no sign in sheet for attendees. The TPP briefing slides are included as **Attachment A** to these meeting minutes.

Mr. Kepner began the presentation with a safety reminder, noting that the SI will conform to requirements in United States Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-1. Site-specific safety procedures will be planned for and followed during SI field work, including establishing controlled work zones during field activities. Key points discussed during the presentation are provided below.

Programmatic Discussion:

- The TPP process is a USACE-established process with the main goal of engaging stakeholders in project planning and reporting. The ARNG has embraced a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) model for the SIs being completed nationwide that will incorporate state-specific guidance, as necessary. The TPP1 meeting (which served as an introduction to the ARNG program/SI process) and the TPP2 meeting (which focused on a discussion of Data Quality Objectives (DQOs), sampling locations, etc.) have been combined in an effort to streamline the process.

- This TPP1/TPP2 meeting provided an overview of the results of the Preliminary Assessment (PA), and an opportunity for stakeholders to discuss the SI Work Plan, sampling locations, and rationale of the SI project. Regulatory stakeholders are afforded the opportunity to formally review and comment on the SI Work Plan.
- Another TPP meeting will occur (TPP3) to present the SI Report findings to all stakeholders; again, regulatory stakeholders will be afforded the opportunity to review and comment on the SI Report.
- The ARNG PFAS program is centrally contracted through USACE and managed by ARNG. Every ARNG facility nationwide responded to a questionnaire on potential PFAS releases. Facilities were prioritized by the likelihood of release and proximity to drinking water sources. The facility-wide PA for the Rochester AASF #2 was completed in July 2020.
- There are nearly 200 facilities on the ARNG's nationwide PA list.

<u>Rochester AASF #2 PA Findings:</u>

- Mr. Kepner provided a brief overview of the PA findings. During the PA, three potential source areas were identified (Area of Interest [AOI] 1) for the Rochester AASF #2. This location is described in the briefing slides, and more detail was provided during the SI overview. The potential PFAS releases were attributed to aqueous film forming foam (AFFF) release and storage.
- Potential adjacent sources of PFAS that are not attributable to ARNG activities, outside of the facility boundary, were also discussed during the overview.

<u>Rochester AASF #2 SI Overview:</u>

- During the SI planning phase, DQOs were established to collect the appropriate data to feed into the conceptual site model (CSM).
- The primary goal of the SI is to determine the presence/absence of a release of PFOS/PFOA/PFBS above DoD screening levels from potential source areas.
- Mr. Kepner reviewed the one AOI:
    - AOI 1 Old Hangar/New Hangar/Hazardous Waste Storage Shed
- Geologic and hydrogeological data will inform the CSM, specifically with respect to the direction and rate of groundwater flow. The ARNG PFAS program includes consideration of enhanced DQOs that assess PFAS at the point of exposure and at the Rochester AASF #2 boundary.

<u>Rochester AASF #2 SI Proposed Activities:</u>

- Proposed sampling methods, locations and rationale were discussed. Sampling is planned as follows:
    - Continuous soil cores to target depth will be collected during the field work in and around the potential source areas. Continuous logging of borings will support understanding lithologic controls of preferential pathways.

  - Three soil samples to include surface soil (0-2 feet [ft] below ground surface [bgs]) and subsurface soil (13-15 ft bgs and 1 ft above the water table) will be collected at the potential source areas.
  - Temporary monitoring wells will be installed in the boreholes to a depth of 42 ft bgs (depending on groundwater elevation) and groundwater will be purged/sampled using low flow techniques.
  - The group discussed Investigation Derived Waste (IDW) and agreed that liquid IDW will be containerized. If sampling results indicate exceedances of PFAS in groundwater, the IDW will be treated with granulated activated carbon prior to release back to the ground surface.
- Document Review and Distribution was discussed as follows:
  - EA asked about the current distribution process which include delivering documents electronically.
  - New York State Department of Environmental Conservation (NYSDEC) concurred that SI documents can be sent electronically.

Questions and Open Discussion:

- Mr. David Pratt (NYSDEC Regional Remediation Engineer) informed the group about the presence and location of the Greater Rochester International Airport Fire Training Burn Pit. Mr. Pratt indicated he would follow up with EA/ARNG with further information regarding this potential adjacent source.
- Ms. Brittany O'Brien-Drake (NYSDEC Assistant Geologist and Project Manager) inquired about the original location of the underground storage tank. Mr. Kepner indicated that he would have to follow up with that information in EA's response to comments on the Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) Addendum.
- Ms. O'Brien-Drake inquired about sampling from the 0-2-inch interval, either as an additional sample or in place of the 0-2-ft interval sample. Ms. Jennifer Li (ARNG G9 Project Manager) explained that the 0-2-ft interval sample was programmatically decided based on the Office of the Secretary of Defense screening level criteria. Ms. Li explained that most of the potential PFAS releases being investigated are not recent, and the deeper depth interval would account for any PFAS migration that may have occurred since the time of the potential release. Ms. Li explained that if the Rochester AASF #2 were to move to a Remedial Investigation (RI), the next phase of the CERCLA process, further characterization would be conducted which would include Applicable or Relevant and Appropriate Requirements (ARARs).
- Mr. Kepner clarified that the samples collected from all three intervals would be discrete samples.
- Ms. O'Brien-Drake asked if the temporary wells will be pre-packed or grouted for surveying purposes. Mr. Kepner explained that, programmatically, pre-packing or grouting is not conducted, and the wells are abandoned following sample collection. Mr. Kepner explained the surveying process using the temporary wells.

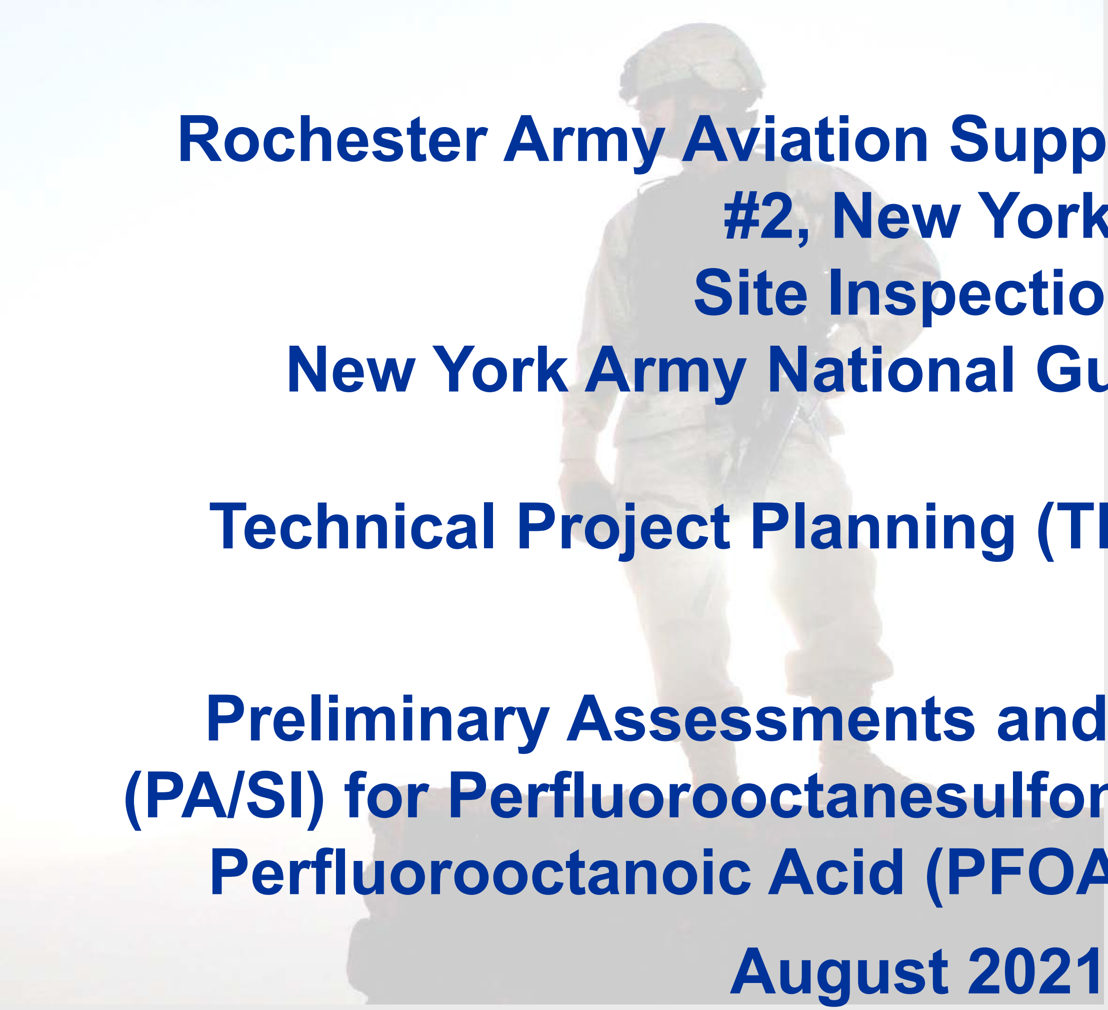
- Ms. Li asked if Mr. Kepner was going to bring the PFAS-free lab water to Rochester for decontamination purposes and Mr. Kepner confirmed that was planned.
- Ms. O'Brien-Drake explained the New York State screening values for PFAS and asked if the state values could be listed in a table within the report. Ms. Li explained that the project follows Department of Defense policy; however, if a RI is warranted, state values would be taken into consideration.
- Ms. Li confirmed with the group that Direct Push Technology will be an acceptable drilling method.

Visual Reconnaissance:

- Proposed sample locations were not visually inspected during this virtual TPP due to COVID-19 considerations. The proposed sample locations will be visually inspected concurrently with the utility clearance.

Action Items:

- EA will issue the Final Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) Addendum upon issuance of NYSDEC comments on the Draft Final UFP-QAPP Addendum and concurrence with responses to NYSDEC comments.
- Obtain further information on the Greater Rochester International Airport Fire Training Burn Pit from Mr. Pratt.



Rochester Army Aviation Support Facility (AASF) #2, New York

Site Inspection

New York Army National Guard (NYARNG)

Technical Project Planning (TPP) Meeting 1 & 2

Preliminary Assessments and Site Inspections (PA/SI) for Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites

August 2021

Prepared for:

Prepared by:

EA Engineering,
Science, and
Technology, Inc., PBC

AGENDA

- Introductions
- Safety Moment
- TPP Meeting Goals
- Army National Guard (ARNG) PA/SI Overview
- Rochester AASF #2 PA Results
- Rochester AASF #2 SI Overview
- Stakeholder Involvement
- Questions and Open Discussion

INTRODUCTIONS

- ARNG G9
  - Dave Connolly, PFAS Program Manager
  - Bonnie Packer, Nationwide Project Manager
  - Jennifer Li, SI Project Manager
- United States Army Corps of Engineers (USACE)
  - Tim Peck, Program Manager/SI Project Manager
- NYARNG
  - Jim Freehart, Acting Branch Chief Environmental Compliance
  - 1LT Steves Vanderpool
- New York State Department of Environmental Conservation (NYSDEC)
  - Brittany O’Brien-Drake, Assistant Geologist
  - David Pratt, Region 8 Engineer
  - Eric Hausamann, Environmental Engineer
- New York State Department of Health (NYSDOH)
  - Sarita Wagh, Project Manager
  - Justin Deming, Region Chief
- EA Engineering, Science, and Technology, Inc., PBC (EA)
  - Michael Kepner, SI Task Manager
  - Caitlin Helms, SI Geologist

SAFETY MOMENT

Site Safety Procedures

- SI will follow USACE Engineering Manual (EM) 385-1-1 requirements:
  - Accident Prevention Plan addresses all component plans for EM 385-1-1, including Construction Support during drilling operations
  - Site Safety and Health Plan addresses project participants, training, and hazard identification and mitigation
- Health and safety documents prepared during SI planning phase

TPP MEETING GOALS

- TPP1:
  - Provide an overview of the ARNG PA/SI Program
    - Regulatory framework
  - Discuss PA Findings
  - Define objectives for SI data collection
  - Encourage stakeholder involvement
  - Review project schedule
  - Capture action items
- TPP2: Discuss proposed SI approach
- TPP3: Discuss SI findings
- Participants:
  - TPP1 and 2: ARNG, USACE, NYSDEC
  - TPP3: ARNG, USACE, NYSDEC, other local stakeholders

ARNG PA/SI OVERVIEW

WORK PHASES

Preliminary Assessment

***Site Inspection**

Remedial Investigation

Feasibility Study

Proposed Plan

Decision Document

Remedial Design

Remedial Action

Notes: *Current stage of activity

- Follows the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Process
- An interim removal action can be conducted or a No Further Action determination can be made at any phase

ARNG PA/SI OVERVIEW

- Activities centrally contracted through USACE and managed by ARNG G9
  - USACE Baltimore manages the contract, with technical project support from other Districts (Louisville, Omaha, Sacramento, Jacksonville, and Seattle Districts)
  - Project support: chemistry, geology, risk screening
- PA ranking (~200 facilities) - state ARNG input
  - Likelihood of release
  - Complete pathway to drinking water receptor
- Priority assigned to facilities with highest likelihood of release near drinking water intake
- PA – facility-wide; SI – areas of interest (AOIs)

ARNG PA/SI OVERVIEW

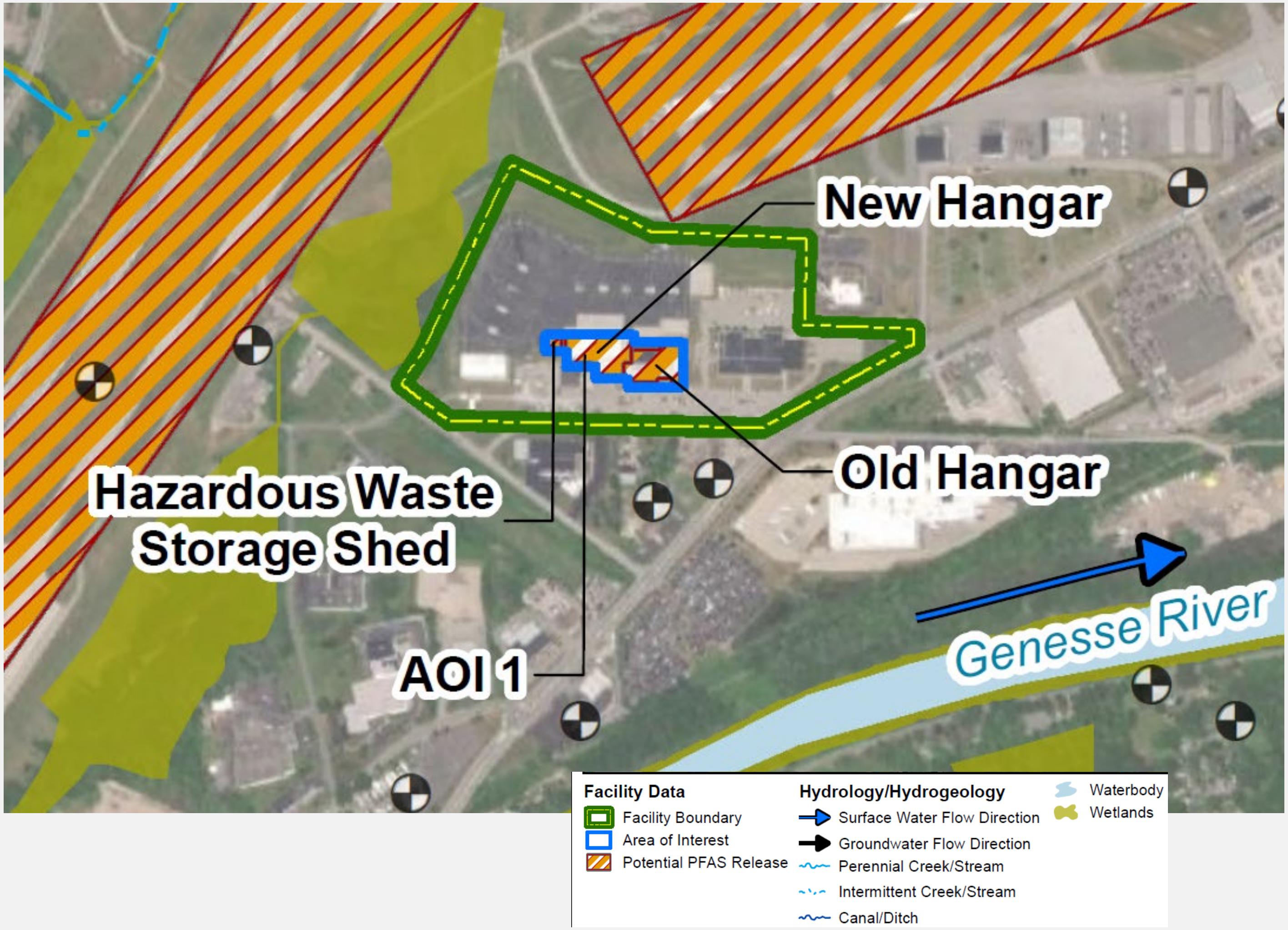
- ARNG / NYARNG
  - Identify potential per- and polyfluoroalkyl substances (PFAS) release locations
  - Provide facility access and points of contact
  - Gather and provide appropriate documents
  - Identify/schedule personnel to interview
  - Supply final PA to the regulatory agencies
- SI Regulatory Involvement
  - CERCLA SI conducted in conjunction with the appropriate regulatory agency

ROCHESTER AASF #2 ARNG PA RESULTS

- Potential PFAS release areas: 3 areas identified during the PA grouped together as AOI 1
- AOI 1: Old Hangar/New Hangar/Hazardous Waste Storage Shed:
  - AOI 1 includes the Old Hangar/New Hangar/Hazardous Waste AOI 1 includes the Old Hangar/New Hangar/Hazardous Waste Storage Shed buildings which encompass the aqueous film forming foam (AFFF) system malfunction at the Old Hangar and the storage of AFFF within the New Hangar and Storage Shed.

ROCHESTER AASF #2 ARNG

SUMMARY OF FINDINGS AND AOIs

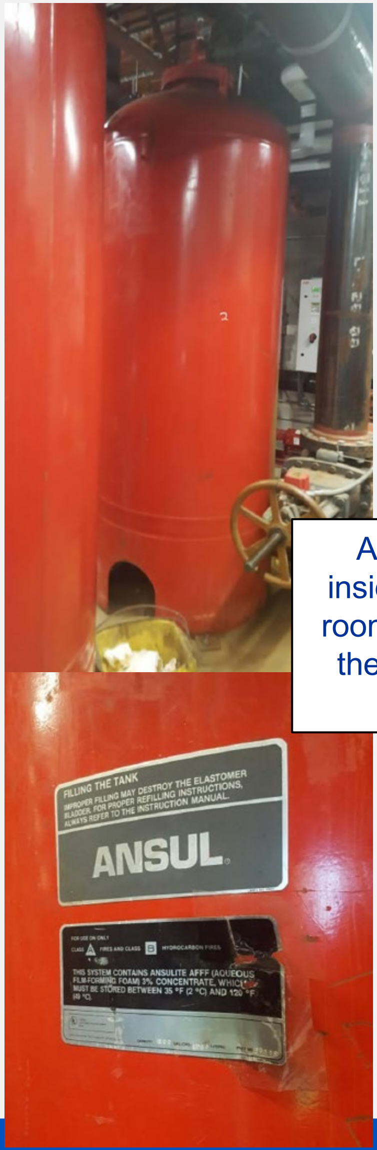


August 2021

ROCHESTER AASF #2 ARNG PA RESULTS

AOI 1: Old Hangar

- The Old Hangar houses two 500-gallon 3 percent (%) AFFF storage tanks connected to a deluge system in the boiler room on the eastern side of the building. The deluge system was previously connected to an underground storage tank that was removed in 2007, at which point a 25,000-gallon above ground storage tank (AST) was installed.
- There are three 36-galllon 3% AFFF mobile storage tanks set up within the Old Hangar that have no reported AFFF releases.
- There was a known AFFF release in 2017 within the confines of the Old Hangar building where the bladders on the two storage tanks in the boiler room malfunctioned. It is unclear how much AFFF was released, but interviews and documented reports state the spill was contained by the deluge system and completely contained by the AST. The AST was later emptied by a contractor without incident. A retrofitting occurred shortly after the incident and the two 500-gallon AFFF tanks were refilled with 3% AFFF.

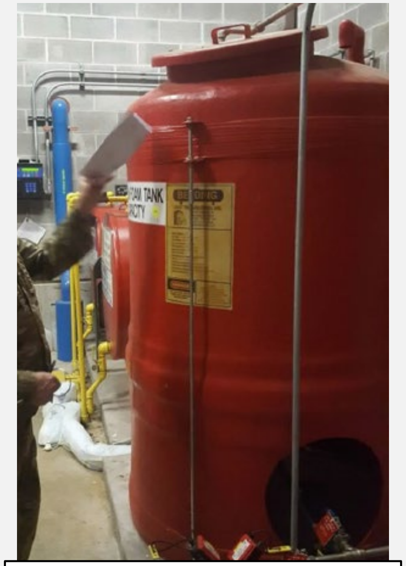


Ansul tanks inside the boiler room, utilized for the old hangar only.

ROCHESTER AASF #2 ARNG PA RESULTS

AOI 1: New Hangar

- The New Hangar, established in 2008, has a fire pump room containing one, 300-gallon, 1.5% AFFF storage tank connected to a deluge system, which is hooked to the same 25,000-gallon AST as the Old Hangar. A storage room contains seven 5-gallon buckets of 3% AFFF left over from the 2007 retrofitting event. Two 36-gallon 3% AFFF mobile tanks are also set up around the New Hangar. There have been no documented reports of AFFF release.



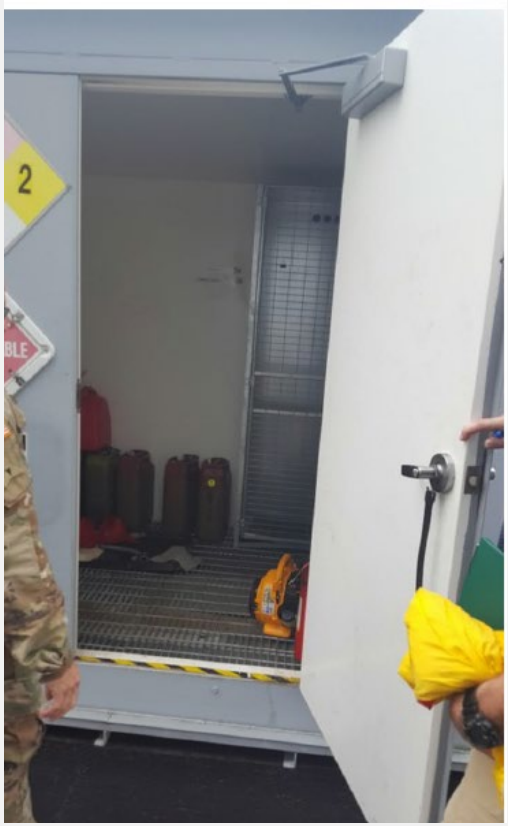
Ansul tank located inside of the pump room of the New Hangar.

5-gallon Ansulite drums located in new hangar (left) and coiled fire extinguisher hose and tank (right).

ROCHESTER AASF #2 ARNG PA RESULTS

AOI 1: Hazardous Waste Storage Shed

- A Hazardous Waste Storage Shed is located adjacent to the New Hangar and houses one 55-gallon drum of 3% AFFF. There is no evidence to suggest any spills, leaks, or releases occurred inside of the storage shed.
- The documented release at the Old Hangar was contained by the deluge system. However, undocumented releases of AFFF could have occurred at the New Hangar or Hazardous Materials Storage Shed on paved areas or grassy surfaces and subsequently infiltrated via cracks in pavement or joints between areas that are paved.



ROCHESTER AASF #2
PA FINDINGS
ADJACENT SOURCES

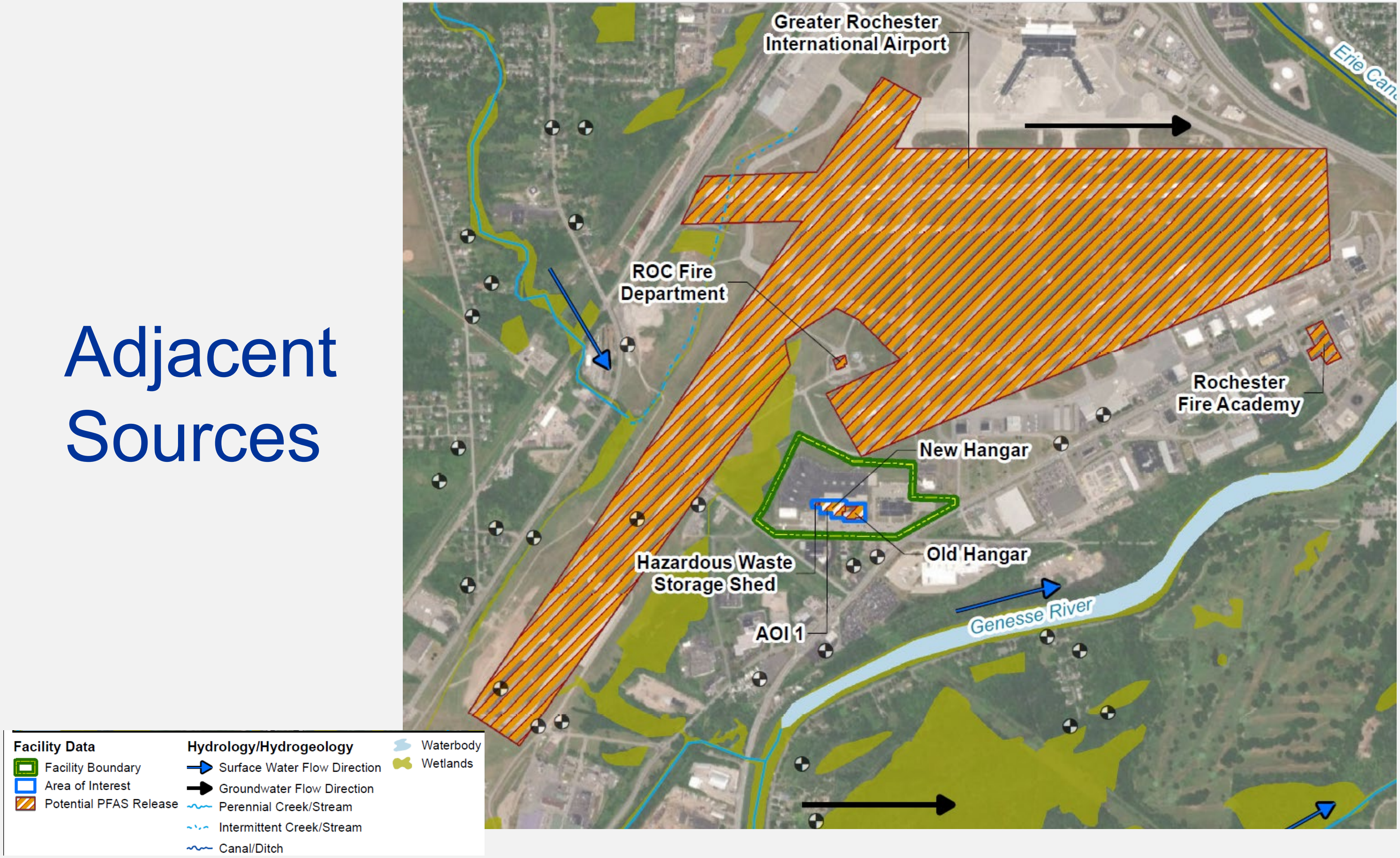
- Greater Rochester International Airport
  - Although information was not available during the PA interviews regarding AFFF usage or storage at the airport, there could have been potential use of AFFF in association with typical airport operations at the airport terminal, along the flightlines, or within the associated hangars. This area is located upgradient and directly adjacent to the facility to the north and west; a wetland area is located immediately west of the Rochester AASF #2, between the upgradient portion of the airport and the AASF.
- Greater Rochester International Airport Fire Department
  - According to current Federal Aviation Administration regulations, since commercial aviation activities occur at this facility, AFFF is required to be stored and used for any potential firefighting activities and firefighting training. This area is located cross-gradient of the AOIs.

ROCHESTER AASF #2
PA FINDINGS
ADJACENT SOURCES

- Gates Fire District
  - This fire department would respond to any emergencies at the Rochester AASF #2. Information was not available during the PA interviews regarding AFFF usage and storage at this location. This area is located up-/cross-gradient of the AOIs, separated by Little Black Creek.
- Rochester Fire Academy
  - Various chemicals from local hazardous waste generators were burned and/or disposed of during training exercises between 1954 to 1980 at the Rochester Fire Academy. It is unknown if AFFF was used at this facility. This area is located downgradient of the AOIs.

ROCHESTER AASF #2
PA FINDINGS

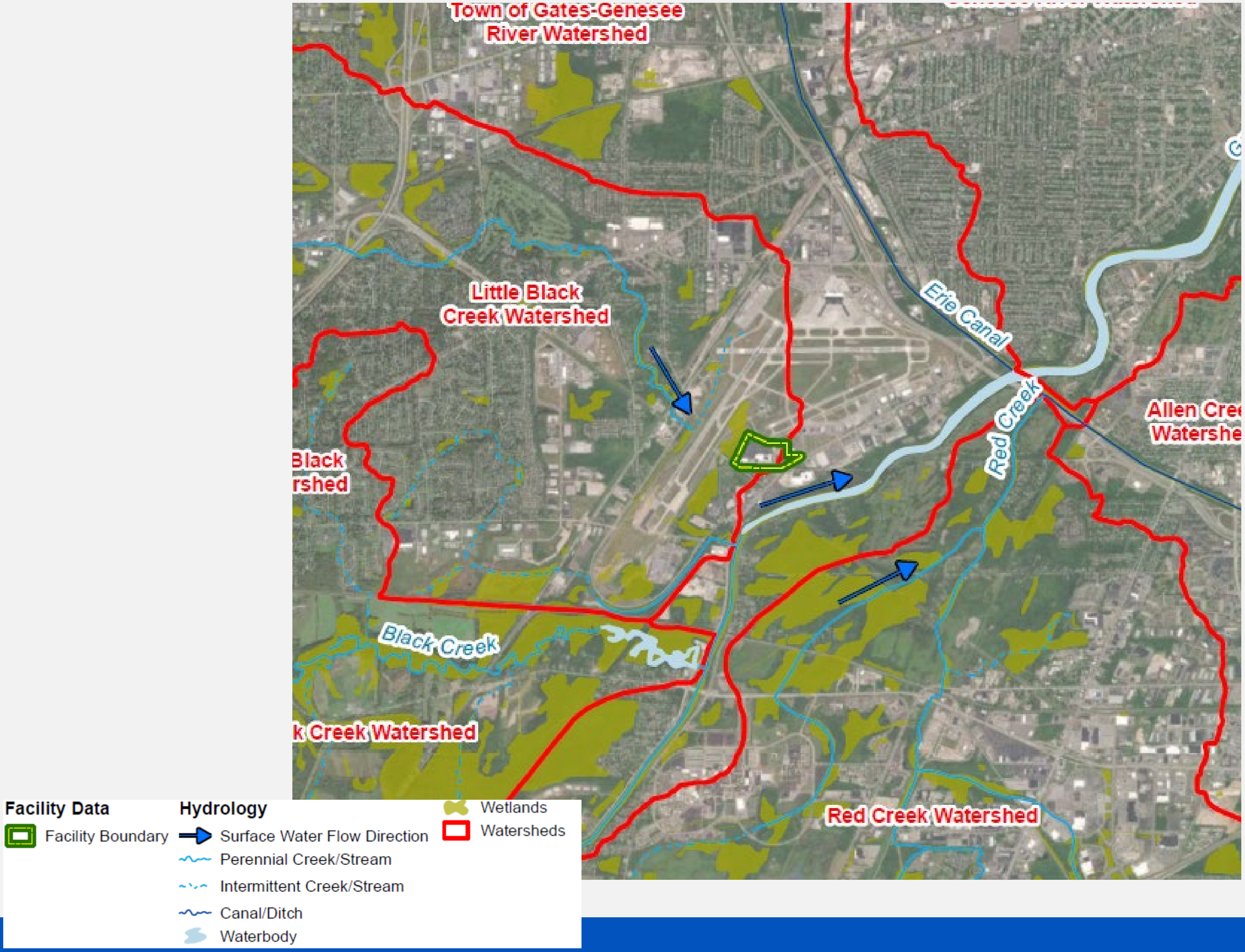
Adjacent Sources



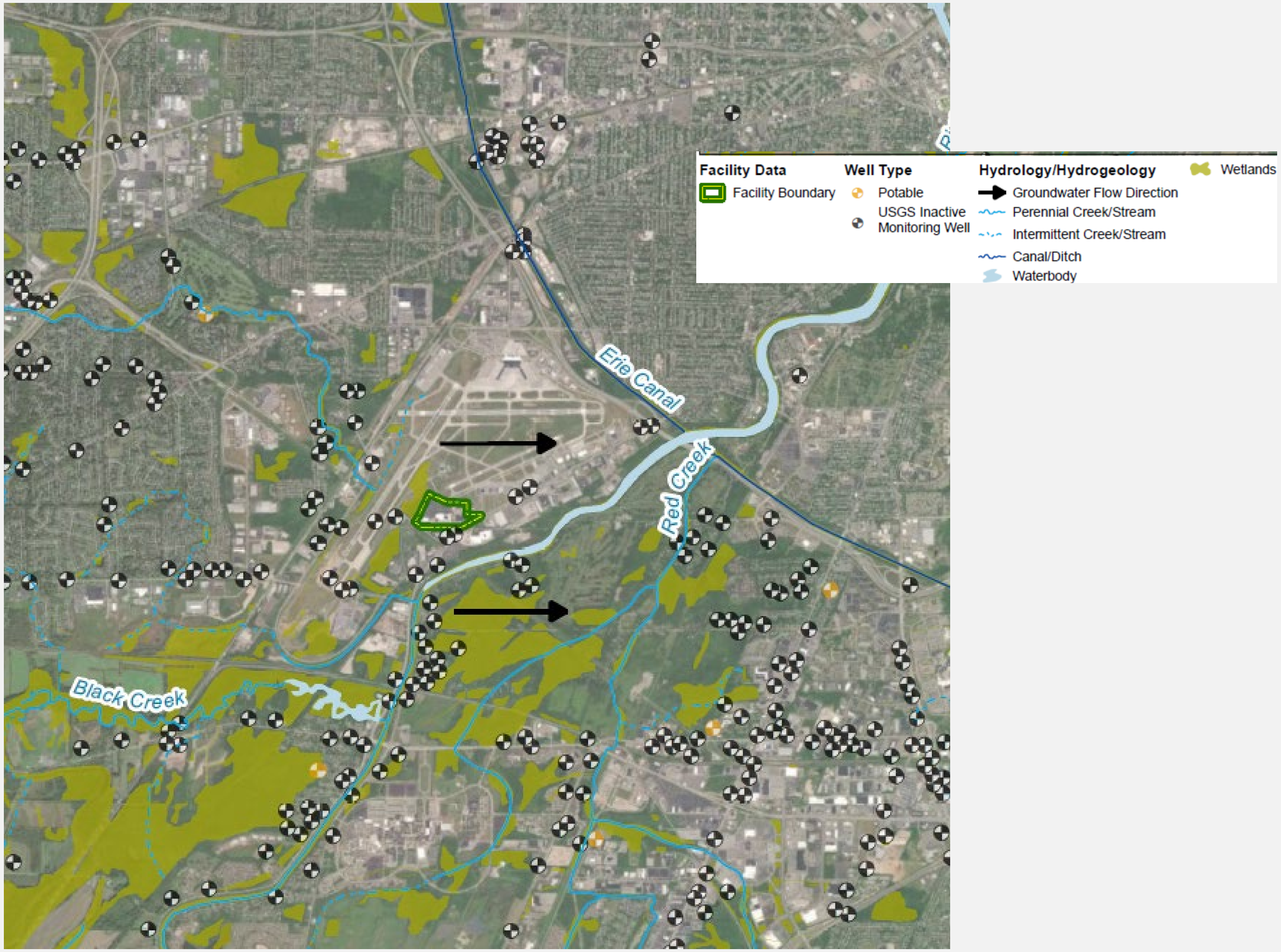
ROCHESTER AASF #2
SI OVERVIEW
DATA QUALITY OBJECTIVES (DQOs)

- Primary SI DQOs
  - Confirm the presence/absence of a release
  - Gather data for conceptual site model (CSM): Understanding of Source-Pathway-Receptor relationships required for establishing sampling strategy
- Extended SI DQOs
  - Determine the presence/absence at facility boundary
  - Check for alternate sources, up- or downgradient
  - Measure PFAS at/near receptor, if warranted

ROCHESTER AASF #2
SI OVERVIEW
CSM – SURFACE WATER FEATURES

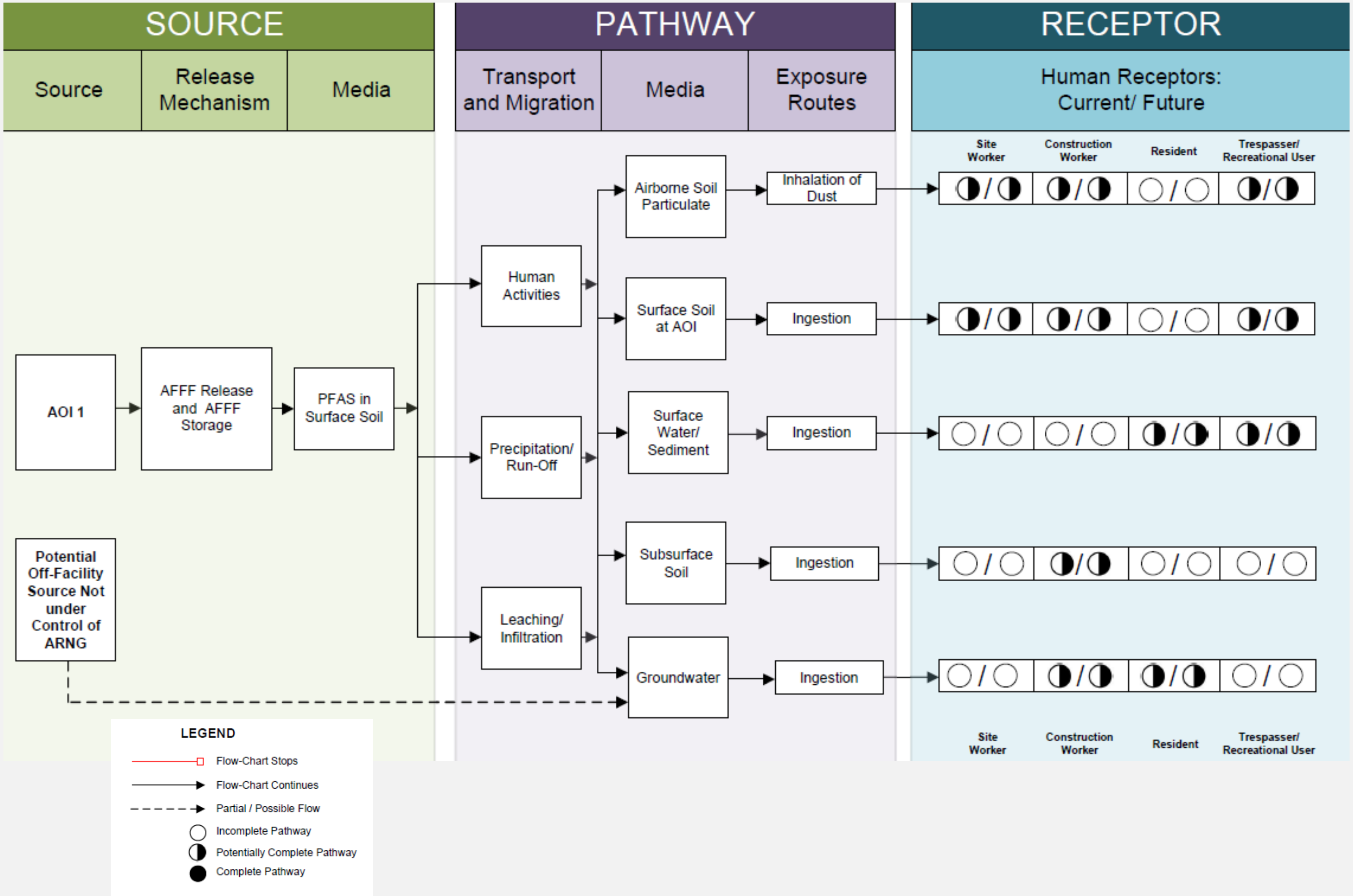


ROCHESTER AASF #2
SI OVERVIEW
CSM – GROUNDWATER FEATURES



August 2021

ROCHESTER AASF #2
SI OVERVIEW
CSM



SOURCE			PATHWAY			RECEPTOR			
Source	Release Mechanism	Media	Transport and Migration	Media	Exposure Routes	Human Receptors: Current/ Future			
						Site Worker	Construction Worker	Resident	Trespasser/ Recreational User
AOI 1	AFFF Release and AFFF Storage	PFAS in Surface Soil	Human Activities	Airborne Soil Particulate	Inhalation of Dust	◐/◐	◐/◐	○/○	◐/◐
			Human Activities	Surface Soil at AOI	Ingestion	◐/◐	◐/◐	○/○	◐/◐
			Precipitation/ Run-Off	Surface Water/ Sediment	Ingestion	○/○	○/○	◐/◐	◐/◐
			Leaching/ Infiltration	Subsurface Soil	Ingestion	○/○	◐/◐	○/○	○/○
Potential Off-Facility Source Not under Control of ARNG			Leaching/ Infiltration	Groundwater	Ingestion	○/○	◐/◐	◐/◐	○/○
						Site Worker	Construction Worker	Resident	Trespasser/ Recreational User

LEGEND

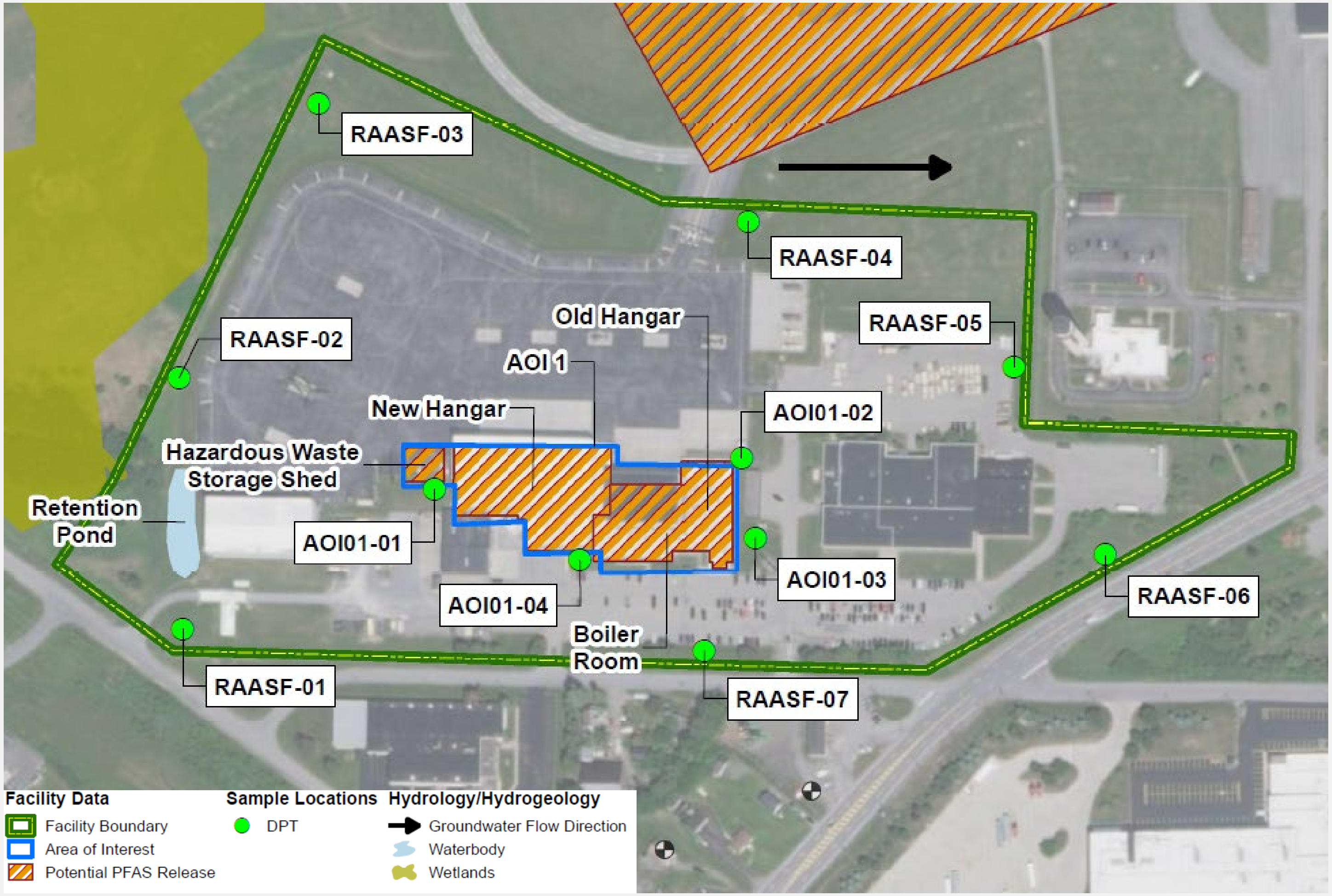
- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- ○ Incomplete Pathway
- ◐ Potentially Complete Pathway
- ● Complete Pathway

August 2021

ROCHESTER AASF #2
SI OVERVIEW
PLANNING AND SAMPLING

- Finalize Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) Addendum
  - Draft Final submitted on 29 June 2021
  - Final to be submitted following the TPP 1&2 meeting after addressing NYSDEC comments
- Continuous soil cores to target depth
  - Soil samples collected at surface (0-2 feet), mid point (to not exceed 15 feet), and approximately 1 foot above water table for temporary well locations
- Collect a groundwater sample from each temporary well
- Well casings will be surveyed and water table will be gauged

ROCHESTER AASF #2
SI OVERVIEW
PROPOSED SAMPLING LOCATIONS



August 2021

ROCHESTER AASF #2
SI OVERVIEW

AOI	# of DPT Borings	Target Depth for DPT Borings	Soil Samples	Target Interval for GW samples	Groundwater Samples	Decontamination Water Samples
1	4	30-40 ft	12	Mid-screen	4	-
Facility Boundary	7	30-40 ft	21	Mid-screen	7	-
Total	**11**	**---**	**33**	**---**	**11**	**1**

- Sample locations will be refined in the field
    - Confirm placement is accessible and will meet DQOs prior to the utility mark-out and locate

ROCHESTER AASF #2
SI OVERVIEW
ANALYTICAL PARAMETERS

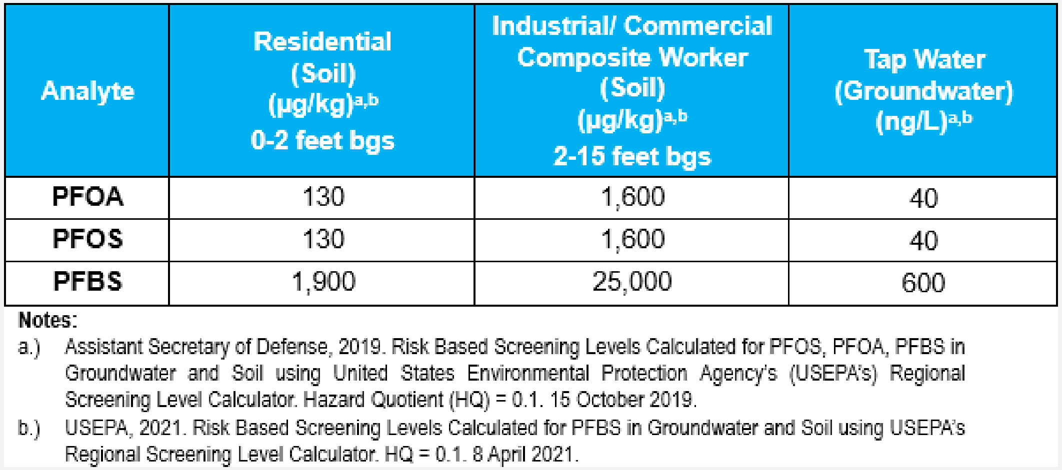
Perfluorooctanesulfonic acid (PFOS)	Perfluoroheptanoic acid (PFHpA)
Perfluorohexanesulfonic acid (PFHxS)	Perfluorononanoic acid (PFNA)
Perfluorooctanoic acid (PFOA)	Perfluorobutanesulfonic acid (PFBS)
Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
Perfluorodecanoic acid (PFDA)	Perfluorotetradecanoic acid (PFTA)
Perfluorododecanoic acid (PFDoA)	Perfluorohexanoic acid (PFHxA)
Perfluorotridecanoic acid (PFTrDA)	Perfluoroundecanoic acid (PFUnA)
6:2 Fluorotelomer sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonate (8:2 FTS)
4:2 Fluorotelomer sulfonate (4:2 FTS)	Perfluorodecane sulfonate PFDS (PFDS)
Perfluoroheptane sulfonate (PFHpS)	Perfluorononane sulfonate (PFNS)
Perfluoropentane sulfonate (PFPS)	Perfluorotetradecanoic acid (PFTeDA)

- Analysis completed by an Environmental Laboratory Accreditation Program/National Environmental Laboratory Accreditation Program-certified laboratory
- Requirement for state-certified laboratory?
- Data will undergo stage 2B (soil and non-drinking water) and stage 4 (drinking water) validation as defined by Department of Defense Federal Data Validation Guidelines

ROCHESTER AASF #2 SI OVERVIEW

Screening Levels

- Results compared to Office of the Secretary of Defense (OSD) Screening Levels (SLs) for soil and groundwater
  - Memorandum from the OSD dated 15 October 2019
  - SLs for groundwater based on direct ingestion
  - SLs for soil based on incidental ingestion; 0-2 ft compared to Residential SL, 2-15 ft compared to Industrial SL, >15 ft not compared to either SL
- AOIs exceeding OSD SLs will proceed to the next phase under CERCLA (i.e., Remedial Investigation)



Analyte	Residential (Soil) (µg/kg)^{a,b} 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)^{a,b} 2-15 feet bgs	Tap Water (Groundwater) (ng/L)^{a,b}
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	1,900	25,000	600

Notes:

a.) Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 15 October 2019.

b.) USEPA, 2021. Risk Based Screening Levels Calculated for PFBS in Groundwater and Soil using USEPA's Regional Screening Level Calculator. HQ = 0.1. 8 April 2021.

STAKEHOLDER INVOLVEMENT

- Use TPPs and open communication to encourage stakeholder involvement
- Key involvement topics
  - Proposed approaches
  - Document review time for NYSDEC and other stakeholders
- Schedule:
  - Address remaining comments and issue Final UFP-QAPP Addendum: August 2021
  - Field Investigation: October 2021
  - Reporting including regulator review: October – December 2021

QUESTIONS AND OPEN DISCUSSION

- Coordination
  - Data transfer
  - Utility mark-out and utility clearance procedures
  - Report distribution (paper, electronic, portable document format)
  - IDW Handling
  - Site Walk
  - Stakeholder relations
- Schedule
- PA findings

ACRONYMS

- % - Percent
- AASF – Army Aviation Support Facility
- AFFF – Aqueous Film Forming Foam
- AOI – Areas of Interest
- ARNG – Army National Guard
- AST – Above ground storage tank
- CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
- CSM – Conceptual Site Model
- DQO – Data Quality Objective
- EA – EA Engineering, Science, and Technology, Inc., PBC
- EM – Engineering Manual
- NYARNG – New York Army National Guard
- NYSDEC – New York State Department of Environmental Conservation
- NYSDOH – New York State Department of Health
- PA – Preliminary Assessment
- PFAS – Per- and Polyfluorinated Alkyl Substances
- PFOS – Perfluorooctanesulfonic Acid
- PFOA – Perfluorooctanoic Acid
- SI – Site Inspection
- TPP – Technical Project Planning
- UFP-QAPP – Uniform Federal Policy- Quality Assurance Project Plan
- USACE – United States Army Corps of Engineers

Appendix B

Standard Operating Procedures

Standard Operating Procedure No. 001
for
Sample Labels

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 0
December 2014

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CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for the use of sample labels. Every sample will have a sample label uniquely identifying the sampling point and analysis parameters. An example label is provided below. Other formats with similar levels of detail are acceptable.

PROJECT NAME_____________PROJECT NUM. ___________
SAMPLE LOCATION/SITE ID __________________________
DATE:____/____/____TIME:______:_____
ANALYTES: METALS VOC EXPLOSIVES ORGANICS OTHER
FILTERED: [NO] [YES]
PRESERVATIVE: [NONE] [HNO_3] [OTHER______]
SAMPLER: ___________________

2. MATERIALS

The following materials may be required: sample label and indelible laboratory marker.

3. PROCEDURE

The following sections describe how to use the sample labeling system.

3.1 LABEL INFORMATION

As each sample is collected/selected, fill out a sample label. Enter the following information on each label:

- Project name
- Project number
- Location/site identification—Enter the media type (i.e., well number, surface water, soil, etc.) sampling number, and other pertinent information concerning where the sample was taken
- Date of sample collection

- Time of sample collection

- Analyses to be performed (NOTE: Due to number of analytes, details of analysis should be arranged with laboratory *prior to start of work)*

- Whether filtered or unfiltered (water samples only)

- Preservatives (water samples only)

- Number of containers for the sample (e.g., 1 of 2, 2 of 2).

3.2 ROUTINE CHECK

Double-check the label information to make sure it is correct. Detach the label, remove the backing, and apply the label to the sample container. Cover the label with clear tape, ensuring that the tape completely encircles the container.

3.3 RECORD INFORMATION

Record the sample number and designated sampling point in the field logbook, along with the following sample information:

- Time of sample collection (each logbook page should be dated)

- Location of the sample

- Organic vapor meter or photoionization meter readings for the sample (when appropriate)

- Any unusual or pertinent observations (oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, etc.)

- Number of containers required for each sample

- Whether the sample is a quality assurance sample (split, duplicate, or blank).

3.3.1 Logbook Entry

A typical logbook entry might look like this:

- 7:35 a.m. Sample No. MW-3. PID = 35 ppm
- Petroleum odor present. Sample designated MW-3-001.

NOTE: Duplicate samples will be given a unique sample designation rather than the actual sample number with an added prefix or suffix. This will prevent any indication to the laboratory that this is a duplicate sample. This fictitious sample number will be listed in the logbook along with the actual location of the sample.

3.4 SHIPMENT

Place the sample upright in the designated sample cooler. Make sure there is plenty of ice in the cooler at all times.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

5.1 INCIDENTAL ODORS

Note that although incidental odors should be noted in the logbook, it is unwise from a safety and health standpoint to routinely "sniff test" samples for contaminants.

5.2 DUPLICATE SAMPLE

No indication of which samples are duplicates is to be provided to the laboratory.

6. REFERENCES

U.S. Environmental Protection Agency. 1980. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans. QAMS-005/80.

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Standard Operating Procedure No. 002
for
Chain-of-Custody Form

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 0
December 2014

CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for use of the chain-of-custody form. An example is provided as Figure SOP002-1. Other formats with similar levels of detail are acceptable.

2. MATERIALS

The following materials may be required: chain-of-custody form and non-waterproof pens, pencils, or ultra-fine Sharpies®.

3. PROCEDURE

- Give the site name and project name/number.
- Enter the sample identification code.
- Indicate the sampling dates for all samples.
- List the sampling times (military format) for all samples.
- Indicate “grab” or “composite” sample with an “X.”
- Specify the sample location.
- Enter the total number of containers per cooler.
- List the analyses/container volume.
- Obtain the signature of sample team leader.
- State the carrier service and air bill number, analytical laboratory, and custody seal numbers.
- Sign, date, and time the “relinquished by” section.
- Upon completion of the form, retain the shipper copy, and affix the other copies to the inside of the sample cooler, in a zip-seal bag to protect from moisture, to be sent to the designated laboratory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency (U.S. EPA). 1980. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80.

———. 1990. Sampler's Guide to the Contract Laboratory Program. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C. December.

———. 1991. User's Guide to the Contract Laboratory Program. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response. January.

Example Chain of Custody Form

Company Name:

Project Manager or Contact:

Phone:

Project No.

Dept.: Task:

Project Name:

Sample Storage Location:

ATO Number:

Page of

Report #:

Parameters/Method Numbers for Analysis

Chain-of-Custody Record

EA Laboratories[1]
231 Schilling Circle
Hunt Valley, MD 21031
Telephone: (410) 584-7000

Report Deliverables:
1 2 3 4 D E

EDD: Yes/No

DUE TO CLIENT: __________

Date	Time	Water	Soil	Sample Identification 19 Characters	**No. of Containers**														**EA Labs Accession Number**	Remarks
				XXXXXXXXXXXXXXXXXXX																**LPM**:
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
				XXXXXXXXXXXXXXXXXXX																
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[1] Please note lab specific COCs will be provided by Eurofins Lancaster Laboratories and/or Eurofins TestAmerica Sacramento for this project.

Standard Operating Procedure No. 003
for
Subsurface Utility Clearance

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 1
July 2018

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP).

SOP No. 003	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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CONTENTS

DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	6/28/2018	Systematic review and update	Matt Bowman	Pete Garger

1. SCOPE AND APPLICATION

1.1 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to prevent injury to workers and damage to subsurface structures (including tanks, pipe lines, water lines, gas lines, electrical service, etc.) during ground disturbance activities (including drilling, augering, sampling, use of direct-push technologies, excavation, trenching, concrete coring or removal, fence post installation, grading, or other similar subsurface operations).

1.2 LIMITATIONS

The procedures set forth in this document are general guidance but may not be entirely applicable to particular sites based on the site-specific considerations. The Project Manager is responsible for making a site-specific evaluation of each site to determine how subsurface utility clearance procedures should be utilized or modified. If safety or other site-specific considerations require a modified or different procedure, the Project Manager should review the modified procedure with the Business Unit Director, Profit Center Manager, or Senior Technical Reviewer. Evaluation support of modified procedures may be provided by the Corporate Health and Safety Director or the Lead Construction Quality Engineer.

Special considerations may be required for utility location activities at complex or challenging project sites (underwater utilities, hazardous waste sites, etc.). Additional subsurface utility clearance procedures should be added as appropriate for difficult sites. When health and safety risks to workers or potential utility damage cannot be effectively managed through utility location, clearance, and protection measures, the Project Manager must consider the modification of ground disturbance activities (e.g., establishing a safe offset from high risk utilities). In these cases, detailed coordination with the client and/or regulatory staff is likely required.

1.3 SCOPE

This SOP provides minimum guidance for subsurface utility clearance activities, which must be followed prior to and during ground disturbance activities at EA project sites. Even after completing the subsurface utility clearance activities required in this SOP, all ground disturbance activities should proceed with due caution.

Deviations from this SOP may be provided on an exception basis for specific situations, such as underground storage tank systems removals, verified aboveground/overhead services/lines, undeveloped land/idle facilities, shallow groundwater conditions, soil stability, or well construction quality assurance/quality control concerns, etc.

EA is responsible for, and shall ensure that, all ground disturbance activities are completed safely, without incident, and in accordance with applicable federal, state, and local regulations.

This SOP shall not override any site-specific or consultant/contractor procedures that are more stringent or provide a greater degree of safety or protection of health or the environment.

2. PROCEDURES

The EA Project Manager or his/her designee must complete the Subsurface Utility Clearance Checklist (Attachment A) in conjunction with the following procedures. The checklist must be completed before initiating any ground disturbance activities. The completed checklist must be submitted to the appropriate team individuals, and/or the client and included in the project files.

2.1 SAFETY

A Health and Safety Plan must be available onsite and followed by all contractors.

Work areas should be defined and secured with safety cones, safety tape, construction fence, other barriers, or signs as appropriate.

Site work permits must be obtained as required by site procedures. Based on site conditions or classification, the use of intrinsically safe equipment may be required.

To ensure the safety of all onsite personnel and subsurface structure integrity, consideration should be given to de-energizing and locking out selected site utilities or temporarily shutting down a portion of or the entire facility.

2.2 SUBSURFACE UTILITY LOCATION ACTIVITIES

To gather all relevant information about potential subsurface structures prior to ground disturbance activities, the project team should pursue multiple lines of evidence on the type, location, depth, size, material of construction, and status (active/abandoned) of all utilities within and near the area planned for ground disturbance activities. A minimum of three lines of evidence should be obtained and documented; however, additional lines of evidence should be secured when possible. Lines of evidence may include the following:

- Historical Site Information
- Public Utility Mark-Out (One Call – 811)
- Private Utility Mark-Out
- Site Inspection
- Client/Facility Interviews and Coordination.

2.2.1 Historical Site Information

The most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) should be obtained, as available.

NOTE: As-built drawings may not accurately depict the locations and depths of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

EA should obtain any other site information such as easements, right-of-ways, historical plot plans, fire insurance plans, tank (dip) charts, previous site investigations, soil surveys, boring logs, and aerial photographs, etc. as relevant to the planned ground disturbance activities. Where applicable, EA should also contact contract personnel who may have historical site knowledge.

2.2.2 Public and Private Utility Mark-Outs

EA must ensure that a thorough mark-out at the site is completed to locate electrical, gas, telephone, water, sewer, low voltage electric lines, product delivery pipelines, fiber optic, and all other subsurface utilities/services.

- Where available, public utility companies must be contacted to identify subsurface utilities. (This can be accomplished through the One-Call system in most instances.) Attachment B provides a brochure for the 811 Utility Locate Call Center.

- In addition, where available and warranted by site conditions, a private utility/pipeline mark-out company should be contracted to perform an electronic subsurface survey to identify the presence of suspected hazardous or critical subsurface utilities and structures. In some cases, this is necessary to confirm public utility mark-outs in the vicinity of planned ground disturbance activities.

EA will review all available site plan subsurface information with the private mark-out company to assist in locating utilities and other subsurface structures.

NOTE: Mark-outs may not accurately depict the exact locations of improvements and subsurface structures and should, therefore, not be **solely** relied upon.

Where possible, EA personnel are encouraged to be onsite at the time of subsurface mark-outs. This is to ensure accuracy and understanding of subsurface utility structures identified and provides an opportunity to exchange information with mark-out company personnel regarding planned work activities.

Subsurface utility structures should be marked throughout the entire work area(s) with adequate materials (e.g., site conditions may require paint and tape/flags). Ground disturbance activities must be started within 30 days of mark-out, unless local ordinances specify a shorter time period.

If activities are not started within required time period or markings have faded, mark-outs must be redone.

EA personnel will record time and date of mark-out request and list all companies contacted by the service and confirmation number. This information should be available for review onsite and checked off after visual confirmation of markings.

2.2.3 Site Inspection

To compare the site plan to actual conditions based on information gathered in other lines of evidence, a site inspection should be performed to identify potential signs of subsurface utilities. These signs may include:

- Signage identifying subsurface utilities
- Asphalt patching or paving scars
- Pull boxes, junction boxes, valve box covers, or manhole covers
- Sewer drains and clean-out traps
- Meters and light poles
- Piping or conduit on the walls or roofs of buildings
- Linear ground depressions
- Markings from previous utility mark-out efforts
- Other utilities including fire hydrants, on/below grade electrical transformers, splice cages, sprinkler systems, steam lines (including insulated tanks that may indicate steam lines), and cathodic protection on lines/tanks.

EA will document all findings and update the site plan with this information. In some regions, it may be more effective and efficient to conduct the site inspection at the same time the contractor performing the ground disturbance activity is mobilized to the site. The site inspection may include others as determined by the consultant/contractor and the Project Manager.

2.2.4 Client/Facility Interviews and Coordination

Knowledgeable client and facility staff familiar with site utilities should be interviewed to obtain information and documentation on potential subsurface utility locations, depth, etc. Results of these interviews should be documented and included with the Subsurface Utility Clearance Checklist. On third party sites, close coordination with the site owner’s representatives for mark-outs, review of as-builts, and other information reviews should be conducted prior to any ground disturbance work. Project Managers are encouraged to provide updated as-built information to the client.

EA will review the selected ground disturbance locations with the client. EA will not proceed with the subsurface activities until the plan has been discussed with the client. During execution of the project, if subsurface activities are required outside of the area previously approved by the client, EA will submit these changes to the client for approval prior to execution.

2.2.5 Ground Disturbance Activity Sequence

When practical, EA will plan ground disturbance activities starting at the point farthest from the location of suspected underground improvements. This is done to determine the natural subsurface conditions and to allow EA site personnel to recognize fill conditions.

Experience has shown that the following warning signs may indicate the presence of a subsurface structure:

- Warning tape (typically indicative of underground services).
- Pea gravel/sand/non-indigenous material (typically indicative of tanks or lines).
- Red concrete (typically indicative of electrical duct banks).
- The abrupt absence of soil recovery in a hand auger. This could indicate pea gravel or sand that has spilled out of the auger. This may not be indicative in areas where native soil conditions typically result in poor hand auger recoveries.
- Any unexpected departure from the native soil or backfill conditions as established by prior onsite digging.

If any of these conditions is encountered by EA site personnel, digging should stop and the client should be contacted.

3. UTILITY PROTECTION MEASURES DURING GROUND DISTURBANCE ACTIVITIES

After mobilization, but prior to the primary ground disturbance activities, the physical location of subsurface utilities should be cleared and verified whenever possible and practical. The clearance method used to clear and verify the subsurface utilities should be compatible with the inherent associated risk given the type of facility/property, subsurface utility material of construction, utility depth, soil stratigraphy, and the location of the ground disturbance activity, such that required delineation is obtained. It should be noted that in areas where there is paving, sufficient paving should be removed to allow clear visibility of the subsurface conditions during clearance activities. The following is a list of potential clearance methods that may be used on a job site:

- Vacuum digging
- Probing
- Hand digging
- Hand augering
- Post-hole digging.

EA personnel will evaluate the potential for electrical shock or fire/explosion for each subsurface disturbance project and will evaluate as necessary the use of non-conductive or non-sparking tools (i.e., fiberglass hand shovels, and thick electrically insulating rubber grips on hand augers or probes). The potential need for the use of non-conductive materials, electrical safety insulated gloves, and footwear will also be evaluated on a case-by-case basis.

For drilling, direct-push technology, fence post installation, or other borehole installation, the area to be delineated will exceed the diameter of the largest tool to be advanced and sufficiently allow for visual inspection of any obstructions encountered.

3.1 SUBSURFACE CLEARANCE PROCEDURES FOR TRENCHING/ EXCAVATION ACTIVITIES

For trenching and excavation activities, appropriate subsurface clearance methods should be conducted along the length and width of the excavation at a frequency sufficient to ensure adequate precautions have been applied to the entire work area. The frequency and density of investigations will be based on site knowledge, potential hazards, and risks of the work area to surrounding locations.

Whenever subsurface structures are exposed, EA will cease work and mark the area (e.g., flags, stakes, cross bracing) to ensure the integrity of these exposed structures is maintained during subsequent trenching/excavation/backfilling.

During ground disturbance activities, EA should consider the use of spotters to monitor the excavation for signs of subsurface utilities (pipes, conduits, cables, bedding material, warning tape, tracing wire, soil material changes, etc.) to provide early warning in the event unknown subsurface utilities are encountered. The decision to use spotters should be based on the risk of encountering unknown subsurface utilities, utility hazards associated potential unknown utilities that could be encountered (electrical, natural gas, etc.), and the physical and environmental hazards to have a spotter in proximity to the excavation.
Spotters, if used, should be briefed on the potential physical and utility hazards that may be present at the site and the signs of subsurface utilities that they should be monitoring for during ground disturbance activities.

Uniform color codes for marking of underground facilities are provided in Attachment C.

Attachment A

Subsurface Utility Clearance Checklist

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SUBSURFACE UTILITY CLEARANCE CHECKLIST

Site Identification: ______________________

Project Consultant/Contractor: ______________________

Section 1: Safety, Preparation Tasks, and Mark-Outs

Activity	Yes	No	N/A	Comments including Justification if Response Is No or Not Applicable
Health and Safety Plan is available and all contractors are familiar with it.				
All applicable local, state, and federal permits have been obtained.				
Site access/permission has been secured.				
Most recent as-built drawings and/or site plans (including underground storage tank, product, and vent lines) obtained.				
Reviewed site information to identify subsurface structures relevant to planned site activities (easements, rights-of-way, historical plot plans, fire insurance plans, tank dip charts, previous site investigations, soil surveys, boring logs, aerial photographs, etc.).				
Utility mark-outs have been performed by public utility company(s). Mark-outs clear/visible.				
Subsurface structure mark-outs performed by private mark-out company. Mark-outs clear/visible.				
Additional Activities: Were dig locations reviewed with site representative?				

Section 2: Initial Site Visit and Selecting Ground Disturbance Locations

Activity	Yes	No	N/A	Comments, including Justification if Response Is No or Not Applicable
Location of all aboveground indicators of subsurface utilities/services that may be leading to or from buildings within the planned work area has been identified.				
Location of utility mark-outs by all utility companies previously contacted has been identified within required time period.				
Location of all subsurface structure mark-outs by private mark-out company has been identified within required time period.				
Location of area lights/signs and associated subsurface lines identified.				
Location of all phones and associated subsurface lines identified.				
Location of all drains and associated interconnecting lines identified.				
Location of all electrical junction boxes and associated interconnecting lines identified				
Location of all-natural gas meters or connections and all interconnecting lines identified				

Completed by: ______________________
Name

Signature: ______________________ ______________
Company Date

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Attachment B

811 Utility Locate Brochure

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ALWAYS CALL BEFORE YOU DIG

One free, easy call gets your utility lines marked AND helps protect you from injury and expense.

Know what's below. Always call 811 before you dig.
Visit call811.com for more information.

811
Know what's below.
Call before you dig.

INSERT
CALL CENTER
LOGO HERE

U.S. Department of Transportation

Building Your Quality of Life

JOHN DEERE

TRAVELERS

Common Ground Alliance

811®

Know what's **below.**
Call before you dig.

Q: WHAT IS 811?

A: 811 is a new federally-mandated N-11 number designated by the FCC to consolidate all local "Call Before You Dig" numbers and help save lives by minimizing damages to underground utilities. One easy phone call to 811 quickly and easily begins the process of getting underground utility lines marked. Local One Call Center personnel will then notify affected utility companies, who will continue to mark underground lines for free.

Q: WHY SHOULD I CALL 811 BEFORE EVERY DIG?

A: Calling 811 will help save lives and protect infrastructure. Knowing where underground utility lines are buried before each digging project begins helps protect you from injury, expense and penalties. The depth of utility lines varies and there may be multiple utility lines in the same area. Even simple digging projects can damage utility lines and can disrupt vital services to an entire neighborhood, harm diggers, and potentially result in expensive fines and repair costs. Marked lines show diggers the approximate location of underground lines and help prevent undesired consequences.

Q: I'm JUST A HOMEOWNER, NOT A CONTRACTOR— IS 811 FOR ME?

A: Calling 811 is for professional excavators and do-it-yourself homeowners. A recent national survey revealed that roughly half of Americans are "active diggers" who have done (or are planning to do) some type of digging project at home. Whether you are a professional excavator or an avid do-it-yourselfer, you need to call 811 before every dig every time.

Q: WHO IS PROMOTING AWARENESS OF 811?

A: The national 811 campaign is a project of The Common Ground Alliance (CGA), working with its 1,400 individual members, member organizations, sponsors and 811 campaign national launch partners. CGA is a member-driven association dedicated to ensuring public safety, environmental protection, and the integrity of services by promoting effective damage prevention practices. In recent years, the association has established itself as the leading organization in an effort to reduce damages to all underground facilities in North America through shared responsibility among all stakeholders.

Attachment C

Uniform Color Codes for Marking of Underground Facilities

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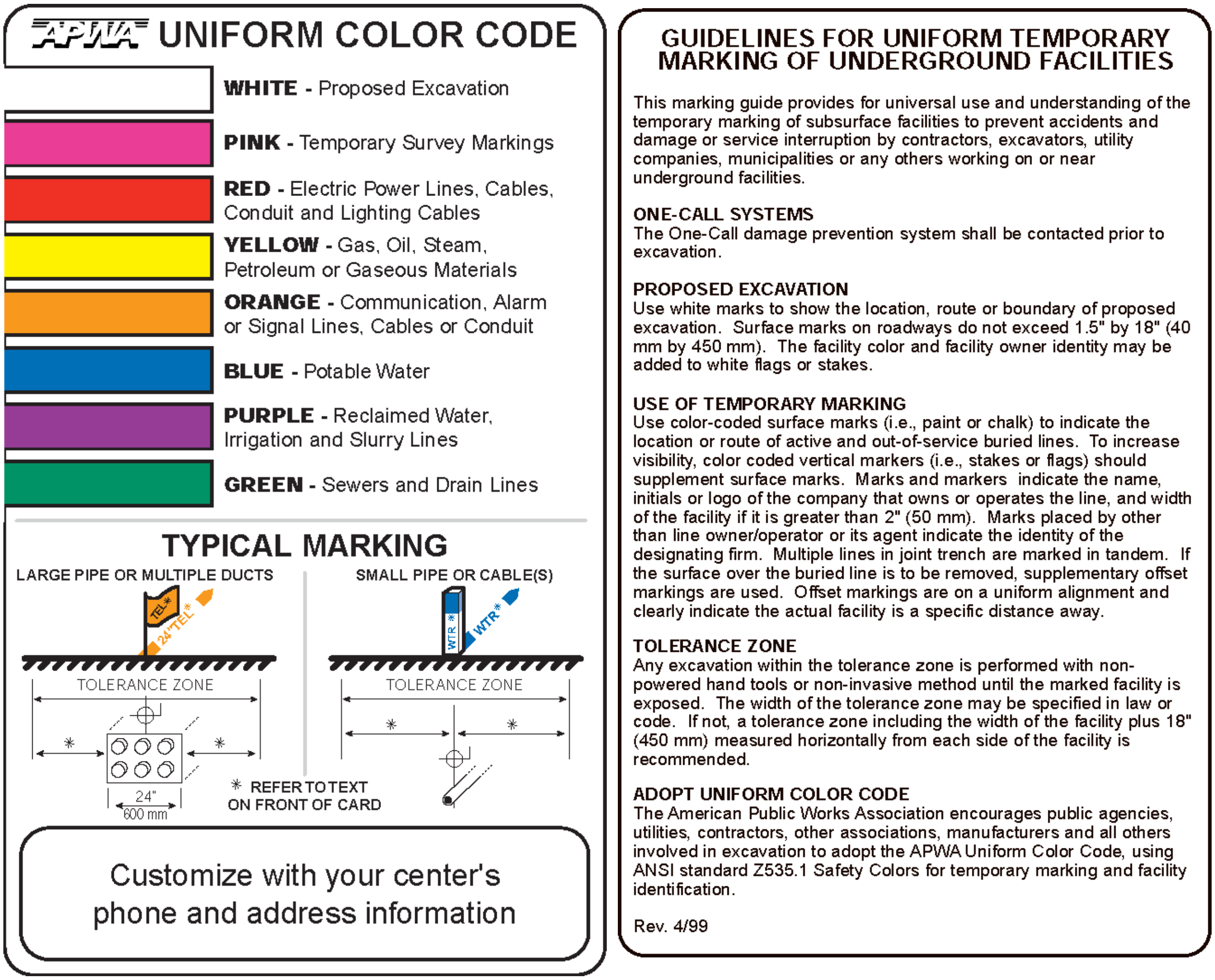

APWA UNIFORM COLOR CODE

WHITE - Proposed Excavation

PINK - Temporary Survey Markings

RED - Electric Power Lines, Cables, Conduit and Lighting Cables

YELLOW - 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 - Sewers and Drain Lines

TYPICAL MARKING

LARGE PIPE OR MULTIPLE DUCTS

SMALL PIPE OR CABLE(S)

* REFER TO TEXT ON FRONT OF CARD

Customize with your center's phone and address information

GUIDELINES FOR UNIFORM TEMPORARY MARKING OF UNDERGROUND FACILITIES

This marking guide provides for universal use and understanding of the temporary marking of subsurface facilities to prevent accidents and damage or service interruption by contractors, excavators, utility companies, municipalities or any others working on or near underground facilities.

ONE-CALL SYSTEMS

The One-Call damage prevention system shall be contacted prior to excavation.

PROPOSED EXCAVATION

Use white marks to show the location, route or boundary of proposed excavation. Surface marks on roadways do not exceed 1.5" by 18" (40 mm by 450 mm). The facility color and facility owner identity may be added to white flags or stakes.

USE OF TEMPORARY MARKING

Use color-coded surface marks (i.e., paint or chalk) to indicate the location or route of active and out-of-service buried lines. To increase visibility, color coded vertical markers (i.e., stakes or flags) should supplement surface marks. Marks and markers indicate the name, initials or logo of the company that owns or operates the line, and width of the facility if it is greater than 2" (50 mm). Marks placed by other than line owner/operator or its agent indicate the identity of the designating firm. Multiple lines in joint trench are marked in tandem. If the surface over the buried line is to be removed, supplementary offset markings are used. Offset markings are on a uniform alignment and clearly indicate the actual facility is a specific distance away.

TOLERANCE ZONE

Any excavation within the tolerance zone is performed with non-powered hand tools or non-invasive method until the marked facility is exposed. The width of the tolerance zone may be specified in law or code. If not, a tolerance zone including the width of the facility plus 18" (450 mm) measured horizontally from each side of the facility is recommended.

ADOPT UNIFORM COLOR CODE

The American Public Works Association encourages public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation to adopt the APWA Uniform Color Code, using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

Rev. 4/99

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Standard Operating Procedure No. 004
for
Sample Packing and Shipping

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 0
December 2014

CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the packing and shipping of samples to the laboratory for analysis.

2. MATERIALS

The following materials may be required:

Clear tape	Plastic garbage bags
Custody seals	Sample documentation
Ice	Waterproof coolers (hard plastic or metal)
Metal cans with friction-seal lids (e.g., paint cans)	Zip-seal plastic bags
Packing material[1]	

3. PROCEDURE

Check cap tightness and verify that clear tape covers label and encircles container. Wrap sample container in bubble wrap or closed cell foam sheets. Enclose each sample in a clear zip-seal plastic bag.

Place several layers of bubble wrap, or at least 1 in. of vermiculite on the bottom of the cooler. Line cooler with open garbage bag, place all the samples upright inside a garbage bag, and tie the bag.

Double bag and seal loose ice to prevent melting ice from soaking the packing material. Place the ice outside the garbage bags containing the samples.

Pack shipping containers with packing material (closed-cell foam, vermiculite, or bubble wrap). Place this packing material around the sample bottles or metal cans to avoid breakage during shipment.

Enclose all sample documentation (i.e., Field Parameter Forms, chain-of-custodies) in a waterproof plastic bag and tape the bag to the underside of the cooler lid. If more than one cooler is being used, each cooler will have its own documentation.

Seal the coolers with signed and dated custody seals so that if the cooler were opened, the custody seal would be broken. Place clear tape over the custody seal to prevent damage to the seal.

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1. Permissible packing materials are: (a) (non-absorbent) bubble wrap or closed cell foam packing sheets, or (b) (absorbent) vermiculite. Organic materials such as paper, wood shavings (excelsior), and cornstarch packing “peanuts” will not be used.

Refer to SOP Nos. 001, 002, and 016.

Tape the cooler shut with packing tape over the hinges and place tape over the cooler drain. Ship all samples via overnight delivery on the same day they are collected if possible.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Any samples suspected to be of medium/high contaminant concentration or containing dioxin must be enclosed in a metal can with a clipped or sealable lid (e.g., similar to a paint can). Label the outer metal container with the sample number of the sample inside.

6. REFERENCES

U.S. Environmental Protection Agency (U.S. EPA). 1980. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80.

———. 1990. Sampler's Guide to the Contract Laboratory Program. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C. December.

———. 1991. User's Guide to the Contract Laboratory Program. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response. January.

Standard Operating Procedure No. 005
for
Field Decontamination

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
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Revision 2
September 2018

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP)

SOP No. 005	
SOP Section	**Variance**
General	Please note that all materials used for decontamination will be certified PFASfree
1	The following statement was added to the SOP introduction: "Decontamination performed during PFAS sampling has specific requirements that must be followed. Review SOP No. 073 prior to mobilizing to the field to perform sampling. "
Global	HPLC Water was replaced with: water obtained from an approved PFAS-free source
Table 1.1	Table was updated to account for PFAS requirements
1.2.3.2	The following text was added: Install a new PFAS-free bladder and reassemble pump.
1.2.3.4	The following text was added: "When possible, sampling with a PFAS-free disposable bailer will be the preferred method of groundwater sampling for this project. These bailers and associated rope will be disposed of after one use. No equipment decontamination is anticipated when using these bailers."
Global	Removed mentions of aluminum foil as its prohibited for use on PFAS projects

Michael O'Neill

Project Manager (Name)

Michael O'Neill

11/16/2020

Project Manager (Signature) Date

CONTENTS

DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	25 September 2018	Systematic update and review	Cristina Radu, Amanda Kohn	Matthew Bowman

1. SCOPE AND APPLICATION

All personnel or equipment involved in intrusive sampling, or that enter a hazardous waste site, must be thoroughly decontaminated prior to leaving the site to minimize the spread of contamination and prevent adverse health effects. This Standard Operating Procedure (SOP) describes the normal decontamination of sampling equipment and site personnel. Specific projects and programs may have additional decontamination requirements. Refer to the planning document(s) for additional site-specific requirements.

As a good practice, sampling at a site should be conducted moving from least to most impacted locations to minimize the potential for cross-contamination. It is advisable to use disposable tools and personal protective equipment to the extent possible such that decontamination is not necessary. If disposable equipment cannot be used, all attempts will be made to minimize the need for decontamination by using dedicated equipment when practical. Decontamination performed during PFAS sampling has specific requirements that must be followed. Review SOP No. 073 prior to mobilizing to the field to perform sampling.

1.1 MATERIALS

The following materials may be required:

Reagent Grade Alcohol	Non-phosphate laboratory detergent (Liquinox)
	Plastic garbage bags
Clean HDPE plastic sheeting	HDPE sheeting, buckets, etc. to collect washwater and rinsates
Approved water (deionized, potable, etc.)	Pressure sprayer, spray bottles, brushes, laboratory wipes, disposable cloth (shop towel or similar)
Water obtained from an approved PFAS-free source	

1.2 PROCEDURE

All reusable (non-dedicated) equipment that contacts or could potentially contact environmental samples shall be decontaminated prior to use at a site, between sampling locations, and at the completion of sampling events before leaving the site. Decontamination procedures are conducted in the Contaminant Reduction Zone, which may or may not be contiguous to the Exclusion Zone. The Contaminant Reduction Zone should be located on a level, preferably paved surface, either in an area upwind of the investigation/sampling area or in an area believed to be free of surface contamination. Care must be employed when moving contaminated tools and equipment to the Contaminant Reduction Zone to prevent the spread of contamination.

Specially designated and properly built decontamination pads may be built at a centralized location to accommodate larger pieces of equipment. The pads are built such that any water produced during the decontamination process can be contained and pumped into investigative-derived waste holding containers (i.e., frac tank, 55-gallon drum, etc.) for waste profiling and disposal.

For other field equipment, the Contaminant Reduction Zone may be a mobile decontamination station set up in the vicinity of the Exclusion Zone or sampling location. Plastic sheeting will be used to create a clean surface for the sampling and decontamination equipment to be placed upon.

1.2.1 Sample Bottles

At the completion of each sampling activity, the exterior surfaces of the sample bottles must be decontaminated as follows:

- Ensure the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

1.2.2 Personnel Decontamination

Review the Health and Safety Plan for the appropriate decontamination of site personnel and reusable personal protective equipment, such as protective suits used at highly contaminated sites, respirators, safety boots, safety glasses, etc. Decontamination will be conducted in a designated Contaminant Reduction Zone as per the Health and Safety Plan and the general decontamination procedures outlined further in this SOP.

1.2.3 Non-Dedicated Equipment

Reasonable attempts will be made to minimize the need for decontamination by using dedicated equipment when practical.

All reusable (non-dedicated) equipment that contacts or could potentially contact environmental samples shall be decontaminated prior to use at a site, between sampling locations, and at the completion of sampling events before leaving the site. Decontamination shall be conducted at a central decontamination station (i.e., decontamination pad) or at the sampling location.

Decontamination stations should be located on a level, preferably paved surface, either in an area upwind of the investigation area or in an area believed to be free of surface contamination. Plastic sheeting will be used to create a clean surface for the sampling and decontamination equipment to be placed upon.

Used decontamination solutions will be disposed of properly according to the site-specific Health and Safety Plan or applicable planning documents (refer to SOP 042).

1.2.3.1 Field Monitoring and Testing Equipment

Water quality meters and temperature, pH, conductivity, redox, and dissolved oxygen probes will be cleaned per the manufacturer's instructions. If no such specifications exist, remove gross contamination and triple rinse probe with HPLC-grade water. If downhole probes are used, wipe the wetted portion of the cable with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination and rinse with water obtained from an approved PFAS-free source.

Electronic water level indicators, weighted tapes, measuring tapes transducers, level loggers, etc. will be decontaminated after each use as follows:

- Wipe the wetted or contaminated portion of the tape or cable and the probe with a clean laboratory wipe or disposable cloth (shop towel or similar) that has been soaked with non-phosphate laboratory detergent solution to remove gross contamination. Rinse cloth in the solution and continue wiping until tape or cable is clean.

- Wipe with a second wipe or cloth or rinse with water obtained from an approved PFAS-free source to remove soap residue.

- Dry tape with a third cloth (or laboratory wipe) and rewind into case or on spool, or re-coil tape.

Other field monitoring or measuring equipment such as beakers and graduated cylinders used to measure flow rates; flow-through cells used for monitoring water quality parameters; piezometers used to determine water levels; packers, mechanical slug device, and downhole equipment used during aquifer (hydraulic) testing; etc. will be decontaminated by washing with a non-phosphate laboratory detergent solution, followed by approved water and then rinse with water obtained from an approved PFAS-free source .

1.2.3.2 Bladder Pumps

Non-dedicated bladder pumps with disposable bladders will be decontaminated as follows:

- Disconnect tubing from pump.

- Completely disassemble the pump, being careful to note the initial position of and retain any springs and loose ball checks.

- Discard the pump bladder.

- Clean all parts in the same manner as provided in Section 1.2.3.1.

- Install a new PFAS-free bladder[2] and reassemble pump.

---

[2] Teflon® should not be used when sampling for PFCs/PFAS

- Store pump in a clean, dedicated polyvinyl chloride, low density polyethylene (for perfluorooctanesulfonic acid/per- and polyfluoroalkyl substances sampling) storage container.

1.2.3.3 Grundfos Redi-Flow® or Similar Submersible Pumps

Non-dedicated Grundfos Redi-Flow® and similar pumps will be disassembled and decontaminated per the manufacturer's instructions on an as-needed basis (i.e., where high concentrations and an elevated risk of cross-contamination exist). Due to the challenges associated with pump decontamination, if possible, consider designating one pump for sampling in highly contaminated areas and a second pump for sampling non-impacted areas or areas with lower contaminant concentrations. In most cases, the pumps will be decontaminated following the procedures below.

The pump and support cable/electrical wires that come in contact with water will be decontaminated via pumping as detailed below. To avoid electrical shock, always disconnect power from the pump when handling the pump body during decontamination procedures.

- Disconnect sample tubing from pump.

- Decontaminate the wetted portion of the cable/electrical wires by washing with non-phosphate laboratory detergent solution, followed by water obtained from an approved PFAS-free source. Coil cable/electrical wires on spools or clean plastic sheeting.

- Scrub the exterior of the pump to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate detergent (steam cleaning may be substituted for detergent scrub).

- Transfer pump to rinse bucket filled with approved water. Rinse by pumping no less than nine volumes or a minimum of 5 minutes of approved water.

- Rinse pump exterior with reagent grade alcohol.

- Rinse pump exterior with water obtained from an approved PFAS-free source.

- Allow pump to air dry.

- Wrap pump in aluminum foil or clean plastic sheeting, or store in a clean, dedicated polyvinyl chloride storage container.

- Prior to reusing pump, rinse exterior again with water obtained from an approved PFAS-free source.

1.2.3.4 Other Liquid Sampling Equipment

When possible, sampling with a PFAS-free disposable bailer will be the preferred method of groundwater sampling for this project. These bailers and associated rope will be disposed of after one use. No equipment decontamination is anticipated when using these bailers. Disposable clean laboratory bottles may be used to collect surface water, groundwater, non-aqueous phase liquid (NAPL), or other liquid samples and transfer the sample to the sampling container. These bottles will be disposed of after one use. No equipment decontamination is anticipated when using the laboratory bottles.

Other sampling equipment used to collect surface water, groundwater, non-aqueous phase liquid (NAPL), or other liquid samples includes but is not limited to dip samplers (whether bucket, long-handled, or short-handled), discrete interval stainless-steel samplers, ball check valves and foot valves, and labware (i.e., beakers, graduated cylinders, vials, and other containers that are used to hold samples for field measurements/screening and water chemistry). This equipment will be decontaminated after each use as follows:

- Discard all ropes, tubing, etc. used in sampling in a properly marked sealable container for disposal offsite, or as directed by the Health and Safety Plan. NOTE: No tubing is to be used in conjunction with a bailer in collecting samples.
- Wash sampling equipment with non-phosphate laboratory detergent and approved water solution using appropriate brush(es), laboratory wipes, or disposable cloth (shop towel or similar) to remove gross (visible) contamination.
- Rinse with water obtained from an approved PFAS-free source.
- Rinse with reagent grade alcohol.
- Rinse with water obtained from an approved PFAS-free source.
- Allow equipment to air dry. If sampling equipment has just been used for purging and is being decontaminated prior to sampling, do not air dry. Double rinse with water obtained from an approved PFAS-free source and proceed to collect samples.
- Wrap equipment in clean HDPE sheeting.
- Rinse equipment with water obtained from an approved PFAS-free source immediately prior to re-use.

1.2.3.5 Solid Materials Samplers

Solid materials samplers include soil and sediment sampling probes, augers, trowels, shovels, sludge samplers, and other sampling equipment (e.g., core tubes, grab samples, core catchers, core liners, scoops, spoons, etc.), which will be decontaminated as follows:

- Scrub the sampler to remove gross (visible) contamination, using appropriate brush(es), approved water, and non-phosphate laboratory detergent (steam cleaning may be substituted for detergent scrub).

- Rinse off detergent with water obtained from an approved PFAS-free source water.
- Rinse sampler with reagent grade alcohol.
- Rinse sampler with water obtained from an approved PFAS-free source.
- Allow sampler to air dry.
- Wrap equipment in clean HDPE sheeting.
- Rinse sampler with water obtained from an approved PFAS-free source immediately prior to re-use.

For larger sediment sampling equipment, if sediment can be collected from the interior of a sampling device and away from potentially contaminated surfaces of the sampler, a site water rinse may be sufficient between stations. A site water rinse may also be sufficient for vessel surfaces between sample locations. However, all tools and equipment coming into contact with the sample should be decontaminated in accordance with the procedures above. Washwater from decontamination activities should be collected and disposed of properly in accordance with plans and SOP 042.

1.2.3.6 Other Sampling and Measurement Probes

Soil (or sediment) gas sampling probes will be decontaminated as solids sampling devices.

1.2.3.7 Drilling Rigs, Sediment Sampling Vessels, and Other Heavy Equipment

All drilling rigs, sediment sampling vessels, and associated equipment such as augers, drill casing, rods, samplers, tools, recirculation tank, and water tank (inside and out) will be decontaminated prior to site entry after over-the-road mobilization and immediately upon departure from a site after drilling a hole. Supplementary cleaning will be performed prior to site entry when there is a likelihood that contamination has accumulated on tires and as spatter or dust on the way from one site to the next.

- Place contaminated equipment in an enclosure (i.e., existing wash pad, decontamination pad, etc.) designed to contain all decontamination residues (water, sludge, etc.).
- Clean equipment until all dirt, mud, grease, asphaltic, bituminous, or other encrusting coating materials (with the exception of manufacturer-applied paint) have been removed.
- Water used will be taken from an approved PFAS-free source.
- Follow SOP 042 with regards to disposal of decontamination fluids (i.e. you may

containerize decontamination fluids in 55-gallon drums; sample; characterize; dispose on the ground; dispose offsite; etc. based on approved site plans).

Other heavy equipment includes use of backhoes, excavators, skid steers, etc. If heavy equipment is utilized during field activities (i.e., a backhoe for test pitting), the bucket should not come in contact with soil to be sampled. If the bucket contacts the soil to be sampled, then it should be decontaminated between sample locations, following the same procedures as listed above for a drill rig.

1.2.3.8 Ice Chests and Reusable Shipping Containers

Scrub exterior/interior with approved brush and Liquinox detergent. Rinse off detergent with approved water. Let air dry and properly store until re-use.

NOTE: If container/ice chest is severely contaminated, clean as thoroughly as possible, render unusable, and properly dispose of.

2. PRECAUTIONS

Segregate all waste streams as specified in the sampling documents and store investigation-derived waste properly- and refer to SOP 042). Dispose of all washwater, rinse water, rinsates, and other sampling wastes (tubing, plastic sheeting, etc.) in properly marked, sealable containers, or as directed by the Health and Safety Plan or applicable planning documents.

Once a piece of equipment has been decontaminated, be careful to keep it in such condition until needed.

3. REFERENCES

Site-specific Health and Safety Plan and/or applicable planning documents.

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Standard Operating Procedure No. 007
for
Surface Water Sampling

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision: 1
December 2014

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP).

SOP No. 007	
SOP Section	**Variance**
3	The following text was added: "Sampling for PFAS has specific requirements that must be followed. Review SOP No. 073 prior to planning or conducting any sampling for PFAS. "
General	Please note that all materials used for surface water sampling will be certified PFAS-free

Michael O'Neill

Project Manager (Name)

Michael O'Neill 11/16/2020

Project Manager (Signature) Date

CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for sampling surface water. This procedure can be applied to the collection of surface water samples from marine and estuarine systems, streams, rivers, ditches, lakes, ponds, and lagoons. Surface water samples provide an indication of the amount of contaminant in the surface water. It is, therefore, important to collect a representative sample.

2. MATERIALS

The following materials may be required:

0.45-µ disposable filters	Sample bottles
Cooler with ice	Short-handled dip sampler (stainless steel)
Long-handled dip sampler (stainless steel)	Stainless steel bucket
Peristaltic pump with 0.45-µM filters and disposable tubing	Niskin bottle (or similar sampling device)

3. PROCEDURE

For all surface water samples, use a Global Positioning System to record sampling coordinates and mark the sampling locations on a site map. Photograph (if cameras are allowed onsite) and describe each location, place a numbered stake above the visible high-water mark on the bank closest to the sampling location, and/or mark adjacent trees with surveyor's flagging. The photographs and descriptions must be adequate to allow the sampling station to be relocated at some future date by someone other than the original sampling crew. Use a long-handled dip sampler where access is poor or non-contact with water is suggested in the Health and Safety Plan.

Sampling should be performed deliberately and methodically to minimize disturbance of bottom sediments, yet as quickly as possible to ensure a representative sample. If wading in a stream, sample downstream of the sampling location to prevent disturbance of the bottom. To prevent contamination of the exterior of the sample container, and/or potential contamination of the surface water sample by laboratory contaminants on the exterior of the bottle, the sample container should never be dipped into the water, rather a decontaminated sampling device should be used to collect unfiltered samples. Sampling for PFAS has specific requirements that must be followed. Review SOP No. 073 prior to planning or conducting any sampling for PFAS.

Remove the cap from the sample bottle.

- Dip a sample of surface water using the sampler.

Sampling with stainless steel sampler (long-handled or measuring cup-type):

- Tilt sample bottle and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.

Sampling with stainless steel bucket:

- Remove cap from sample bottle.
- Gently dip collection bucket in the water. Fill bucket and carefully lift from water body.
- Tilt sample bottle and gently pour sample from sampler into the bottle. Allow the sample to trickle down the side of the bottle. Avoid aerating the sample.
- Add preservative as specified by the project-specific Sampling and Analysis Plan. Replace cap, and place in cooler immediately.

– OR –

- Use smaller sampling cup to transfer sample from bucket to sample bottle as described above.

Sampling with a Niskin bottle (or similar device):

- Prepare the bottle for deployment by placing the ends of the bottle in the open position and lock the ends into the trigger mechanism.
- Lower the bottle to desired depth of sampling (on either a wire cable or rope).
- Place a messenger (triggering device) on the cable/rope and deploy by allowing free-fall down the cable/rope.
- Bring the bottle back to the surface and pour sample into a sample container.

Sampling with a peristaltic pump and PFAS-free tubing:

- Cut a length of PFAS-free tubing to the depth of sampling specified by the client or project- specific Sampling and Analysis Plan.
- Insert one end of the tubing into the intake hose on the peristaltic pump.
- Place a weight on the tubing and lower to the specified depth.
- Cut a length of tubing and insert into the output (out-flow) hose on the peristaltic pump.

- After applying power to the peristaltic pump, proceed to pump site water through the tubing apparatus. Approximately five times the hose volume should be pumped through the tubing before sampling.

- Fill the required sample containers.

- If filtering is required, obtain filtered sample by placing a 0.45-µM in-line filter on the end of the output tube and fill the required sample containers.

Both filtered and unfiltered samples may be required for metals analyses. Bulk samples for filtration will be collected using the stainless steel bucket method described above. Sample filtration must be performed immediately upon retrieval of the bulk sample as follows.

Filtration will be performed immediately after collecting sample. Set up filtration equipment prior to collecting sample. Filtration may be accomplished by gravity or, if necessary due to slow filtering, a peristaltic pump will be used to pressure filter the sample. Vacuum filtration will not be used due to the possibility of analyte volatilization.

Gravity filtration will be accomplished as follows:

- Using decontaminated forceps, place a 0.45-µM membrane in a decontaminated filter funnel.

- Slowly pour sample into the funnel and collect filtrate directly into appropriate sample container(s).

- Add preservative(s) as required by project-specific Sampling and Analysis Plan. Immediately cap container and place in cooler.

- Dispose of filter membrane.

Pressure filtration will be accomplished as follows:

- Using previously assembled disposable tubing, 45-µ in-line filter, and peristaltic pump, filter sample from collection bucket into appropriate container.

- Adjust pump rate to avoid aeration of sample.

- Fill container, immediately cap container, and place in cooler.

- Dispose of filter and tubing.

Refer to SOP Nos. 001, 002, 004, 005, and 016

4. MAINTENANCE

Refer to manufacturer's specifications for maintenance procedures on generators and pumps.

5. PRECAUTIONS

Avoid disturbing bottom sediments.

Consult the Health and Safety Plan prior to collecting any samples for personal protective equipment such as dermal and respiratory protection and personal flotation devices when sampling in or near deep water or from boats.

Always decontaminate the sampling and filtration equipment, and change gloves between sampling locations to minimize the risk of cross-contamination.

Always set up generators downwind of working area. Never service generators onsite.

6. REFERENCES

None.

Standard Operating Procedure No. 013
for
Collection of Monitoring Well Samples

Prepared by

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Revision: 1
January 2019

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP).

SOP No. 013	
SOP Section	**Variance**
2	Materials list was edited to include – PFAS-free approved tubing*, PFAS-free rope, and PFAS-free bailers
3.1	The following statement was added: "NOTE: Sampling monitoring wells that contain PFAS have specific requirements that must be followed. Review SOP No. 073 prior to planning or conducting any sampling for PFAS."
3.1	The following footnote was added: "When possible, sampling with a PFAS-free disposable bailer will be the preferred method of sampling for this project"
3.6 and 3.7	Edited to indicated PFAs free disposable bailers and rope should be used when sampling
General	Please note that all material used during the sampling of monitoring wells will be PFAS-free

Michael O'Neill

Project Manager (Name)

Michael O'Neill

11/16/2020

Project Manager (Signature) Date

CONTENTS

DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	1/23/2019	Systematic update and review	Jason Stroup, Scott Dobson	Matthew Bowman

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the collection of groundwater samples from monitoring wells.

2. MATERIALS

The following materials may be required:

0.45-µM filters	Sample bottles and labels
Bladder pump (dedicated to one well only)	PFAS-free bailer (for purging and sampling)
Conductivity meter	Submersible pump and hose (for purging only)
Dissolved oxygen meter	Thermometer (optional)[1]
Generator	Transparent bailer with a double check valve
Logbook or book of field parameter forms	Turbidity meter
Peristaltic pump with tubing for filtering samples	PFAS-free approved tubing*
pH meter with oxidation-reduction potential probe	Variable speed, low flow submersible pump (e.g., Grundfos MP1 groundwater sampling pump) (for purging and sampling)
Photoionization detector organic vapor analyzer.	Peristaltic head tubing
Variable speed peristaltic pump	Water level indicator
HDPE sheeting	Interface probe
Polypropylene rope	

NOTES: HDPE = High-density polyethylene.
µM = Micrometer(s).
L = Liter.
mL = Millimeter.
PFAS = Per- and polyfluoroalkyl substances.
PFC = Perfluorinated compound.
VOC = Volatile organic compound.

* Poly or Teflon® and/or Teflon® lined tubing (PTFE or Teflon® should not be used when sampling for PFCs/PFAS)

3. PROCEDURE

3.1 GENERAL

Groundwater sampling will follow these general steps:

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1. Temperature compensation and measurement capabilities are generally available as integral functions of pH meters and conductivity meters. If this is the case, a separate thermometer is not required.
2. Although use of a controlled flow bottom discharge valve is historically preferred, use of such a device can cause aeration of the sample.

- Arrive onsite
- Set up apparatus (generators, pumps, etc.)
- Glove
- Organic vapor check, water level, and well depth measurements
- Sample non-aqueous phase liquids (NAPLs) (as required)
- Begin purge procedure
  - — If using bailer to purge and sample, see Section 3.6
  - — If using pump to purge and bailer to sample, see Section 3.7
  - — If using bladder or low-flow pump to purge and sample, see Section 3.8
- Decontaminate/re-glove
- Take samples
  - — If with bailer, see Section 3.6[3]
  - — If with bladder or low flow pumps, see Section 3.8
- Decontaminate/dispose of wastes (SOP 042), move equipment to next site.

NOTE: Sampling monitoring wells that contain PFAS have specific requirements that must be followed. Review SOP No. 073 prior to planning or conducting any sampling for PFAS.

3.2 GENERAL RULES FOR GROUNDWATER FIELD PARAMETER LOGBOOK

Use only one site or installation per logbook, and only one sampling location per page or form (if using pre-printed forms). The same logbook may be used for more than one sampling event. The first five pages will be reserved for index, general notes, etc. Sign and date each entry. The last five pages will be reserved for recording calibration data for the pH, temperature, turbidity, oxidation-reduction potential, dissolved oxygen, and conductivity meters. Use the page number or a separately recorded "Cal Reference Number" to refer to each calibration.

As appropriate, insert the cardboard flap under the form being filled out so that writing does not go through to the pages below. As appropriate, fill in the forms from front to back of the logbook, tearing out the white copy for each sample when the sample has been collected. This copy goes in the cooler with the sample, directly to the laboratory. The original copy must be torn out before you write on the back of the duplicate form. As appropriate, duplicate copies, index pages, and calibration sheets remain intact.

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[3] When possible, sampling with a PFAs-free disposable bailer will be the preferred method of sampling for this project

Reference SOP No. 016 for additional procedures and requirements for the use and maintenance of field logbooks for sampling.

3.3 GROUNDWATER SAMPLING GENERAL RULES

Groundwater samples will be collected from the least contaminated wells first, progressing to the most contaminated[3]. Upon arrival at the well site, immediately set up and organize the purging, sampling, and filtration equipment. If needed, due to muddy or contaminated ground, remoteness from sampling vehicle, and/or for placement of hose(s) and/or power cord if a pump is used, place clean plastic sheeting at, or around the well, to serve as a clean staging area for purging and sampling equipment, as conditions warrant. Care must be exercised not to step on plastic sheeting. If the well is remote from the sampling vehicle, set up the filtration equipment and place rope, wrapped bailer, and pre-labeled sample containers on the plastic sheet from the well. When a pump is to be used, situate the portable generator on level ground approximately 15 feet (ft) away from and downwind from the well. All generator maintenance (oil and fueling) is to be performed offsite. If the hose(s) and/or power cord of the pump are not on a reel, place the pump with its hose and power cord on the plastic sheeting downhill from the well.

Check well headspace for organic vapor, which may pose a health and safety hazard and indicate the presence of NAPL. Measure depth(s) to and thickness(es) of NAPL(s) as appropriate. Measure the depth to water and depth of well. From the water depth, well diameter, sand pack length, etc., calculate the equivalent volume (1 EV) of water in the well.

$$1 \text{ EV} = \text{volume in casing} + \text{volume in saturated sand pack}$$

Therefore, if the water table lies below the top of the sandpack, use the following equation:

$$1 \text{ EV} = (\pi R_w^2 h_w) + (0.30\pi(R_s^2 - R_w^2)h_w) * (0.0043)$$

If the water table lies above the top of the sandpack use this equation:

$$1 \text{ EV} = [(\pi R_w^2 h_w) + (0.30\pi(R_s^2 - R_w^2)h_s)] * (0.0043)$$

where

R_s = Radius of sandpack in inches
R_w = Radius of well casing in inches
h_s = Height of sandpack in inches
h_w = Water depth in inches
0.0043 gallons (gal)/inch $(\text{in.})^3$
Assumed filter pack porosity = 30 percent.

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[3] First round samples are to be collected from upgradient wells first, moving to downgradient wells under the assumption that upgradient wells will be less contaminated than downgradient wells. Results of first round analysis may mandate a change in sampling sequence.

Samples will always be collected in order of decreasing volatility (i.e., the samples to be analyzed for the volatile constituents should be collected first). Deliver the VOC sample to the vial by allowing the water to trickle down the inside wall of the vial at a rate no greater than approximately 100 mL/minute. Other samples may be delivered at a faster rate. Sampling rates will at no time exceed 1 L/minute. Procedures for each class of samples are contained in the site-specific Quality Assurance Project Plan.

When collecting samples for volatile analysis, care should be taken to prevent analyte loss by volatilization. The following procedures should be adhered to when collecting these samples:

- Avoid excessive aeration and agitation of sample.
- Fill vial so that a reverse meniscus is present by adjusting the flow rate from the sampling device.
- Place septum on vial so that the side is in contact with the sample. After the cap is on the bottle, check for air bubbles in the sample. If air bubbles are present, properly dispose of that sample and recollect the sample in the same vial or a new vial if prepreserved.
- Make sure vial is labeled and immediately transfer the vial to the cooler with ice.

Filtered and unfiltered samples will be taken for inorganics (metals) analyses, as appropriate. The samples will be filtered through an in-line 0.45-µM filter (preferred method), or by gravity through a 0.45-µM membrane placed in a filter funnel. Use forceps to place the membrane into the funnel and pour sample through funnel until appropriate volumes have been filtered.

If necessary, due to slow filtering, a peristaltic pump may be used to filter the sample through an in-line filter. Connect the pump to the generator and attach PFAS-free tubing to the bottom discharge valve on the bailer. Start pump and collect sample from the end of the in-line filter directly into the proper container, preserved, and placed in the cooler. Filtered samples will be preserved in the field with acid to a pH of less than 2. Make sure sample bottle is labeled and the cap is on tightly. Then place in cooler with ice immediately.

— OR —

If a low flow pump is used collect the samples, filtered samples will be taken by installing a 0.45-µM filter in-line and pumping the water through the filter. Collect sample from the end of the in-line filter directly into the proper container, preserved, and placed in the cooler. If a flow-through cell is used to measure water quality parameters, collect samples before flow-through cell. Filtered samples will be preserved in the field with acid to a pH of less than 2. Make sure sample bottle is labeled and the cap is on tightly. Then place in cooler with ice immediately.

Unfiltered samples will be collected by slowly pouring the sample water into the appropriate sample container, being careful not to agitate or cause bubbles to form. Do not overfill bottles. Make sure sample bottle is labeled and the cap is on tightly, then place the sample in cooler with ice immediately.

All samples will be delivered to the laboratory as soon as possible. If possible, samples will be shipped on the same day as they are collected. If samples must be retained due to weekend sampling (Friday through Sunday), the laboratory will be notified as to the time sensitive nature of the samples.

3.4 SAMPLING OF NON-AQUEOUS PHASE LIQUIDS

If NAPLs are detected in the well, a sample from all layers must be collected prior to any purging activities. NAPLs may be indicated by the presence of volatiles in the well headspace and confirmed by the oil/water interface probe.

Collecting light non-aqueous phase liquid (LNAPL) will be accomplished using a transparent bailer with a double check valve. This bailer will be slowly lowered until the bottom of the bailer is 1-2 in. below the LNAPL-water interface, then slowly withdrawn. Verify that the interface was sampled by visual inspection of the bailer contents through the side of the bailer. Measure the thickness of the LNAPL in the bailer and note in the Field Logbook. Sample for laboratory analysis. An additional field verification may be performed by decanting the remainder of the contents of the bailer into a glass jar, adding a hydrophobic dye such as Sudan IV, or Redoil, shaking the sample and looking for coloration of NAPL. Alternate field tests are: examine the sample under ultraviolet light (many fluoresce), or allow the sample to stand overnight, and examine for interface and/or volatiles in the headspace the following day. Refer to the following sections on purging and sample collection for setup and general operation.

Collecting dense non-aqueous phase liquids (DNAPLs) will be accomplished using a transparent bailer with a double check valve. The bailer must be lowered very slowly to the bottom of the well and raised slowly out of the well in a controlled fashion. Sample for analysis as above. The same field check described above may be employed for DNAPL. Refer to the following sections on purging and sample collection for set up and general operation.

If NAPLs are present in the well, **and** a low-flow pump is to be used for purging and sampling, the well will be allowed to re-equilibrate prior to purging and sampling. This will be accomplished by allowing the well to stand undisturbed for at least 8 hours prior to purging and sample collection.

3.5 WELL PURGING GENERAL RULES

Water within the casing of a well will stagnate, de-gas, lose volatiles, possibly precipitate metals due to changes in redox potential, and may react with the screen and/or casing material. It is, therefore, necessary to purge a sufficient volume of this stagnant water from the well and/or casing to ensure that a representative sample of formation water can be obtained. Traditionally, the volume of water to be purged was arbitrarily set at 3-5 equivalent volumes. Recent advances in sampling technologies have caused a re-thinking of such arbitrary purge volumes. It is, for this reason, that monitoring of select chemical and physical properties of the sample medium will be used instead of strict volumes to determine when a representative sample may be taken from a well.

Acceptable purge/sampling devices include: bailers, high-discharge submersible pumps (purge only), and variable speed, low-flow pumps that include both submersible pumps (purge and sample) and dedicated bladder pumps (purge and sampling). It is recommended to purge and sample at similar rates with one type device per well. An acceptable exception to this general rule is to use a high-discharge submersible pump to purge a deep, fast-recharging well, and a bailer to sample the same well.

Peristaltic, gas-lift, and centrifugal pumps can cause volatilization, produce high pressure differentials, and result in variability in the analysis of some analytes of interest. For this reason, these pumps should be used with caution and flow rate slowed to minimize volatilization.

To prevent groundwater from cascading down the sides of the screen into an open hole, thereby aerating the sample, purge rates will closely match recharge rates. If the static water level is within the casing, the initial purge rates may be set high enough to lower the water level to the top of the screen, then reduced to maintain that level and identify the well’s recharge rate.

Purging will be accomplished with either a submersible pump, a low-flow (submersible or bladder) pump, or bailer. The choice of bailer or pump will be based on depth to water table, volume to be purged, and permeability of the aquifer. If the well recharges rapidly and/or has greater than 20 gal (estimated EV) to be purged, water may be removed with a submersible pump or a low-flow pump. If the well recharges slowly and/or has less than 20 gal to be purged, water will be removed with a bailer or a low-flow pump.

Purging will be accomplished with as minimal disturbance to the surrounding formation as possible.

Purge water will be containerized onsite until analysis of samples is completed. Based on sample results, accumulated purge water will be properly disposed of.

If the water level is within the screened interval and the well recharge rate is less than 0.1 L/minute, purge the well using a low-flow pump as follows:

1. Draw the water down to within 1 ft of the top of the pump.

2. Allow the well to recover.

3. Check and record field parameters.

4. Repeat Steps 1 through 3 then collect samples for metals analysis only[4].

5. Note the event in the Field Logbook, and report the problem to the Project Manager. If this extremely low recharge problem consistently occurs in a given well, the well may be considered for re-development and/or replacement.

6. If adjacent wells have elevated VOC levels, additional soil gas surveys will be considered in the vicinity of the low recharge well to help determine the need for replacement.

3.6 PURGING AND SAMPLING WITH BAILERS

Bailers may be used for both purging and sampling wells if: (1) the well recharge rate is less than 4 L/minute, (2) depth to the water table is less than 50 ft, and (4) less than 20 gal are to be purged (5 EV < 20 gal)[5].

When purging, a PFAS-free bailer will be attached to a spool of PFAS-free rope. The rope will be attached to the bailer using a bowline knot, dispensing the needed length (a few feet more than the well depth), and cutting the remainder away; then, at the end opposite the bailer, make a slip knot and place it around the well casing or protective posts to prevent losing the bailer and rope down the well. The rope will be not reused; it will be properly disposed of. The bailer will be repeatedly lowered gently into the well until it fills with water, is removed, and the water discharged into an appropriate container until purging is complete. Care must be taken not to unduly agitate the water, as this tends to aerate the sample, increase turbidity, makes stabilization of required parameters difficult to achieve, and generally prolongs purging.

After purging 2 EV, obtain a sample of groundwater and measure the following stabilization parameters: temperature, conductivity, pH, turbidity, redox potential (Eh), and dissolved oxygen level at each successive half-well volume. When three of these stabilization parameters are in agreement within approximately 10 percent in three consecutive half-well volume samples, sufficient water has been purged from the well. The results of these tests should be recorded in the sampling logbook. Should these parameters not reach agreement, no more than five well volumes will be purged.

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4. Analyte losses due to volatilization in a drained well are too high for valid VOC sampling (McAlary and Barker 1987).
5. These numbers are based on the following assumptions: (1) In purging, it is preferable to remove water at approximately the recharge rate; (2) 4 L/minute is estimated as the approximate maximum rate at which water can be removed with a bailer from depths of 20-50 ft; and (3) 20 gal is estimated to be at the limit of the sampler's endurance, at which point fatigue and sloppiness of technique begin.

Immediately upon completion of purging, collect samples for laboratory analysis using a bailer on a cable. The bailer will be equipped with double check valve top and controlled flow bottom discharge attachments for VOC sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles).

Slowly, so as not to agitate the water, lower the bailer into the well, using a spool of PFAS-free rope. Allow bailer to fill, withdraw smoothly. Refill bailer as needed.

If the controlled flow bottom discharge attachment is used for VOC sampling, attach it to the bottom of the bailer. Using the stopcock valve on the bailer to control the flow, and fill sample vials as described above in Section 3.3.

Remove check valve top and pour unfiltered sample into inorganics sample bottles.

Collect filtered samples as described in Section 3.3. Decontaminate bailer and cable.

3.7 PURGING WITH PUMP, SAMPLING WITH BAILER

If the recharge rate of the well is greater than 30 L/minute, or the water level is deeper than 50 ft, or more than 20 gal of purge water will be generated (5 EV > 20 gal), then purging and sampling may be accomplished using a submersible pump/bailer combination.

When purging with a pump, gradually lower the intake until it is submerged within the screened interval. Lower an electronic water level probe to the top of the screen (as determined from completion records) to the monitor water level, start pump, and slowly lower the pump as the water level continues to fall. Care should be exercised to lower the water column to the top of the screened interval (water level probe will stop beeping) but not below the top of the screen if possible. This will ensure that the stagnant layer has been removed, but should minimize the detrimental effects of over pumping the well. Secure hose(s) and/or power cord to casing and place discharge hose into the proper container, downhill and as far away from the well as possible. Determine and record the discharge rate.

Discharge rate = volume of container/time to fill container

The discharge rate will be established at approximately equal to or just greater than the well's recharge rate (determined from well development). If well development records are incomplete, recharge rate can be determined by monitoring the rise/fall of the water level within the casing as one purges the well. If the water level is static at a given pumping rate, but fluctuates up or down as pumping rate is decreased or increased, the pumping rate at which the water level is static is the recharge rate.

After purging 2 EV, obtain a sample of groundwater and measure the following stabilization parameters: temperature, conductivity, pH, turbidity, redox potential (Eh), and dissolved oxygen level at each successive half-well volume. When three of these stabilization parameters are in agreement within approximately 10 percent in three consecutive half-well volume samples, sufficient water has been purged from the well. The results of these tests should be recorded in the sampling logbook. Should these parameters not reach agreement, no more than five well volumes will be purged.

Immediately upon completion of purging, collect samples for laboratory analysis using a PFAS-free rope. The bailer will be equipped with a double check valve top and controlled flow bottom discharge attachments for VOC sampling (40-mL vials), and top discharge attachment for collecting larger samples (1-L bottles). Filtration of metals samples will be accomplished using either an in-line filter attached to the bottom of the bailer, or a funnel and appropriate filter (Section 3.3).

Slowly, so as not to agitate the water, lower the bailer into the well, using a spool PFAS-free rope. Allow bailer to fill, withdraw smoothly, and fill sample containers as described in Section 3.6. and dispose of the bailer and rope.

3.8 PURGING AND SAMPLING WITH LOW-FLOW PUMP

To obtain representative samples, subsurface disturbances should be kept to a minimum, thereby preventing sample alteration due to sampling actions. The reasoning behind the use of low-flow pumps to purge and sample monitoring wells is that these pumps minimize physical disturbance (turbulence) at the sampling point and chemical changes (aeration) in the medium. For these reasons, the low-flow pump is the preferred method for both purging and sampling in most cases. For the purposes of this SOP, “low-flow pumps” are defined as either dedicated bladder pumps or variable speed submersible pumps. Practical operational flow rates for these sampling devices range from 0.1 to 30 L/minute.

Low-flow pumps may be used for purging and sampling any well having recharge greater than 0.1 L/minute, which is the practical lower limit of pump performance. Below that pumping rate, pump inefficiencies and/or overheating may alter the physical and chemical properties of the sample. If the pump is continuously operated at sampling rates higher than the well recharge rate, the water level will be lowered in the well, possibly allowing aeration of the sample that is unacceptable sampling procedure. Low-flow pumps are suitable for sampling wells with recharge rates lower than 0.1 L/minute if precautions are taken to avoid aeration of the sample.

Low flow submersible pumps will be used as follows:

- Lower the pump into the well, slowly so as not to agitate the water, until the pump is at the mid-point of the screened interval or the mid-point of the water column if the static water table lies below the top of the screen.[6]

- Attach the pump's umbilical cord (which will consist of power cord and sampling tubing) to the protective casing, or lock the cord spool so that the pump cannot move vertically in the well during sampling.

- Lower the water level probe into the well behind the pump until it just touches water. This will allow the sampler to monitor the water level while purging and sampling, and prevent the inadvertent drying of the well.

- Begin purging at the pump's lowest setting, then gradually increase rate[7] until the pumping rate matches the aquifer recharge rate. **If the water level is above the top of the screen**, the pumping rate may be allowed to slightly exceed recharge rate, lowering the water level to no less than 1 ft above the screen, then reduced until it matches recharge rate and purging continued. **If the water level is below the top of the screen**, always keep the purge rate lower than well's recharge rate.

- Monitor stabilization parameters listed in Section 3.6 beginning immediately, using an in-line monitoring system. Record parameters regularly, at a rate of one set of parameters per each 1-3 liters of water removed from the well. When these parameters stabilize to within 10 percent over three consecutive readings, reduce[8] flow rate to 0.1 L/minute (if needed) and begin collecting VOC samples directly from the discharge line.

- If the well recharges at a rate less than 0.1 L/minute, purge until the water level is even with the top of the screen, allow the well to recover, and sample immediately.

- Remove and decontaminate water level probe and pump.

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[6] This assumes a 10-ft screened interval. If the screened interval is greater than 10 ft, multiple samples should be taken as follows:
  - If the screen is 10-12 ft, sample the canter of the water column, as outlined above.
  - If the screen is longer than 12 ft, and the water column is 10 ft or less, sample the center of the water column.
  - If the screen is longer than 12 ft, and the water column fills the screen, or extends above the screen, sample at 1/3 and 2/3 the height of the water column, or about every 6 ft.

[7] Some sources indicate that the pumping rate should not exceed 1 L/minute, with 0.5 L/minute being preferable. The optimal purge rate is highly aquifer dependent, and may range from less than 0.5 L/minute to greater than 10 L/minute. The purge rate for a given well will, therefore, be a field decision, based on well development, purge, and sampling records rather than SOP mandate.

[8] Sampling should occur at the same rate as purging as long as aeration of sample does not occur.

4. MAINTENANCE

Refer to manufacturer's requirements for maintenance of pumps and generators.

5. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for appropriate personal protective equipment.

6. REFERENCES

McAlary, T.A. and J.F. Barker. 1987. Volatilization Losses of Organics During Groundwater Sampling From Low Permeability Materials, in Groundwater Monitoring Review. Fall.

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Standard Operating Procedure No. 014
for
Collection of Production Well Samples

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Revision 0
December 2014

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CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the collection of groundwater samples from production wells. This protocol will allow for collection of samples from both active production wells and inactive production wells (Section 3).

2. MATERIALS

The following equipment may be required:

Conductivity meter	pH meter
Dissolved oxygen meter	Sample bottles and labels
Logbook or field parameter form	Temperature meter
Oxidation-reduction potential probe	Turbidity meter

3. PROCEDURE

Upon arrival at the well site, immediately set up and organize the sampling and ancillary equipment. If needed, due to muddy or contaminated ground and/or remoteness from sampling vehicle, place plastic sheeting at or around the sampling location as conditions warrant. Exercise caution not to step on and contaminate the sheeting.

If the well is remote from the sampling vehicle, set up the filtration equipment and place sample containers on the plastic sheet, uphill of the sampling location.

If a pump is to be used for filtration, situate the portable generator on level ground approximately 15 ft away from and downwind from the sampling location. All generator maintenance (oil and fueling) is to be preformed offsite.

If the well is currently in use, as close as possible to the well, open a tap to a high flow rate and allow the well to purge.

Obtain a sample of groundwater for temperature, conductivity, oxidation-reduction potential, dissolved oxygen, turbidity, and pH measurements. Record values in sampling logbook.

Take samples for physical stabilization (water quality) parameters every 5 minutes during the well purging process.

Allow the well to purge until the water quality parameters of pH, temperature, conductivity, turbidity, oxidation-reduction potential, and dissolved oxygen measurements stabilize within 10 percent in three consecutive 5-minute sampling periods, purging will be considered complete and sampling may proceed. Slow water flow rate to a trickle.

For procedures for collecting samples, with the exception of the sample source being a bailer, refer to SOP No. 013.

If the well is not currently in use, use a pump and bailer, or low-flow pump for sampling. Refer to SOP No. 013 for purging and sampling protocol. Decontaminate equipment. Refer to SOP Nos. 001, 002, 004, 005, 013, and 016.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Not applicable.

6. REFERENCES

U.S. Army Toxic and Hazardous Materials Agency. 1990. Installation Restoration Quality Assurance Program, December 1985, 1st Edition, March 1987, 2nd Edition.

Standard Operating Procedure No. 016
for
Surface Water, Groundwater, and Soil/Sediment Field Logbooks

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for recording surface water, groundwater, soil/sediment sampling information, instrument calibration data, and data from hydrologic testing in the field logbooks. Per SOP073, for this project all field records will be recorded electronically or using loose paper (non-waterproof) on aluminum or Masonite clipboards. Example field forms are provided herein. Alternate, equivalent forms are acceptable.

2. MATERIALS

The following material may be required: Loose paper (non-waterproof) on aluminum or Masonite clipboards and non-waterproof pens, pencils, or ultra-fine Sharpies®.

3. PROCEDURE

Information pertinent to soil/sediment, groundwater, or surface water sampling will be recorded electronically or loose paper (non-waterproof) on aluminum or Masonite clipboards. Each page/form will be consecutively numbered. If written, entries will be made using non-waterproof pens, pencils, or ultra-fine Sharpies®. Corrections will consist of line-out deletions that are initialed and dated.

3.1 SOIL/SEDIMENT LOGBOOK (Requires Figures SOP016-1 and SOP016-3)

3.1.1 Field Parameter Form (Items on Figures SOP016-1 and SOP016-2)

1. HIGH CONCENTRATION EXPECTED?: Answer “Yes” or “No.”
2. HIGH HAZARD?: Answer “Yes” or “No.”
3. SITE: Record the complete name of the site.
4. AREA: Record the area designation of the sample site.
5. INST CODE: Record the 2-letter installation code appropriate for the installation or site. Correct abbreviations can be found on Pages 3-6 of the IRDMS User’s Guide for chemical data entry.
6. FILE NAME: Record “CSO” for a soil sample or “CSE” for a sediment sample.
7. SITE TYPE: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User’s Guide for chemical data entry. This entry must match the Site Type on the map file form.

8. SITE ID: Record a code up to 10 characters or numbers which is unique to the site.

9. FIELD SAMPLE NUMBER: Record a code specific for the sample.

10. DATE: Enter the date the sample was taken.

11. TIME: Enter the time (12-hour or 24-hour clock acceptable as long as internally consistent) the sample was taken.

12. AM PM: Circle "AM" or "PM" to designate morning or afternoon (12-hour clock).

13. SAMPLE PROG: Record "GQA" (Groundwater Quality Assessment) or other appropriate sample program.

14. DEPTH (TOP): Record the total depth sampled.

15. DEPTH INTERVAL: Record the intervals at which the plug will be sampled.

16. UNITS: Record the units of depth (feet, meters)

17. SAMPLE MEASUREMENTS: Check the appropriate sampling method.

18. CHK: Check off each container released to a laboratory.

19. ANALYSIS: Record the type of analysis to be performed on each sample container.

20. SAMPLE CONTAINER: Record the sample container type and size.

21. NO.: Record the number of containers.

22. REMARKS: Record any remarks about the sample

23. TOTAL NUMBER OF CONTAINERS FOR SAMPLE: Record the total number of containers.

24. SITE DESCRIPTION: Describe the location where the sample was collected.

25. SAMPLE FORM: Record the form of the sample (i.e., clay, loam, etc.) using The Unified Soil Classification System.

26. COLOR: Record the color of the sample as determined from standard Munsell Color Charts.

27. ODOR: Record the odor of the sample or "none." See SOP No. 001 Section 5.

28. PID (HNu): Record the measured PID (HNu) values.

29. UNUSUAL FEATURES: Record anything unusual about the site or sample.

30. WEATHER/TEMPERATURE: Record the weather and temperature.

31. SAMPLER: Record your name.

3.1.2 Map File Form (Figure SOP016-3)

1. The map file form will be located on the reverse of the field parameter logbook form, or on an adjoining page of the field logbook (if level book is used).

2. SITE ID: Record the Site ID from the field parameter form.

3. POINTER: Record the field sample number for the sample being pointed to.

4. DESCRIPTION/MEASUREMENTS: Describe the location where the sample was taken, along with distances to landmarks.

5. SKETCH/DIMENSIONS: Diagram the surroundings and record the distances to landmarks.

6. MAP REFERENCE: Record which U.S. Geological Survey Quad Map references the site.

7. COORDINATE DEFINITION: Write the compass directions the X- and Y-Coordinates of the map run.

8. COORDINATE SYSTEM: Write “UTM” (Universal Transverse Mercator).

9. SOURCE: Record the 1-digit code representing the Map Reference.

10. ACCURACY: Give units (e.g., write “1-M” for 1 meter).

11. X-COORDINATE: Record the X-Coordinate of the sample site location.

12. Y-COORDINATE: Record the Y-Coordinate of the sample site location.

13. UNITS: Record the unit’s map sections are measured in.

14. ELEVATION REFERENCE: Record whether topography was determined from a map or a topographical survey.

15. ELEVATION SOURCE: Record the 1-digit code representing the elevation reference.

16. ACCURACY: Record the accuracy of the map or survey providing the topographical information.

17. ELEVATION: Record the elevation of the sampling site.

18. UNITS: Write the units in which the elevation is recorded.

19. SAMPLER: Write your name.

3.2 SURFACE WATER LOGBOOK (Requires Figures SOP016-2 and SOP016-3)

3.2.1 Field Parameter Form (Items Unique to Figure SOP016-3)

1. CAL REF: Record the calibration reference for the pH meter.

2. pH: Record the pH of the sample.

3. TEMP: Record the temperature of the sample in degrees Celsius.

4. COND: Record the conductivity of the water.

5. For all other sections, see Section 3.2.1.

3.3 GROUNDWATER SAMPLING LOGBOOK (Requires Figures SOP016-2, SOP016-3, and SOP016-4)

3.3.1 Field Parameter Form (Items on Figure SOP016-4)

1. WELL NO. OR ID: Record the abbreviation appropriate for where the sample was taken. Correct abbreviations can be found on Pages 18-21 of the IRDMS User’s Guide for chemical data entry.

2. SAMPLE NO.: Record the reference number of the sample.

3. WELL/SITE DESCRIPTION: Describe the location where the sample was taken, along with distances to landmarks.

4. X-COORD and Y-COORD: Record the survey coordinates for the sampling site.

5. ELEV: Record the elevation where the sample was taken.

6. UNITS: Record the units the elevation was recorded in.

7. DATE: Record the date in the form MM/DD/YY.

8. TIME: Record the time, including a designation of AM or PM.

9. AIR TEMP.: Record the air temperature, including a designation of C or F (Celsius or Fahrenheit).

10. WELL DEPTH: Record the depth of the well in feet and inches.

11. CASING HT.: Record the height of the casing in feet and inches.

12. WATER DEPTH: Record the depth (underground) of the water in feet and inches.

13. WELL DIAMETER: Record the diameter of the well in inches.

14. WATER COLUMN HEIGHT: Record the height of the water column in feet and inches.

15. SANDPACK DIAM.: Record the diameter of the sandpack. Generally, this will be the same as the bore diameter.

16. EQUIVALENT VOLUME OF STANDING WATER: Use one of the following equations, to determine one equivalent volume (EV):

    1 EV = Volume in casing + volume in saturated sand pack. Or to restate:

    $1\ EV = (BR_w^2 h_w + 0.30B(R_s^2 - R_w^2)h_s) * (0.0043)$

    where
    R_s = Radius of sandpack in inches
    R_w = Radius of well casing in inches
    h_s = Height of sandpack in inches
    h_w = Water depth in inches

    $0.0043 = \text{gal/in.}^3$
    and filter pack porosity is assumed as 30 percent

    — OR —

    Volume in casing = $(0.0043\ \text{gal/in.}^3)(B)(12\ \text{in./ft})(R_c^2)(W_h)$

    where
    R_c = Radius of casing in inches
    W_h = Water column height in feet

    Vol. in sandpack = $(0.0043\ \text{gal/in.}^3)(B)(12\ \text{in./ft})(R_b^2 - R_c^2)(W_h)(0.30)$

    (if W_h is less than the length of the sandpack),

— PLUS —

Vol. in sandpack = (0.0043 gal/in.^{3})(B)(12 in./ft)(R_b^2 - R_c^2)(S_h)(0.30)

(if W_h is greater than the length of the sandpack).

where
R_b = Radius of the borehole
S_h = Length of the sandpack.

Show this calculation in the comments section.

17. VOLUME OF BAILER OR PUMP RATE: Record bailer volume or pump rate.

18. TOTAL NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers required to remove 3 equivalent volumes (EV) of water from the well or the total purge time and volume as applicable.

19. WELL WENT DRY? Write “YES” OR “NO.”

20. NUMBER OF BAILERS OR PUMP TIME: Record the number of bailers or pump time which made the well go dry.

21. VOLUME REMOVED: Record the volume of water (gal) removed before the well went dry.

22. RECOVERY TIME: Record the time required for the well to refill.

23. PURGE AGAIN?: Answer “YES” or “NO.”

24. TOTAL VOL. REMOVED: Record the total volume of water (in gal) removed from the well.

25. CAL REF.: Record the calibration reference for the pH meter.

26. TIME: Record time started (INITIAL T[0]), 2 times DURING the sampling and the time sampling ended (FINAL).

27. pH: Record the pH at start of sampling (INITIAL), twice DURING the sampling and at the end of sampling (FINAL).

28. TEMP: Record the water temperature (Celsius) at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

29. COND: Record the conductivity of the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

30. D.O.: Record the dissolved oxygen level in the water at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

31. TURBIDITY: Record the readings from the turbidity meter (nephelometer) and units at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

32. ORD: Record the oxidation/reduction (RedOx) potential of the water sample at the start of sampling, twice DURING the sampling and at the end of sampling (FINAL).

33. HEAD SPACE: Record any positive readings from organic vapor meter reading taken in well headspace prior to sampling.

34. NAPL: Record the presence and thickness of any non-aqueous phase liquids (light or dense)

35. COMMENTS: Record any pertinent information not already covered in the form.

36. SIGNATURE: Sign the form.

3.4 FIELD CALIBRATION FORMS (Maintained as a separate logbook, or incorporated into sampling logbooks)

3.4.1 Items on Figure SOP016-5

1. Record time and date of calibration. Note whether 12- or 24-hour clock was used.

2. Record calibration standard reference number.

3. Record meter I.D. number

4. Record initial instrument reading, recalibration reading (if necessary), and final calibration reading on appropriate line.

5. Record value of reference standard (as required).

6. COMMENTS: Record any pertinent information not already covered on form.

7. SIGNATURE: Sign form.

3.5 GROUNDWATER HYDROLOGY TESTS LOGBOOK (Must include Figures SOP016-6 and SOP016-7 and/or SOP016-8, OR SOP016-9 or SOP016-10)

3.5.1 Field Permeability Test Data Sheet (Items on Figures SOP016-6)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

4. PROJECT NO.: Record the contractor assigned project number or the contract number.

5. LOCATION: Specific location

6. CLIENT: Agency or company with the contract under which the work is being performed.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

9. TEST TYPE: Short description of the type of test to be performed.

10. RISING/FALLING HEAD WITH SLUG: Check if the test involved the insertion/removal of and inert object.

11. RISING/FALLING HEAD WITHOUT SLUG: Check if the test involved the addition/removal of a quantity of water.

12. START DATE: Date on which the test was begun.

13. CLOCK TIME: Time each datum (depth to groundwater level) is collected. Note whether 12- or 24-hour clock was used.

14. ELAPSED TIME: Time since the last datum was collected.

15. DEPTH TO GWL (ft): Depth to the top of the groundwater table (Groundwater Level) as measured by manual methods.

16. REC. (ft): Water level as reported by transducer/datalogger (this is the depth of water above the transducer.

17. TIME: Time the discharge rate check was begun (addition or removal of water method). Note whether 12- or 24-hour clock was used.

18. FLOW METER (Addition or removal of water method): The amount of water added or removed as registered by the flowmeter, in gal of liters.

19. DISCHARGE RATE: Flowmeter reading divided by time interval (gal/min or liters/min).

20. SIGNATURE: The person completing this form must sign the form at the end of the test.

21. DATE: Date the form was signed.

3.5.2 Groundwater Levels – Single Well (Items on Figure SOP016-7)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

Well Data

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: Remedial investigation wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATE: Date of each water level reading

16. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

17. ELAPSED TIME: Time since test was begun.

18. DEPTH TO WATER: Measured depth to the groundwater table.

19. WATER ELEVATION: Elevation of the top of the groundwater table (use datum listed above).

20. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

21. TAPE NO.: The unique identification number of the traceable standard tape used to calibrate the measuring device.

22. WELL STATUS: Condition of the well at the time of measuring (see abbreviation key at the bottom of the data sheet).

23. REMARKS: Any additional pertinent comments not specifically required above.

24. INITIALS: Initials of person completing this data entry.

25. ABBREVIATION KEYS: Self explanatory.

26. SIGNATURE: The person completing this form must sign the form at the end of the test.

27. DATE: Date the form was signed.

3.5.3 Groundwater Levels – Single Well (Items on Figure SOP016-8)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor’s organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

WELL DATA

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day’s field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write “MAP”) or survey data (write “SURVEY”).

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

15. DATALOGGER: This section is record of pertinent datalogger information.

16. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

17. MODEL: Enter the model number of the datalogger.

18. S/N: Enter the serial number of this datalogger.

19. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger’s program to indicate that this unit was used to record a given data set?

20. TRANSDUCER: This section is a listing of pertinent information about the transducer used.

21. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

22. MODEL: Enter the model number of the transducer.

23. S/N: Enter the serial number of this transducer.

24. INPUT/UNITS: What are the units this transducer uses?

25. RANGE: Record the pressure or depth range over which this transducer is certified.

CALIBRATION

26. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer. (Usually in psi, or kpa).

27. "SUBMERGENCE =____(V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

28. VOLUME WATER ADDED/REMOVED: (Applicable if inert object insertion/removal method was not employed.) Record the volume of water added to or removed from the well.

29. DISCHARGE RATE: If z (above) is filled, enter the rate at which this water was added or removed.

30. INITIAL WATER LEVEL (ft): Enter the water level in the well at the beginning of the test.

31. PRESSURE TRANSDUCER SUBMERGENCE: Record the depth to which the transducer is submerged at the beginning of the test and the depth to the transducer at the end if the test. All depths will be recorded to the nearest 0.01 ft.

32. TIME: Record the time the test is begun and ended. Note whether 12- or 24-hour clock was used.

33. OBSERVED CHANGES IN ADJACENT WELLS: Note any changes in water levels in nearby wells.

34. RESULTS RECORDED ON DISKETTE #: Tracking number of the diskette on which these data are archived.

35. DISKETTE FILE NAME: Name of the file(s).

36. SIGNATURE: The person completing this form must sign the form at the end of the test

37. DATE: Date the form was signed.

3.6 GROUNDWATER LEVELS – MULTIPLE WELLS (Items on Figure SOP016-9)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

5. LOCATION: Specific location.

6. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

7. CLIENT: Agency with the contract under which the work is being performed.

8. REMARKS: Any pertinent observations not specifically required above.

9. WELL: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

10. DATE: Date this measurement was made.

11. TIME: Time this measurement was made. Note whether 12- or 24-hour clock was used.

12. DEPTH TO WATER: Depth from MP to top of groundwater table.

13. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

14. MP ELEV.: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

15. MEAS. METH.: Method used to measure the water level in the well (see abbreviation key at the bottom of the data sheet).

16. REMARKS/MP: Describe the location and nature of the measuring point.

17. INITIALS: Initials of the person completing this form.

18. ABBREVIATION KEYS: Self-explanatory.

19. SIGNATURE: The person completing this form must sign the form at the end of the test.

20. DATE: Date the form was signed.

3.7 GROUNDWATER LEVELS – DATALOGGERS (Items on Figure SOP016-10)

1. CONTRACTOR: Organization performing the test.

2. SEQ. #: Enter page number of this set of forms (page # of #).

3. PROJECT NO.: Record the contractor assigned project number or the contract number.

4. WELL #: Record the well number as it appears on the well completion tag, affixed to the protector casing or well completion records.

5. PROJECT NAME: Record the name assigned by the contractor's organization to the project.

6. LOCATION: Specific location.

7. FIELD PARTY CHIEF: Printed name of the person responsible for this particular field test.

8. CLIENT: Agency with the contract under which the work is being performed.

WELL DATA

9. STICKUP: Enter the length of well casing extending above the average ground surface at the base of the protective casing.

10. MEASURED UP(+)/DOWN(-) FROM: Describe the starting point for the previous measurement.

11. MP ELEVATION: Enter the elevation of the measuring point here. NOTE: This datum may require reference to tables and/or maps and may be added after completing the day's field work.

12. DATUM = MSL OR: Is the datum for the previous elevation Mean Sea Level? If not, what? Also tell whether it was derived from a map elevation (write "MAP") or survey data (write "SURVEY").

13. MEASURING POINT DESCRIPTION: Describe the point used as the origin for all down-hole (water table) measurements. NOTE: All Rhode Island wells are required to have a permanently marked reference (measuring) point (refer to SOP No. 019, Section 3.4).

14. REMARKS: Record any pertinent observations about the site/well conditions not specifically required in the preceding.

DATALOGGER (This section is a record of pertinent datalogger information)

15. MANUFACTURER: Record the manufacturer/brand name as stated on the datalogger.

16. MODEL: Enter the model number of the datalogger.

17. S/N: Enter the serial number of this datalogger.

18. TAG PROGRAMMED IN LOGGER: What is the identifier used in the datalogger's program to indicate that this unit was used to record a given data set?

TRANSDUCER (This section is a listing of pertinent information about the transducer used)

19. MANUFACTURER: Record the manufacturer/brand name as stated on the transducer.

20. MODEL: Enter the model number of the transducer.

21. S/N: Enter the serial number of this transducer.

22. INPUT/UNITS: What are the units this transducer uses?

23. RANGE: Record the pressure or depth range over which this transducer is certified.

CALIBRATION

24. PRESSURE RATING: This is taken from the manufacturer's specifications for a given transducer (usually in psi, or kpa).

25. "SUBMERGENCE =____(V) / (MV)": Record the voltage returned by the transducer at a given depth of submergence. Indicate whether the reading is in volts (v), or millivolts (mv).

26. DATE: Date of each water level reading

27. TIME: Time of each water level reading. Note whether 12- or 24-hour clock was used.

28. LOGGING TIME INTERVAL: Time since test was begun.

29. WL FEET BELOW MP: Measured depth to the groundwater table from measuring point.

30. SUBMERGENCE: Depth of water above the transducer.

31. MEAS.METHOD: What device/method was used to measure the water level.

32. TAPE NO.: Record the tape identification number.

33. TRANSDUCER MOVED?: Was the transducer moved since the last water level reading?

34. REMARKS: Any pertinent remarks not otherwise specified.

35. INITIALS:

DATA TRANSFER TO DISKETTE:

36. DATE: Date data were archived onto diskette.

37. TIME: Time stamp the computer assigns the data file.

38. FILE NAME: Name assigned the data file.

39. SOFTWARE USED FOR TRANSFER: Any special software, or computer operating system used to write the files to diskette. NOTE: If a "shareware" archiver which compresses files was used, and the archived file is not self-extracting, a copy of the unarchive program should be copied onto the diskette also.

40. OUTPUT FORMAT: What is the format of the output file? (DOS, UNIX, Binary, Compressed?)

41. INITIALS: Initials of the person who copied the data to diskette.

42. ABBREVIATION KEY: Self-explanatory.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

None.

6. REFERENCES

U.S. Environmental Protection Agency. 1984. User's Guide to the Contract Laboratory Program. July.

FIGURE SOP016-1
FIELD PARAMETER LOGBOOK
SOIL AND SEDIMENT SAMPLES

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

INSTALLATION/SITE________________________________AREA ___________________

INST CODE FILE NAME ____

SITE TYPE SITE ID
FIELD SAMPLE NUMBER

DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.

DEPTH (TOP) DEPTH INTERVAL UNIT ____________

SAMPLING METHOD:

SPLIT SPOON AUGER SHELBY TUBE SCOOP OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION:____
SAMPLE FORM______________________COLOR______________ODOR _____________
PID (HNu)_______________________UNUSUAL FEATURES _______________________

WEATHER/TEMPERATURE
SAMPLER

HIGH CONCENTRATION EXPECTED? HIGH HAZARD?

FIGURE SOP016-2
FIELD PARAMETER LOGBOOK
GROUNDWATER AND SURFACE WATER SAMPLES

INSTALLATION/SITE AREA
INST CODE FILE NAME SITE TYPE
SITE ID FIELD SAMPLE NUMBER
DATE (MM/DD/YY) / / TIME AM PM SAMPLE PROG.
DEPTH (TOP) DEPTH INTERVAL UNITS

SAMPLING MEASUREMENTS

CAL REF.	pH	TEMPERATURE C	CONDUCTIVITY	OTHER

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE

DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION
SAMPLING METHOD
SAMPLE FORM COLOR ODOR
PID (HNu)
UNUSUAL FEATURES
WEATHER/TEMPERATURE__________________________SAMPLER __________________

FIGURE SOP016-3
MAP FILE LOGBOOK

SITE ID POINTER____________________
DESCRIPTION/MEASUREMENTS
SKETCH/DIMENSIONS:

MAP REFERENCE
COORDINATE DEFINITION (X is Y is)
COORDINATE SYSTEM SOURCE ACCURACY
X-COORDINATE Y-COORDINATE UNITS
ELEVATION REFERENCE
ELEVATION SOURCE ACCURACY ELEVATION
UNITS

SAMPLER

FIGURE SOP016-4
MAP FILE AND PURGING LOGBOOK
GROUNDWATER SAMPLES

WELL COORD. OR ID SAMPLE NO.______________
WELL/SITE
DESCRIPTION____
____
X-COORD. Y-COORD.________________ELEV. UNITS
DATE____/____/____TIME AIR TEMP.

WELL DEPTH__________ft___________in. CASING HT.__________ft_________in.
WATER DEPTH___________ft__________in. WELL DIAMETER____________in.
WATER COLUMN HEIGHT__________ft__________in. SANDPACK DIAM._________in.
EQUIVALENT VOLUME OF STANDING WATER_____________(gal) (L)
VOLUME OF BAILER____________(gal) (L) <u>or</u> PUMP RATE____________(gpm) (lpm)
TOTAL NO. OF BAILERS (5 EV)___________or PUMP TIME_____________MIN. WELL
WENT DRY? [Yes] [No] NUM. OF BAILERS_______________or PUMP TIME_______MIN
VOL. REMOVED___________(gal) (L) RECOVERY TIME___________MIN
PURGE AGAIN? [Yes] [No] TOTAL VOL. REMOVED___________(gal) (L)

Date and Time	Quantity Removed	Time Required	pH	Cond	Temp	ORD	Turb	DO	Character of water (color/ clarity/odor/partic.)
(before)									
(during)									
(during)									
(during									
(after)									

COMMENTS:____
____
____
____

____
SIGNATURE

FIGURE SOP016-5
FIELD CALIBRATION: pH, CONDUCTIVITY, TEMPERATURE, TURBIDITY, OXIDATION-REDUCTION POTENTIAL, AND DISSOLVED OXYGEN METERS

INITIAL CALIBRATION	FINAL CALIBRATION
DATE:	DATE:
TIME:	TIME:

pH METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: ________________

METER ID ________________________________

pH STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
7.0			
10.0			
4.0			

CONDUCTIVITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: ________________

METER ID __________________

COND. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

TEMPERATURE METER CALIBRATION

METER ID _________________

TEMP. STANDARD	INITIAL READING	RECALIB. READING	FINAL READING
ICE WATER			
BOILING WATER			
OTHER			

FIGURE SOP016-5 *(continued)*

TURBIDITY METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: ________________

METER ID _________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

ORD METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: ________________

METER ID _________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

DISSOLVED OXYGEN METER CALIBRATION

CALIBRATION STANDARD REFERENCE NO: ________________

METER ID ______________________________

STANDARD	INITIAL READING	RECALIB. READING	FINAL READING

COMMENTS:____
____
____
____

____
SIGNATURE

FIGURE SOP016-6
FIELD PERMEABILITY TEST DATA SHEET

Contractor: **Seq. #** /

Project Name:	Project #:
Location:	Client:
Party Chief:	Contractor:
Observation Well:	
Test Type: Rising/Falling Head w/Slug	Rising/Falling Head w/out Slug

Start Date:								Discharge Rate		
Clock Time	Elapsed Time (min)	Depth to GWL (ft)	Rec (ft)	Clock Time	Elapsed Time	Depth to GWL (ft)	Rec (ft)	Time	Flow Meter	Discharge Rate

Signature:______________________________________**Date:** ______________________

FIGURE SOP016-7
GROUNDWATER LEVELS – SINGLE WELL

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:
Well No.: Site: Area:
Site: Area:
Area:

up (+)/down (-) from: Datum = MSL or:
Datum = MSL or:

Measuring Point Description:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:

Transducer: Manufacturer: Model: S/N:
Input/Units: Range:

Calibration:
Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v) / (mv)

Volume Water Added/Removed:
Discharge Rate:
Initial Water Level (ft):

Pressure Transducer Submergence
Initial (ft): Final(ft): Time:Start: End:
Observed Changes in Adjacent Wells:

Results Recorded on Diskette #:
Diskette File Name:

Signature:____ **Date:** ______________________

FIGURE SOP 016-8
GROUNDWATER LEVELS – MULTIPLE WELLS

Contractor: **Seq. #** /

Project No.:
Project Name:
Field Party Chief:

WELL DATA:

Stickup: (ft)
MP Elevation:

Measuring Point Description:
Remarks:
Well No.:
Site: Area: up (+)/down (-) from:
up (+)/down (-) from:
up (+)/down (-) from:
Datum = MSL or:

Date	Time	Elapsed Time	Depth to Water	Water Elevation	Meas. Meth.	Tape No.	Well Status	Remarks	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

Signature:____**Date:** _______________________

FIGURE SOP016-8 *(continued)*

Contractor: **Seq. #** /

Project No.:
Project Name: Location:
Field Party Chief: Client:

Well	Date	Time	Depth to Water	Stickup	MP Elev.	Meas. Meth.	Tape No.	Remarks/MP	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently pumped
NP = Nearby well pumping
NRP = Nearby well recently
X = Obstructed

FIGURE SOP016-9
GROUNDWATER LEVELS DATALOGGERS

Contractor

Project No.: **Well No.:**
Project Name: **Site:**
Field Party Chief: **Area:**

WELL DATA: Stickup: **(ft)** **up (+)/down (-) from:**
MP Elevation: **Datum = MSL or:**

Measuring Point Description:
Remarks:

Datalogger:
Manufacturer: Model: S/N:
Tag No. Programmed in Logger:
Transducer: Manufacturer: Model: S/N:
Input/Units: Range:
Calibration: Pressure Rating:
0 ft submergence = (v) / (mv) ft submergence = (v)

Logging	Date	Time	Logging Time Interval	WL, ft Below MP	Submergence (logger reading)	Meas. Method	Tape No.	Well Status	Transducer Moved	Remarks	Initials
Start											
Stop											
Start											
Stop											

Data Transfer to Disk

Date	Time	File Name	Software Used for Transfer	Output Format	Initials

Measurement Method:
A = Airline
C = Chalk and tape
E = Electric tape
T = Tape with popper
X = Other (describe in remarks)

Well Status:
D = Dry
F = Flowing
P = Pumping
RP = Recently
NP = Nearby well pumping
NRP = Nearby well recently pumped
X = Obstructed

Signature **Date**

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Standard Operating Procedure No. 019
for
Monitoring Well Installation

Prepared by

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Revision 0
December 2014

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-specific variances to this Standard Operating Procedure (SOP).

SOP No. 019	
SOP Section	**Variance**
General	Please note that all materials used during monitoring well installation will be certified PFAS free
3.2	A table describing potential drilling methods has been added to the SOP.

Michael O'Neill

Project Manager (Name)

Michael O'Neill 11/16/2020

Project Manager (Signature)

CONTENTS

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1. SCOPE AND APPLICATION

The installation of monitoring wells is contingent upon the existing conditions at the project site. The purpose of this Standard Operating Procedure is to delineate the quality control measures required to ensure the accurate installation of monitoring wells. The applicable Work Plan should be consulted for specific installation instructions. The term "monitoring wells," as used herein, is defined to denote any environmental sampling well. An example well log form is provided in Appendix A. Alternate, equivalent forms are acceptable.

2. MATERIALS

2.1 DRILLING EQUIPMENT

The following drilling equipment may be required:

- Appropriately sized drill adequately equipped with augers, bits, drill stem, etc.
- Steam cleaner and water obtained from approved source for decontaminating drilling equipment.
- Photoionization Detector: Microtip HL-200 (or equivalent)
- Water level indicator
- Weighted steel tape measure
- Lower explosive limit – oxygen monitor
- Steel drums for intrusion derived wastes (drill cuttings, contaminated personal protective equipment, decontamination solutions, etc.) if applicable in accordance with approved plans and SOP 042.
- Source of approved water
- Heavy plastic sheeting
- Sorbent pads and/or log.

2.2 WELL INSTALLATION MATERIALS[1]

The following well installation materials may be required:

- Well screen:[2]
  - Polyvinyl chloride (PVC): JOHNSON (or equivalent); PVC 0.010 slot; Schedule 40; flush-threaded (leak-proof) joints; PVC complies with American Society for Testing and Materials (ASTM) D2665, ASTM D1784, and ASTM F480; free of ink markings; cleaned and prepackaged by manufacturer.
  - Stainless steel: JOHNSON (or equivalent); stainless steel 0.010 slot; 304 stainless steel[3]; ASTM F480 flush threads; cleaned, wrapped, and heat sealed by manufacturer.
- Riser pipe:
  - PVC: JOHNSON (or equivalent); STD; PVC; Schedule 40; flush-threaded (leak-proof) joints; PVC complies with ASTM D2665, ASTM D1784, and ASTM F480; free of ink markings; cleaned and prepackaged by manufacturer.
  - Stainless steel: JOHNSON (or equivalent); Schedule 5; 304 stainless steel; ASTM Type A312 material; 4-in. diameter; cleaned, wrapped, and heat sealed by manufacturer.
- Plugs/caps: JOHNSON (or equivalent); standard PVC or stainless steel.
- Filter pack: MORIE, 100 well gravel (or equivalent). NOTE: Final gradation may vary as a function of the gradation of the formation.[2]
- Fine Ottawa sand.
- Bentonite seal: BAROID, bentonite pellets (3/8-in. diameter)
- Cement: Type II Portland Cement (table below).

---

1. Technical information on all installed materials (screens, riser pipe, filter pack, bentonite, cement, etc.) and representative samples of the proposed filter pack, bentonite powder, and bentonite pellets will be supplied to the Project Manager.
2. Well screen slot size and filter pack gradation will be determined from sieve analysis of aquifer materials. Screen and casing material type will be determined based on field tests of groundwater chemistry and contaminants.
3. Unless the sum of Cl-, F-, and Br- is >1,000 ppm, in which case Type 316 should be used.

Cement Type	Special Characteristics	Recommended Usage
I	No special properties	General use as grout mix or cement plug (if sulfates <250 ppm), surface pad.
IA	Air-entraining Type I (Note that air entrainment properties can be achieved by chemical admixtures)	Air entrainment gives cement greater freeze-thaw resistance. Recommended for surface pads.
II	Moderate sulfate resistance, low heat of hydration	General use as grout mix or cement plug where groundwater sulfate >250 ppm and <1,500 ppm, surface pad.
IIA	Air-entraining Type II	See Type IA.
III	High early strength, high heat of hydration	Elevated temperature can damage well casing and fracture grout/cement plugs. NOT RECOMMENDED.
IIIA	Air-entraining Type III	NOT RECOMMENDED.
IV	Low heat of hydration	General use as grout mix or cement plug preferred type for well abandonment to ensure intact grout/cement plug.
V	High Sulfate resistance	Use when groundwater sulfate levels >1,500 ppm.

- Bentonite powder: BAROID, Aquagel Gold Seal.
- Steel protective casing: BRAINARD-KILMAN (or equivalent) zinc-plated steel, lockable, painted.[4]
- Geotextile: MIRAFI (or equivalent); GTF 130; non-woven; 4 oz.
- Coarse (blanket) gravel: Crushed stone aggregate.
- Containers for purged water, as required.
- Submersible pump or bailer of appropriate capacity, and surge block sized to fit well.
- Hach DREL 2000 portable laboratory (or equivalent).
- Conductivity, pH, oxidation-reduction potential (ORP), turbidity, dissolved oxygen, and temperature meters.
- Electric well sounder and measuring tape.
- Portland Type II cement (see previous table).
- Steel Posts (pickets), painted (see footnote).

---

4. All painted components (protector casing, steel pickets) will be painted high-visibility orange and allowed to dry completely prior to being brought onsite.

2.3 DOCUMENTATION

The following document may be provided:

- Copy of appropriate Work Plan
- Copy of approved Health and Safety Plan
- Copies of well and excavation permits
- Boring log forms
- Well completion diagram form
- Well development form.

2.4 GEOLOGIST'S PERSONAL EQUIPMENT

The following equipment may be required for the geologist:

- 10X handlens
- Unified Soil classification System chart
- Munsell color chart
- Sieve set (Keck model SS-81 or equivalent)
- Personal protective equipment as required by the Health and Safety Plan.

3. PROCEDURE

3.1 MATERIALS APPROVAL

Water sources for drilling, grouting, sealing, filter placement, well installation, and equipment decontamination must be approved by the Project Manager prior to arrival of the drilling equipment. Information required for the water source includes: water source, manufacturer/ owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analyses over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives (bentonite) will be the only drilling fluid additive allowed, and its use must be approved by the Project Manager prior to the arrival of the drilling equipment. The information required for evaluation includes: brand name, manufacturer, manufacturer's address and telephone number, product description, and intended use for the product.

Granular Filter Pack material must be approved by the Project Manager prior to drilling. A 1-pint representative sample must be supplied to the Project Manager. Information required includes: lithology, grain size distribution, brand name, source, processing method, and slot size of intended screen.

Portland Type II cement will be used for grout (see previous table).

3.2 DRILLING

The objective of the selected drilling technique is to ensure that the drilling method provides representative data while minimizing subsurface contamination, cross-contamination of aquifers, and drilling costs. The preferred drilling method is with a hollow-stem auger. Other drilling methods[5] are approved as conditions warrant, and will not require variances be issued by the U.S. Environmental Protection Agency. The method used at a specific site will be proposed in the work plan and evaluated by the Project Manager Additional drilling methods are described in Table 3-1 of this SOP.

A Site Geologist will be present during all well drilling and installation activities and will fully characterize all tasks performed in support of these activities into the monitoring well logbook. The Site Geologist will be responsible at only one operating rig for the logging of samples, monitoring of drilling operations, recording of water losses/gains and groundwater data, preparing the boring logs and well diagrams, and recording the well installation procedures of the rig. The Site Geologist will have onsite sufficient equipment in operable condition to perform efficiently his/her duties as outlined in the contractual documents. Items in the possession of each Site Geologist will include the approved Health and Safety Plan, this Standard Operating Procedure, a hand lens (10X), a standard color chart, grain-size chart, and a weighted (with steel or iron) steel tape long enough to measure the deepest well, heavy enough to reach that depth, and small enough to fit readily within the annulus between the well and drill casing. The Site Geologist will also have onsite, a water level measuring device, preferably electrical.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole drilling equipment. Additives containing either lead or copper will not be allowed. In addition, polychlorinated biphenyls will not be permitted in hydraulic fluids or other fluids used in the drilling rig, pumps, and field equipment/vehicles.

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[5] If the design depth of the well is <100 ft, open, hollow-stem augers will be used to drill the well unless "running sands" preclude the use of open augers. In that case, an inert "knockout" plug may be used in the bottom of the auger string. This plug will be driven out of the augers and left at the bottom of the hole when the well is installed.

If the design depth of the well is >100 ft, rotary drilling methods may be used to install wells. The following drill fluids and methods are approved in the order listed: (1) rotary drilling with water from an approved source as drilling fluid (clays from the formations will tend thicken the fluid and coat the walls of the borehole and this is acceptable); (2) rotary drilling with water as a fluid, advancing a temporary casing with the bit to maintain an open hole; and (3) mud rotary using water with additives as drill fluid. Due to the potential for aquifer contamination and plugging, mud rotary drilling is not recommended for monitoring wells. If, however, "running sands" are encountered and the aquifer is expected to have a relatively high flow rate, then mud rotary is considered an approved method. Pure sodium bentonite is the only approved additive. Mud rotary drilling must be halted at the last aquitard above the target aquifer. Casing must be set, all bentonite-bearing fluids flushed from the hole and drill rig, and drilling may be resumed using water only as the drill fluid until the target depth is reached.

Table 3-1 - Drilling Methods

Drilling Method	Description
Hollow Stem Auger	Borings are advanced by rotating steel hollow stem augers with an attached cutting head. Soil cuttings are displaced by the cutting head and transported to the surface via continuous spiral flights attached to each auger stem. This method is widely used for unconsolidated soils that have a tendency to collapse within the boring. A bottom plug can be placed in the bottom auger to prevent soils from entering and clogging the auger, especially in the case of heaving sands. However, a bottom plug cannot be used when soil samples are to be collected through the augers. Soil plugs that accumulate in the bottom of the auger must be removed or knocked out prior to sampling or well installation.
Solid Stem Auger	This type of drilling method is similar to HSA drilling using a solid stem or sealed hollow stem auger flights to advance the boring. Solid stem, continuous flight auger use is limited to semi-consolidated sediments or to cohesive or semi-cohesive unconsolidated sediments that don't have a tendency to collapse when disturbed.
Sonic Method	High frequency mechanical oscillations, developed in a special drill head, are transmitted as resonant vibrations, along with a rotary action, through the tooling to the bit. The vibratory action fluidizes the soil particles, destroying the shear strength and pushing the particles away from the drill bit and along the sides of the drill string. The outer drill casing also holds the borehole open while installing monitoring wells, piezometers, vents, observation wells, instrumentation, or other down-hole equipment. Outer drill casing sizes include nominal diameters of 6 and 8 inches, allowing sufficient space to install the common monitoring well sizes of 2 and 4-inches. While constructing wells, the vibratory effect reduces "bridging" of the filter pack and seal, and also reduces the potential problem of "sand locking" and inadvertently removing the well as the outer drill casing is extracted. This positive placement of well construction materials allows for controlled well installations.
Mud or air rotary	This method makes use of a constantly rotating bit to penetrate any type of formation to depths that can exceed 1,000 feet. As drilling proceeds, cuttings are removed by a continuous circulation of fluid (either air or water based) that flows down inside the pipe string and up-hole along the annular space between the borehole walls and the pipe string. The penetration rate is often faster and the bit life longer when using air as compared with water based drilling fluids. A drag bit is normally used to penetrate unconsolidated to semi- consolidated sediments; while a cone-type or roller bit is used to drill consolidated rock. The bit can be rotated either by a top-drive or a table-drive system. The rotation speed is adjusted according to the hardness of the formation material. The drilling fluids serve several functions, which are principally to: lift and transport drill cuttings to the surface; stabilize borehole walls and prevent caving by the action of pressure and; cool and clean the bit. In some instances however, air tends to cause loosen unconsolidated formations. The method is limited to borehole diameter of less than 24 inches, due to the fluid's viscosity and up-flow velocity that make it difficult to clean out the cuttings.

Surface runoff or other fluids will not be allowed to enter any boring or well during or after drilling/construction.

Antifreeze used to keep equipment from freezing will not contain rust inhibitors and sealants. Antifreeze is prohibited in areas in contact with drilling fluid. The ground surface at the well site will be protected from possible coolant, fuel, and hydraulic fluid spills and/or leakage by placement of plastic sheeting with raised edges, draining into a lined catch basin large enough to contain spills and/or leakage from motors, radiators, or vehicle tanks. Sorbent pillows will be placed to catch obvious leaks from the drill rig. Sorbent logs may be used instead of, or in conjunction with, a lined catch basin to contain spills.

An accurate measurement of the water level will be made upon encountering water in the borehole and later upon stabilization. Levels will be periodically checked throughout the course of drilling. Any unusual change in the water level in the hole, such as a sudden rise of a few inches may indicate artesian pressure in a confined aquifer, will be the basis for cessation of drilling. The geologist will immediately contact the Project Manager[6]. Particular attention for such water level changes will be given after penetrating any clay or silt bed, regardless of thickness, which has the potential to act as a confining layer.

Anticipated depths of wells are given in well specific work plans. In case the previously defined criteria have not been met before the depth range for a given hole is reached, the geologist will stop the drilling and confer with the Project Manager. The current boring conditions (depth, nature of the stratigraphic unit, and water table depth) will be compared to those of other wells nearby to decide to continue drilling or to terminate and complete the well.

If the well is to be installed in the surficial aquifer, drilling will be terminated before penetrating the basal aquitard. The basal aquitard is defined as the first 2 ft-thick clay below the water table, or below 5 ft in the case of a shallow aquifer.

If the well is to be installed in a lower, confined aquifer:

- Penetrations of aquifers located lower than the water table aquifer will be limited to avoid cross-contamination.

- Placement of new upper confined aquifer wells will be initially limited to those areas where contamination has been confirmed.

- The location of upper confined aquifer wells will be based upon the findings of the water table aquifer investigation. Areas of known contamination will be targeted for installing upper confined aquifer wells for the purposes of delineating vertical contamination.

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[6] The contract technical oversight will also be contacted for guidance.

- Where possible, upper-confined aquifer wells will be located such that they afford triangulation with other wells within the same aquifer to allow for a determination of groundwater flow direction.

- Some upper-confined aquifer wells will be installed approximately 10-15 ft from water table wells to enable the accurate assessment of vertical hydraulic gradients. If the direction of groundwater flow is known, wells within a group will be located side gradient of each other.

- The boring will be advanced until the base of the surficial aquifer is reached (Section 3.2).

- An outer, surface casing will be set 2-5 ft into the confining layer to minimize the potential for cross-contamination from the unconfined aquifer during drilling activities.

- The surface casing will be driven into the confining bed and grouted into place. Grout will be tremied into the annulus around the outside of the casing to within 5 ft of the ground surface. A grout plug at least 2 ft thick will be tremied into the bottom of the surface casing. The grout will be permitted to cure for 24 hours. All drilling fluids within the surface calling will then be removed, and the casing will be flushed with clean potable water.

- The drilling equipment will be decontaminated, a smaller bit or auger selected, and the hole will be continued through the grout plug into the confined aquifer.

- If deeper aquifers are to be screened, repeat preceding steps until total depth is reached.

If dense non-aqueous phase liquid (DNAPL) contamination is detected during drilling, the well will be terminated and completed at the base of the aquifer. Drilling will not continue through the confining unit.

Stainless steel screens will be used in DNAPL wells. Screen size selection will be according to criteria set forth in Section 3.4. The formation grain size will be multiplied by the higher factor (6) to determine filter pack grain size. This will ensure that the filter pack is sufficiently coarse to permit DNAPL to pass freely from the formation into the coarser filter pack, then into the open well (Cohen and Mercer 1993).

DNAPL sampling cups are prohibited. The well screen will be capped, and set 0.3 ft (0.5 ft max.) into the top of the confining bed and rest on the bottom of the hole or bentonite backfill (if used). No sand will be placed below the screen. The remainder of the well installation and completion will be accomplished according to Section 3.4.

3.3 LOGGING

All borings for monitoring wells will be logged by a geologist. Logs will be recorded in a field logbook and/or a boring log. If the information is recorded in a logbook, it will be transferred to Boring Log Forms on a daily basis. Field notes are to include, as a minimum:

- Boring number
- Material description (as discussed below)
- Weather conditions
- Evidence of contamination
- Water conditions (including measured water levels)
- Daily drilling footage and quantities (for billing purposes)
- Notations on man-placed materials
- Drilling method and borehole diameter
- Any deviations from established field plans
- Blow counts for standard penetration tests
- Core and split-spoon recoveries.

Material description for soil samples must include:

- Classification
- Unified Soil Classification symbol
- Secondary components and estimated percentages
- Color
- Plasticity
- Consistency
- Density
- Moisture content
- Texture/fabric/bedding and orientation
- Grain angularity
- Depositional environment and formation
- Incidental odors
- Photoionization detector reading(s)
- Staining.

Material description for rock samples must include:

- Classification
- Lithologic characteristics
- Bedding/banding characteristics
- Color
- Hardness
- Degree of cementation
- Texture
- Structure and orientation

- Degree of weathering
- Solution or void conditions
- Primary and secondary permeability
- Sample recovery
- Incidental odors
- Photoionization detector reading(s)
- Staining.

3.4 WELL CONSTRUCTION AND INSTALLATION

After the hole is drilled and logged, backfill hole as required for proper screen placement. The integrity of the aquitard will be restored by placing a bentonite plug of an appropriate thickness, either to the top of the aquitard (normal well installation) or to within 0.3 ft of the top of the aquitard (DNAPL well). Aquifer fill will be clean filter pack.

Normal screen placement for the water table (surficial) aquifer will be within 2 ft of the screen extending above the static water level. The bottom of the screen will rest no more than 6 in. from the bottom of the hole or backfill material, whichever is applicable.

NOTE: The end cap in DNAPL wells will rest on the bottom of the bottom of the hole, or bentonite backfill if applicable (Section 3.2).

Screen placement for a confined aquifer well will normally be at the top of the confined aquifer.

Screen lengths will not normally exceed 10 ft. If it appears advantageous in a given situation (e.g., to screen an entire aquifer which is thicker than 10 ft), approval must be sought on a case-by-case basis from the appropriate regulatory agency. Otherwise, wells will be screened as follows:

Thickness of Aquifer	Action
<10 ft	Screen entire aquifer
>10 ft <30 ft	Screen top 10 ft consider vertically nested well cluster
>30 ft	Install vertically nested well cluster

The installation of monitoring wells in uncased or partially cased holes will begin within 12 hours of completion of drilling, or if the hole is to be logged, within 12 hours of well logging, and within 48 hours for holes fully cased with temporary drill casings. Once installation has begun, work will continue until the well has been grouted and the drill casing has been removed.

Well screens, casings, and fittings will conform to National Sanitation Foundation Standard 14 or ASTM equivalent for potable water usage. These materials will bear the appropriate rating logo. If the logos are not present, a written statement from the manufacturer/supplier stating that the materials contain the appropriate rating must be obtained. Material used will be new and essentially chemically inert to the site environment.

Well screen and casing should be inert with respect to the groundwater; therefore, the selection of screen and casing material will be based on select field tests of aquifer chemistry and potential contaminants. The screen will be capped without sediment trap or DNAPL sampling cup, and lowered into the hole. The well casing will be pre-cut to extend 2-2.5 ft above ground surface. Prior to placement of the last piece of well casing, a notch or other permanent reference point will be cut, filed, or scribed into the top edge of the casing.

Screen slot size will be appropriately sized to retain 90-100 percent of the filter pack material, the size of which will be determined by sieve analysis of formational material (Section 3.4).

The tops of all well casing will be capped with covers composed of materials compatible with the products used in the well installation. Caps may either be vented, or a telescopic fit, constructed to preclude binding to the well casing caused by tightness of fit, unclean surfaces, or weather conditions. In either case, it should be secure enough to preclude the introduction of foreign material into the well, yet allow pressure equalization between the well and the atmosphere.

Filter pack material will be placed, lightly tamped, and leveled. Filter pack will extend from the bottom of the hole to a height of 1-2 ft above the top of the screen. The filter pack will be capped with a minimum of 1 ft of fine (Ottawa) sand to prevent the bentonite seal from infiltrating the filter pack. If the bentonite seal is placed as a slurry, a minimum of 2 ft of fine sand will be required.

If the hole is less than 20-ft deep, the filter pack may be poured into the annulus directly. If the hole is deeper than 20 ft, the filter pack must be tremied into place.

Granular filter packs will be chemically and texturally clean, inert, and siliceous.

Filter pack grain size will be based on formation grain-size analysis. The D30 (70 percent retained) sieve size multiplied by a factor of not less than 3 nor greater than 6 will be used to determine the appropriate grain size.

Calculations regarding filter pack volumes will be entered into the Field Logbook along with any discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10 percent exists between calculated and actual volumes exists, an explanation for the discrepancy will also be entered in the Field Logbook.

Bentonite seals will be no less than 2-ft thick nor more than 5-ft thick as measured immediately after placement. The normal installation will include a 5-ft seal. Thinner seals may be used in special cases. The final depth to the top of the bentonite seal will be measured and recorded.

3.4.1 Grout

Grout used in construction will be composed by weight of:

- 20 parts cement (Portland cement, type II) (see previous table)
- 0.4-1 part (maximum) (2-5 percent) bentonite
- 8-gal (maximum) approved water per 94-lb bag of cement.

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump prior to placement. Grout placement will be performed using a commercially available grout pump and a rigid, side discharge tremie pipe.

The following will be noted in the Field Logbook: (1) calculations of predicted grout volumes; (2) exact amounts of cement, bentonite, and water used in mixing grout; (3) actual volume of grout placed in the hole; and (4) any discrepancies between calculated and actual volumes used. If a discrepancy of greater than 10 percent exists between calculated and actual volumes exists, an explanation for the discrepancy will also be entered in the Field Logbook.

Well protective casings will be installed around all monitoring wells on the following day as the initial grout placement around the well. Any annulus formed between the outside of the protective casing and the borehole will be filled to ground surface with cement.

The construction of each well will be depicted as built in a well construction diagram. The diagram will be attached to the boring log and will graphically denote:

- Screen location, length
- Joint location
- Granular filter pack
- Seal
- Grout
- Cave-in
- Centralizers
- Height of riser
- Protective casing detail.

3.5 MONITORING WELL COMPLETION

Assemble appropriate decontaminated lengths of pipe and screen. Make sure these are clean and free of grease, soil, and residue. Lower each section of pipe and screen into the borehole, one at a time, screwing each section securely into the section below it. No grease, lubricant, polytetrafluoroethelyne tape, or glue may be used in joining the pipe and screen sections.

If a well extends below 50 ft, centralizers will be installed at 50 ft and every 50 ft thereafter except within screened interval and bentonite seal. Centralizer material will be PVC, polytetrafluoroethelyne, or stainless steel. Determination of centralizer material will be based on the same criteria as screen and calling selection.

Cut the riser with a pipe cutter approximately 2-2.5 ft above grade. All pipe cuts MUST be square to ensure that the elevation between the highest and lowest point of the well casing is less than or equal to 0.02 ft Notch, file, or otherwise permanently scribe a permanent reference point on the top of the casing.

Torches and saws may not be used to cut the riser. Care must be taken that all filings or trimmings cut from the reference point fall outside the riser rather than into the well. **Under no circumstances will a permanent marker or paint pencil be used to mark the reference point**.

In some locations, safety requirements may mandate that a well be flush-mounted with no stick-up. If a flush-mounted well is required at a given location, an internal pressure cap must be used instead of a vented cap to ensure that rainwater cannot pool around the wellhead and enter the well through the cap.

When the well is set to the bottom of the hole, temporarily place a cap on top of the pipe to keep the well interior clean.

Place the appropriate filter pack (Section 3.4). Monitor the rise annulus with a weighted tape to assure that bridging is not occurring.

After the pack is in place, wait 3-5 minutes for the material to settle, tamp and level a capped PVC pipe, and check its depth weighted steel tape.

Add a 1-2 ft cap of fine-grained (Ottawa) sand to prevent infiltration of the filter pack by overlying bentonite seal. See Section 3.4 for guidance on appropriate thickness of fine sand layer.

Install the bentonite seal (2- to 5-ft thick) by dropping bentonite pellets into the hole gradually. If the well is deeper than 30 ft, a tremie pipe will be used to place either bentonite pellets or slurry. Tamp and level pellets. If the well is 30 ft, tamp with a capped PVC pipe, if >30 ft, tamping bay be accomplished with the weighted end of the tape. In either case, check the depth to the top of the seal with a weighted tape as above.

If the bentonite pellets are of poor quality, they may have a tendency to hydrate and swell inside the tremie pipe and bridge. This situation may be solved by the following procedure:

1. Use a different brand of pellets. Different brands may have longer hydration times.

2. Freeze the pellets[7]. Note that this will require a longer wait time to allow proper hydration after the pellets thaw.

3. Place the bentonite seal as a slurry using a side-discharge tremie pipe as though installing grout. Note (Section 3.4) this will require that a minimum of 2 ft of fine sand be placed as a cap on top of the filter pack material.

Wait for the pellets to hydrate and swell. Hydration times will be determined by field test or by manufacturer's instructions. Normally this will be 30-60 minutes. Document the hydration time in the field notebook. If the pellets are above the water level in the hole, add several buckets of clean water to the boring. Document the amount of water added to the hole.

Mix an appropriate cement-bentonite slurry (Section 3.4). Be sure the mixture is thoroughly mixed and as thick as is practicable.

Lower a side discharge tremie pipe into the annulus to the level of the pellet seal.

Pump the grout slurry into the annulus while withdrawing the tremie pipe and temporary casing.

Stop the grout fill at 5 ft below the ground surface. Allow to cure for not less than 12 hours. If grout settles more than 6 in., add grout to bring level back up to within 5 ft of ground surface. Place approximately 2 ft of bentonite pellets (minimum 0.5 ft) in annulus. Seat the protective casing in the bentonite seal, allowing no more than 0.2 ft between the top of the well casing and the bottom of the protective casing cap. Fill inner annulus (between well casing and protective casing) with bentonite pellets to the level of the ground surface. Cover bentonite pellets with 1 ft of clean granular material (coarse sand or pea gravel filter pack). Fill the outer annulus (between the protective casing and the borehole) with neat cement. Allow the cement to mound above ground level and finish to slope away from the casing. Lock the cap.

— OR —

Continue the grout fill to the ground surface. Seat the protective casing in the grout, allowing no more than 0.2 ft between the top of the well casing and the bottom of the protective casing cap. Lock the cap.

— AND —

Allow the grout slurry to set overnight.

---

[7] Bentonite pellets may be "flash-frozen" by brief immersion in liquid nitrogen (LN2). This can be accomplished by pouring LN2 over a small quantity (0.25-0.5 bucket) of pellets, allowing the LN2 to boil off, then pouring the pellets into the tremie pipe. **NOTE:** Use of LN2 is an additional jobsite hazard and must be addressed in the contractor's Health and Safety Plan. This contingency must be covered before drilling starts in order to avoid delays in well installation.

Fill the outer annulus (between the casing and the borehole) with neat cement. Allow the cement to mound above ground level and finish to slope away from the casing.

Slope the ground surface away from the casing for a distance of 2 ft, at a rate of no less than 1 in. in 2 ft. Surface this sloping pad with a geotextile mat covered by 3 in. of coarse gravel.

— OR —

Frame and pour a 4-ft square × 6-in. thick (4 ft × 4 ft × 6 in.) concrete pad centered around the protective casing.

— AND —

Set pre-painted protective steel pickets (3 or 4) evenly around and 4 ft out from well. These pickets will be set into 2 ft deep holes, the holes will then be filled with concrete; and if the pickets are not capped, they will also be filled with concrete.

3.6 WELL DEVELOPMENT

Well development is the process by which drilling fluids, solids, and other mobile particulates within the vicinity of the newly installed monitoring well have been removed while restoring the aquifer hydraulic conductivity. Development corrects any damage to or clogging of the aquifer caused by drilling, increases the porosity of the aquifer in the vicinity of the well, and stabilizes the formation and filter pack sands around the well screen.

Well development will be initiated after 48 consecutive hours but no longer than 7 calendar days following grouting and/or placement of surface protection.

Two well development techniques, over pumping and surging, will be employed in tandem. Over pumping is simply pumping the well at a rate higher than recharge. Surging is the operation of a plunger up and down within the well casing similar to a piston in a cylinder.

3.6.1 Materials Required

The following materials will be required for well development:

- Well Development Form
- Boring Log and Well Completion Diagram for the well
- Submersible pump or bailer of appropriate capacity, and surge block
- Conductivity, pH, ORP, turbidity, dissolved oxygen, and temperature meters
- Electric well sounder and measuring tape
- Containers for purged water, if required.

3.6.2 Summary of Procedures and Data Requirements

Pump or bail the well to ensure that water flows into it, and to remove some of the fine materials from the well. Removal of a minimum of one equivalent volume is recommended at this point. The rate of removal should be high enough to stress the well by lowering the water level to approximately half its original level. If well recharge exceeds 15 gpm, the requirement to lower the head will be waived.

Slowly lower a close-fitting surge block into the well until it rests below the static water level, but above the screened interval. (NOTE: This latter is not required in the case of a light non-aqueous phase liquid well.)

Begin a gentle surging motion which will allow any material blocking the screen to break up, go into suspension, and move into the well. Continue surging for 5-10 minutes, remove surge block, and pump or bail the well, rapidly removing at least one equivalent volume.

Repeat previous step at successively lower levels within the well screen until the bottom of the well is reached. Note that development should always begin above, or at the top of, the screen and move progressively downward to prevent the surge block from becoming sand locked in the well casing. As development progresses, successive surging can be more vigorous and of longer duration as long as the amount of sediment in the screen is kept to a minimum.

Development is expected to take at least 2 hours in a small well installed in a clean sand, and may last several days in large wells, or in wells set in silts with low permeabilities.

Development will continue until little or no sediment can be pulled into the well, and target values for parameters listed below are met.

At a minimum, development will remove 3-5 well volumes of water. One development volume (DV) is defined as (1) equivalent volume, plus (1) the amount of fluid lost during drilling, plus (1) the volume of water used in filter pack placement.

1. Monitor water quality parameters before beginning development procedures, and after removing 2, 2.5, and 3 well volumes of water.

2. If these parameters have stabilized over the three readings, the well will be considered developed.

3. If the parameters have not stabilized after these three readings, continue pumping the well to develop, but stop surging. Monitor the stabilization parameters every half DV.

4. When the parameters have stabilized over three consecutive readings at half DV intervals, the well will be considered developed.

All water removed must be disposed of as directed by the Work Plan.

Record all data as required on a Well Development Record Form (Appendix A), which is made a part of the complete Well Record. These data include:

- Depths and dimensions of the well, casing, and screen obtained from the well diagram.
- Water losses and uses during drilling, obtained from the boring log for the well.
- Measurements of the following indicator parameters: turbidity, pH, conductivity, ORP potential, dissolved oxygen, and temperature.
- Target values for the indicator parameters listed above are as follows: pH – stabilize, conductivity – stabilize, ORP – stabilize, dissolved oxygen –- stabilize, temperature – stabilize, turbidity – 5 nephelometric turbidity units or stabilize. A value is considered to have stabilized when three consecutive readings taken at half DV intervals are within 10 percent of each other.
- Notes on characteristics of the development water.
- Data on the equipment and technique used for development.
- Estimated recharge rate and rate/quantity of water removal during development.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during well development activities.

6. REFERENCES

Aller, L. et al. 1989. Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, National Water Well Association.

American Society for Testing and Materials (ASTM). D2487-92 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

———. D5092-90 Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers.

Cohen, R.M. and J.W. Mercer. 1993. DNAPL Site Evaluation, CRC Press, Inc.

Nielsen, D.M. 1993. Correct Well Design Improves Monitoring, in *Environmental Protection*, Vol.4, No.7. July.

U.S. Army Toxic and Hazardous Materials Agency. 1987. Geotechnical Requirements for Drilling, Monitoring Wells, Data Acquisition and Reports. March.

U.S. Environmental Protection Agency. 1989. Groundwater Handbook.

Appendix A

Field Record of Well Development Form

FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:
Well Volume Calculations	
A. Depth To Water (ft):	D. Well Volume/ft:
B. Total Well Depth (ft):	E. Total Well Volume (gal)[C*D]:
C. Water Column Height (ft):	F. Five Well Volumes (gal):

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						
Parameter	6 Volumes	7 Volumes	8 Volumes	9 Volumes	10 Volumes	End
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (µmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

NOTE: NTU = Nephelometric turbidity unit.
ORP = Oxidation-reduction potential.

COMMENTS AND OBSERVATIONS: ______________________________

FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (μmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						
Parameter	6 Volumes	7 Volumes	8 Volumes	9 Volumes	10 Volumes	End
Time (min)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (μmhos/cm)						
Dissolved Oxygen						
Turbidity (NTU)						
ORP (mV)						

Standard Operating Procedure No. 021
for
Sediment Sampling

Prepared by

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December 2014

CONTENTS

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1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) delineates protocols for sampling sediments from streams, rivers, ditches, lakes, ponds, lagoons, and marine and estuarine systems.

EA recognizes that other protocols have been developed that meet the criteria of quality and reproducibility. Clients may have their own sediment sampling protocols which may contain methodologies and procedures that address unique or unusual site-specific conditions or may be in response to local regulatory agency requirements. In such cases, EA will compare its and the client’s protocols. The goal is to provide the client with the most quality; therefore, if the client’s protocols provide as much or more quality assurance than EA’s protocols for the particular site or project, EA will adopt those particular protocols and this SOP will be superseded in those respects. If EA is required to implement the client’s protocols in lieu of EA’s protocols, EA will make the client formally aware of any concerns regarding differences in protocols that might affect data quality and will document such concerns in the project file.

2. PROCEDURES

The water content of sediment varies. Sediments range from soft to dense and fine to rocky. A variety of equipment may be necessary to obtain representative samples, even at a single site. Factors to consider in selecting the appropriate sampling equipment include sample location (edge or middle of the waterbody), depth of water and sediment, grain size, water velocity, and analytes of interest. Sampling for PFAS has specific requirements that must be followed. Review SOP No. 073 prior to planning or conducting any sampling for PFAS.

3. GENERAL PROCEDURES

1. Surface water and sediment samples are to be collected at the same location (if both are required in the project-specific Sampling and Analysis Plan).

2. Collect the surface water sample first. Sediment sampling usually results in disturbance of the sediments, which may influence the analytical results of the surface water samples.

3. Wear gloves when collecting samples. Comply with the Health and Safety Plan specifications for proper personal protective equipment.

4. If sampling from a boat or near waterbodies with depths of 4 ft or more, the sampling team will wear life jackets.

5. Wading into a waterbody disturbs the sediment. Move slowly and cautiously, approach the sample location from downstream. If flow is not strong enough to move entrained particles away from the sample location, wait for the sediment to resettle before sampling.

6. Collect samples first from areas suspected of being the least contaminated, thus minimizing the risk of cross-contamination.

7. Collecting samples directly into sample containers is not recommended. Sediment samples should be placed in stainless steel, or glass trays, pans, or bowls for sample preparation. **Bowls composed of Teflon or glass should not be used when sampling for PFCs/PFAS.**

8. Use the proper equipment and material construction for the analytes of interest. For example, for volatile organic compound analysis, the sampling material in direct contact with the sediment or surface water must consist of Teflon, polyethylene, or stainless steel. **Containers composed of Teflon should not be used when sampling for PFCs/PFAS.**

9. Refer to EA SOP No. 005 (Field Decontamination) for proper decontamination methods before and after sampling and between samples.

10. Collect samples for volatile organic compound analysis first. Do not mix such samples before placing them in the sample containers. For composite volatile organic compound samples, place equal aliquots of each subsample in the sample container.

11. Sediment that will be analyzed for other than volatile organic compounds should be prepared as follows:

    - Place the sediment in a mixing container.

    - Divide the sediment into quarters.

    - Mix each quarter separately and thoroughly.

    - Combine the quarters and mix thoroughly.

    - For composite samples, mix each subsample as described above. Place equal aliquots of each subsample in a mixing container and follow the procedure described above.

12. Mark the sampling location on a site map. Record sampling location coordinates with a Global Positioning System unit, photograph (optional, recommended) and describe each location, and place a numbered stake above the visible high-water mark on the bank closest to the sampling location. The photographs and description must be adequate to allow the sampling station to be relocated at a future date.

13. Dispose of investigation-derived wastes according to applicable rules and regulations in accordance with approved plans and SOP 042.

4. CORERS

A corer provides a vertical profile of the sediment, which may be useful in tracing historical contaminant trends. Because displacement is minimal, a corer is particularly useful when sampling for trace metals and organics. Corers can be constructed out of a variety of materials.

For example, a 2-in. diameter polyvinyl chloride pipe with a polyethylene liner can be lowered into the sediment; a 2-in. diameter well cap can be used to form an airtight seal and negative pressure as the pipe is withdrawn.

- Ensure that the corer and (optional) liner are properly cleaned.
- Stand downstream of the sample location.
- Force the corer into the sediment with a smooth continuous motion. Rotate (not rock) the corer if necessary to penetrate the sediment.
- Twist the corer to detach the sample; then withdraw the corer in a single smooth motion. If the corer does not have a nosepiece, place a cap on the bottom to keep the sediment in place.
- Remove the top of the corer and decant the water (into appropriate sample containers for surface water analysis, if required).
- Remove the nosepiece or cap and deposit the sample into a stainless-steel tray.
- Transfer the sample into sample containers using a stainless-steel spoon (or equivalent device).

5. SCOOPS AND SPOONS

When sampling at the margins of a waterbody or in shallow water, scoops and spoons may be the most appropriate sampling equipment. For collecting samples several feet from shore or in deeper water, the scoop or spoon may be attached to a pole or conduit.

- Stand downstream of the sample location.
- Collect the sample slowly and gradually to minimize disturbing the fine particles.
- Decant the water slowly to minimize loss of fine particles.
- Transfer the sediment to sample containers or mixing trays, as appropriate.

6. DREDGES

Three types of dredges are most frequently used: Peterson, Ponar, and Eckman. Many other dredge types are available; their applicability will depend upon site-specific factors.

6.1 PETERSON AND PONAR DREDGES

These dredges are suitable for hard, rocky substrates, deep waterbodies, and streams with fast currents. Ponars have top screens and side plates to prevent sample loss during retrieval.

- Open the jaws and place the cross bar into the proper notch.

- Lower the dredge to the bottom, making sure it settles flat.

- When tension is removed from the line, the cross bar will drop, enabling the dredge to close as the line is pulled upward during retrieval.

- Pull the dredge to the surface. Make sure the jaws are closed and that no sample was lost during retrieval.

- Open the jaws and transfer the sediment to sample containers or to a mixing tray.

6.2 ECKMAN DREDGE

The Eckman dredge works best in soft substrates in waterbodies with slow or no flow.

- Open the spring-loaded jaws and attach the chains to the pegs at the top of the sampler.

- Lower the dredge to the bottom, making sure it settles flat.

- Holding the line taut, send down the message to close the jaws.

- Pull the dredge to the surface. Make sure the jaws are closed and that no sample was lost during retrieval.

- Open the jaws and transfer the sediment to sample containers or a mixing tray.

7. REFERENCES

None.

Standard Operating Procedure No. 025
for
Soil Sampling

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CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to delineate protocols for sampling surface and subsurface soils. Soil samples give an indication of the area and depth of site contamination, so a representative sample is very important. Sampling for PFAS has specific requirements that must be followed. Review SOP No. 073 prior to planning or conducting any sampling for PFAS.

2. MATERIALS

The following materials may be required:

Bucket auger or push tube sampler	Split-spoon, Shelby tube, or core barrel sampler
Drill rig and associated equipment	Stainless steel bowl
Personal protective equipment as required by the Health and Safety Plan	Stainless steel spoon, trowel, knife, spatula (as needed)

3. PROCEDURE

3.1 SUBSURFACE SAMPLES

Don personal protective equipment. Collect split-spoon, core barrel, or Shelby Tube samples during drilling. Upon opening sampler, or extruding sample, immediately screen soil for volatile organic compounds using either a photoionization detector or flame ionization detector. If sampling for volatile organic compounds, determining the area of highest concentration, use a stainless-steel knife, trowel, or laboratory spatula to peel and sample this area. Log the sample in the Field Logbook while it is still in the sampler. Peel and transfer the remaining sample in a decontaminated stainless-steel bowl. Mix thoroughly with a decontaminated stainless-steel spoon or trowel. Place the sample into the required number of sample jars. Preserve samples as required. Discard any remaining sample into the drums being used for collection of cuttings. Decon sampling implements. All borings will be abandoned.

NOTE: If sample recoveries are poor, it may be necessary to composite samples before placing them in jars. In this case, the procedure will be the same, except that two split-spoon samples will be mixed together. The Field Logbook should clearly state that the samples have been composited, which samples were composited, and why the compositing was done.

Samples taken for geotechnical analysis will be undisturbed samples, collected using a thin-walled (Shelby tube) sampler.

3.2 SURFICIAL SOIL SAMPLES

Don personal protective equipment. Remove vegetative mat. Collect a sample from under the vegetative mat with a stainless-steel trowel, push tube sampler, or bucket auger. If a representative sample is desired over the depth of a shallow hole or if several shallow samples are to be taken to represent an area, composite as follows:

- As each sample is collected, place a standard volume in a stainless-steel bowl.
- After all samples from each hole or area are in the bucket, homogenize the sample thoroughly with a decontaminated stainless-steel spoon or spatula.

If no compositing is to occur, place sample directly into the sample jars. Place the leftover soil in the auger borings and holes left by sampling. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas. Samples for volatile organic compounds will not be composited. A separate sample will be taken from a central location of the area being composited and transferred directly from the sampler to the sample container. Preserve samples as required. Decon sampling implements.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the Health and Safety Plan.

Soil samples will not include vegetative matter, rocks, or pebbles, unless the latter are part of the overall soil matrix.

6. REFERENCES

ASTM International. Method D1586-84, Penetration Test and Split-Barrel Sampling of Soils.

———. Method D1587-83, Thin Walled Sampling of Soils.

Department of the Army, Office of the Chief of Engineers. 1972. Engineer Manual 1110-2-1907 Soil Sampling. 31 March.

Standard Operating Procedure No. 028
for
Well and Boring Abandonment

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to establish the protocols by which all wells and borings will be safely abandoned. The primary objective of well abandonment is to ensure that the abandoned well or boring does not provide a conduit for the vertical migration of contamination between aquifers.

2. MATERIALS

The following materials may be required:

Drill rig	Bentonite pellets (seal)
Filter pack material	Cement (Portland Type II)
Pure sodium bentonite with no additives (bentonite) powder (grout)	Approved water

3. PROCEDURE

The procedures used in boring abandonment will ideally accomplish two objectives: (1) protect aquifers from cross-contamination by sealing the borehole, and (2) restore the strata in the borehole to nearly original conditions by selective placement of fill material.

Any casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 ft of the ground surface and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site or cluster.

If the hole is within 10 ft of a monitoring well in the same aquifer, or a replacement well is to be installed within 10 ft of the well, any temporary casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, the hole will then be backfilled with filter pack material opposite sand strata and bentonite or grout opposite substantial (2 ft or thicker) clay and silt strata. Where sand as backfill approaches the ground surface, 2 ft of bentonite will be placed above the sand and a 3-ft concrete plug will be placed at the surface. Otherwise, backfill materials will be placed from the bottom of the hole to within 3 ft of the ground surface. These materials will be allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

If the well is not within 10 ft of another monitoring well, or if there are no substantial, continuous sand bodies, and no replacement well is planned within 10 ft of the original well location, then the hole may be grouted from the bottom to the top.

3.1 GROUT

Grout used in construction will be composed by weight of:

- 20 parts cement (Portland cement, Type II or V)
- 0.4-1-part (maximum) (2-5 percent) bentonite
- 8 gal (maximum) approved water per 94-lb bag of cement.

Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be recirculated through the grout pump prior to placement.

Grout placement will be performed using a commercially available grout pump and a rigid tremie pipe removal and grouting will be accomplished in stages, aquifer by aquifer, sealing the boring from the bottom to ground surface. This will be accomplished by placing a grout pipe to the bottom and pumping grout through the pipe until undiluted grout reaches the bottom of the next higher section of casing or, for the top-most section, until grout flows from the boring at ground surface. Efforts will be made to grout incrementally as the temporary casing is removed.

After 24 hours, the abandoned drilling site will be checked for grout settlement. On that day, any settlement depression will be filled with grout and rechecked 24 hours later. This process will be repeated until firm grout remains at the ground surface.

3.2 BORINGS

The term “Borings” as used in this Standard Operating Procedure applies to any drilled hole made during the course of a remedial investigation which is not completed as a well. This includes soil test borings, soil sampling borings, and deep stratigraphic borings. Whether completed to the planned depth or aborted for any reason prior to reaching that depth, borings will be grouted and normally closed within 4 hours, or within 4 hours or completion of logging of completion of logging.

3.2.1 Shallow Borings not Penetrating Water Table

Shallow borings made for the collection of subsurface soil samples will be abandoned by backfilling the hole with cuttings from the hole, **if and only if the boring does not penetrate the water table.** Clean sand will be used to make up any volume not filled by the cuttings.

3.2.2 Borings Penetrating the Water Table

Shallow borings made for the collection of subsurface soil samples **which penetrate the water table** will be abandoned by grouting the hole from the bottom to the top.

3.2.3 Deep Stratigraphic Borings

Deep stratigraphic borings will normally be located in areas which, by virtue of the historical record, are presumed relatively uncontaminated. Therefore, these borings are usually over 100 ft from any sampling well locations. Any boring located within 10 ft of a proposed well location, or located directly upgradient or downgradient (on anticipated flow line) of a proposed well location, will be abandoned by placing clean sand in the aquifer intervals and bentonite or grout in aquitard intervals as described above. If the boring is over 10 ft from and/or not upgradient of a proposed well location, the boring will be completely filled with grout.

3.3 WELLS

The following procedure applies to wells aborted prior to completion and existing wells determined to be ineffective or otherwise in need of closure.

Prior to abandoning any developed well, the proper well licensing body will be provided written notification along with an abandonment plan for that well.

If the well is within 10 ft of another monitoring well in the same aquifer, or a replacement well is to be installed within 10 ft of the well, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, the hole will then be backfilled with filter pack material opposite sand strata and bentonite or grout opposite substantial (2 ft or thicker) clay and silt strata. Where sand as backfill approaches the ground surface, 2 ft of bentonite will be placed above the sand and below the concrete plug near the surface. Backfill materials will be placed from the bottom of the hole to within 3 ft of the ground surface. These materials will be allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

If the well is not within 10 ft of another monitoring well and is not to be replaced by another well within 10 ft of the original location, casing will be pulled, drilled out, or thoroughly pierced. Using tremie pipe, grout will be placed from the bottom of the hole to within 3 ft of the ground surface and allowed to settle for 24 hours. The remainder of the hole will be filled with concrete. The surface of the concrete will be mounded, smoothed, and inscribed with “ABD,” for abandoned, any assigned well or boring designation, and the date the hole was abandoned. All boring logs, samples, completion records, and abandonment procedures will be included in the records of work on the site cluster.

4. REPLACEMENT WELLS

Replacement wells (if any) will normally be offset at least 10 ft from any abandoned well in a presumed upgradient or crossgradient groundwater direction. Site-specific conditions may necessitate variation to this placement.

5. PRECAUTIONS

None.

Standard Operating Procedure No. 042
for
Disposal of
Investigation-Derived Material

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision 1
December 2014

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP).

SOP No. 042	
SOP Section	**Variance**
General	Please note that all procedures and materials used for the Disposal of Investigation-Derived Material will be PFAS-approved.
3.1	Edited to meet requirements on project and satisfy comments received on the draft programmatic QAPP.
3.2	Edited to accompany potential scenarios that may be encountered during the execution of the project.
3.3	Edited to meet requirements on project and satisfy comments received on the draft programmatic QAPP.
General	Please note that the handling of IDW will vary from facility to facility and state to state.

Michael O’Neill

Project Manager (Name)

Michael O'Neill 11/16/2020

Project Manager (Signature) Date

CONTENTS

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to define the required steps for staging and disposing of investigation-derived material (IDM) generated during field activities.

IDM, as used herein, includes soil cuttings, drilling muds, extraneous sediment, purged groundwater, decontamination fluids, and disposable personal protective equipment. For the sake of clarity and ease in use, this Standard Operating Procedure is subdivided into procedures for disposal of liquid IDM and solid IDM as follows:

- Liquid IDM (Section 3.2) includes the following materials:
  - — Water from initial development of new wells and the redevelopment of existing wells
  - — Purge water from groundwater sampling
  - — Decontamination fluids (Section 3.4)
- Solid IDM (Section 3.3) consists of the following materials:
  - — Soil drill cuttings from monitoring well installation
  - — Sediment remaining after collection of the required sample volume
  - — Grout, a mixture of cement and bentonite, generated during installation of monitoring wells
  - — Disposable personal protective equipment (Section 3.4).

2. MATERIALS

The following materials may be required:

Any additional equipment that may be dictated by project or site-specific plans	Hazardous waste labels
Bar codes	Permanent marker
Chain-of-custody forms	Field logbook (bound)
Department of Transportation 17C specification metal containers	Waste identification labels

3. PROCEDURE

3.1 GENERAL

No container will be labeled as a "Hazardous Waste" unless the contents are in fact known to be hazardous as defined by 40 Code of Federal Regulation 261.

IDM is to be considered impacted with PFAS if analytical results indicate that PFAS analytes are present above screening levels (i.e. Office of the secretary of Defense [OSD] PFAS Screening Levels [SL's] or the U.S. Environmental Protection Agency [EPA] PFAS Health Advisory [HA] levels). IDM impacted with PFAS below appropriate screening levels may be disposed onsite if approved by USACE, ARNG, and regulatory personnel and documented in an approved work plan for the site or in a separate written approval notice.

3.2 PROCEDURES FOR LIQUID INVESTIGATION-DERIVED MATERIAL DISPOSAL

All water/fluids from the initial development of new wells, decontamination, and purge water generated during soil and groundwater sampling, will be containerized in Department of Transportation approved 55-gallon drums and disposed of using methods documented in the work plan generated for the site. Water/fluid which is containerized will remain on-site until analytical results are received and an agreeable path forward is determined. The water may be discharged to the ground surface directly, run thru carbon and discharged onsite, or removed from the site for treatment and disposal. The disposal method will be approved by the USACE, ARNG, and regulatory personnel and documented in an approved work plan for the site or in a separate written approval notice.

1. Label all containers as to type of media, date the container was sealed, point-of-generation, and points-of-contact. The well number or numbers and container number will be identified on the container.

2. The contractor/support personnel will log all media generated onsite into a bound Field Logbook. Media information should include the following: date of generation, contents of containers, number of containers with the same contents (if applicable), location of containers, well number the media it is associated with, personnel sampling the media, sampling dates, and sampling results.

3. Containers of well development water, decon water and purge water will be stored at a designated staging area within State ARNG property boundaries in accordance with the work plan generated for the site.

4. In some cases, if the analytical data of the liquid media are non-detect or below OSD SLs and EPA HAs, the water may be gradually infiltrated into the ground in an area deemed appropriate by the client, regulatory personnel, and the contractor/support personnel.

    i. Disposal locations must allow percolation of the water and prohibit “ponding.”

    ii. Upon completion of water discharge to ground, enter type of media, amount of media, date of disposal, and discharge point(s) in a bound Field Logbook and provide this information to the client.

    iii. Empty containers are to be properly decontaminated, stored, and reused or disposed of by the appropriate personnel.

5. In some cases, the liquid media will be pumped through a carbon filter prior to being discharged to the ground surface as previously described (above).

6. In some cases, containerized liquids will be sampled to determine if the wastes are hazardous. If the results indicate the contents of the drums are considered hazardous waste, the containers of liquid will be labeled as hazardous, and disposed of offsite in accordance with local and state regulations.

3.3 PROCEDURES FOR SOLID INVESTIGATION-DERIVED MATERIAL DISPOSAL

During soil drilling or sediment sampling, the resulting cuttings, mud, and/or extraneous sediment will be containerized in Department of Transportation approved 55-gallon drums or spread on the ground if approved by the client, facility, and regulatory personnel and documented in the approved work plan for the site. Solid IDM which is containerized will remain on-site until analytical results are received and an agreeable path forward is determined. The Solid IDM may be discharged to the ground surface or removed from the site for treatment and disposal. The disposal method will be approved by the USACE, ARNG, and regulatory personnel and documented in an approved work plan for the site or in a separate written approval notice. If containerized the following procedures will apply:

1. All IDM containers will be labeled with the type of media, date the container was sealed, point-of- generation, and name of the contact person. The well number or sample location and container number should be identified on the container.

2. The contractor/support personnel will log all media generated onsite into a bound Field Logbook. Media information should include date of generation, contents in containers, number of containers with the same contents, location of containers, and well number or sample location the media is associated with.

3. Containers will be kept at an identified staging area within State ARNG property boundaries in accordance with the work plan generated for the site, until analytical results are received.

4. In some cases, if analytical results indicate that PFAS contaminants are below OSS SLs, solid IDM may be spread on the ground in an area deemed appropriate by the USACE, ARNG, and regulatory personnel.

5. In some cases, if analytical results indicate that PFAS contaminants are above risk-based SLs, the cuttings will remain containerized until the IDM can be disposed in accordance with state and local regulations. When the waste is removed, enter the type of waste, amount of waste, date of pickup, and destination of the waste in a bound Field Logbook. This information must be provided to the client.

3.4 PROCEDURES FOR DECONTAMINATION SOLUTION AND PERSONAL PROTECTIVE EQUIPMENT DISPOSAL

Decontamination solutions include catch water from drill rigs, as well as smaller quantities of soapy water and rinse solutions used in decontaminating field sampling equipment. The decontamination solution will be treated as liquid IDM and combined with other liquid wastes and addressed as noted above (Section 3.2).

Personal protective equipment and disposable sampling equipment will be containerized onsite, appropriately labeled, and disposed in a designated trash receptacle.

4. MAINTENANCE

The waste manifest document and bill of lading should be uploaded to the project file as soon as possible in either hard copy or electronic format. Refer to EA's Records Retention Policy for archiving information.

5. REFERENCES

Environment Article Section 7-201(t).

U.S. Environmental Protection Agency. 1991. Management of Investigation-Derived Wastes during Site Inspections PB91-921331, OERR Directive 9345.3-02. Office of Emergency and Remedial Response U.S. Environmental Protection Agency, Washington, D.C. May.

Standard Operating Procedure No. 042A
For Treating Liquid Investigation-Derived Material (Purge water, drilling water, and decontamination fluids

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
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Revision 1
March 2021

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP).

SOP No. 042A	
SOP Section	**Variance**
General	Please note that all procedures and materials used for the treatment of Investigation-Derived Material (IDM) will be be confirmed to be Per- and polyfluoroalkyl substances (PFAS)-free.
General	This SOP covers disposal of liquid IDM associated with the PFAS Site Inspection (SI) sampling at Army National Guard (ARNG) sites. This SOP does not cover disposal of Solid IDM.

Michael O'Neill

Project Manager (Name)

Michael O'Neill 03/02/2021

Project Manager (Signature) Date

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1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to define the required steps for staging and treating liquid investigation-derived material (IDM) generated during Per- and polyfluoroalkyl substances (PFAS) Site Investigation (SI) field activities. IDM, as used herein, includes purged groundwater and decontamination fluids (liquids) associated with PFAS sampling. This SOP also addresses the management of residuals left in the drum.

2. MATERIALS

The following materials may be required:

Department of Transportation (DOT) approved 55-gallon open top drum (steel) containers	Drum labels and paint pen
55-gallon container containing charcoal granular activated carbon (GAC)	Drum Dolly
PFAS free transfer pump(s) and hoses	Field logbook (bound)
Prefilter for sediment removal	Waste identification labels (Non-Haz, Non-RCRA" labels)
Drum Generation Information (provided by generator)	Previous sampling results from purge/decontamination water
Any additional equipment that may be dictated by project, site location, or site-specific plans	Sampling Equipment and containers (i.e., hoses, gauges, 5-gallon buckets, etc.)
Level D personal protective equipment [long sleeves, gloves, safety vest, safety glasses, and steel toe shoes	

3. PROCEDURE

3.1 GENERAL

No container will be labeled as a “Hazardous Waste” unless the contents are in fact known to be hazardous as defined by 40 Code of Federal Regulation 261. If contents are considered hazardous (as supported by generator knowledge or analytical results), the U.S. army Corps of Engineers (USACE) and ARNG will be contacted and no handling or treatment will occur.

The IDM is considered impacted with PFAS if analytical results indicate that perfluorooctanoic acid [PFOA], perfluorooctanesulfonic acid [PFOS] and perfluorobutanesulfonic acid (PFBS) analytes are present at or above the 2019 Office of the Secretary of Defense (OSD) screening levels (SLs) (Deputy Assistant Director of Defense, 2019). IDM impacted with PFAS at or above appropriate OSD SLs will be treated after which it may be discharged onsite if approved by USACE,[1] ARNG, and regulatory personnel and documented in an approved work plan for the site or in a separate written approval notice.

3.2 PROCEDURES FOR LIQUID INVESTIGATION-DERIVED MATERIAL DISPOSAL

The following general conditions are anticipated prior to moving forward with handling and disposal of liquid IDM.

- Water/fluids from the initial development of new SI wells, decontamination, and purge water generated during soil and groundwater sampling, has been containerized in DOT approved 55-gallon drums and staged in accessible areas.
- Water/fluid which is containerized will remain on-site until analytical results are received, and an agreeable path forward is determined.
- The disposal method after treatment (i.e., containerize and sample again, disposal to the ground surface, or other) will be approved by the USACE, ARNG, and regulatory personnel and documented in an approved work plan for the site or in a separate written approval notice prior to EA Engineering, Science, and Technology, Inc., PBC (EA) engaging in the handling and disposal of liquid IDM .

The following general sequence is anticipated for handling and disposal of liquid IDM.

1. Prior to arrival onsite:
    a. Review sampling results and confirm PFAS levels and quantity of material to be treated. If there are any other hazardous substances (as designated by EPA) or contaminants of concern in IDM other than PFAS that require management other than on site GAC treatment, immediately contact USACE, ARNG, and generator to resolve any discrepancy and confirm path forward.
    b. Based on the volume of IDM liquid and maximum PFAS concentrations, the GAC treatment cannister(s) will be sized to achieve the site-specific treatment levels with an appropriate safety factor for the type of GAC used to prevent PFAS breakthrough.
    c. Review/determine site logistics including access requirements, drum locations and general conditions (hardstand or other), and discharge requirements (i.e., containerize after treatment, dispose on ground surface in vicinity, or disposal in alternate location). Immediately contact USACE, ARNG, and generator to resolve any discrepancy and confirm path forward.

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[1] Site-specific maximum PFAS levels detected at the site and total volume of IDM fluids will be used to size GAC treatment canisters with safety factor necessary to achieve treatment levels established for the site.

   d. Determine if work requires any changes to SOP (i.e., use of additional equipment [i.e., Photoionization detector for VOC monitoring] or personal protective equipment beyond what is specified in SOP).

2. Upon arrival onsite:
   a. Confirm containers as to type of media, generation date of the container, point-of- generation, and points-of-contact and condition (still sealed, any damage, leaking etc.).
   b. Confirm the sampling and container identification with the description provided by the generator. If containers do not match or if there is evidence of damage, leaking, non-matching drum count is observed, immediately contact USACE, ARNG, and generator to resolve any discrepancy and confirm a path forward.
   c. Confirm site logistics and confirm treatment and discharge approach with ARNG to ensure it matches previous documentation/understanding (i.e., team not receiving new instructions).

3. Treatment of IDM will proceed in the following general sequence:
   a. Open existing 55-gallon IDM containers and confirm contents. If conditions do not match or there is evidence of damage/leaks, or if non-matching drum count is observed, immediately contact USACE, ARNG, and generator to resolve any discrepancy and confirm path forward.
   b. Set up equipment, pump, prefilter, influent and effluent hoses, and empty drum (if containerizing after treatment).
   c. Lower pump intake hose into drum being careful to keep it above any sediment/soils.
   d. Pump the liquid media through the prefilter and then through the GAC. Dispose via the approved disposal method after treatment and described in the work plan. Flow rates should be monitored with a maximum flow rate of 5 gallons per minute unless authorized by the engineer for empty bed contact time of 15 mins or greater. Treatment flow rate is likely to be lower due to filter pressure.
   e. Monitor discharge and pressure gauges to confirm back pressure.
   f. Monitor filter and stop pumping to change filter when pressures increase, or filter media is observed to be built up with sediment.
   g. Empty remaining sediment/liquids into existing soils/sediment drums onsite. Consolidate residual material per sampling location. Document the quantity, type of material, and source of material emptied into existing soil/sediment drums on-site.
   h. Rinse the drum with PFAS free water, treat the rinsate, and collect the effluent. Label drums as clean/empty. Final drum disposition is discussed below.
   i. If water is pumped into drums instead of being discharged to the ground surface after GAC treatment, one water sample will be collected from one drum of water (likely the final drum of treated water). Samples will be shipped next day for analysis of PFAS compounds (existing Table B-15 PFAS list).
   j. Document process/remaining conditions. Collect photographs of treatment

activities, empty drums, and site conditions if appropriate.

   k. Provide a written summary of treatment activities to the client.
   l. Post treatment GAC will be moved to a secure location as identified by the installation and left for future use.
   m. Adhere a drum label to remaining drums and as a backup also label drums with a paint pen. Label drums as “GAC filtered liquid”.

4. When discharge is approved by USACE and ARNG the following process will be followed:
   a. Discharge should be in an area deemed appropriate by the ARNG and regulatory personnel as documented.
   b. Discharge should conform to any received written instructions. Generally, if a discrepancy arises immediately contact USACE, ARNG, and generator to resolve any discrepancy and confirm path forward.
   c. Discharge water may be gradually infiltrated into the ground. Disposal locations must allow percolation of the water and prohibit “ponding.” No discharge into a stream or municipal system.
   d. Upon completion of water discharge to ground, enter type of media, amount of media, date of disposal, and discharge point(s) in a bound Field Logbook. Collect photographs of discharge activities and discharge locations.
   e. Provide a written summary of discharge activities to the client.
   f. Confirm location and move empty drums. Adhere a drum label 2) As a backup also label with a paint pen. Installation to dispose of or recycle empty drums.

3.3 PROCEDURES FOR DECONTAMINATION SOLUTION AND PERSONAL PROTECTIVE EQUIPMENT DISPOSAL

Decontamination solutions include catch water from drill rigs, as well as smaller quantities of soapy water and rinse solutions used in decontaminating field sampling equipment. The decontamination solution will be treated as liquid IDM and combined with other liquid wastes and addressed as noted above (Section 3.2).

Personal protective equipment and disposable sampling equipment will be containerized onsite, appropriately labeled, and disposed in a designated trash receptacle.

4. MAINTENANCE

The waste disposal records collected during operations will be incorporated into the project file as soon as possible in either hard copy or electronic format. Refer to EA’s Records Retention Policy for archiving information. Records will be distributed to USACE and ARNG as noted in previous sections.

5. REFERENCES

Deputy Assistant Secretary of Defense. 2019. Investigation Per- and Polyfluoroalkyl Substances within The Department of Defense Cleanup Program. United States Department of Defense. 19 October.

Environment Article Section 7-201(t).

U.S. Environmental Protection Agency. 1991. Management of Investigation-Derived Wastes during Site Inspections PB91-921331, OERR Directive 9345.3-02. Office of Emergency and Remedial Response U.S. Environmental Protection Agency, Washington, D.C. May.

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Standard Operating Procedure No. 043 for Multi-Probe Water Quality Monitoring Instruments

Prepared by

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Hunt Valley, Maryland 21031

Revision 1
December 2014

CONTENTS

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1. PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure is to delineate protocols for field operation of multi-probe water quality instruments. The instrument can monitor a variety of basic parameters including dissolved oxygen, percent saturation, temperature, pH, specific conductance, resistivity, salinity, total dissolved solids, oxidation reduction potential (ORP), level, and depth.

Use of brand names in this Standard Operating Procedure is not intended as endorsement or mandate that a given brand be used. Alternate equivalent brands of detectors, sensors, meters, etc. are acceptable. If alternate equipment is to be used, the contractor will provide applicable and comparable standard operating procedures for the maintenance and calibration of same.

2. MATERIALS

The following materials may be required:

- Multi-probe instrument
- Probe/sonde with appropriate cables
- Appropriate standards
- Accessories (batteries, charger, case, etc.)
- Instrument logbook
- Manufacturer’s Operations Manual.

3. CALIBRATION PROCEDURE

Calibration must be performed daily at a minimum before using the instrument. Calibration may be performed in the laboratory or in the field. Detailed step-by-step calibration procedures for the equipment described below are provided in the most recent version of the manufacturer’s Operations Manual. Documentation includes at a minimum: time, date, analyst, standard, primary standard lot number, secondary standard lot number, and expiration dates of standards.

Fill the calibration cup with the appropriate standard as follows:

Temperature:	None required
Specific Conductance:	Conductivity standards
pH:	pH 7 buffer plus pH 4 and/or pH 10 buffer
Dissolved Oxygen:	Saturated air or saturated water
ORP:	Quinhydrone (Zobell’s Solution)
Turbidity:	Nephelometric turbidity unit (NTU) standards
Salinity:	Calibration for specific conductance
Depth/Level:	Set zero in air.

3.1 CONDUCTIVITY CALIBRATION

Conductivity meters are calibrated at least once per day to at least one standard. The standard should be selected in accordance with the range expected to be measured (e.g., 1.0 µS/cm standard should not be used to calibrate meters being used in saltwater). See manufacturer's recommendations in the Operations Manual for additional information on calibration standard selection. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.2 pH CALIBRATION

The pH meters are calibrated at least once per day to a minimum of two standard buffers (pH 4 and 7, or pH 7 and 10) in accordance with the range expected to be measured. The calibration is verified using a fresh solution of pH 7 buffer post-calibration. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.3 DISSOLVED OXYGEN CALIBRATION

Dissolved oxygen meters are air calibrated at least once per day. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.4 OXIDATION REDUCTION POTENTIAL CALIBRATION

ORP meters are calibrated at least once per day to at least one standard. It is recommended that Zobell's Solution is used; however, another solution can be used as long as it meets the manufacturer's specifications for calibration. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.5 TURBIDITY CALIBRATION

The turbidity meters are calibrated at least once per day to a minimum of two standards (0 NTU and 100 or 126 NTUs recommended) in accordance with the range expected to be measured. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.6 DEPTH/LEVEL CALIBRATION

The depth and level calibration are performed with the depth sensor module in the air and not immersed in any solution. The appropriate correction for height above the water surface is inputted into the meter. Calibration information is recorded in conjunction with the data collected for that sampling event.

3.7 ADDITIONAL CALIBRATIONS

Additional measurements may be taken with the multi-probe water quality instruments. For any of these measurements, the calibration procedures will be conducted in accordance with the manufacturer's specifications. Calibration information is recorded in conjunction with the data collected for that sampling event.

4. FIELD OPERATION

4.1 SETUP OF MULTI-PROBE WATER QUALITY INSTRUMENT

Post-calibration and prior to sampling, the multi-probe water quality instrument will be set up for data collection. If the cables have been unattached, they will be reconnected to the transmitter (if applicable) and the display. Once all cables are attached, the meter will be turned on and allowed to warm up for a few seconds in order to allow the display screen to load.

4.2 SURFACE WATER

Prior to sampling, check the condition of the probes before each deployment. When sampling in surface water, the sensor must be in an amount of water sufficient for all probes to be submerged. Data values displayed on the display screen are recorded in the field logbook and accepted into the instrument's data logger. Post-data collection, the sensor will be retrieved and rinsed for use at the next sample location. If travel time between sample locations is great, the display is to be turned off. When all sampling is completed, disconnect all equipment and return it to its proper storage location.

4.3 GROUNDWATER

Prior to sampling, check the condition of the probes before each deployment. When sampling groundwater, mount sampler on a flow-through sampler cup. Start sampler pump and allow pump/hose system to be purged of air bubbles. Sampling rate should be set to record all parameters each time 1-3 liters (unless otherwise specified in the sampling plan) have been removed from the well. Record all the monitored values in the appropriate field logbook to ensure against inadvertent data loss.

5. MAINTENANCE

All maintenance should be performed in accordance with the manufacturer's Operations Manual.

6. PRECAUTIONS

Check the condition of the probes frequently between sampling. Do not force pins into connections, note keying sequence. If field readings are outside the expected range, check for bubbles on, or damage to, the probes. If there are no bubbles or damage, recalibrate the sensor.

7. REFERENCES

Manufacturer's Operations Manual.

Standard Operating Procedure No. 047
Direct-Push Technology Sampling

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Revision: 0
December 2014

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP).

SOP No. 047	
SOP Section	**Variance**
General	Please note that all procedures and materials used for the direct-push technology sampling will meet the requirements of SOP 073.

Michael O'Neill

Project Manager (Name)

Michael O'Neill 11/16/2020

Project Manager (Signature) Date

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CONTENTS

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1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) establishes the protocol for using direct-push technology (DPT) in media sampling and performing subsurface characterization. This SOP includes the following DPT methods: Geoprobe®, Hydropunch®, Cone Penetrometer Testing (CPT), and Site Characterization and Analysis Penetrometer System (SCAPS).

2. MATERIALS

The following materials may be required:

Appropriately sized, all-terrain vehicle-skid-or track-mounted; DPT equipment; and supplies (i.e., hydraulic derrick and hammer assembly)	Personal protective equipment
Bentonite grout and clean sand for DPT hole abandonment	Phosphate-free, laboratory-grade detergent (e.g., Liquinox, Alconox, etc.)
DPT stainless steel rods	Source of approved water
Heavy plastic sheeting	Steam cleaner/sprayer and water obtained from approved source for decontaminating DPT equipment
Logbook	Steel drums for intrusion derived wastes (e.g., contaminated personal protective equipment, decon solutions, etc.)
Long-handled bristle brushes	Wash and rinse tubs
Mini-bailer or tubing and peristaltic pump (groundwater sampling only)	

3. GEOPROBE® AND HYDROPUNCH®

3.1 MATERIALS

Water sources for Geoprobe® and Hydropunch® activities, grouting, sealing, filter placement, well installation, and equipment decontamination must be approved by the Project Manager prior to arrival of the Geoprobe® and Hydropunch® equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives will be the only additive allowed, and its use must be approved by the Project Manager prior to the arrival of the Geoprobe® and Hydropunch® equipment. The information required for evaluation includes brand name, manufacturer, manufacturer's address and telephone number, product number, product description, and intended use for the product.

Portland Type II cement will be used for grout (refer to SOP No. 019).

3.2 GROUNDWATER – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow grab samples to be taken at a selected site to facilitate aquifer characterization and analysis of potential contaminants. The analytical results from sampling can also be used to determine the placement of monitoring wells.

A site geologist will be present during all sampling and installation procedures and will fully document all procedures and soil characteristics in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Work Plan, a hand lens (10X), a standard color chart, and a grain size chart.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole Geoprobe® and Hydropunch® equipment.

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after DPT activities.

The subcontractor will use the equipment specific guidelines for installation of the Geoprobe® DPT equipment. Probe rods will be forced into the ground by hydraulic means.

- Drive the sampler to the desired groundwater sampling interval. At the desired depth, insert extension rods down the inside diameter of the probe rods until the extension reaches the bottom of the screen. Remove the probe rods and sampler sheath while holding the screen in place.
- Collect the groundwater sample in the screen interval with a mini-bailer, peristaltic or vacuum pump, or other acceptable small diameter sampling device.
- The head of the rod may be equipped with a sensing device for characterization of soil properties or the contaminant content.

The subcontractor will use the equipment-specific guidelines for installation of the Hydropunch® equipment. Rods will be forced into the ground by hydraulic means.

- The Hydropunch® tool is a double cylinder, designed to be sealed until the desired sampling depth is reached. Upon reaching the desired sampling depth, the outer cylinder is pulled back, exposing a perforated, stainless steel sampling barrel covered with filter material.
- The water sample enters the barrel and the sample is retrieved by pulling the probe rods from the hole with the hydraulic derrick and hammer assembly. Groundwater is the only media that is sampled by Hydropunch® equipment.

- The head of the rod may be equipped with a sensing device for characterization of the soil properties or the contaminant content.

- The sample volume collected with this technique is approximately 500-1,000 ml. Larger sample volumes can be collected by inserting tubing attached to a peristaltic pump into the rods to obtain water samples.

If desired, a small diameter monitoring well may be installed at this point. Refer to SOP No. 019 (Monitoring Well Installation).

If a well will not be installed, the rods will be removed as the borehole is simultaneously filled with a bentonite/grout mixture. A polyvinyl chloride (PVC) tube fed into the rod casing will allow the addition of grout.

3.3 SUBSURFACE SOIL – HYDRAULIC PUSHING AND SAMPLING

The objective of the selected DPT sampling technique is to allow grab samples to be taken at a selected site for characterization of the stratigraphy and for analysis of potential contaminants. The analytical results from sampling can also be used to determine the placement of monitoring wells.

A site geologist will be present during all DPT sampling and soil characterization. All procedures and soil characteristics will be fully documented in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole Geoprobe® equipment.

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after DPT activities.

The subcontractor will use the equipment specific guidelines for installation of the Geoprobe® DPT equipment. Probe rods will be forced into the ground by hydraulic means. Additional rods will be added in 3- to 4-ft increments until the leading edge of the sampler reaches the top of the desired sampling interval.

Once the desired sampling depth has been reached, insert extension rods down the inside diameter of the probe rods until it reaches the top of the sampler assembly. Attach the extension rod handle to the top extension rod. Turn the handle clockwise until the stop-pin detaches from the drive head. Remove the extension rods and the stop-pin. Attach a drive cap to the probe and drive the sampler approximately 2 ft using hydraulic derrick.

The DPT sampler can be retrieved by pulling the probe rods from the hole with the hydraulic derrick and hammer assembly.

The liner will be capped with non-Teflon® containing tape and vinyl end caps. The liners can be split open to remove samples for composition analysis or for transfer to other containers for shipment to the laboratory for analysis.

The head of the rod may be equipped with a sensing device for characterization of the soil properties or the contaminant content.

3.4 DECONTAMINATION

All Geoprobe® and Hydropunch® DPT equipment must be thoroughly cleaned before and after each use to allow retrieval of representative groundwater samples. Geoprobe® soil sample liners are disposed of after each use. Scrub all metal parts with a stiff, long bristle brush and a non-phosphate soap solution. Steam cleaning may be substituted where available. Rinse with distilled water and allow to air-dry before assembly.

After decontamination, a new clean liner will be installed, and all parts will be inspected for wear or damage.

Refer to SOP No. 005 (Field Decontamination).

3.5 ABANDONMENT

Pure bentonite or a bentonite/grout mixture (20:1) will be used to fill the resulting borehole if the water table is penetrated. Boreholes that do not penetrate the water table will be backfilled with cuttings from the hole and topped with a bentonite seal. Clean sand will be used to fill any remaining volume in the borehole.

Abandonment of Geoprobe® and Hydropunch® generated DPT boreholes will meet the standards established under SOP No. 028 (Well and Boring Abandonment).

4. CONE PENETROMETER TESTING

4.1 MATERIALS

A CPT rig typically consists of an enclosed 20- to 40-ton truck equipped with vertical hydraulic rams that are used to force a sensor probe into the ground. The weight of the CPT rig is dependent upon the thrust required at the site. The majority of CPT rigs are mounted in heavy-duty trucks that are ballasted to a total dead weight of approximately 15 tons. Screw anchors are utilized to develop the extra reaction to reach the maximum thrust of 20 tons. The rig is separated into two separate workspaces: data acquisition and hydraulic push areas.

Water sources for CPT activities and decontamination must be approved by the Project Manager prior to arrival of the CPT equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives will be the only additive allowed, and its use must be approved by the Project Manager prior to the arrival of the DPT equipment. The information required for evaluation includes brand name, manufacturer, manufacturer’s address and telephone number, product number, product description, and intended use for the product.

Portland Type II cement will be used for grout (refer to SOP No. 019).

4.2 SUBSURFACE CHARACTERIZATION

The objective of this technology is to collect stratigraphic information using CPT equipment to determine subsurface stratigraphy and geotechnical properties at a particular site. CPT activities will be in accordance with American Society for Testing and Materials D 3441-86 and American Society for Testing and Materials D 5778-95. The stratigraphic information gathered can be used to facilitate the selection of DPT sampling screen intervals. At the same time, it is possible to install a 0.25-in. diameter pre-packed PVC monitoring well.

CPT rods are used to hydraulically push the CPT probe into the subsurface. Probes cannot be pushed into hard rock, and significant gravel or cobble content in the formation may impede or preclude penetration of the probe. The depth of penetration achievable depends on the type of formation, type of sampling probe, and size of the hydraulic equipment used.

The CPT probe includes the following components:

- A conical tip to measure vertical resistance beneath the tip.
- A friction sleeve to measure frictional resistance on the side of the probe, as a function of depth.

- Two internal strain gauge-type load cells, which independently measure the vertical resistance and side friction.

- A cone pressure gauge to measure the water pressure as the probe is pushed into the ground.

- Inclinometer to determine potential drifting of the probe (optional).

- Seismic transducers to perform downhole seismic surveys (optional). Therefore, stratigraphic data collected with the CPT include tip resistance, local friction, friction ratio, pore pressure, and resistivity.

Data will be transferred from the probe to the data acquisition system or logger through an electrical cable. The hole will be advanced continuously at a rate of 0.6-1.0 in. per second. The data will be logged at every 0.4-0.8 in. of penetration. Monitor the probe's stratigraphic position will be monitored as it advances downward. Perform pore water pressure dissipation tests in representative hydrostratigraphic intervals. Record dissipated pore water pressures to represent hydraulic head values.

Once the confining unit underlying the surficial aquifer or the required depth has been reached, the CPT is pulled from the ground. Target interval samples can be collected during CPT hole advancement using direct push sampling techniques, i.e., Geoprobe® or Hydropunch® (Section 3).

4.3 DECONTAMINATION

All CPT equipment must be thoroughly cleaned before arrival at the work site, between test holes, and prior to being moved out of a work area. Scrub all metal parts with a stiff, long bristle brush and a non-phosphate soap solution. Steam cleaning may be substituted where available. Rinse with distilled water and allow to air-dry before assembly.

Refer to SOP No. 005 (Decontamination).

4 .4 ABANDONMENT

If the push hole was developed for the stratigraphic test only, once the testing is completed, grout the hole from bottom to top. If the hole has not collapsed after removing the CPT, PVC piping will be used to grout the hole. If the hole has collapsed after removing the CPT, then hollow CPT rods and a sacrificial tip will be used to grout the hole. The PVC pipe or CPT rods will be pushed to the bottom of the hole. Grout will then be pumped to the bottom of the hole as the PVC pipe or CPT rods are withdrawn.

Refer to SOP No. 028 (Well and Boring Abandonment).

5. SITE CHARACTERIZATION AND ANALYSIS PENETROMETER SYSTEM

5.1 MATERIALS

SCAPS cone penetrometer and laser induced fluorescence (LIF) technology requires the use of a specialized 20-ton truck. The truck has two separate enclosed compartments. Each compartment is temperature controlled and monitored for air quality. The two rooms are the data acquisition and processing room, and the hydraulic ram/rod handling room. Approximately 20 ft of overhead clearance is required to fully extend the hydraulic ram and allow for leveling jack movement.

All materials required to complete SCAPS analysis are provided by the subcontractor to include cone penetrometer equipment. All hydraulic equipment, SCAPS rods, nitrogen lasers, etc. are included within the vehicle. A decontamination water source and a source of water for mixing the grout are required.

Water sources for equipment decontamination must be approved by the Project Manager prior to arrival of the SCAPS equipment. Information required for the water source includes: water source, manufacturer/owner, address and telephone number, type of treatment and filtration prior to tap, time of access, cost per gallon (if applicable), dates and results associated with all available chemical analysis over the past 2 years, and the name and address of the analytical laboratory (if applicable).

Pure sodium bentonite with no additives will be the only additive allowed, and its use must be approved by the Project Manager prior to the arrival of the SCAPS equipment. The information required for evaluation includes brand name, manufacturer, manufacturer's address and telephone number, product number, product description, and intended use for the product.

Portland Type II cement will be used for grout (refer to SOP No. 019).

5.2 HYDRAULIC PUSHING AND SAMPLING

The objective of the SCAPS technique is to allow grab samples and stratigraphic information to be collected at a selected site to facilitate subsurface characterization and for analysis of potential contaminants. The analytical results obtained can also be used to determine the placement of monitoring wells. At the same time, it is possible to install a small diameter well for sampling purposes. Refer to SOP No. 019 (Monitoring Well Installation). If a well will not be installed, the borehole can be grouted as the equipment is removed.

A site geologist will be present during all installation and sampling procedures and will fully document all procedures and soil characteristics in the Field Logbook (refer to SOP No. 016).

The site geologist will have on hand, at a minimum, a copy of the approved Health and Safety Plan, this SOP, the Field Investigation Work Plan, a hand lens (10X), a standard color chart, and a grain-size chart.

Only solid vegetable shortening (e.g., Crisco®) without flavoring or additives may be used on downhole SCAPS equipment.

Surface runoff or other fluids will not be allowed to enter any DPT location or well during or after direct-push activities.

The subcontractor will use the equipment specific guidelines for installation of the SCAPS DPT equipment. Prior to SCAPS field activities, calibration soil samples will be collected and analyzed in order to determine the LIF sensor fluorescence threshold and detection limits for the site.

SCAPS LIF technology uses a pulsed nitrogen laser coupled with an optical detector to make fluorescence measurements via optical fibers. The LIF sensor is mounted on a cone penetrometer probe so that soil classification data and fluorescence data are collected simultaneously. The laser consumes nitrogen gas, which is supplied from cylinders stored on the accompanying trailer.

The SCAPS CPT sensors are used to gather stratigraphic information. See Section 4 for CPT operating procedures.

Target interval samples can be collected during SCAPS hole advancement using direct push sampling techniques such as Geoprobe® or Hydropunch® (Section 3).

5.3 DECONTAMINATION

Decontamination of SCAPS equipment is automated after initialization by a field team member. A pressurized hot water system is used to decontaminate the push rods as they are retracted from the ground. The SCAPS vehicle is equipped with a decontamination collar mounted to the bottom that cleans the rods. The decontamination water is removed by vacuum and transferred to a storage drum prior to disposal or treatment. A trailer attached to the back of the vehicle contains the water pump, heater for decontamination, and decontamination water containment drum.

Worker exposure is reduced by minimizing contact with contaminated media.

Refer to SOP No. 005 (Decontamination).

5.4 ABANDONMENT

SCAPS automatically grouts the penetrometer cavity as the rods are removed. The grout is pumped at high pressure through a 0.25-in. diameter tube in the center of the penetrometer rods. The tip is sacrificed at the bottom of the cavity to allow release of the grout.

A trailer attached to the back of the vehicle contains the 300-gal grout mixing bin and pump.

If the automatic grout feed does not work, the cavity will be manually filled with grout.

Abandonment of SCAPS generated borehole will meet the standards established under SOP No. 028 (Well and Boring Abandonment).

6. MAINTENANCE

Not applicable.

7. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for discussion of hazards and preventive measures during intrusive activities.

8. REFERENCES

American Society for Testing and Materials (ASTM). 1986. ASTM Designation D3441-86. American Society for Testing and Materials, Standard Test Method for Deep, Quasi-Static, Cone and Friction-Cone Penetration Test of Soil. December.

Battelle. 1994. Northern Boundary Area Ground Water Assessment Work Plan, Appendix B.

Department of Energy Environmental Management. 1998. Technology Description. World Wide Web Site: www.em.doe.gov/cgi-bin/parse/plumesfa/intech/conepen/tech.html. January.

(U.S.) Environmental Protection Agency (EPA). 1993. Subsurface Characterization and Monitoring_Techniques, Volume 1, Appendices A and B. May.

———. 1997. The Site Characterization and Analysis Penetrometer System Laser-Induced Fluorescence Sensor and Support System. Innovative Technology Verification Report. February.

Kejr Engineering, Inc. 1995. Geoprobe® Screen Point 15 Groundwater Sampler Standard Operating Procedure, Technical Bulletin No. 95-1500.

———. 1996a. Geoprobe® Large Bore Soil Sampler Standard Operating Procedure, Technical Bulletin No. 93-660.

———. 1996b. Geoprobe® Macro-Core® Soil Sampler Standard Operating Procedures, Technical Bulletin No. 95-8500.

Standard Operating Procedure No. 051
for
Low Flow Purge and
Sampling with Dedicated Pumps

Prepared by

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Revision: 1
December 2014

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PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP).

SOP No. 051	
SOP Section	**Variance**
General	Please note that all procedures and materials used for the Low Flow Purge and Sampling with Dedicated Pumps will meet the requirements of SOP 073.

Michael O’Neill

Project Manager (Name)

Michael O'Neill

11/16/2020

Project Manager (Signature)

Date

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1. SCOPE OF APPLICATION

The purpose of this Standard Operating Procedure is to establish the protocol for collecting groundwater samples using dedicated pump systems. The procedure is designed to permit the collection of groundwater samples with minimum turbidity, and is intended to be used in conjunction with the analyses for the most common types of groundwater contaminants (volatile organic compounds and semivolatile organic compounds, pesticides, polychlorinated biphenyls, metals, and inorganic compounds). This Standard Operating Procedure was prepared based on draft guidance prepared by the U.S. Environmental Protection Agency Region 1 and conforms to the procedures described in the Long-Term Monitoring Plan.

2. EQUIPMENT/MATERIALS

- Sampling for PFAS has specific requirements that must be followed. Review SOP No. 073 prior to planning or conducting any sampling for PFAS.

- Well construction data, location map, and field data from last sampling event.

- Field logbook, Field Record of Well Gauging Form (Figure SOP051-1), and Field Record of Well Gauging, Purging, and Sampling Form (Figure SOP051-2).

- Electronic water level measuring device, 0.01 ft accuracy for monitoring water level during pumping operations.

- Pumps: adjustable rate, submersible pumps constructed of stainless steel and Teflon. **Pumps including Teflon parts should not be used when sampling for PFCs/PFAS.**

- Tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic and inorganic analyses. **No tubing composed of Teflon should be used when sampling for PFCs/PFAS.**

- Flow measurement supplies (e.g., graduated cylinder and stopwatch).

- Power source (generator, etc.).

- Water quality indicator parameter monitoring instruments—pH, turbidity, specific conductances, and temperature. Optional indicators—Eh and dissolved oxygen. Water quality indicator parameters will be measured in the field in accordance with EPA-600/4-79-020 (1983) using the following methods: temperature (Method 170.1), pH (Method 150.1), turbidity (Method 180.1), specific conductance (Method 120.1), and dissolved oxygen (Method 360.1).

- Flow-through cell for water quality parameters.

- Decontamination supplies (for monitoring instrumentation).

- Sample bottles and sample preservation supplies (as required by the analytical methods).

- Sample tags or labels.

- Cooler with bagged ice for sample bottles.

3. PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing well purging and groundwater sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Check well for damage or evidence of tampering; record pertinent observations in the field logbook and sampling form.

- Lay out sheet of polyethylene for monitoring and sampling equipment.

- Unlock well and remove well cap (if applicable).

- Measure volatile organic compounds with a photoionization detector instrument at the rim of the well and in the breathing zone and record the readings in the field logbook and the sampling form.

- Measure and record the height of protective casing above the concrete pad or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.

- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will be measured following completion of the sampling because of the potential to stir up sediment at the bottom of the well.

- Prepare the pump by checking electrical connections, discharge tubing, and motor (Grundfos Redi-Flo2). Locate the generator (if applicable) downwind of the well; connect the power converter to the generator and the pump.

4. SAMPLING PROCEDURE

The following general procedure should be followed to obtain representative groundwater samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and total well depth.

- Connect the flow-through cell containing the instrumentation header to the pump discharge and begin purging the well at 0.2-0.5 L/min, unless a different purge rate has been previously established for that well. Fill the flow-through cell completely. Care should be taken not to cause entrapment of air in the system. Record the purge start time and purge rate.

- Establish that the water level has not dropped significantly such that the pump is dry (bubbles in discharge) or water is heard cascading down the inside of the well. Ideally, the pump rate should cause little or no water level drawdown in the well (<0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 L/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the water level continues to drop with the pump on the lowest flow rate, the pump will be shut off and the well allowed to recharge to prevent it from going dry. **The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and groundwater samples.** Sampling will commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples with the pump.

- During purging of the well, monitor the water quality indicator parameters, including pH, temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity, every 3-5 minutes (or as appropriate). Record purge rate, volume purged, depth to water, water quality indicator parameters values, and clock time at 3- to 5-minute intervals in the field logbook and sampling record. Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within the following: ± 0.1 for pH, ± 3 percent for conductivity, ± 10 mV for redox potential, and ± 10 percent for turbidity and dissolved oxygen. Temperature readings should also be recorded along with the aforementioned water quality indicators. Although it is not critical in determining the stabilization of the discharge water, it is important for data interpretation and should also be measured.

Additionally, turbidity readings consistently below 25 nephelometric turbidity units (NTUs) are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized but the turbidity is not in the range of the goal of 25 NTUs, the pump flow rate should be decreased, and measurement of the parameters should continue every 3-5 minutes; however, it is important to note that natural turbidity levels in groundwater at some sites may exceed 25 NTUs and a sample can be collected regardless of turbidity subsequent to three 20 minute purge cycles. .

- Prior to sampling, disconnect the discharge tubing from the flow-through cell. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing. Record pertinent observations in the field logbook and sampling records.

- The purging rate will be controlled so that the well is not purged dry before sampling. If necessary, purging will be temporarily halted to permit recharge rather than allowing the well to be purged dry.

- Begin filling sample containers from the pump discharge, allowing the water to fill the containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible.

- Label each sample as collected. Those samples requiring cooling will be placed into an ice cooler for delivery to the laboratory.

- After collection of the samples, restore the dedicated pumping assembly to the well by hanging the tube, electric line, and support cable inside the well by the specially designed PVC well cap assembly. Lock well.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form (Figure SOP051-2) after each well is sampled, including sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

5. SAMPLE PRESERVATION

Minimum sample preservation requirements for each parameter group are summarized in worksheet #19 and #30 of the Programmatic UFP-QAPP

6. FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the groundwater samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each sample delivery group (a sample delivery group may not exceed 20 samples) at the frequency noted:

- ***Field Duplicate***—Required at a frequency of 10 percent per sample delivery group

- ***Matrix Spike/Matrix Spike Duplicate***—Required at a frequency of 5 percent

- ***Equipment Rinsate Blank***—Required once prior to installation of dedicated pump systems

- ***Source Water Blank***—Required at a frequency of once per sampling event when equipment rinsate blank is required.

- ***Trip Blank***—Required for volatile organic compound samples at a frequency of one per sample shipment.

NOTE: The dedicated pumps remain in the wells between sampling events.

7. DECONTAMINATION

Non-dedicated sampling equipment and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternative procedures must be approved by the Project Manager prior to sampling event. Decontamination fluids will be collected in a 5-gal bucket and treated at the groundwater treatment plant.

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

Figure SOP051-1. Field record of well gauging.

Project Name:			Project No:		Date:
Weather/Temperature:					
EA Personnel:			Equipment:		
Well Number	Well Elevation	Depth to Water	Depth to LNAPL	LNAPL Thickness	Corrected Water Table Elevation[(a)]

(a) Based on an assumed specific gravity of 0.80 for LNAPL.

NOTE: All measurements in feet.
LNAPL = Light, non-aqueous phase liquid.

Figure SOP051-2. Field record of well gauging, purging, and sampling.

Site Name:		Project Number:	
Well ID:		Well Lock Status:	
Well Condition:		Weather:	

Gauge Date:		Gauge Time:	
Sounding Method:		Measurement Ref:	
Stick Up/Down (ft):		Well Diameter (in.):	

Purge Date:		Purge Time:	
Purge Method:		Field Personnel:	
Ambient Air VOCs (ppm):		Well Mouth VOCs (ppm):	

WELL VOLUME			
A. Well Depth (ft):		D. Well Volume/ft (L):	
B. Depth to Water (ft):		E. Well Volume (L) (C*D):	
C. Liquid Depth (ft) (A-B)		F. Three Well Volumes (L) (E*3):	
G. Measurable LNAPL? Yes________/ft No _________			

Parameter	Beginning	1	2	3	4	5
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (°C)						
Conductivity (µmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Total Quantity of Water Removed (L):			
Samplers:		Sampling Time (Start/End):	
Sampling Date:		Decontamination Fluids Used:	
Sample Type:		Sample Preservatives:	
Sample Bottle IDs:			
Sample Parameters:			

Standard Operating Procedure No. 059
for
Field Logbook

Prepared by

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Revision: 1
December 2014

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1. SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to delineate protocols for recording field survey and sampling information in the Field Logbook.

2. MATERIALS

The following materials may be required:

- Field Logbook (Loose paper (non-waterproof) on aluminum or Masonite clipboards)[1]
- Non-waterproof pens, pencils, or ultra-fine Sharpies®.

3. PROCEDURE

All information pertinent to a field survey or sampling effort will be recorded in a logbook[2]. Each page/form will be consecutively numbered, dated, and signed. All entries will be made in indelible ink, and all corrections will consist of line-out deletions that are initialed and dated. The person making the correction will provide a brief explanation for the change. Entries are factual only. No personal opinions should be entered.

There should be no blank lines on a page. A single blank line or a partial blank line (i.e., at the end of a paragraph) should be lined to the end of the page. If only part of a page is used, the remainder of the page should have an “X” drawn across it. The bottom of each page must be signed and dated by the field personnel entering the information.

At a minimum, entries in the Field Logbook will include but not be limited to the following:

- Date.
- Project number and project name.
- Name and address of field contact.
- Identification of sample crew members.
- Documentation should include model numbers of equipment used (e.g., drilling rigs) and calibration (if applicable). Each day’s entry should begin with time onsite, who is onsite (including observers other than the sampling crew), brief description of what work will be performed that day and how, and the weather.

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[1] Waterproof field books, plastic clipboards, binders, or spiral hard cover notebooks are prohibited during PFAS sampling activities.

[2] Loose paper (non-waterproof) on aluminum or Masonite clipboards will be used as the logbook for this project.

- If samples are being taken in or near tidal waters, the time of high and low tide for the site should be determined from local gauges or tables and recorded.

- References such as maps of the sampling site.

- Times of key daily milestones should be entered (e.g., time borings began, times personnel arrived and left site, times subcontractors arrived and left site, etc.). Time should be recorded in the left-hand margin on the page in military time.

- Sample-specific information:

  — Unique, sequential field sample number

  — Purpose of sampling

  — Location, description, and log of photographs of each sampling point

  — Details of the sample site (e.g., elevation of the casing, casing diameter and depth, integrity of the casing, etc.)

  — Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters and absorbing reagents)

  — Type of media of sample (e.g., groundwater, surface water, soil, sediment, and product)

  — Suspected waste composition

  — Number and volume of sample taken

  — Sampling methodology, including distinction between grab and composite sample

  — Sample preservation

  — Date and time of collection

  — Collector's sample identification number(s)

  — Sample shipment (e.g., name of the laboratory and cartage agent: Federal Express, United Parcel Service, etc.)

  — Field observations (e.g., oily sheen on groundwater sample, incidental odors, soil color, grain size, plasticity, moisture content, layering, Unified Soil Classification System classification, etc.)

- Any field measurements made (e.g., pH, conductivity, explosivity, water depth, organic vapor analyzer readings, etc.)

- Signature and date by the personnel responsible for observations

- Decontamination procedures.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a Field Logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the sampler's memory. Further, the project work plan or field sampling plan should be reviewed to identify additional specific information or requirements that should be included in the Field Logbook.

The Project Manager will keep a master list of all Field Logbooks assigned to the Sampling Team Leaders. One Field Logbook kept by the Project Manager will be a master site log of daily activities and will contain the list of Field Logbooks assigned to Sampling Team Leaders.

Project name and number should be clearly marked on the outside cover using indelible ink. If more than one Field Logbook exists for the project, then the number of the Field Logbook should also be clearly marked on the outside cover.

4. MAINTENANCE

At the end of the field sampling effort, the Field Logbook should be scanned and filed in the electronic file for the project and maintained according to the EA Records Retention Policy or contract requirements.

5. PRECAUTIONS

None.

6. REFERENCES

EA Engineering, Science, and Technology, Inc., PBC. 2014. Standard Operating Procedure No. 016 for Surface Water, Groundwater, and Soil/Sediment Field Logbooks. December.

U.S. Environmental Protection Agency. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80.

———. 1990. *Sampler's Guide to the Contract Laboratory Program*. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C. December.

———. 1991. *User's Guide to the Contract Laboratory Program*. EPA/540/O-91/002, Directive 9240.0-01D. Office of Emergency and Remedial Response. January.

Standard Operating Procedure No. 073
for
Sampling for Per- and Polyfluorinated Alkyl Substances

Prepared by

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Revision 1
June 2019

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are client-, project-, or site-specific variances to this Standard Operating Procedure (SOP).

SOP No. 073	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**
1	June 2019	Note regarding water-tight lids	F. Barranco	F. Barranco

1. SCOPE AND APPLICATION

The objective of this Standard Operating Procedure (SOP) is to delineate protocols for collecting environmental samples for analysis of per- and polyfluorinated alkyl substances (PFAS), also known generally as perfluoroalkyl compounds or chemicals (PFCs).

This SOP includes sampling procedures and requirements specific to analysis of PFAS, which are ubiquitous and have a high potential for cross-contamination from common consumer products and sampling materials, even when new and clean. This SOP should be used in combination with appropriate SOPs applicable to the target medium and sampling methodology (e.g., but not limited to SOP No. 007 Surface Water Sampling, SOP No. 013 Collection of Monitoring Well Samples, SOP No. 21 Sediment Sampling, SOP No. 25 Soil Sampling, or SOP No. 047 Direct-Push Technology Sampling).

This SOP was developed primarily based on guidance from the U.S. Army Corps of Engineers (2016) and the Interstate Technology Regulatory Council (ITRC 2018).

2. ACCEPTABLE MATERIALS

Table 1 provides a summary of Prohibited Items that should NOT be used or present during sampling for PFAS because they may contain PFAS, along with Acceptable (PFAS-free) Alternatives that may be used if appropriate for project requirements. In general, in the context of sampling events, PFAS are commonly found in waterproof and nonstick materials (including food packaging, rain gear, and anything containing Teflon®), personal care products, and certain plastics (e.g., low-density polyethylene [LDPE]) and synthetic fibers.

Table 1. Prohibited Items and Acceptable Alternatives for Use during PFAS Sampling

Prohibited Items	Acceptable Alternatives
Field Equipment	
Teflon-containing or LDPE materials (including tubing, bailers, tape)	HDPE or silicone materials
Waterproof field books, plastic clipboards, binders, or spiral hard cover notebooks	Loose paper (non-waterproof) on aluminum or Masonite clipboards
Sharpies®/markers, waterproof pens	Non-waterproof pens or pencils
Sticky notes (e.g., Post-It®) and glues	Not applicable
Re-usable chemical (blue) ice packs	Regular ice in polyethylene bags (double bagged)
Aluminum foil	Thin HDPE sheeting
Plastic spoons used in soil/sediment sampling	Stainless steel trowels/spoons
Reusable core liners	Single-use PVC or acetate liners
LDPE HydraSleeve	HDPE HydraSleeve
Field Clothing and Personal Protective Equipment	
New cotton clothing; synthetic water resistant, waterproof, or stain- treated clothing; clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of natural fibers (preferably cotton)
Clothing laundered using fabric softener	No fabric softener
Boots (e.g., steel-toed or waders) containing Gore-Tex™ or waterproof coatings	Boots made with polyurethane or PVC with no waterproof coating

Prohibited Items	Acceptable Alternatives
Coated Tyvek® suits	Uncoated/plain Tyvek suits not containing PFAS
Cosmetics, shampoo, conditioner, body gel, moisturizers, hand cream, waxed dental floss, or other personal care products used on the day of sampling.	Use bar soap not containing moisturizers and rinse well on the day of sampling (including for hand washing). Use any other required products the night before (rather than the day of) sampling.
Paper towels	Air dryers (for hand drying)
No sunscreens or insect repellents except approved 100% natural products such as those noted in the Alternatives column.	**Acceptable Sunscreens:** Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, "free" or "natural" sunscreens for babies **Acceptable Insect Repellents:** Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect Repellant, Herbal Armor, California Baby
Sample Containers	
LDPE or glass containers	HDPE containers (or polypropylene if required)
Teflon-lined caps	Unlined HDPE (or polypropylene if required) caps
Rain Events	
Rain gear that has been treated to make it waterproof/resistant and breathable (e.g., Gore-Tex™ treated)	PVC or polyurethane- or wax-coated rain gear that is confirmed not to contain PFAS, or utilize a gazebo tent that is only touched or moved prior to and following sampling activities.
Equipment Decontamination	
Decon 90	Alconox®, Liquinox®, and/or Citranox®
Water from an onsite well	Potable water from municipal drinking water supply (not containing PFAS), and "PFAS-free" deionized water for final rinse
Food Considerations	
All food and drink, with exceptions noted in the Alternatives column. Paper food packaging (e.g., fast food wrappers, drink cups, paper bags) and foil, in particular, often contain PFAS.	Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area
NOTES: HDPE = High-density polyethylene. PVC = Polyvinyl chloride.	

If a plastic product or chemical not included in the Acceptable Alternatives column of Table 1 is proposed for use, it is recommended that Safety Data Sheets and other references be reviewed prior to use to confirm that the material does not contain PFAS. Indications of potential PFAS ingredients, in addition to the items listed in Table 1, include the following materials (ITRC 2018):

- Polytetrafluoroethylene (fluorocarbon solids such as Teflon)
- Fluorinated ethylene propylene
- Ethylene tetrafluoroethylene
- Polyvinylidene fluoride
- Generally, any other ingredient names containing the prefix "fluoro."

Specific to the use of HDPE sample containers, note that the associated lids are not typically "water-tight." Therefore, HDPE sample containers should be individually placed in water-tight bags prior to placement in shipping containers loaded with ice.

3. PROCEDURES

As stated above, this SOP includes procedures specific to analysis of PFAS, and should be used in combination with the appropriate SOPs applicable to the target medium and sampling methodology.

3.1 GENERAL CONSIDERATIONS

Materials listed in the Prohibited Items column of Table 1 and other materials containing PFAS ingredients should not be used. However, in some cases, these materials must be used due to factors outside the control of the scope of the work or utility of the project team (e.g., health and safety requirements where other hazardous chemicals are present, or where the sampling requirements are prescriptive, unexpected, or time-sensitive). In these cases, the sampling team should purge/rinse equipment adequately with PFAS-free water where available, and collect additional quality control samples (Section 3.7) to assess the degree of cross-contamination associated with the use of known or suspected PFAS-containing materials during sampling.

NOTE: Most steel-toed boots are made from coated leather and synthetic fibers. PVC or polyurethane are preferred PFAS-free materials for boots. If not possible to obtain PFAS-free footwear that comply with specified health and safety requirements for personal protective equipment, then field personnel should minimize contact with footwear while in the sampling area, and always change gloves after touching footwear.

Disposable nitrile gloves shall be worn at all times during PFAS sampling activities. A new pair of nitrile gloves shall be donned after contacting potential contaminants including all non-decontaminated surfaces. New gloves shall also be donned before touching containers used for storage of PFAS samples, decontaminating re-usable sampling equipment, or handling quality control samples (Section 3.7).

Food shall not be eaten within 10 meters of any sampling area. Before eating or drinking, sampling personnel shall remove their gloves and any outer garments (e.g., coveralls) and leave the work area. When finished, sampling personnel shall wash their hands, remove any visible residue, and put new gloves and any outer garments back on prior to returning to the work area.

PFAS-containing stain resistant products are often applied to vehicle seats that have fabric upholstery. Therefore, if no outer garments (e.g., coveralls) will be worn, or if the outer garments will be worn in the field vehicle then, if feasible, the seats of the vehicle should be covered in a well-laundered cotton blanket to avoid contact between clothing and the seats.

Visitors to the sampling area shall remain at least 10 meters at a distance.

As indicated in Table 1, sampling personnel shall not use the personal care products or cosmetics (other than bar soap) prior to or during sample collection on any day. Additionally, clothes worn during sampling should be well-washed natural fibers.

Other personnel who come within 2-3 meters of the sample collection area should follow the guidelines above and in Table 1.

Fluids used during laboratory- or fieldwork (e.g., drilling for monitoring well installation or for deep soil sampling) should be confirmed PFAS-free.

When sampling on a surface water body, associated gear (e.g., waders, life preservers) should be confirmed PFAS-free.

3.2 EQUIPMENT DECONTAMINATION

Wherever possible, dedicated or disposable equipment shall be used to avoid the need for decontamination, which introduces additional potential for cross-contamination.

Large field equipment (e.g., drill rigs) should be decontaminated with potable water using steam or high-pressure water. Laboratory-certified "PFAS-free" water should be used to perform a final rinse of portions of the sampling equipment that will be in direct contact with samples, wherever practical.

Hand-held, non-dedicated sampling equipment, which is used at multiple field sampling locations, shall be decontaminated using the following procedure:

- Rinse with a non-PFAS-containing detergent (e.g., Alconox, Liquinox, or Citranox)
- Rinse with laboratory-provided, "PFAS-free" water (Grade 3 distilled, Millipore deionized)
- Rinse with methanol
- Rinse with laboratory-provided, "PFAS-free" deionized water.

The Safety Data Sheet for the selected detergent should be reviewed to ensure that it does not contain fluoro-surfactant ingredients.

Wherever possible, equipment should be rinsed with "PFAS-free" water immediately prior to use at each sampling location.

3.3 SAMPLE COLLECTION AND PRESERVATION

The sampling team shall coordinate with the analyzing laboratory regarding requirements for sample bottle, volume, and preservation requirements for samples for PFAS analysis, and the laboratory should provide certified "PFAS-free" containers. HDPE bottles with unlined caps are typically used for collection of samples for PFAS analyses. Polypropylene may also be used for specific applications (e.g., collection of drinking water samples to be analyzed for the short list of PFASs by Method 537) (Department of Defense Environmental Data Quality Workgroup 2017).

Containers for collection of PFAS samples shall never be left uncapped, either before or after sample collection, and the lid/cap shall be kept in a gloved hand and not be set down while removed from the container.

Sampling personnel shall put on a clean pair of nitrile gloves immediately prior to collection of each sample for PFAS analyses, prior to removing the lid from the sampling container. After the sample is collected and the container is closed, pens or pencils, but not markers, shall be used in completing sample labels or in the vicinity of samples during collection.

Following sample collection and addition of preservative (if required), sample containers for PFAS analyses shall be placed in coolers with new, double-bagged ice and not re-usable chemical ice packs unless confirmed PFAS-free and regulatorily accepted, such that meltwater does not contact sample containers during transport.

3.4 SOIL/SEDIMENT SAMPLING CONSIDERATIONS

Surface soil and sediment samples for PFAS analyses should be collected using a clean, stainless-steel tool (e.g., a trowel or Ponar grab sampler).

For field collection of soil and sediment cores, single-use PVC, HDPE, or acetate liners shall be used, and samples for PFAS analysis should be collected from the cores directly or using a stainless-steel tool.

3.5 GROUNDWATER SAMPLING CONSIDERATIONS

It is recommended that, where feasible, measurements of monitoring well water levels and well depths be performed after sampling for PFAS to avoid possible cross-contamination.

HDPE or silicone tubing shall be used for purging and sample collection, where applicable. Teflon and LDPE shall NOT be used. During sampling, sampling personnel shall ensure that no tubing or other equipment contacts the inside or rim of the sample bottle. Any foaming observed in the sample during collection should be noted on the chain-of-custody form that accompanies the samples to the analytical laboratory.

If analyses to be performed by the laboratory include less common PFAS chemicals that have relatively high volatility (including fluorotelomers and sulfonamide/alcohols such as fluorotelomer alcohols, fluorotelomer acrylates, and methyl/ethyl fluorosulfonamides and sulfonamidoethanols), then precautions should be taken during sample collection to minimize loss of volatiles (e.g., minimizing turbulence in water as it flows into the sample container).

If use of passive/no-purge sample collection technology is to be utilized, it is critical to confirm that the sampling device does not contain LDPE (e.g., HydraSleeves made of HDPE rather than LDPE may be requested for PFAS sampling).

Filtration is not recommended because the filter may sorb PFAS or be a source of PFAS contamination.

3.6 SURFACE WATER AND POREWATER SAMPLING CONSIDERATIONS

Capped surface water sample containers shall be rinsed multiple times with site surface water prior to sampling.

Because PFAS tend to accumulate at the air/water interface, specific procedures for surface water sampling shall be followed. After rinsing, the capped container shall be lowered into the surface water, with the top pointed down. The container shall then be reoriented with the top pointed upward and opened under water at the depth targeted for sampling, ideally at least 10 centimeters from both the sediment surface and the water surface. During sample collection, the sample collection point shall be positioned upstream of the sampler, gloves, etc. If an extension rod must be used due to the depth of sampling, the rod shall be made of clean, PFAS-free material.

For porewater sampling, the common stainless-steel and PVC samplers, with HDPE and silicone tubing, are acceptable. The samplers should not be reused at multiple sampling locations.

As for groundwater samples, filtration is not recommended.

3.7 FIELD QUALITY CONTROL SAMPLES

It is recommended that field blanks and equipment (i.e., rinsate) blanks be collected at least daily, using laboratory supplied “PFAS-free” water, to detect any cross-contamination that occurred despite precautions taken during sampling. If a peristaltic pump is used for sample collection, then at least one equipment blank should be collected by pumping “PFAS-free” water through the pump with clean HDPE tubing.

Field duplicates should also be collected to assess the precision of the results.

Analysis of trip blanks may be advisable on a project-specific basis, particularly if relatively volatile PFAS chemicals will be analyzed.

The same precautions taken during collection of specified samples should be taken during the collection of quality control samples (Section 3.7).

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

See detailed precautions noted above.

6. REFERENCES

Department of Defense Environmental Data Quality Workgroup. 2017. *Bottle Selection and other Sampling Considerations When Sampling for Per-and Poly-Fluoroalkyl Substances (PFAS)*. Revision 1.2. July.

Interstate Technology Regulatory Council (ITRC). 2018. *Fact Sheet: Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS).* March.

U.S. Army Corps of Engineers. 2016. *Standard Operating Procedure 047: Per/Poly Fluorinated Alkyl Substances (PFAS) Field Sampling*. March.

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Standard Operating Procedure No. 075
for
Collection of Water Samples from Faucets, Taps, and Sampling Ports

Prepared by

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Revision 0
November 2019

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are any client-, project-, or site-*specific* variances to this Standard Operating Procedure (SOP).

SOP No. 075	
SOP Section	**Variance**

Project Manager (Name)

Project Manager (Signature) Date

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DOCUMENT REVISION HISTORY

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Revision Number	**Revision Date**	**Revision Summary**	**Revised By**	**Reviewed By**

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure is to provide protocols for the collection of water samples from faucets, taps, and sampling ports (e.g., from a residential treatment system such as a Point-of Entry Treatment System [POETS] or Point-of-Use Treatment System [POUTS]).

2. MATERIALS

The following materials may be required:

- Non-powdered, disposable gloves (i.e., nitrile gloves)
- Paper towels or cloth towels
- 5-gallon bucket(s)
- Sample bottles and labels
- Decontamination materials (e.g., Alconox and water obtained from an approved PFAS-free source)

3. PROCEDURE

The following procedures shall be followed when collecting water samples from faucets, taps, and sample ports:

- Extreme care must be taken not to contaminate samples. A clean pair of new, non-powdered, disposable gloves (i.e, nitrile gloves) shall be donned prior to the collection of each sample and worn for only that sample. The gloves should not come into contact with the media being sampled.

- For private well sampling, water samples should be collected outside the residence, as close to the well head as possible.

- Depending on project specific data quality objectives, purging of stagnant water may be required. Prior to ANY sample collection, review the project specific Quality Assurance Project Plan for purging requirements. Note: If sampling to determine the impact of pipes or other appurtenances on water quality, no purging should be performed.

    - For private well sampling, the spigot should turned on for a minimum of 5 to 10 minutes (depending on proximity to well head) to allow stagnant water to be moved through the piping from the well head and provide a representative sample of groundwater used for drinking water.

    - For public water supply system sampling under continuous flow, no purging is generally necessary.

  - For small-scale treatment system sampling (e.g., residential POETS or POUTS), the sampling port should be opened or turned on for a minimum of 2 to 5 minutes (effluent) or 5 to 10 minutes (influent) to provide a representative sample for evaluation of treatment system performance.

- If the sampling point has both a cold and hot water tap, the sample should be collected from the cold water tap.

- Collect sample directly in the sample container. During sample collection, make sure the tap or spigot does not contact the sample container.

- If the spigot being sampled is too close to the ground to allow for the sample container to be placed between the spigot and the ground surface, then a shallow transfer container can be used to transfer the spigot water into the sample container. The transfer container may consist of a new spare PFAS sample bottle trimmed by cutting off the upper portion of the bottle. The transfer container will be dedicated and will not be re-used between sampling locations.

- Taps that have water leaking from the valve stem handle, down the outside of the faucet, or taps that have water running along the outside of the lip, should be avoided for use as sampling points. Any hoses, filters, or aerators should be removed from taps prior to purging and/or sampling.

- Once collected the sample container shall be sealed and stored in a secure location to preclude conditions which could alter the properties of the sample. Samples requiring reduced temperature storage should be placed on ice immediately.

- Collected samples must remain in the custody of the sampler until the samples are relinquished to another party using a Chain-of-Custody.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

Refer to the site-specific Health and Safety Plan for appropriate personal protective equipment.

6. REFERENCES

U.S. Environmental Protection Agency. 2013. *Operating Procedure, Potable Water Supply.* 30 May 2013.

Appendix C

Community Air Monitoring Plan

Memorandum for Appendix C: Community Air Monitoring Plan

Site Inspection UFP-QAPP Addendum
Rochester Army Aviation Support Facility #2, New York
Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites,
ARNG Installations, Nationwide

To protect the community from any potential airborne releases that could result from field activities associated with the Site Inspection, community air monitoring will be performed in general accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP), Attachment 1A of the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation, as attached to this Memorandum (NYSDEC, 2010). A CAMP is required by the NYSDEC whenever intrusive work is conducted as part of an environmental investigation or remediation.

Per DER-10, continuous air monitoring will be performed in the vicinity of the drill rig when intrusive activities are underway. Air monitoring will consist of a dust monitor placed on a tripod adjacent to the work areas, in a downwind location. Background (upwind) levels will be measured each day prior to start- up of site activities and periodically throughout the day. Per the NYSDOH Generic CAMP, the following actions will be taken if acceptable levels of air impacts are exceeded:

- If particulate levels (PM10) are greater than 100 micrograms per cubic meter (µg/m3) above background for a 15 minute period, or if airborne dust is observed leaving the work area, dust suppression techniques will be employed. Work will continue with these suppression techniques provided that PM10 levels do not exceed 150 µg/m3 above background and no visible dust is migrating from the work area. If PM10 exceeds 150 µg/m3 over background, work will be stopped, and a re-evaluation of activities will be initiated.

Signed:

EA Engineering, Science, and Technology, INC, PBC
Mike Kepner P.G. (Task Manager)
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New York State Department of Health
Generic Community Air Monitoring Plan
(Appendix 1A of the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation)

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. Periodic monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009