FINAL
Site Inspection Quality Assurance Project Plan Addendum Camp Smith, Cortlandt, New York

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

October 2019

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

Acronyms and Abbreviations

A	Analytical
ACSIM	Assistant Chief of Staff for Installation Management
AECOM	AECOM Technical Services, Inc.
AFFF	Aqueous film forming foam
AFSA	Academy of Fire Science Annex
AOI	Area of Interest
APP	Accident Prevention Plan
ARNG	Army National Guard
bgs	below ground surface
˚C	Degrees Celsius
Camp Smith	Camp Smith Training Facility
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFMO	Construction and Facilities Management Officer
CFR	Code of Federal Regulations
COC	Chain of custody
CPR	Cardiopulmonary resuscitation
CSM	Conceptual site model
CSMS	Combined Support Maintenance Shop
DASA ESOH	Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health
DL	Detection limit
DO	Dissolved Oxygen
DoD	Department of Defense
DPT	Direct Push Technology
DQI	Data Quality Indicators
DQO	Data Quality Objective
DUA	Data Usability Assessment
EDD	Electronic data deliverables
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
°F	Degrees Fahrenheit
FRB	Field Reagent Blank
FTA	Fire Training Area
GCAL	Gulf Coast Analytical Laboratories, LLC
gpm	gallons per minute
GPS	Global Positioning System
HA	Health Advisory
HAZWOPER	Hazardous waste operations and emergency response
HDPE	High-density polyethylene
IDQTF	Intergovernmental Data Quality Task Force
IDW	Investigation Derived Waste

LCMS	Liquid Chromatography/ Mass Spectrometry
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
LOD	Level of Detection
LOQ	Level of Quantification
MC	munitions constituents
µg/kg	Micrograms per kilogram
µS/cm	microSiemens per centimeter
MPC	Measurement Performance Criteria
MS/MSD	Matrix spike/ matrix spike duplicate
NA	Not applicable
ND	Non-detect
NY	New York
NYCRR	New York Codes, Rules, and Regulations
NYARNG	New York Army National Guard
NYS	New York State
ng/L	Nanograms per liter
ORA	Operational Range Assessment
ORP	Oxidative Reduction Potential
PA	Preliminary Assessment
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
pH	Potential of hydrogen
PID	Photoionization detector
PM	Project Manager
ppm	Parts per million
ppt	Parts per trillion
PQAPP	Programmatic UFP-QAPP
PSC	Project Screening Criteria
PVC	Poly-vinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
QSM	Quality Systems Manual
RI	Remedial Investigation
RPD	Relative percent difference
RSL	Regional Screening Level
S	Sampling
SDG	Sample Delivery Group
SI	Site Inspection
SOP	Standard operating procedure

SRM	Standard reference material
SSHP	Site Safety and Health Plan
TCRA	Time critical removal action
TO	Task Order
TOC	Total organic carbon
TPP	Technical Project Planning
TSA	Technical System Audits
UCL	Upper confidence limit
UFP	Uniform Federal Policy
US	United States
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VSI	visual site inspection

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1. Introduction

1.1 Project Authorization

This is the Installation-Specific Addendum to the Army National Guard (ARNG) Site Inspection (SI) Programmatic Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP). This SI UFP-QAPP Addendum addresses specific SI activities to be completed at Camp Smith Training Facility (Camp Smith), Cortlandt, New York.

Programmatically, the ARNG is assessing the potential environmental impacts primarily from aqueous film forming foam (AFFF) and similar chemical releases suspected at their properties under a task order titled *Preliminary Assessments and Site Inspections (PA/SI) for Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites, ARNG Installations, Nationwide*. Each SI will assess potential impacts to human health and the environment related to processes that used per- and polyfluoroalkyl substances (PFAS) (e.g., metal plating and water proofing) and adjacent off-site businesses or operations (not under the control of ARNG) that could potentially be responsible for a PFAS release. This project is being executed by AECOM Technical Services, Inc. (AECOM) under Contract Number W912DR-12-D-0014, Task Order W912DR17F0192, issued 11 August 2017, by the United States (US) Army Corps of Engineers (USACE) Baltimore District on behalf of the ARNG-Installations & Environment Division, Cleanup Branch.

The SI project elements will be performed in compliance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations [CFR] Part 300), and in compliance with USACE requirements and guidance for field investigations including specific requirements for sampling for PFOA and PFOS 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 and PFOA, which are the key components of AFFF, and the other 16 related compounds listed in the task order. This UFP-QAPP Addendum focuses on the SI phase of work specific to Camp Smith.

1.2 SI Purpose

The main purpose of this SI effort is to determine the presence or absence of PFAS contamination at ARNG facilities and assess whether or not a complete pathway exists between the source and potential receptors.

As stated in the *Federal Facilities Remedial Site Inspection Summary Guide* (United States Environmental Protection Agency [USEPA] 2005), an SI has four goals:

1) Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.
2) Determine the potential need for a removal action (i.e., time critical removal action [TCRA]).
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).

In addition to the USEPA identified goals of an SI, the ARNG SI effort will also aim to identify potential off-facility sources.

1.3 QAPP Addendum Organization

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

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

Table 1-1: Comparison of PQAPP to QAPP Addendum

QAPP Addendum Worksheets	Applicable Document
Worksheets #1 and #2- Title and Approval Page and QAPP Identifying Information	**Programmatic/Site-Specific**
Worksheets #3 and #5- Project Organization and QAPP Distribution	**Programmatic/Site-Specific**
Worksheets #4, #7, #8- Personnel Qualifications and Sign-off Sheet	**Programmatic/Site-Specific**
Worksheet #6- Communication Pathways	**Programmatic/Site-Specific**
Worksheet #9- Technical Project Planning Session Summary	**Site-Specific**
Worksheet #10- Conceptual Site Model	**Site-Specific**
Worksheet #11- Project/ Data Quality Objectives	**Site-Specific**
Worksheet #12- Measuring 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 QC Summary	**Programmatic/Site-Specific**
Worksheet #21- Field Standard Operating Procedures (SOPs)	**Programmatic**
Worksheet #22- Field Equipment Calibration, Maintenance, Testing and Inspection	**Programmatic**
Worksheet #23- Analytical SOPs	**Programmatic**
Worksheet #24- Analytical Instrument Calibration	**Programmatic**

QAPP Addendum Worksheets	Applicable Document
Worksheet #25- Analytical Instrument and Equipment Maintenance, Testing and Inspection	**Programmatic**
Worksheets #26 and #27- Sample Handling, Custody and Disposal	**Programmatic**
Worksheet #28- Analytical Quality Control and Corrective Actions	**Programmatic**
Worksheet #29- Project Documents and Records	**Programmatic**
Worksheets #31, #32 and #33- Assessments and Corrective Action	**Programmatic**
Worksheet #34- Data Verification and Validation Inputs	**Programmatic**
Worksheet #35- Data Verification Procedures	**Programmatic**
Worksheet #36- Data Validation Procedures	**Programmatic**
Worksheet #37- Data Usability Assessment	**Programmatic**

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

Site Name/Project Name: Army National Guard / MAES Delivery Order 00014/ Preliminary Assessments
(PA) and Site Inspections (SI) for Perfluorooctane-Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites, ARNG Installations, Nationwide

Installation: Camp Smith, New York

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

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

Investigative Organization Project Manager Printed Name / Organization	Gwinn, Rosa Digitally signed by Gwinn, Rosa DN: cn=Gwinn, Rosa, ou=USGRM2 Date: 2019.10.30 14:53:41 -04'00' Signature / Date Rosa Gwinn/ AECOM Project Manager
Investigative Organization Quality Manager Printed Name / Organization	Gettier, Sarah Digitally signed by Gettier, Sarah Date: 2019.10.28 17:41:22 -04'00' Signature / Date Sarah Gettier/ AECOM Project Quality Manager
Army National Guard Printed Name / Organization	HESS.PAMELA.SUE.1146563313 Digitally signed by HESS.PAMELA.SUE.1146563313 Date: 2019.11.01 10:35:30 -04'00' Signature / Date Captain Pamela Hess/ ARNG Program Manager
New York Army National Guard Printed Name / Organization	2019 7 11 Signature / Date Peter Jensen/ Environmental Branch Chief
Contract Organization Project Manager Printed Name / Organization	PECK.TIMOTHY.JOSEPH.1252325553 Digitally signed by PECK.TIMOTHY.JOSEPH.1252325553 Date: 2019.10.31 13:25:26 -04'00' Signature / Date Timothy Peck / USACE, Baltimore District

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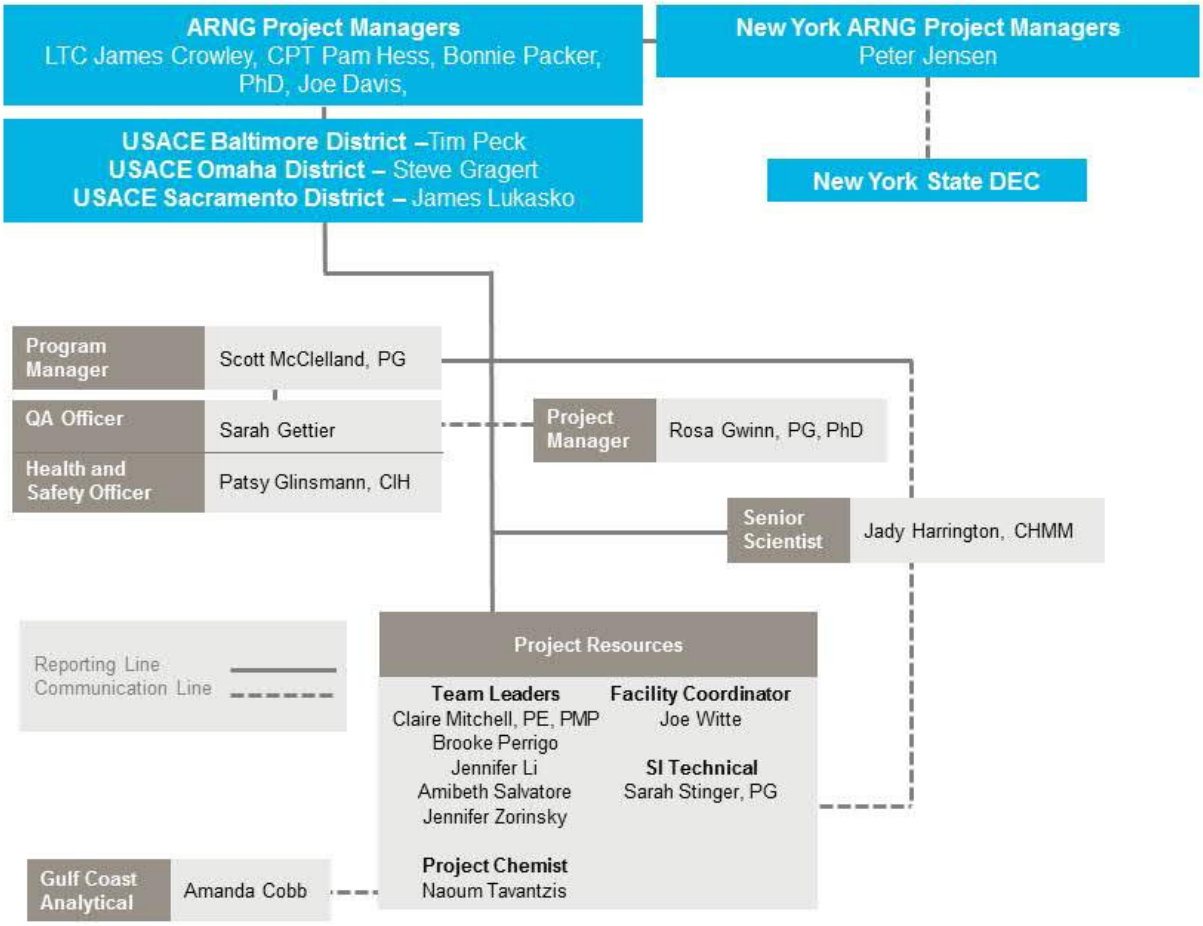
QAPP Worksheets #3 & #5: Project Organization and QAPP Distribution

The organization chart in **Figure WS #3/5-1** identifies key project personnel as well as lines of authority and lines of communication among the ARNG, USACE, and prime contractor (AECOM). The QAPP will be distributed to all parties noted in the figure below. This organization chart is consistent with the PQAPP with the exception of the state ARNG and regulatory personnel.

Figure WS #3/5-1 Project Organizational Chart



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

This worksheet contains a list of the key project personnel who are identified as performing the tasks that are defined in this QAPP Addendum for Camp Smith 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 and agree to implement it.

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Scott McClelland, PG	Prime Contractor (AECOM)	Program Manager	Education: BA, Geology MS, Geology Experience. 30 years; executing and managing environmental investigation and remediation projects including program management of USACE Baltimore contracts.	Professional Geologist, KY AECOM Certified PM	*Approval on file* 28 October 2019
Rosa Gwinn, PG, PhD	AECOM	Project Manager	Education: BA, Geology MS, Geology PhD, Geology Experience: 33 years; managed 4 ORA Phase II TOs of similar scope, complexity, and duration for USACE and ARNG; experience with PFAS investigations.	Professional Geologist, WA, UT AECOM Certified PM 40hr HAZWOPER OSHA 8hr Refresher	*Approval on file* 28 October 2019
Jady Harrington, CHMM	AECOM	Senior Scientist	Education: BA, Biology Experience: 27 years; served as senior scientist for ORA Phase II TOs; MMRP RIs, experience with PFAS investigations.	CHMM AECOM Certified PM 40hr HAZWOPER OSHA 8hr Refresher 8hr OSHA Supervisor First Aid/CPR	*Approval on file* 28 October 2019

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Sarah Gettier	AECOM	QC Officer/ SI Team Leader	Education: BS, Civil Engineering, MS Environmental Engineering Experience: 15+ years direct experience developing QAPPs and other environmental planning documents as a technical leader.	OSHA 40hr HAZWOPER OSHA 8hr Refresher OSHA 8hr Supervisor First Aid/CPR	*Approval on file* 28 October 2019
Patsy Glinsmann, CIH	AECOM	Health and Safety Officer	Education: BS, Chemistry MS, Environmental Biology MHS, Occupational Safety and Health Experience: 25+ years; occupational health and safety.	Certified Industrial Hygienist	*Approval on file* 28 October 2019
Claire Mitchell, PE, PMP	AECOM	SI Team Leader	Education: BS, Civil Engineering Experience: 8+ years of environmental engineering experience including task management for PFAS investigations for DoD clients.	Professional Engineer, MO PMP Certification AECOM Certified PM 40hr HAZWOPER OSHA 8hr Refresher First Aid/ CPR	*Approval on file* 28 October 2019
Brooke Perrigo	AECOM	Camp Smith SI Task Manager	Education: BS, Environmental Science MS, Environmental Planning and Management Experience: 7+ years of environmental engineering experience including deputy project management for PFAS investigations for DoD clients.	40hr HAZWOPER OSHA 8hr Refresher First Aid/CPR	*Approval on file* 28 October 2019
Robert Kennedy	AECOM	Senior Chemist	Education: BA, Chemistry Experience: 27 years; served as senior scientist for ORA Phase II TOs; experience with PFAS investigations.	Auditing/Data Review training	*Approval on file* 28 October 2019

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Naoum Tavantzis	AECOM	Project Chemist	Education: BA, Environmental Science Masters of Business Administration Experience: 9+ years; project chemist for ORA Phase II TOs; PFAS investigations, data validation, laboratory coordination.	40hr HAZWOPER OSHA 8hr Refresher OSHA Supervisor training	*Approval on file* 28 October 2019
Michael Stankevich	AECOM	GIS Specialist	Education: BA, Environmental Studies Experience: 9 years; completed SDSFIE submittals for multiple ARNG installations.	ArcGIS Training	*Approval on file* 28 October 2019
Gretchen Welshofer	AECOM	Regulatory Specialist	Education: BA, Communication MS, Environmental Science Experience: 17+ years; performing human health risk assessments; expertise in evaluating potential risks and hazards to human health posed by MC emanating from small arms and large caliber ranges; expertise in evaluating contaminant fate and transport for validity of exposure pathways.		*Approval on file* 28 October 2019
Sarah Stinger, PG	AECOM	Technical/ Quality	Education: BS, Geology MS, Geology Experience: 33 years; performing CERCLA investigations; served as task leader and in QA role for ORA Phase II TOs at multiple ARNG installations.	Professional Geologist, VA, PA, LA AECOM Certified PM 40hr HAZWOPER OSHA 8hr Refresher	*Approval on file* 28 October 2019
Joe Witte	AECOM	Project Coordinator	Education: BS, Environmental Science and Policy Experience: 4+ years with 2 years direct experience working on ARNG and Army investigations under MMRP and ORA and developing QAPPs.	40hr HAZWOPER OSHA 8hr Refresher First Aid/CPR	*Approval on file* 28 October 2019

Name	Organization	Project Role	Education/Experience	Specialized Training / Certifications	Signature/Date
Amanda Cobb	GCAL	Laboratory Project Manager	Education: BS, Biology Experience: 3+ years as Project Manager.		*Approval on file* 28 October 2019
William Perry	GCAL	Laboratory Quality Assurance Specialist (GCAL)	Education: BS, Chemistry American Chemistry Society Program Experience: 30 years including QAPP development, data validation, laboratory auditing and procurement, laboratory and sampling management, organic analysis and sample preparation management.	Statistics and 17025/TNI/QSM standards	*Approval on file* 28 October 2019

Notes:
AECOM = AECOM Technical Services, Inc.
BA = Bachelor of Arts
BS = Bachelor of Science
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CHMM = Certified Hazardous Materials Manager
CIH = Certified Industrial Hygienist
CPR = cardiopulmonary resuscitation
DoD = Department of Defense
GCAL = Gulf Coast Analytical
HAZWOPER = Hazardous Waste Operations and Emergency Response
hr = hour
KY = Kentucky
LA = Louisiana
ORA= Operational Range Assessments
MC = munitions constituents
MHS = Masters of Health Science
MMRP = Military Munitions Response Program
MS = Master of Science
MO = Missouri
QAPP = Quality Assurance Project Plan
QC = quality control
OSHA = Occupational Safety and Health Administration
PA= Pennsylvania
PE = Professional Engineer
PFAS = Per- and polyfluoroalkyl substances
PG = Professional Geologist
PhD = Doctor of Philosophy
PM = Project Manager
PMP= Project Management Professional
RI = Remedial Investigation
SI = Site Inspection
TO = Task Order
USACE = United States Army Corps of Engineers
UT = Utah
VA = Virginia
WA = Washington

QAPP Worksheet #6: Communication Pathways

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

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
Program Manager decisions and modification	USACE, Baltimore District Project Manager USACE, Omaha District, Project Manager USACE, Sacramento District, Project Manager	Tim Peck Steve Gragert James Lukasko	410-962-3416 timothy.j.peck@usace.army.mil 402-995-274353 steve.p.gragert@usace.army.mil 916-557-5392 james.j.lukasko@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.
Program Technical Review	ARNG	Bonnie Packer	703-607-7977 bonnie.m.packer.ctr@mail.mil	The AECOM PM will obtain ARNG technical review and concurrence of the QAPP and project documents and any field modifications/QAPP changes as necessary. All approved modifications will be included in QAPP revisions (prior to field work). ARNG technical review and comments will be incorporated into the QAPP and project documents and a record of ARNG comments saved in project files for documentation.
Installation interface	NYARNG	Peter Jensen Sean Martin	518-786-4548 carle.p.jensen.nfg@mail.mil 914-945-7377 sean.r.martin33.nfg@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.

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
Regulatory agency interface (New York State Department of Environmental Conservation)	NYARNG	Greg Austin	518-786-4318 gregory.t.austin.nfg@mail.mil	Communicate technical approaches and decisions directly to regulatory agencies' representative(s) on an as-needed basis, documented via phone records and emails.
Community/ media interface	NYARNG	Eric Durr	518-786-4581 eric.durr5.nfg@mail.mil	Communicate information directly to communities or media on an as-needed basis.
Manage all project phases Field progress reports Field modifications/QAPP changes	AECOM Project Manager (PM)	Rosa Gwinn	301-820-3131 rosa.gwinn@aecom.com	All materials and information about the project will be forwarded from the AECOM PM to ARNG/ USACE. Any field or laboratory changes will be coordinated with Steve Gragert (USACE), Bonnie Packer (ARNG), and Sean Martin (NYARNG). The AECOM PM will obtain ARNG/ USACE approval/ concurrence for field modifications/QAPP changes as necessary. All approved modifications will be included in QAPP revisions (prior to field work) or non-conformance report(s) (during field work), and resolution / corrective action identified.
	AECOM SI Task Manager	Brooke Perrigo	703-399-3966 brooke.perrigo@aecom.com	Support AECOM PM in implementing SI tasks/procedures.
	AECOM QC Officer	Amibeth Salvatore	301-820-3628 amibeth.salvatore@aecom.com	Oversees/conducts quality audits to assure field program performed in accordance with approved protocols. Supports AECOM PM, Technical Task Manager and Team Leaders to assure quality reviews are completed on project deliverables, including consistency and conformance with applicable regulatory and DoD guidance and with industry practices. Works with Project Chemist to resolve performance problems with contracted analytical laboratory.

Communication Driver	Organization	Name	Contact Information	Procedure (Timing, Pathway, Documentation)
Analytical laboratory modifications and performance problems	AECOM Project Chemist / Data Validator	Naoum Tavantzis	301-267-8761 naoum.tavantzis@aecom.com	Notify AECOM PM and QC Officer in a timely manner of performance problems encountered by the contracted analytical laboratory. PM will secure approval for modifications to the QAPP as necessary from ARNG/ USACE. All approved modifications will be included in non-conformance Reports.
Data verification issues (e.g., incomplete records) and data validation issues (e.g., non-compliance with procedures)				Verify/validate all analytical chemistry sample results from analytical laboratories with criteria developed in this QAPP and deliver to the PM and the Project QA Managers.
Data review corrective actions				Notify Laboratory PMs to identify resolution/corrective actions.
Sample receipt variances	GCAL	Amanda Cobb	225-214-7047 amanda.cobb@gcal.com	Report all project non-conformances and problems to the AECOM Project Chemist.
Laboratory QC variances				Report all project non-conformances and problems to the AECOM Project Chemist.
Analytical corrective actions				Report all project non-conformances and problems to the AECOM Project Chemist.
Laboratory modifications and performance problems				Report all project non-conformances and problems to the GCAL PM. GCAL PM will report to AECOM Project Chemist.

Notes:
AECOM = AECOM Technical Services, Inc.
ARNG = Army National Guard
DoD = Department of Defense
GCAL = Gulf Coast Analytical
NYARNG = New York Army National Guard
PM = project manager
QA = quality assurance
QAPP = Quality Assurance Project Plan
QC= Quality Control
SI = Site Inspection
USACE = United States Army Corps of Engineers

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QAPP Worksheet #9: Technical Project Planning Session Summary

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

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

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

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QAPP Worksheet #10: Conceptual Site Model

The information presented in this section was gathered during the PA at Camp Smith. The PA process included the following tasks:

- Reviewed data resources to obtain information relevant to suspected PFAS releases
- Conducted a 1-day site visit on 28 June 2018
- Interviewed current and retired NYARNG Camp Smith personnel during the site visit including the Environmental Manager, Maintenance Equipment Mechanic, Sanitation and Camp Smith Post Director
- Completed visual site inspections (VSIs) at known or suspected PFAS release locations and documented with photographs
- Developed a CSM to outline the potential release and pathway of PFAS for the Areas of Interest (AOIs) and the facility

The findings of the PA as well as the CSM developed as part of the PA process are summarized in this worksheet. Additional details about Camp Smith can be found in the PA Report (AECOM, 2019).

Facility Location and Description

Camp Smith is in Cortlandt, Westchester County, New York (NY) (**Figure 10-1**). Camp Smith borders Putnam County to the north and the city of Peekskill to the east - southeast. The Hudson River lies west and south of Camp Smith. Camp Smith can be accessed directly from New York State (NYS) Route 6. Bear Mountain Bridge Road runs along the facility on the western and southern borders, and the US Military Academy at West Point is located across the Hudson River, approximately 10 miles north (NYSDMNA, 2018).

Camp Smith comprises roughly 1,600 acres of training property for the NYARNG. Approximately 94 percent of Camp Smith is rugged mountainous terrain, while the remaining 95 acre cantonment area consists of outdoor ranges, training simulation facilities, administrative buildings and a maintenance shop sitting on a plateau overlooking the Hudson River. Camp Smith has no air support facilities. Camp Smith is approximately 30 miles north of New York City and approximately 0.75 miles east of the Hudson River (NYSDMNA, 2018)

Facility Environmental Setting

Westchester County is a predominately suburban area largely consisting of rolling hills in the Hudson Valley region of New York. The terrain of the facility is consistent with the majority of Westchester County. The county has a total of 430.5 square miles (US Census, 2010). The nearest residential properties to the facility are along the northern property line. The Camp Smith trail head is approximately 0.5 miles to the west of the facility. Two miles to the west across the Hudson River lies Iona Island and the Iona Island Component Hudson River National Estuarine Research Reserve.

Geology

Camp Smith is east of the Hudson River, within the eastern geological region of the Hudson Highlands formation (NYARNG, 2015), a segment of the New England Uplands physiographic province. This region forms part of the Reading Prong, an extension of the Ridge and Valley province extending from Pennsylvania, through northern New Jersey and southern New York, and ending in Connecticut. The Hudson Highlands were formed as a result of periods of mountain building during Precambrian, Ordovician, and Devonian periods. These mountains were consequently scoured and leveled by glaciation events during the Pleistocene period.

Most of the 95 acre cantonment area lies in a shallow valley outwash plain. The majority of both the surface and underlying material of the northern section of Camp Smith are Pleistocene age unconsolidated glacial deposits, recent floodplain deposits, and lacustrine delta. These sediments consist of silts underlain by fine sands and gravels of variable thicknesses ranging between 40 to nearly 200 feet (Berkley et al., 1919; Isachsen et al., 2000). This overlies Precambrian bedrock consisting of hornblende gneiss, which comprises two-thirds of all rock found at Camp Smith.

A previous NYARNG subsurface investigation indicated that the southern portion of Camp Smith contains intermixed layers of unconsolidated sand, silt, and clay, with variable amounts of gravel and a variable layer of peat and organic clay (NYARNG, 2015). The majority of this southern portion is poorly drained Ipswich mucky peat (69.9 percent), well drained Riverhead loam (24.8 percent), and somewhat poorly drained Udorthents (1.4 percent).

On the southernmost boundary of Camp Smith, near the Hudson River, is exposed (or within 3 feet of surface) Precambrian bedrock, which travels north along the western boundary of the training facility (Eric et al., 1954; Klemic et al., 1959). Many of the drinking water wells in the Hudson Valley come from bedrock; however, they do not yield as much as unconsolidated sediments.

Hydrogeology

Based on the USEPA's map of Sole Source Aquifers, a sole source aquifer does not lie beneath Camp Smith. The New York State Department of Environmental Conservation's Map of Principal and Primary Aquifers in New York State indicates that a primary aquifer does not lie beneath the Camp Smith cantonment area. Unconsolidated aquifers make up over 60 acres of the 95 acre cantonment area. Infiltration of precipitation and runoff is the sole source of recharge for aquifers at Camp Smith (USGS, 1995).

Unconsolidated glacial deposits of thick sand and gravel underlie flood plains and terraces along tributaries to the Hudson River and occupy many valleys (Chazen, 2003), yielding the largest supply to wells in Westchester County. However, more than 70 percent of the drinking water wells in Westchester County are gneiss or schist bedrock wells with yields averaging 30 gallons per minute (gpm). If limestone is tapped, yields can range from 2 to as much as 450 gpm.

Groundwater in the Camp Smith cantonment area generally flows from north to south towards the Hudson River (**Figure 10-2**), or towards various creeks and surface water features, which run south to the Hudson River. Two potable wells in the cantonment area supply drinking water to Camp Smith: Wells A and B are the primary source for drinking water and are located on the edge of the wetlands area in the southern portion of Camp Smith (**Figure 10-2**). A water quality assessment for groundwater under the influence of surface water was performed at Camp Smith in 2008. The assessment concluded that groundwater at Camp Smith is not influenced by surface water (Ecology and Environment, 2008). Well A is 80 feet deep, with a screen installed between 65 and 80 feet below ground surface (bgs), and Well B is 100 feet deep, with a screen installed between 82 and 100 feet bgs (NYARNG, 2015). Groundwater was sampled at Wells A and B during four sampling events completed from April 2017 to February 2018. Groundwater concentrations were detected but were below the USEPA Health Advisories (HAs) for PFOA and PFOS. Borings from the wetland area in a previous NYARNG study indicate a thick organic clay confining unit, which separates surface water from the confined aquifer below. Wells A and B draw water from the confined aquifer. The extent of this clay layer is not known. It is possible that the clay layer thins out and is not present further up-gradient in the northern cantonment area. This would potentially allow upgradient surface water and groundwater to infiltrate the deeper aquifer, where groundwater is drawn from. One other potentially potable well at Camp Smith is used for lavatory purposes: there are no drinking water fountains connected to this potentially potable well.

Hydrology

Camp Smith is in the Lower Hudson River watershed, which is a part of the 13,300 square mile Hudson River basin. The main channel of the Hudson River spans nearly 1,000 feet of Camp Smith's western and southern boundaries and forms a deep gorge through the Hudson Highlands in this area (NYARNG, 2015). Surface water resources at Camp Smith include natural streams, rivers, and open water features. Several unnamed intermittent tributaries and numerous vernal pools and wetlands are scattered throughout the facility. All surface runoff from the Camp Smith eventually drains into the Hudson River.

Dickiebusch Lake is on the northeastern end of Camp Smith (**Figure 10-3**). Dickiebusch Lake covers approximately 6 acres and is connected to several streams, one of which is Putnam Brook. The headwaters of Putnam Brook flow into the northern-most portion of Dickiebusch Lake, which then drains south bordering Camp Smith on the west before draining into the Annsville Creek impoundment. Annsville Creek borders Camp Smith on the eastern side of the facility before turning southwest to border the southern portion.

The confluence of the Annsville Creek and Putnam Brook at the Annsville Creek impoundment is tidally influenced, as this impoundment is connected to the Hudson River (**Figure 10-3**). This small bay/impoundment/tidal wetland was artificially created by a railroad berm.

Climate

The climate at Camp Smith and the surrounding Westchester County is predominantly continental, with an average annual temperature of 52.45 degrees Fahrenheit (°F). Seasonally, temperatures vary from an average summer high of 61.2 °F, to average winter lows of 26 °F (NOAA, 2018). The annual average wind speed is 8.9 miles per hour (mph), although winter months can have gusts up to 35 mph. The total mean annual precipitation is 42.3 inches. July is the driest month, with an average of 2.91 inches of precipitation, while August is the wettest month, with 4.49 inches of precipitation. Short, intense thunderstorms are the major sources of summer precipitation. The average annual snowfall is 55 inches.

Current and Future Land Use

Camp Smith is a private facility with one access point through a guarded security gate off Route 202 that runs parallel to the Hudson River. The majority of the property is an NYARNG installation used for military training. Approximately 94 percent of Camp Smith is rugged mountainous terrain (NYSDMNA, 2018). The remaining 95 acres cantonment area consists of outdoor ranges, training simulation facilities, administrative buildings, and a maintenance shop sitting on a plateau overlooking the Hudson River (NYSDMNA, 2018). There are no current expansion plans for Camp Smith and, in general, the future use of the facility is not expected to change.

Summary of Potential Source Areas

The potential source areas identified in the PA (AECOM, 2019) including Fire Training Areas (FTAs), non-FTAs, and Emergency Response Areas are described below.

Fire Training Areas

Two FTAs were identified at Camp Smith during the PA. These locations are presented on **Figure 10-4**.

Former Fire Pit

The Former Fire Pit is on the northern end of the property, adjacent to Dickiebusch Lake (**Figure 10-4**) at geographic coordinates 41°18'36.96"N; 73°56'24.19"W. This area is approximately 184 feet long by 113 feet wide and is essentially a dirt expanse of sand and gravel on the eastern side of N. Camp Road.

During the VSI, a bare earthen patch was observed that appeared to have been smoothed and paved over multiple times in the past. Interviewees described it as a former live fire training exercise area that occurred with some frequency, possibly once per month; however, the presence or use of AFFF for these exercises could not be confirmed during the VSI or interviews with NYARNG personnel. The Former Fire Pit was the training ground for the Camp Smith fire fighters and emergency responders and was active between 1980 and 1996.

Former New York State Academy of Fire Science Annex

An interview with the Construction and Facilities Management Officer (CFMO) was performed at the NYARNG headquarters in Latham, NY (directly adjacent to the NYARNG Albany Army Aviation Support Facility). The CFMO stated that a "former NYS fire inspection agency" was formerly located on-post, located slightly northwest of the new Combined Support Maintenance Shop (CSMS) building, and was associated with a cluster of former buildings. The duration of occupancy of the buildings by the "former fire inspection agency" is unclear; however, historic aerials indicate that the buildings were built sometime between 1974 and 1984 and demolished sometime between October 2014 and April 2016.

Additional research after submission of the Final PA confirmed that the facility complex was the New York State Academy of Fire Science Annex (AFSA)[1]. Activities at the former NYS AFSA were described as including classroom training, fire services, forensics, and arson investigation. Because personnel with first-hand knowledge of training activities that occurred at the AFSA were not available for interviews during the PA, there are data gaps for this location. It is unknown if any of the training activities that occurred at the facility included fire training with AFFF or other firefighting foams. As such, PFAS may have been released at the former NYS AFSA and is thus a potential source area (**Figure 10-4**). The former NYS AFSA operated beginning in the late 1990's and ceased operation in September 2006.

Following demolition of the buildings in approximately 2014, nearly 8 feet of fill from the general area of the former NYS AFSA was removed and transported for use in the foundation of the new CSMS building. Because of this, potentially PFAS contaminated soil was spread from the source location to below the new CSMS building.

Non-Fire Training Areas

Three non-FTAs were identified at Camp Smith during the PA. These locations are presented on **Figure 10-5**.

Former Airfield

Located at the southeastern end of Dickiebusch Lake, geographic coordinates 41°18'31.19"N; 73°56'24.87"W, and approximately 2,500 feet in length running north to south, interviews during the VSI described an area referred to as the "former airfield" (**Figure 10-5**). Aerial photographs confirm a runway was constructed sometime after 1955, but before 1960, and was later removed in the late 1970s. The Camp Smith Maintenance Equipment Mechanic, working at Camp Smith since 1988, stated that the Former Airfield was possibly active during parts of the Korean and Viet Nam wars, but he is unaware of any incidents that occurred which required the use of AFFF.

Former Fire Station

Based on aerial photographs, the Former Fire Station was approximately 500 feet east of the southern end of the former airfield runway, geographic coordinates 41°18'10.01"N;

[1]The Final PA Report (AECOM, 2019) referred to this facility as the "Former NYS Fire Inspection Agency". The reference has been corrected throughout the SI QAPP and will also be reflected in the upcoming SI Report.

73°56'21.34"W, was active between 1980 and 1996. When operational, the interviewee stated that two trucks were parked inside the Former Fire Station: an old Chevy half-deuce water truck and an old Ford that was not operational. In its last few years of operation, there were only civilian hourly employees on-site during the weekends. The interviewee indicated he was not aware of any AFFF use or storage at Camp Smith. After 1996, the former fire station was torn down and replaced with a parking lot (**Figure 10-5**). The two trucks were given to the Continental Village Fire Department, the municipal fire department for Westchester County, which provides emergency services for all major incidents at Camp Smith.

Former Combined Support Maintenance Shop

The former CSMS building was adjacent to the Former Fire Station from approximately 1976 until a new building was finished in 2018 (**Figure 10-5**). The interviewee stated there were no documents confirming AFFF storage, discharge, or use in the former CSMS building. A 2009 NYARNG Camp Smith SOP mandated that firefighting equipment be stored on-site and ready for use during refueling activities, but no firefighting equipment was observed during the VSI. The SOP was unclear as to what type of firefighting equipment was required. The interviewee also indicated that the CSMS personnel were the first to respond to any minor fire-related incidents that occurred after 1996.

Emergency Response Areas

No instances of emergency response were identified at Camp Smith during the PA. The Camp Smith Maintenance Equipment Mechanic indicated that since 1996, firefighting support for major incidents has been provided by the Continental Village Fire Department, the municipal fire department of Westchester County, roughly 2.25 miles north of Camp Smith. The Combined Support Maintenance building mechanics respond on-site to all other minor fire related incidents. During VSI, the interviewee was not aware of any crashes that have occurred at Camp Smith.

Adjacent Sources

Information acquired during PA interviews (AECOM, 2019), the VSI, as well as data presented in the Environmental Data Resource (EDR) report all indicated that no adjacent off-facility sources of PFAS are located near Camp Smith.

Conceptual Site Model

Since the 1970s, PFAS have potentially been released to soil at several locations within the boundary of Camp Smith. Based on preliminary data and assumed groundwater flow directions, three different AOIs were identified. The AOIs have been established based on proximity of the potential source areas to one another and assumed groundwater flow direction. These AOIs are described below and presented on **Figure 10-6**.

- AOI 1 – Former Fire Pit. Groundwater is assumed to be flowing to south-southwest.
- AOI 2 – Former Fire Station: Represents two potential source areas (Former Fire Station and Former CSMS Building). Groundwater is assumed to be flowing south-southwest.
- AOI 3 – Former Airfield/Former NYS AFSA: Represents two potential source areas (Former Airfield and Former NYS AFSA). Groundwater is assumed to be flowing south-southwest.

The CSM identifies the three components necessary for a potentially complete exposure pathway: (1) source, (2) pathway, (3) receptor. If any of these elements are missing, the pathway is considered incomplete.

In general, the potential PFAS exposure pathways are ingestion and inhalation. Studies have shown that dermal contact is not to be considered a potential exposure pathway as PFAS absorption through skin is very limited (NGWA, 2018). Receptors at Camp Smith include site

workers, construction workers, recreational users, and trespassers. The CSM for Camp Smith indicates which specific receptors could potentially be exposed to PFAS.

NYARNG began quarterly sampling of drinking water at potable water wells on-facility, Wells A and B, located approximately 0.7 miles south of Dickiebusch Lake, in April 2017. Four rounds of samples were taken from the spigot and tap of buildings within 100 feet of Wells A and B. Since the initial sampling event, PFAS chemicals have consistently been detected in drinking water below the USEPA Drinking Water HA level of 70 parts per trillion (ppt), ranging between 3.47 and 49.9 ppt. No Drinking Water HA risk levels have been promulgated by the state of New York at the time of reporting.

AOI 1 – Former Fire Pit

AOI 1 includes the former fire pit training area and the eastern portion of Dickiebusch Lake. PFAS have consistently been detected downgradient in the drinking water wells (Wells A and B) located approximately 0.7 miles south of AOI 1. Potential PFAS releases to soil may have occurred during the monthly live fire training exercises; however, there are no documented reports of AFFF use during these training exercises.

The former training area is less than 100 feet from the eastern side of Dickiebusch Lake and is included in the AOI extent (**Figure 6-1**). Surface water runoff near the former pit drains into Dickiebusch Lake. The headwaters of Putnam Brook flow from Dickiebusch Lake and travel south, passing within 500 feet to the west of Wells A and B until finally discharging into the Hudson River. Potential PFAS releases at the western edge of the former pit may have flowed to the eastern portion of Dickiebusch Lake. PFAS are water soluble and can migrate readily from soil to groundwater or surface water via leaching and run-off. Because potential AFFF releases to surface soil and localized runoff systems may have occurred at AOI 1, it is possible that potential PFAS contamination has migrated from the soil at AOI 1 to these surface water bodies. Ground-disturbing activities to surface soil could result in site worker and construction worker exposure to potential PFAS contamination via inhalation of dust particles or ingestion of surface soil. Ground-disturbing activities to subsurface soil could also result in site worker and construction worker exposure via ingestion of subsurface soil. Therefore, the exposure pathways for these receptors are potentially complete.

A previous investigation (NYARNG, 2015) indicates that there may be a clay confining layer separating surface water from the deep water aquifer. The deep water aquifer is used at Camp Smith as a drinking water source (Wells A and B). This confining unit, acting as a natural aquitard may prevent the migration of potential PFAS contamination to the confined deep aquifer; however, the extent of the confining layer is unknown. Due to the groundwater detections of PFAS in Wells A and B, the close proximity to the AOI, and that Camp Smith obtains drinking water and wash water from these contaminated wells, the pathway for PFAS contamination in groundwater is potentially complete to site workers and construction workers on-facility, along with residents, trespassers and recreational users potentially ingesting drinking water that may have migrated downgradient off-facility. Annsville Creek is southeast, Putnam Brook is west, and the Hudson River is south of all AOIs. It is possible that PFAS contamination has migrated to these surface water bodies. PFAS are water soluble and can migrate readily from soil to groundwater or surface water via leaching and run-off. As such, potential AFFF releases may migrate to nearby surface water bodies.

Because drinking water wells are located downgradient of the AOI and recreational use of the surrounding surface water bodies is likely, the ingestion exposure pathway for groundwater, surface water, and sediment is considered potentially complete for off-post residents, trespassers and recreational users at AOI 1.

AOI 2 – Former Fire Station

AOI 2 includes the former Fire Station building and the former CSMS building. Potential AFFF releases to soil may have occurred during the storage of materials and the washing of firefighting equipment, although, it is unknown exactly what type of firefighting equipment was stored or if any AFFF was spilled.

The pathways and receptors are the same as those outlined for AOI 1.

AOI 3 – Former Airfield/ Former NYS AFSA

AOI 3 includes the former Airfield and the former NYS AFSA. Potential AFFF releases to soil may have occurred during active use of the Former Airfield or during training activities at the Former NYS AFSA, although it is unknown if AFFF was released at either location.

The pathways and receptors are the same as those outlined for AOI 1 and AOI 2.

QAPP Worksheet #11: Project/ Data Quality Objectives

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

The development of DQOs will follow the seven steps of USEPA's DQO process:

1. State the Problem

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 at both federal and state levels continues to evolve. The USEPA issued Drinking Water HAs for PFOA and PFOS in May 2016. In the absence of federal maximum contaminant levels, some states have adopted their own promulgated drinking water standards for PFAS. The state of New York currently uses the USEPA HAs for PFOA and PFOS.

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 FTAs, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use as possible source areas. In addition, metal plating operations, which used certain PFOS-containing mist suppressants, shall be considered possible source areas."
- "Based on a review of site records…determine whether a CERCLA PA is appropriate for identifying PFOS/PFOA release sites. If the PA determines a PFOS/PFOA release may have occurred, a CERCLA SI shall be conducted to determine presence/absence of contamination."
- "Identify sites where polyfluoroalkyl 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."

2. Identify the Goals of the Study

The goals of the SI include the following:

1) Determine the presence or absence of PFAS contamination at Camp Smith.
2) Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.

3) Determine the potential need for a TCRA. The primary actions that will be considered include provision of alternative water supplies or wellhead treatment.
4) Collect or develop data to evaluate the release
5) Collect data to better characterize the release for more effective and rapid initiation of an RI.
6) Identify, within 4 miles of the installation, other potential PFAS sources (fire stations, major manufacturers, other Department of Defense (DoD) facilities) and receptors including both groundwater and surface water receptors in order to determine whether the ARNG is the likely source of PFAS or whether there is an off-facility source of PFAS responsible for installation detections of PFAS (USEPA, 2005).

3. Identify Information Inputs

Primary information inputs include:

- PA for Camp Smith
- Analytical data collected during other environmental sampling efforts at Camp Smith
- Groundwater, surface water, soil and/or sediment sample data collected in accordance with this UFP-QAPP Addendum
- Field data collected including groundwater elevation and water quality parameters measured using a multi-parameter water quality meter

4. Define the Boundaries of the Study

The scope of the SI is bounded by the property limits of Camp Smith. 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 property owner(s).

5. Develop the Analytic Approach

All samples will be analyzed by a DoD Environmental Laboratory Accreditation Program and National Environmental Laboratory Accreditation Program certified laboratory (i.e., Gulf Coast Analytical Laboratories [GCAL]). Data will be compared to Project Screening Criteria (PSC) and decision rules as defined in the PQAPP will be applied. Decision rules have been developed for groundwater and soil that will apply to all data collected. These rules will govern response actions based on the results of the SI sampling effort.

The decision rules described in the tables at the end of this section (**Tables WS11-1** and **WS11-2**) identify actions based on the following:

Groundwater/Surface Water:

1.) Is there a human receptor within 4-miles of the facility?

2.) What is the concentration of PFAS constituents at the potential source area?

3.) What is the concentration of PFAS constituents at the boundary?

4.) What does the CSM suggest in terms of source, pathway and receptor?

Soil/Sediment:

1.) What is the concentration of PFAS constituents in shallow surface soil or sediment (0-2 feet below ground surface [bgs])?

2.) What is the concentration of PFAS constituents in deep soil (i.e., capillary fringe) (25-30 feet bgs)?

3.) What does the CSM suggest in terms of source, pathway and receptor?

Soil, groundwater, and sediment samples will be collected from each of the potential source areas identified in the PA. Based on previous investigations, groundwater is expected to be encountered at approximately 30 feet bgs. Groundwater sampling has been performed by NYARNG at Camp Smith, and PFAS were detected in groundwater at two wells (Well A and Well B). Proposed SI sample locations and depths are defined in **Worksheet #18**.

6. Specify Performance/Acceptance Criteria

See **QAPP Worksheet #37**.

7. Develop the Detailed Plan for Obtaining Data

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

Table WS11-1: Groundwater Decision Rules				
Scenario	**Data Location (source/ boundary)**	**PFAS Concentration Range**	**Response Action (Off-facility human receptor within 4 miles)**	**Response Action (No off-facility human receptor within 4 miles)**
Scenario 1	AOI 1-3	ND	No further action required during SI phase.	No further action required during SI phase.
	Boundary	ND		
Scenario 2	AOI 1-3	> ND (any positive detection)	1.) Assess CSM including: - Data reliability and bias - Migration via groundwater flow (i.e., groundwater flow towards potential receptors) - Flow to surface water bodies, drinking water intakes - Distance from boundary to receptor - Aquifer where drinking water well(s) are screened - Estimated timeframe of release(s) 2.) Identify sentinel well(s) on-facility close to a receptor, slated for future groundwater monitoring. 3.) If all PFAS detections in sentinel wells are below promulgated values: (a) Monitor existing sentinel wells to revalidate results or (b) Install additional sentinel wells at the facility boundary and collect an additional round of samples or (c) Collect samples between a potential source (e.g., municipal airport or fire station) and facility boundary. (d) Based on sampling results, ARNG to update CSM and determine if additional evaluation is needed. 4.) If PFAS detections in sentinel wells are above PSC: (a) Proceed to Scenario 3, Step 2.	1.) Assess CSM as described. 2.) ARNG to consider future investigation.
	Boundary	< PSC		

Table WS11-1: Groundwater Decision Rules				
Scenario	**Data Location (source/ boundary)**	**PFAS Concentration Range**	**Response Action (Off-facility human receptor within 4 miles)**	**Response Action (No off-facility human receptor within 4 miles)**
Scenario 3	AOIs 1-3	> ND (any positive detection)	1.) Assess CSM as described above and: - Potential off-facility alternative sources 2.) If the assessment of the CSM implies unacceptable risk to human health, initiate off-facility sampling protocol: (a) ARNG to notify ACSIM and Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health (DASA ESOH) with appropriate authorizing letter from The Adjutant General. (b) Request to sample private drinking water well(s) nearest to the facility boundary where the elevated concentration or exceedance(s) was observed. If access is not granted: (c) Request ROE to install a monitoring well adjacent to the residential property, screened in the same aquifer as the private drinking water well(s). 3.) If PFAS in off-facility samples are detected below the PSC: (a) Evaluate data for laboratory blank detections. If detection is not attributable to a laboratory blank detection, initiate a monitoring protocol at the private well. (b) Identify a 'sentinel well' on-facility close to a receptor, slated for future groundwater monitoring. 4.) If PFAS in off-facility samples are detected above the PSC: (a) Collect confirmation sample. (b) Initiate TCRA (i.e., provide alternative drinking water source to resident). 5.) Proceed to RI if: (1) If PSCs have been exceeded, (2) there is probable risk to human receptor and (3) ARNG is	1.) Assess CSM as described. 2.) ARNG to consider future investigation.
	Boundary	> PCS		

Table WS11-1: Groundwater Decision Rules				
Scenario	**Data Location (source/ boundary)**	**PFAS Concentration Range**	**Response Action (Off-facility human receptor within 4 miles)**	**Response Action (No off-facility human receptor within 4 miles)**
			likely the responsible party. Otherwise, ARNG to consider future monitoring and/or investigation.	
Scenario 4	AOIs 1-3	ND	1.) Assess potential off-facility sources	1.) Assess CSM as described.
	Boundary	> ND	2.) ARNG to consider future investigation	2.) ARNG to consider future investigation.

Notes:
ACSIM = Assistant Chief of Staff for Installation Management
AOI = area of interest
ARNG = Army National Guard
CSM = Conceptual Site Model
DASA ESOH = Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health
ND = non-detect
PSC = Project Screening Criteria
PFAS = per- and polyfluoroalkyl substances
SI = Site Inspection
RI = Remedial Investigation
ROE = Right of Entry
TCRA = Time Critical Removal Action

Table WS11-2: Soil Data Decision Rules			
Scenario	**Data Location (depth)**	**PFAS Concentration Range**	**Response Action**
Scenario 1	Surface/ Shallow	ND	No further action during SI Phase.
	Deep (capillary fringe)	ND	
Scenario 2	Surface/ Shallow	> ND (any positive detection)	1. Assess CSM including: - Potential for particulate runoff (i.e., transport via surface water) - Nearby receptors and land use at the source location (i.e., is anyone in direct contact?) - 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. ARNG to consider need for additional evaluation.
	Deep (capillary fringe)	ND	
Scenario 3	Surface/ Shallow	> PSC	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. ARNG to assess need for a potential action for the protection of human receptors.
	Deep (capillary fringe)	> PSC	

Notes:
ARNG = Army National Guard
CSM = Conceptual Site Model
ND = non-detect
PFAS = per- and polyfluoroalkyl substances
PSC = Project Screening Criteria
SI = Site Inspection

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Final PQAPP Worksheet #12: Measuring Performance Criteria

Matrix Groundwater & Surface Water
Analytical Group Per- and polyfluoroalkyl substances
Concentration Low

Sampling Procedure	Analytical Method/SOP	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)
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Precision/ Accuracy/Bias	LCS/LCSD shall be spiked with all analytes. Analyte recovery limits 70-130%, RPD<30%	LCS	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	±20% of the target ratio, which is the ion ratio in the midpoint of the calibration standard.	Ion ratio confirmation for all analytes excluding PFBA, PFPeA, and FOSA using 2nd SRM transition	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	50-150% recovery	Extraction Internal Standard	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	At least 5 points. After calibration, each point, except the lowest, should be back calculated and be within 70-130%.	Initial calibration standards	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Lab Contamination	No analytes detected > ½ LOQ or >1/10 the amount measured in any sample	Method Blank	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	MS/MSD shall be spiked with all analytes. Analyte recovery limits 70-130%. RPD<30	MS/MSD	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Sensitivity	Detection limits ≤ to acceptance criteria	Detection Limits	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Completeness	Completeness criteria will be considered met if 100% of all planned sample data (as requested on COC in lab reports and EDD; including requested reanalyses) are collected	Reported Sample Data	S & A

Matrix Groundwater & Surface Water
Analytical Group Per- and polyfluoroalkyl substances
Concentration Low

Sampling Procedure	Analytical Method/SOP	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)
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Comparability	Based on accuracy and media comparison	Use of standardized SOPs in field and laboratory	S & A

Groundwater and Surface Water Notes:
A= Analytical
COC = Chain of custody
EDD = Electronic data deliverable
EPA = Environmental Protection Agency
FOSA = Perfluorooctanesulfonamide
LCMS = Liquid chromatography/ mass spectrometry
LCS/LCSD = Laboratory Control Sample/ Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS/MSD = Matrix spike/ matrix spike duplicate
PFBA =Perfluorobutyrate
PFOA = perfluorooctanoic acid
PFPeA = Perfluoro-n-pentanoic acid
QSM = Quality Systems Manual
QC = Quality Control
RPD = Relative percent difference
S = Sampling
SOP = Standard operating procedure
SRM = Standard Reference Material

Matrix Drinking Water
Analytical Group Per- and polyfluoroalkyl substances
Concentration Low

Sampling Procedure	Analytical Method/SOP	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)
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Precision/ Accuracy/Bias	LCS/LCSD shall be spiked with all analytes. Analyte recovery limits 70-130%, RPD<30%	LCS	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	±20% of the target ratio, which is the ion ratio in the midpoint of the calibration standard.	Ion ratio confirmation for all analytes excluding PFBA, PFPeA, and FOSA using 2nd SRM transition	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	50-150% recovery	Extraction Internal Standard	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	At least 5 points. After calibration, each point, except the lowest, should be back calculated and be within 70-130%.	Initial calibration standards	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Lab Contamination	No analytes detected > ½ LOQ or >1/10 the amount measured in any sample	Method Blank	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	MS/MSD shall be spiked with all analytes. Analyte recovery limits 70-130%. RPD<30	MS/MSD	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Sensitivity	Detection limits ≤ to acceptance criteria	Detection Limits	A
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Completeness	Completeness criteria will be considered met if 100% of all planned sample data Presentation 100% completion of samples and analyses (as requested on COC in lab reports and EDD; including requested reanalyses) are collected	Reported Sample Data	S & A

Matrix Drinking Water
Analytical Group Per- and polyfluoroalkyl substances
Concentration Low

Sampling Procedure	Analytical Method/SOP	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)
Water sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Comparability	Based on accuracy and media comparison	Use of standardized SOPs in field and laboratory	S & A

Drinking Water Notes:
A= Analytical
COC = Chain of custody
EDD = Electronic data deliverable
EPA = Environmental Protection Agency
FOSA = Perfluorooctanesulfonamide
LCMS = Liquid chromatography/ mass spectrometry
LCS/LCSD = Laboratory Control Sample/ Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS/MSD = Matrix spike/ matrix spike duplicate
PFBA =Perfluorobutyrate
PFOA = perfluorooctanoic acid
PFPeA = Perfluoro-n-pentanoic acid
QSM = Quality Systems Manual
QC = Quality Control
RPD = Relative percent difference
S = Sampling
SOP = Standard operating procedure
SRM = Standard Reference Material

Matrix Soil/ Sediment
Analytical Group Per- and polyfluoroalkyl substances
Concentration Low

Sampling Procedure	Analytical Method/SOP	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)
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Precision/ Accuracy/Bias	LCS/LCSD shall be spiked with all analytes. Analyte recovery limits 70-130%, RPD<30%	LCS	A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	±20% of the target ratio, which is the ion ratio in the midpoint of the calibration standard.	Ion ratio confirmation for all analytes excluding PFBA, PFPeA, and FOSA using 2nd SRM transition	A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	50-150% recovery	Extraction Internal Standard	A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	At least 5 points. After calibration, each point, except the lowest, should be back calculated and be within 70-130%.	Initial calibration standards	A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Lab Contamination	No analytes detected > ½ LOQ or >1/10 the amount measured in any sample	Method Blank	A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Accuracy/Bias	MS/MSD shall be spiked with all analytes. Analyte recovery limits 70-130%, RPD<30	MS/MSD	A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Sensitivity	Detection limits ≤ acceptance criteria	Detection Limits	A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Completeness	Completeness criteria will be considered met if 100% of all planned sample data (as requested on COC in lab reports and EDD; including requested reanalyses) are collected	Reported Sample Data	S & A
Soil/Sediment sampling	EPA 537 Modified, QSM 5.1 Table B-15/ LCMS-011	Comparability	Based on accuracy and media comparison	Use of standardized SOPs in field and laboratory	S & A

Soil/Sediment Notes:
A= Analytical
COC = Chain of custody
EDD = Electronic data deliverable
EPA = Environmental Protection Agency
FOSA = Perfluorooctanesulfonamide
LCMS = Liquid chromatography/ mass spectrometry
LCS/LCSD = Laboratory Control Sample/ Laboratory Control Sample Duplicate

LOQ = Limit of Quantitation
MS/MSD = Matrix spike/ matrix spike duplicate
PFBA =Perfluorobutyrate
PFOA = perfluorooctanoic acid
PFPeA = Perfluoro-n-pentanoic acid
QSM = Quality Systems Manual
QC = Quality Control
RPD = Relative percent difference
S = Sampling
SOP = Standard operating procedure
SRM = Standard Reference Material

Final PQAPP Worksheet #13: Secondary Data Uses and Limitations

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

Data Type	Source	Data Uses Relative to Current Project	Factors Affecting Reliability of Data and Limitations on Data Use
Meteorological	National Weather Service	Estimates of seasonal fluctuations in precipitation.	Meteorological data is generally for a regional area. Actual site conditions may vary.
Topographic	United States Geological Survey	Inferred groundwater flow pathways based on local topography at each site. All 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.

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

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

Task	Start Date	End Date
Pre-mobilization	July 2019	August 2019
Mobilization	September 2019	October 2019
Field Work	September 2019	October 2019
Demobilization	October 2019	October 2019
Data Review/ Validation	November 2019	December 2019
Reporting	December 2019	January 2020

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

Matrix: Aqueous
Analyte Group: Per- and polyfluoroalkyl substances EPA Method 537 Modified, QSM 5.1 Table B-15

Analyte	CAS Number	Laboratory Control Spike Lower Control Limit (%)	Laboratory Control Spike Upper Control Limit (%)	Achievable Laboratory Limits		
				DL (ng/L)	LOD (ng/L)	LOQ (ng/L)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	70	130	1.70	4.0	2
Perfluoroheptanoic acid (PFHpA)	375-85-9	70	130	1.85	4.0	2
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	70	130	1.64	4.0	2
Perfluorononanoic acid (PFNA)	375-95-1	70	130	1.68	4.0	2
Perfluorooctanoic acid (PFOA)	335-67-1	70	130	1.80	4.0	2
Perfluorobutanesulfonic acid (PFBS)	375-73-5	70	130	1.47	4.0	2
Perfluorobutanoic acid (PFBA)	375-22-4	70	130	2.13	4.0	2
Perfluoropentanoic acid (PFPA)	2706-90-3	70	130	2.35	4.0	2
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	70	130	5.38	8.0	2
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	70	130	4.60	8.0	2
Perfluorodecanoic acid (PFDA)	335-76-2	70	130	1.65	4.0	2
Perfluorotetradecanoic acid (PFTA)	376-06-7	70	130	2.76	4.0	2
Perfluorododecanoic acid (PFDoA)	307-55-1	70	130	2.45	4.0	2
Perfluorohexanoic acid (PFHxA)	307-24-4	70	130	1.94	4.0	2
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	70	130	2.56	4.0	2
Perfluoroundecanoic acid (PFUnA)	2058-94-8	70	130	1.86	4.0	2
6:2 Fluorotelomer sulfonate (6:2 FTS)	27619-97-2	70	130	1.79	4.0	2
8:2 Fluorotelomer sulfonate (8:2 FTS)	39108-34-4	70	130	1.63	4.0	2

CAS = Chemical Abstracts Service
DL= Detection Limit
EPA = Environmental Protection Agency
LOD = Limit of Detection
LOQ = Limit of Quantitation
ng/L = nanograms per liter
QSM =Quality Systems Manual

Matrix: Soil/ Sediment
Analyte Group: Per- and polyfluoroalkyl substances EPA Method 537 Modified, QSM 5.1 Table B-15

Analyte	CAS Number	Laboratory Control Spike Lower Control Limit (%)	Laboratory Control Spike Upper Control Limit (%)	Achievable Laboratory Limits		
				DL (µg/kg)	LOD (µg/kg)	LOQ (µg/kg)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	70	130	0.094	0.40	1.0
Perfluoroheptanoic acid (PFHpA)	375-85-9	70	130	0.096	0.40	1.0
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	70	130	0.080	0.40	1.0
Perfluorononanoic acid (PFNA)	375-95-1	70	130	0.091	0.40	1.0
Perfluorooctanoic acid (PFOA)	335-67-1	70	130	0.089	0.40	1.0
Perfluorobutanesulfonic acid (PFBS)	375-73-5	70	130	0.092	0.40	1.0
Perfluorobutanoic acid (PFBA)	375-22-4	70	130	0.114	0.40	1.0
Perfluoropentanoic acid (PFPA)	2706-90-3	70	130	0.149	0.40	1.0
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	70	130	0.145	0.40	1.0
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	70	130	0.116	0.40	1.0
Perfluorodecanoic acid (PFDA)	335-76-2	70	130	0.095	0.40	1.0
Perfluorotetradecanoic acid (PFTA)	376-06-7	70	130	0.118	0.40	1.0
Perfluorododecanoic acid (PFDoA)	307-55-1	70	130	0.099	0.40	1.0
Perfluorohexanoic acid (PFHxA)	307-24-4	70	130	0.110	0.40	1.0
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	70	130	0.104	0.40	1.0
Perfluoroundecanoic acid (PFUnA)	2058-94-8	70	130	0.097	0.40	1.0
6:2 Fluorotelomer sulfonate (6:2 FTS)	27619-97-2	70	130	0.196	0.40	1.0
8:2 Fluorotelomer sulfonate (8:2 FTS)	39108-34-4	70	130	0.092	0.40	1.0

CAS = Chemical Abstracts Service
DL= Detection Limit
EPA = Environmental Protection Agency
LOD = Limit of Detection
LOQ = Limit of Quantitation
µg/kg = micrograms per kilogram
QSM =Quality Systems Manual

Matrix: Soil
Analyte Group: Wet Chemistry

Analyte	Method	PSC (mg/kg)	PSC Reference	Laboratory Control Spike Lower Control Limit (%)	Laboratory Control Spike Upper Control Limit (%)	Achievable Laboratory Limits		
						DL (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
Total Organic Carbon	9060A	NA	NA	90	110	150	200	250
pH	150.1	NA	NA	90	110	NA	NA	NA

DL= Detection Limit
LOD = Limit of Detection
LOQ = Limit of Quantitation
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
NA = Not applicable
pH = Potential of hydrogen
PSC = Project Screening Criteria

Groundwater Project Screening Criteria

Analyte	CAS Number	USEPA PSC (ng/L)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	70[a]
Perfluoroheptanoic acid (PFHpA)	375-85-9	-
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	-
Perfluorononanoic acid (PFNA)	375-95-1	-
Perfluorooctanoic acid (PFOA)	335-67-1	70[a]
Perfluorobutanesulfonic acid (PFBS)	375-73-5	400,000[b]
Perfluorobutanoic acid (PFBA)	375-22-4	-
Perfluoropentanoic acid (PFPA)	2706-90-3	-
N-ethyl perfluorooctanesulfonamidoacetic acid	2991-50-6	-
N-methyl perfluorooctanesulfonamidoacetic acid	2355-31-9	-
Perfluorodecanoic acid (PFDA)	335-76-2	-
Perfluorotetradecanoic acid (PFTA)	376-06-7	-
Perfluorododecanoic acid (PFDoA)	307-55-1	-
Perfluorohexanoic acid (PFHxA)	307-24-4	-
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	-
Perfluoroundecanoic acid (PFUnA)	2058-94-8	-
6:2 Fluorotelomer sulfonate (6:2 FTS)	27619-97-2	-
8:2 Fluorotelomer sulfonate (8:2 FTS)	39108-34-4	-

Groundwater PSC Notes:

a.) United States Environmental Protection Agency (EPA). 2016. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOS). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-004. May 2016. / EPA. 2016. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-005. May 2016.

b.) Regional Screening Levels (RSL) for PFBS as presented in the USEPA RSL Summary Table (TR=1E-06, HQ=1) November 2014 through May 2019.

CAS = Chemical Abstracts Service
ng/L = nanograms per liter
PSC = Project Screening Criteria
USEPA = United States Environmental Protection Agency

Soil Impact to Groundwater: Project Screening Criteria (PSC)

Analyte	CAS Number	USEPA RSL (µg/kg)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.378[a]
Perfluoroheptanoic acid (PFHpA)	375-85-9	--
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	--
Perfluorononanoic acid (PFNA)	375-95-1	--
Perfluorooctanoic acid (PFOA)	335-67-1	0.172[a]
Perfluorobutanesulfonic acid (PFBS)	375-73-5	130[a]
Perfluorobutanoic acid (PFBA)	375-22-4	--
Perfluoropentanoic acid (PFPA)	2706-90-3	--
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	--
-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	--
Perfluorodecanoic acid (PFDA)	335-76-2	--
Perfluorotetradecanoic acid (PFTA)	376-06-7	--
Perfluorododecanoic acid (PFDoA)	307-55-1	--
Perfluorohexanoic acid (PFHxA)	307-24-4	--
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	--
Perfluoroundecanoic acid (PFUnA)	2058-94-8	--
6:2 Fluorotelomer sulfonate (6:2 FTS)	27619-97-2	--
8:2 Fluorotelomer sulfonate (8:2 FTS)	39108-34-4	--

Soil Impact to Groundwater PSC Notes:

a.) Regional Screening Levels (RSL) for PFBS as presented in the USEPA RSL Summary Table (TR=1E-06, HQ=1) November 2014 through May 2019. As of June 2018, values for PFOA and PFOS calculated by the EPA RSL calculator using EPA OW RfDs, HQ of 1, and residential exposure assumptions.

CAS = Chemical Abstracts Service
PSC = Project Screening Criteria
RSL = Regional Screening Level
µg/kg = micrograms per kilogram
USEPA = United States Environmental Protection Agency.

Soil: Human Health Screening Levels/ Project Screening Criteria (PSC)

Analyte	CAS Number	USEPA RSL (µg/kg)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	1,260[a]
Perfluoroheptanoic acid (PFHpA)	375-85-9	--
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	--
Perfluorononanoic acid (PFNA)	375-95-1	--
Perfluorooctanoic acid (PFOA)	335-67-1	1,260[a]
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,260,000[a]
Perfluorobutanoic acid (PFBA)	375-22-4	--
Perfluoropentanoic acid (PFPA)	2706-90-3	--
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	--
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	--
Perfluorodecanoic acid (PFDA)	335-76-2	--
Perfluorotetradecanoic acid (PFTA)	376-06-7	--
Perfluorododecanoic acid (PFDoA)	307-55-1	--
Perfluorohexanoic acid (PFHxA)	307-24-4	--
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	--
Perfluoroundecanoic acid (PFUnA)	2058-94-8	--
6:2 Fluorotelomer sulfonate (6:2 FTS)	27619-97-2	--
8:2 Fluorotelomer sulfonate (8:2 FTS)	39108-34-4	--

Human Health Screening Levels PSC Notes:
a. USEPA. 2019, RSLs calculated using the RSL Calculator (May 2019) (TR=1E-06, HQ=1).

CAS = Chemical Abstracts Service
PSC = Project Screening Criteria
RSL = Regional Screening Level
µg/kg = micrograms per kilogram
USEPA = United States Environmental Protection Agency

QAPP Worksheet #17: Sampling Design and Rationale

Worksheet #17a-h describes the sampling design, basis for its selection, and field investigation details. Filed activities will be completed per the SOPs in PQAPP **Appendix C**.

The objectives for the SI are to determine presence or absence of PFAS in soil, groundwater, surface water, or sediment (if present) at each AOI and assess if PFAS constituents are migrating off-facility by sampling relevant media at the boundary.

The potential source areas were divided into three AOIs **(Figure 10-6**) in the PA. The AOIs were established based on proximity of the potential source areas to one another and assumed groundwater flow direction.

- AOI 1 – Former Fire Pit: Groundwater is assumed to be flowing to south-southwest.
- AOI 2 – Former Fire Station: Represents two potential source areas (Former Fire Station and Former CSMS Building). Groundwater is assumed to be flowing south-southwest.
- AOI 3 – Former Airfield/Former NYS AFSA: Represents two potential source areas (Former Airfield and Former NYS AFSA. Groundwater is assumed to be flowing south-southwest.

The investigation will be conducted as described below:

Soil and groundwater samples will be collected at each AOI identified in the PA report and surface water and sediment from several runs. The media sample descriptions for the three AOIs are listed below and presented on **Figures 17-1** through **17-4**. The wells will be divided amongst the various potential source areas where PFAS were potentially released, upgradient of the potential source areas to assess if PFAS may be coming from upgradient sources and downgradient of the potential source areas. One round of groundwater samples will be collected from the newly installed monitoring wells.

Table 17-1: Site Inspection Sample Count

AOI	Potential Source Area	# of Boring Locations	Approximate Depth (feet bgs)	Groundwater Samples	Soil Samples	Surface Water /Sediment
1	Former Fire Pit	3	25 to 40	3	9	4
2	Former Fire Station Former CSMS Building	1	25 to 40	1	3	1
3	Former Airfield / Former NYS AFSA	2	25 to 40	2	6	0
		Total (not including QC)		**6**	**18**	**5**

Notes:
# = number
AOI = Area of Interest
bgs = below ground surface
N/A = Not Applicable
QC = quality control
TBD = to be determined

Sampling Tasks

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

- **Worksheet #17a**- Mobilization
- **Worksheet #17b**- Direct Push Boring Installation and Soil Sampling
- **Worksheet #17c**- Temporary Groundwater Monitoring Well Installation and Grab Groundwater Samples
- **Worksheet #17d**- Surface Water and Sediment Sampling
- **Worksheet #17e**- Water Level Measurements
- **Worksheet #17f**- Geographic Position Measurements
- **Worksheet #17g**- Investigation-Derived Waste Management

QAPP Worksheet #17a
Sampling Design and Rationale
Mobilization

Site Preparation

The site preparation activities for the SI field investigation operations include mobilization of field team personnel and equipment. No vegetation clearance is planned during field investigation activities. Traffic control measures may be required to complete investigations near some AOIs to ensure compliance with facility requirements.

PFAS Site Water Supply Sampling and Sampling Equipment Acceptability

A sample from the potable water source at Camp Smith was collected prior to mobilization to confirm if it was PFAS-free for use during field activities. The water was not PFAS- free, therefore, totes of water will be brought onsite from another source determined to be PFAS-free and will be used for all field activities

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 PQAPP **Appendix C**, **Table 1**. As an additional layer of control, prior to the start of field work each day, a PFAS Sampling Checklist will be completed (PQAPP **Appendix C**, **Table 2**). The check list will serve as a reminder to each field team member regarding the allowable materials within the sampling environment. An example of the checklist is provided below.

Example PFAS Daily Sampling Checklist

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

Personnel Qualifications

All personnel mobilized to the 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) (**Appendix A**). Additionally, all AECOM employees that will be performing field work will take an internal PFAS sampling guidance training.

Permits and Notifications

Utility clearance will be conducted by NYARNG with input from the AECOM field team. AECOM or its drilling subcontractor will contact "Dig Safely NY" (1-800-962-7962), the local one-call utility location system. AECOM will also contact the Camp Smith Environmental Manager at least five business days prior to the scheduled start of the field activities. A site walk will be scheduled with the appropriate ARNG personnel to mark out locations of the subsurface utilities. As a precaution, the first five feet of each boring will be advanced using air knifing methods. All field work will be coordinated with the ARNG Environmental Manager and/or his/her designee.

Health and Safety Requirements

Health and safety requirements for SI field activities are provided in the APP (**Appendix A**). Field personnel will wear PFAS-free Level D personal protective equipment. Detailed job 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.

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

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

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

Soil samples will be collected via direct-push technology (DPT) (SOP 3-17). A GeoProbe® DT45 or DT60 dual-tube sampling system (or equivalent) will be used to collect continuous soil cores to the target depth. DPT will be used to collect one surface soil (0.5-1 feet depth), one subsurface soil sample approximately 1 foot above the groundwater table, and one subsurface soil sample at the mid-point between the surface and the groundwater table. If refusal is encountered before the desired depth of sample location, additional attempts will be made adjacent to the original location to collect a soil sample at the desired depth. All drilling materials will be PFAS-free. The proposed sample locations are shown on **Figure 17-1** and **Figure 17-2** and described in **Worksheet #18**. The target depths for the borings are provided in the table below.

Table 17-2: Target Depths for Soil Borings

Area of Interest	Number of Borings	Target Depth (feet bgs)
AOI 1	3	30
AOI 2	1	30
AOI 3	2	30

Notes:
bgs = below ground surface

The soil cores will be continuously logged for lithological descriptions by a field geologist using the Unified Soil Classification System (USCS) per SOP 3-20. A photo ionization 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. If permitted by ARNG, 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 clay layer is observed in a boring with a thickness in excess of three feet, boring activities will be terminated in order to avoid completely penetrating a competent clay layer.

DPT borings will be abandoned using bentonite chips at completion of sampling activities unless they are being converted into monitoring wells. Borings in grass will be abandoned by backfilling with bentonite chips. It is anticipated that all borings will be installed in the grass; however, if they are required in asphalt, they will be abandoned by backfilling with bentonite chips to approximately 6 inches bgs, and the remainder of the borehole will be patched with asphalt cold patch. Borings into concrete are to be avoided if possible to minimize foreign object debris, which can severely damage aircraft. However, if borings are advanced into concrete, the borings will be restored similar to those in asphalt except that concrete will be placed in the borehole to provide as flush a surface as possible.

Field duplicate samples will be collected at a rate of 10 percent and analyzed for the same parameters as the accompanying samples. Matrix spike and matrix spike duplicates (MS/MSDs) will be collected at the rate of 5 percent and analyzed for the same parameters as the accompanying samples. Field Reagent Blanks (FRBs) will accompany each cooler containing samples for PFAS analysis and will be analyzed for select PFAS. Equipment blanks will not be prepared or analyzed unless a deviation from this plan requires sample handling using non-

dedicated equipment. If non-dedicated sampling equipment is used, equipment blank(s) will be collected at a rate of 1 per 20 samples and will be analyzed for the same analytes as the groundwater samples. A temperature blank shall be placed in each cooler to ensure that samples are preserved at or below four 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 (EPA Method 537 Modified. Selected samples will be sampled for total organic carbon (TOC) (EPA Method 9060A) and potential of hydrogen (pH) (EPA Method 9045D) based on the discretion of the field geologist; however, at least one will be sampled from each AOI. All sample containers will be PFAS free. The laboratory method detection limits (DLs) for these analytes are presented in **PQAPP Worksheet #15**. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard chain-of-custody procedures to the laboratory (See SOP 3-04).

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

Boreholes for temporary wells will be created using a GeoProbe® DT45 or DT60 dual-tube sampling system (or equivalent). 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. Groundwater samples will be collected in accordance with low-flow sampling protocols using a peristaltic pump with tubing that has been determined to be PFAS free (i.e. high-density polyethylene [HDPE] or other PFAS free material). If the peristaltic pump cannot generate enough hydraulic lift to bring the groundwater to the surface, groundwater samples will be collected using PFAS free 0.85 inch Geotech Bladder pump.

The target depth is specified for each AOI is described in **Table 17-3** below:

Table 17-3: Proposed Screen Interval by Area of Interest

Area of Interest	# Temporary wells	Target Screen Interval (feet bgs)
AOI 1	3	25 to 30
AOI 2	1	25 to 30
AOI 3	2	25 to 30

Notes:
bgs = below ground surface

The temporary well will be allowed to recharge after installation. The well will be purged at a rate determined by the estimated recharge rate into the well in order to reduce turbidity in the groundwater prior to sampling.

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) will be measured and recorded on the field sampling form after the grab sample has been collected. Water quality parameters will be measured using a water quality meter and flow-through cell. See SOP 3-14: Monitoring Well Sampling and SOP 3-24: Water Quality Parameter Testing for more details.

Each sample will be collected into laboratory-supplied bottleware and submitted to the laboratory for analysis of selected parameters (EPA Method 537 Compliant with Quality Systems Manual (QSM) 5.1 Table B-15). All sample containers will be PFAS free. The laboratory method DLs for these analytes are presented in **PQAPP Worksheet #15**. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard chain-of-custody procedures to the laboratory (See SOP 3-04).

Temporary wells in grass will be abandoned by removing the PVC pipe and backfilling the hole with bentonite chips. It is anticipated that all wells will be installed in the grass; however, if they are required in asphalt, they will be abandoned by backfilling with bentonite chips to approximately 6 inches bgs and the remainder will be patched with asphalt cold patch.

QAPP Worksheet #17d
Sampling Design and Rationale
Surface Water and Sediment Sampling

Surface water and sediment samples (See SOP 3-10 and 3-22; respectively) will be collected from north and south of Dickiebusch Lake and along Putnam Brook.

Surface water and sediment sampling in streams will be initiated at the most downstream end while moving upstream to the next sample location. Sediment samples will be co-located with surface water samples. The surface water sample will be collected prior to the collection of the sediment sample. A surface water grab sample will be collected from a single point in the waterbody using a dip sampler, approximately two-thirds up from the bottom of the water body. Sampling will be performed deliberately and methodically to minimize disturbance of bottom sediments and as quickly as possible to ensure a representative sample is collected. The surface water sample will be transferred to appropriate sampling container. A sediment coring device will be used to collect the sediment sample from the first one foot of sediment. The sediment will be transferred to a stainless steel bowl where stones in excess of 1 centimeter will be removed. The ArcGIS Collector application will be used to collect Global Positioning System (GPS) coordinates for the sample location.

General water quality parameters will be collected at each sampling location (i.e., temperature, pH, conductivity, DO and Oxidative Reduction Potential [ORP]) with a water quality meter. The surface water dipper, sediment coring device, and water quality probe will be stainless steel or another PFAS-free material.

Each surface water and sediment sample will be collected into laboratory-supplied bottleware and submitted to the laboratory for analysis of selected parameters (EPA Method 537 Compliant with QSM 5.1 **Table B-15**). All sample containers will be PFAS free. The laboratory method DLs for these analytes are presented in **PQAPP Worksheet #15**. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard chain-of-custody procedures to the laboratory (See SOP 3-03 and SOP 3-04).

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

Groundwater levels will be used to determine site-wide groundwater elevations and assess groundwater flow. Water level elevation measurements will be collected from all newly installed temporary monitoring wells. Before groundwater sampling, the water level measurement will be taken from the northern side of the PVC temporary well casing.

QAPP Worksheet #17f
Sampling Design and Rationale
Geographic Position Measurement

Latitude, longitude, and ground surface elevation measurements will be taken at all sampling locations using a high-accuracy Global Navigation Satellite System, such as a handheld Trimble® unit.

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

Currently, the disposal of PFAS investigation derived waste (IDW) is not regulated. PFAS IDW is considered a non-hazardous waste and will be managed in accordance with USEPA, *Management of Investigation Derived Waste* (2014), ARNG guidance, and applicable state regulations, such as the NYSDEC Division of Environmental Remediation *Technical Guidance for Site Investigation and Remediation*.

Non-hazardous solid IDW (i.e., soil cuttings) generated during SI activities that appear to be non-contaminated (e.g. no visual or olfactory evidence of contamination, no elevated readings on the PID) will be left in place at the point of the source. The soil cuttings will be distributed evenly around the borehole, or if it is a temporary well or/and borehole location, placed back in the borehole after sample collection. This IDW will not be sampled and will assume the PFAS characteristics of the associated soil samples collected from that source location. Excess drill cuttings and drill cuttings/spoil that appear to be contaminated shall be containerized for off-site disposal at a properly permitted treatment, storage or disposal facility. Further coordination with the NYSDEC will take place to ensure proper disposal is in accordance with Section 6 New York Codes, Rules, and Regulations (NYCRR) Part 364.

Soil IDW generated near high traffic areas, aprons, flightlines, or highly visible landscaped areas will be containerized in properly labeled 55-gallon drums (See SOP 3-05). The IDW will be stored within the fenced boundary of Camp Smith at a location designated by NYARNG. AECOM will coordinate with ARNG for waste profiling, transportation, and disposal of the solid IDW.

Liquid IDW (e.g., well development/purge water and decontamination fluids) shall be containerized and placed into properly labeled 55-gallon drums that will be temporarily stored on the facility at a location designated by NYARNG until the laboratory analytical results for groundwater are available (See SOP 3-05). In the event that elevated levels of contaminants are encountered in the groundwater, the liquid IDW shall be disposed off-site at a properly permitted treatment, storage, or disposal facility. Water to be sent off-site for disposal shall be done so in a timely manner and transported by a hauler licensed in accordance with 6 NYCRR Part 364. If groundwater contamination is not detected, the well development/purge water may be discharged onto the ground surface at the site slightly downgradient from the point of origin, pending NYSDEC review and approval. . AECOM will coordinate with ARNG and NYSDEC for waste profiling, transportation, and disposal of the liquid IDW.

In addition to leaving the soil and liquid IDW at the source of generation, AECOM will collect GPS points around (i.e., polygon) the location of where the IDW was placed. The polygon will be included in the reporting phase for future use, if required.

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

QAPP Worksheet #18: Sampling Locations and Methods

The table below describes the samples that will be collected during the Camp Smith SI. Note: Sampling SOPs can be found in Appendix C of the PQAPP.

Phase 1						
AOI	**Sample Identifier**	**Matrix**	**Depth (feet bgs)**	**Type (Sampling Tool)**	**Analyte/ Analytical Group**	**Sampling SOP**
1	AOI1-SB1-[Depth] AOI1-SB2-[Depth] AOI1-SB3-[Depth]	Soil	0-2 ft bgs, mid-point, above groundwater table	Geoprobe Dual-tube Sampling System	PFAS (EPA Method 537 Compliant with QSM 5.1 Table B-15) TOC (Method 9060A) pH (Method 9045D)	3-21
2	AOI2-SB1-[Depth]	Soil	See Above	See Above	PFAS (EPA Method 537 Compliant with QSM 5.1 Table B-15)	3-21
3	AOI3-SB1-[Depth] AOI3-SB2-[Depth]	Soil	See Above	See Above	PFAS (EPA Method 537 Compliant with QSM 5.1 Table B-15)	3-21
All	CS-SD01-[Depth] CS-SD02-[Depth] CS-SD03-[Depth] CS-SD04-[Depth] CS-SD05-[Depth]	Sediment	0-1 ft bgs	Sediment Coring Device	PFAS (EPA Method 537 Compliant with QSM 5.1 Table B-15)	3-22
1	AOI1-GW1 AOI1-GW2 AOI1-GW3	Groundwater	Mid-screen	Peristaltic Pump	PFAS (EPA Method 537 Compliant with QSM 5.1 Table B-15)	3-14
2	AOI2-GW1	Groundwater	Mid-screen	See Above	See Above	3-14

Phase 1						
AOI	**Sample Identifier**	**Matrix**	**Depth (feet bgs)**	**Type (Sampling Tool)**	**Analyte/ Analytical Group**	**Sampling SOP**
3	AOI3-GW1 AOI3-GW2	Groundwater	Mid-screen	See Above	See Above	3-14
All	CS-SW01 CS-SW02 CS-SW03 CS-SW04 CS-SW05	Surface Water	Two-thirds from bottom of surface water body	Dip Sampler	See Above	3-10

Notes:
AOI = Area of Interest
bgs = below ground surface
CS = Camp Smith
EPA = Environmental Protection Agency
GW = groundwater
MW = monitoring well
PFAS= Per-and polyfluoroalkyl substances
QSM =Quality Systems Manual
SB = soil boring
SD = sediment
SW = surface water
SOP = Standard Operating Procedure
TBD = to be determined
TOC = Total Organic Carbon

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

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

Analyte/ Analyte Group	Matrix	Method/SOP	Accreditation Expiration Date	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
PFAS	Aqueous	EPA 537 Modified, QSM 5.1 Table B-15/ SOP LCMS-011	ELAP-12/31/2018 NELAP-6/30/2018	HDPE w/ HDPE screw cap 2 x 250mL	Cool, 0-6°C	14 days from collection to extraction	28 days from extraction to analysis	28 days
PFAS	Drinking Water	EPA 537 Modified, QSM 5.1 Table B-15/ SOP LCMS-011	ELAP-12/31/2018 NELAP-6/30/2018	HDPE w/ HDPE screw cap 2 x 250mL	Cool, 0-6°C; Trizma	14 days from collection to extraction	28 days from extraction to analysis	28 days
PFAS	Solid	EPA 537 Modified, QSM 5.1 Table B-15/ SOP LCMS-011	ELAP-12/31/2018 NELAP-6/30/2018	HDPE w/ HDPE screw cap 2 x 125 mL	Cool, 0-6°C	14 days from collection to extraction	28 days from extraction to analysis	28 days
Total Organic Carbon	Solid	EPA 9060A, SM 5310 B-2011/WL-057	ELAP: 12/31/2018 NELAP: 6/30/2018	Polyethylene, Glass 1x2oz	Cool, 0-6ºC,	30 days to extraction	7 days from extraction to analysis	28 days
pH	Solid	EPA 9045D/EXT-032	ELAP-12/31/2018 NELAP-6/30/2018	Polyethylene, Glass 1x2oz	None	NA	Immediate	28 days

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

°C = Degrees Celsius
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
EPA = Environmental Protection Agency
GCAL = Gulf Coast Analytical
HDPE = High-density polyethylene
LCMS = Liquid chromatography/ mass spectrometry
mL = milliliter
NA = Not Applicable
NELAP = National Environmental Laboratory Accreditation Program
oz = ounce
PFAS= per- and polyfluoroalkyl substances
pH = potential of hydrogen
QAPP = Quality Assurance Plan
QSM = Quality Systems Manual
SOP = Standard Operating Procedure

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Final PQAPP Worksheet #20: Field QC Summary

Matrix	Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Reagent Blanks	Equipment Blanks	Field Trip Blanks	Total # Analyses
Groundwater	PFAS	6	1	1	1	1	1	1	12
Surface Water	PFAS	5	1	1	1	1	1	1	11
Soil	PFAS	18	2	1	1	1	1	1	25
Sediment	PFAS	5	1	1	1	1	1	1	11

Notes:
*Applies only if use of non-dedicated sampling equipment is necessary

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

Matrix Spike/Matrix Spike Duplicate	PFAS, TOC	One per 20 field samples[1]	Bias/Accuracy/Precision (lab)	RPD ≤ 30%; Refer to Worksheet #28 for recovery criteria
Reagent Blank	PFAS	One per sampling event[3]	Accuracy/ Bias	No target analytes ≥ ½ LOQ, unless target analytes in field samples are > 10x those in rinsate blank
Equipment Rinsate Blank	PFAS, TOC	One per 20 field samples per type of reusable equipment used[2]	Accuracy/ Bias	No target analytes ≥ ½ LOQ, unless target analytes in field samples are > 10x those in rinsate blank
Cooler Temperature Blank	PFAS	One per cooler	Representativeness	Temperature must be above freezing and ≤ 6 °C

Measurement Performance Criteria Table Notes:

1.) Analyzed more frequently than one per twenty samples or per Sample Delivery Group

2.) Only for re-usable equipment, not for disposable equipment/ supplies.

3.) Regardless of matrix

4.) FRB - An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FRB is to determine if method analytes or other interferences are present in the field environment

°C = Degrees Celsius
FRB = Field Reagent Blank
LOQ = Limit of Quantitation
MPC = Measurement Performance Criteria
PFAS = per- and polyfluoroalkyl substances
QC = Quality Control
RPD = Relative Percent Difference
TOC = Total Organic Carbon

Final PQAPP Worksheet #21: Field Standard Operating Procedures (SOPs)

A summary of SOPs is provided in the table below which can be found in **Appendix C** of the PQAPP. All field staff will be trained through AECOM's internal PFAS Sampling Training prior to performing any sampling activities. A summary of the acceptability of certain materials for use in the PFAS sampling environment is provided in PQAPP **Appendix C**, **Table 1**. A PFAS sampling checklist to be completed daily is provided as PQAPP **Appendix C**, **Table 2**.

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Modified for Project Work?	Comments
N/A	*Appendix C, Table 1: Summary of Acceptability of Material for Use in PFAS Sampling Environment* *Appendix C, Table 2: PFAS Daily Sampling Checklist*	AECOM	N	See PQAPP Appendix C, Table 1 and Table 2
3-01	*Utility Clearance*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-02	*Logbooks*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-03	*Recordkeeping, Sample Labeling and Chain-of-custody*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-04	*Sample Handling, Storage, and Shipping*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-05	*Investigation-Derived Waste Management*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-06	*Equipment Decontamination*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-07	*Land Surveying*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-10	*Surface Water and Liquid Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-12	*Monitoring Well Installation*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Modified for Project Work?	Comments
3-13	*Monitoring Well Development*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-14	*Monitoring Well Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-15	*Monitoring Well and Borehole Abandonment*	AECOM	N	See SOP for detailed procedures
3-16	*Soil and Rock Classification*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-17	*Direct Push Sampling Techniques*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-20	*Operation and Calibration of Photoionization Detector*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-21	*Surface and Subsurface Soil Sampling Procedures*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-22	*Sediment Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures
3-24	*Water Quality Parameter Testing for Groundwater Sampling*	AECOM	Y	Modified for PFAS sampling See SOP for detailed procedures

Notes:
N = No
PFAS = per- and polyfluoroalkyl substances
SOP = Standard operating procedure
Y= Yes

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

Field Equipment	Calibration Activity	Maintenance Activity	SOP Reference	Testing Activity	Inspection Activity	Title or Position of Responsible Person	Frequency	Calibration Acceptance Criteria	Corrective Action
Horiba U-52 Water Quality Standards (pH, ORP, DO, Conductivity, Temperature, Turbidity)	Calibrate with standard solutions	Per page 8 of SOP C24	Field Equipment SOP C24	Operational equipment check and calibration	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	pH: ± 0.01 pH units Conductivity: ± 0.01 µS/cm Turbidity: ± 0.01 NTU DO: ± 0.01 mg/l Temp: ± 0.01 °C	Minor: Repair Major: Replace instrument
MiniRAE 2000 (PID)	Calibrate with fresh air and isobutylene calibration gas	Per page 4 of SOP C20	Field Equipment SOP C20	Operational equipment check and calibration	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	0-99 ppm ± 0.1 ppm 100-1,999 ppm ± 1.0 ppm 2000-10,000 ppm ± 10 ppm	Minor: Repair Major: Replace instrument
QED MP10 Controller (Bladder Pump Controller Box)	NA	--	Field Equipment SOP C14	Operational equipment check	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	NA	Minor: Repair Major: Replace instrument
QED SamplePro (Stainless Steel Submersible Bladder Pump)	NA	Per page 7 of SOP C14	Field Equipment SOP C14	Operational equipment check	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	NA	Minor: Repair Major: Replace instrument
Solinst 101 (Water Level Meter)	NA	Per page 5 of SOP C14	Field Equipment SOP C14	Operational equipment check	Visually inspect for cleanliness and obvious defects (broken/missing parts)	Field Technician Lead	Prior to use	NA	Minor: Repair Major: Replace instrument

Notes:
N = No
DO = Dissolved Oxygen
NA = Not Applicable
NTU = nephelometric turbidity unit
µS/cm = microSiemens / centimeter
PFAS = per- and polyfluoroalkyl substances
PID = photoionization detector
ppm = parts per million
ORP = Oxidative Reduction Potential
SOP = Standard Operating Procedure
Temp = Temperature

Final PQAPP Worksheet #23: Analytical Standard Operating Procedures (SOPs)

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
LCMS-011	Analysis of PFAS, 10/12/17, Revision 02	Definitive	Water/PFAS	Agilent 6460 Triple Quad LC/MS/MS	GCAL	N
			Solid/PFAS			
WL-057	SOP for TOC, 09/18/17, Revision 07.1	Definitive	Solid/TOC	Shimadzu TOC-V CSH or TOC-V CPH analyzer	GCAL	N
EXT-032	pH in Aqueous and Soil/Waste Samples, 10/26/17, Revision 18	Definitive	Solid/pH	Orion 720A pH Meter, Combination Electrode	GCAL	N

Notes:
GCAL = Gulf Coast Analytical
LC/MS/MS liquid chromatography/mass spectrometry
N = No
PFAS = per- and polyfluoroalkyl substances
pH = potential of hydrogen
SOP = Standard Operating Procedure
TOC = Total Organic Carbon
Y= Yes

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Final PQAPP Worksheet #24: Analytical Instrument Calibrations

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	Calibration Standards	NA	Prior to sample analysis	For analytes which have both linear and branched isomers and have standards available containing both linear and branched isomers, the analytes are calibrated and quantitated using a single continuous baseline to integrate all identifiable isomers.	NA	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Minimum five-point initial calibration for all analytes (ICAL)	5.0 – 100ppb on column	Initial calibration prior to sample analysis	For each calibration standard, each analyst must calculate to be within 70-130% of true value. RSD <20% or $r^2 \geq 0.99$ S/N Ratio: ≥ 10:1 for all ions used for quantitation. For analytes having a promulgated standard, (e.g., HA levels for PFOA and PFOS), the qualitative (confirmation) transition ion must have an S/N Ratio of ≥ 3:1.	Repeat calibration if criterion is not met	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Second source calibration verification	50ppb on column	Once after each initial calibration	All analytes must calculate to be within 70-130% of true value and internal standard must calculate to be within 50-150% of true value.	Remake standard, recalibrate if necessary	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Retention Time Windows	NA	Prior to sample analysis	Established with the first CCV of the day or the average of the ICAL on days when calibration is performed. See Table 3 of LCMS-011 for RT Windows.	Perform maintenance on pump or column. Recalibrate if necessary to re-establish retention times.	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Tune check	Agilent ESI-L Low Concentration Tuning Mix	Daily, prior to sample analysis, only once per analytical batch. No time constraints.	Manufacturer recommended criteria which include delta and FWHM tolerance checks of 6 m/z's over the spectrum of the detector.	Retune instrument and repeat check tune. Maintenance may be required.	Analyst, Supervisor, QA Manager	LCMS-011

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	LOD/LOQ verification	Various, see Table 3 of LCMS-010	Quarterly	LOD meets method qualitative requirements or is at least 3x higher than noise; LOQ is recovered within LCS criteria.	Perform instrument maintenance and repeat failed LOD or LOQ study passing two consecutive tests or perform new DL study.	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Calibration verification (CCV)	5ppb and 50ppb on column	Daily, before sample analysis, every 10 samples, and at end of batch. Alternating concentration between low and mid-range.	All targets 70-130% of true value. Each extracted internal standard must be 50-150% of the true value.	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification. Alternatively, immediately analyze two consecutive CCVs for the failed analytes. If both pass, samples may be reported without reanalysis.	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Mass Spectral Acquisition Rate	NA.	Each analyte, Extracted Internal Standard Analyte, and Injection Internal Standard Analyte.	A minimum of 10 spectra scans are acquired across each chromatographic peak.	NA.	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Calibration, Calibration Verification, and Spiking Standards	5ppb and 50ppb on column	All analytes.	Standards containing both branched and linear isomers must be used when commercially available. If not available, the total response of the analyte must be integrated (i.e., accounting for peaks that are identified as linear and branched isomers) and quantitated using a calibration curve which includes the linear isomer only for that analyte (e.g., PFOA).	NA.	Analyst, Supervisor, QA Manager	LCMS-011
LC/MS/MS	Instrument Sensitivity Check (ISC)	NA.	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Analyst, Supervisor, QA Manager	LCMS-011

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
LC/MS/MS	Instrument Blanks	NA.	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ ½ the LOQ.	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 acceptance criteria are not met after the highest standard which is not included in the calibration, the standard cannot be used to determine the highest concentration in samples at which carryover does not occur. If acceptance criteria are not met after sample, additional instrument blanks must be analyzed until acceptance criteria are met. Additional samples shall not be analyzed until acceptance criteria are met.	Analyst, Supervisor, QA Manager	LCMS-011
Shimadzu TOC-V CSH or TOC-V CPH	Initial Calibration (ICAL)	Various	Analyzed and evaluated before any result can be quantitated.	The correlation coefficient must be 0.995 or greater	Correct problem; recalibrate instrument, new calibration verified	Analyst, Supervisor, QA Manager	WL-057
Shimadzu TOC-V CSH or TOC-V CPH	Independent Calibration Verification (ICV)	10,000 µg & 20,000 µg	Immediately following the ICAL	±10% (90-110% of true value)	Instrument maintenance, reanalysis of ICV or initial calibration or re-preparation of the standards	Analyst, Supervisor, QA Manager	WL-057

Instrument/ Equipment	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person(s) Responsible for CA	SOP Reference
Shimadzu TOC-V CSH or TOC-V CPH	Continuing Calibration Verification (CCV)	10,000 µg	Each day that an ICAL is not performed a CCV must be performed before sample analysis, Also analyze every 10 samples ant at the end of analytical batch	±10 % (90-110% of true value)	Instrument maintenance, reanalysis of ICV or initial calibration or re-preparation of the standards	Analyst, Supervisor, QA Manager	WL-057
Shimadzu TOC-V CSH or TOC-V CPH	Continuing Calibration Blank (CCB)	<250 mg/kg	Analyzed after every 10 samples or more frequently and at the end of analytical batch	Concentration must be less than the LOQ	Correct problem; recalibrate instrument	Analyst, Supervisor, QA Manager	WL-057
Shimadzu TOC-V CSH or TOC-V CPH	Initial Calibration (ICAL)	Various	Analyzed and evaluated before any result can be quantitated.	The correlation coefficient must be 0.995 or greater	Correct problem; recalibrate instrument, new calibration verified	Analyst, Supervisor, QA Manager	WL-057
Orion 720 pH Meter	Calibrate meter	1.00-13.00	Daily before use	92-108%	Recalibrate meter	Analyst, Supervisor QA Manager	EXT-032
Orion 720 pH Meter	Quality Control (QC) Check Buffer	8.00	Immediately after calibration and with every 20 samples	0.05 pH units of the true value	Recalibrate meter	Analyst, Supervisor, QA Manager	EXT-032

Notes:
µg = micrograms
amu = atomic mass unit
CCB = Continuing Calibration Blank
CCV = Continuing Calibration Verification
DL = detection limit
ESI= Electrospray Ionization
HAL = Health Advisory Limit
ICAL = Initial Calibration
ICV = Independent Calibration Verification
LCMS/MS = Liquid chromatography-tandem mass spectrometry
LCS = Laboratory Control Spike
LOD = Limit of Detection
LOQ = Limit of Quantitation
mg/kg = milligram per kilogram
NA = Not applicable
PFOA = Perfluorooctanoic acid
PFOS = Perfluorooctanesulfonic acid
ppb = parts per billion
QA = quality assurance
QC = quality control

RSD = Relative Standard Deviation

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

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

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

Sampling Organization: AECOM

Laboratory: GCAL

Method of sample delivery (shipper/carrier): FedEx

Number of days from reporting until sample disposal: 60 Days

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

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

Matrix: Soil & Aqueous

Analytical Group: Per- and Polyfluorinated Substances

Analytical Method: EPA Method 537 Modified, QSM 5.1 Table B-15

SOP Reference: LCMS-011

Certification Status: DOD/ELAP Certification

QC Sample	Frequency/Number	Method/SOP Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Aqueous Sample Preparation	Each sample and associated batch QC samples.	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations (e.g., AFFF formulations). Inline SPE is acceptable. Samples of known high PFAS concentrations can be prepared by serial dilution instead of SPE, with documented project approval.	NA	NA	As per Table B-15
Soil & Sediment Sample Preparation	Each sample and associated batch QC samples.	Entire sample received by the laboratory must be homogenized prior to subsampling.	NA	NA	As per Table B-15
Method Blank	One per preparatory batch, maximum of 20 samples	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem; reanalyze any sample associated with a blank that fails criteria, except when the sample analysis resulted in a non-detect (ND).	Analyst, Supervisor, QA Manager	As per Table B-15

QC Sample	Frequency/Number	Method/SOP Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Laboratory Control Spike (LCS)	One per preparatory batch, maximum of 20 samples	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. 70-130% of True Value	Reanalyze and/or reprep all associated samples unless recoveries are high with no detection of analytes.	Analyst, Supervisor, QA Manager	As per Table B-15
Matrix Spike	One per preparatory batch. Not required for aqueous samples prepared by serial dilution instead of SPE.	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. 70-130% of True Value	Evaluate the data to determine if the failed criteria are due to sample matrix or laboratory error. Re-prep if sufficient sample is available when lab error is suspected, otherwise qualify data with narrative.	Analyst, Supervisor, QA Manager	As per Table B-15
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	For MSD: One per preparatory batch. For MD: Each aqueous sample prepared by serial dilution instead of SPE.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. For MSD: 70-130% of True Value Relative percent difference (RPD) ≤ 30% (between MS and MSD or sample and MD).	The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ. The MD is a second aliquot of the field sample that has been prepared by serial dilution.	Analyst, Supervisor, QA Manager	As per Table B-15

QC Sample	Frequency/Number	Method/SOP Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Extracted Internal Standards	Every field sample, standard, blank, and QC sample.	Added to sample prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to samples prior to analysis. Extracted Internal Standard Analyte recoveries must be within 50% to150% of the true value.	If recoveries are acceptable for QC samples, but not field samples, the field samples must be re-prepped and reanalyzed (greater dilution may be needed). If recoveries are unacceptable for QC samples, correct problem, and reanalyze all associated failed field samples.	Analyst, Supervisor, QA Manager	As per Table B-15
Instrument Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to aliquot of sample dilutions, QC samples, and standards just prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not performed, the peak areas must be within -50% to +50% of the peak area measured in daily initial CCV.	If peak areas are unacceptable, analyze a second aliquot of the extract or sample if enough extract remains. If there is not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags.	Analyst, Supervisor, QA Manager	As per Table B-15

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

Matrix: Soil

Analytical Group: Total Organic Carbon

Analytical Method: EPA 9060A

SOP Reference: WL-057

Certification Status: DOD/ELAP Certification

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

Matrix: Soil

Analytical Group: pH

Analytical Method: EPA 6045D

SOP Reference: EXT-032

Certification Status: DOD/ELAP Certification

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

Notes:
CA = Corrective Action
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
ICAL = Initial Calibration
LCS = Laboratory Control Spike
LOQ = Limit of Quantitation
MS/ MSD = Matrix Spike/ Matrix Spike Duplicate
NA = Not applicable
PFAS = Per- and Polyfluoroalkyl Substances
QA = Quality Assurance
QC = Quality Control
RPD =Relative Percent Difference
SPE = Solid Phase Extraction

Final PQAPP Worksheet #29: Project Documents and Records

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Logbook	Field Logbook	Sample receipt, custody, and tracking records	Field sampling audit records	N/A
Chain-of-Custody Records	Field Sampling Forms	Sample prep logs	Laboratory audit records	
Air Bills	Equipment Inspection Forms	Equipment calibration logs	Data validation reports	
Custody Seals	Boring Logs	Run logs	Data usability assessment reports	
Corrective Action Forms	Corrective Action Forms	Equipment maintenance test, and inspection logs	Corrective Action Forms	
Field Sampling Forms	Daily Tailgate H&S Sign In Sheet	Corrective Action Forms		
Sample location and depth data	APP/SSHP Acknowledgement	Reported analytical results		
Field equipment calibration logs	Dig Permits	Data package completeness checklists		
		Sample disposal records		
		Extraction/cleanup records		
		Raw data		
		EQUIS™		
		ROE Agreements		
		Photographic Logs		

Notes:
APP/SSHP = Accident Prevention Plan/ Site Safety and Health Plan
H&S = Health and Safety
N/A = Not Applicable
ROE = Right of Entry

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

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

Assessments:

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

Assessment Response and Corrective Action:

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

Laboratory Assessments: GCAL

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

Notes:
COC = Chain of Custody
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
GCAL = Gulf Coast Analytical Laboratories, LLC.
ICAL = Initial Calibration
LOQ = Limit of Quantitation
NA = Not applicable
PJLA = Perry Johnson Laboratories Accreditation
PT = Proficiency Testing
QA = Quality Assurance
QAM = Quality Assurance Manager
QC = Quality Control
SPE = Solid Phase Extraction
TSA = Technical System Audits

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Final PQAPP Worksheet #34: Data Verification and Validation Inputs

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

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Final PQAPP Worksheet #35: Data Verification Procedure

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

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Chain of custody forms and shipping forms	Chain of Custody, Shipping Documents	Chain of custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain of custody should be initialled by the reviewer, a copy of the chain of custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment.	Appropriate Field Sampling Team Leaders for the individual medias
Review of field logbooks	Field Logbooks	Review for completeness and accuracy.	Appropriate field Sampling Team Leaders
Field sampling TSAs	TSA Reports	Assessment of field sampling process prior to start of, or as close to the start of sampling as possible.	QA Manager or designee
Fixed laboratory analytical data review	Laboratory Data Package	Data controls are compared to this QAPP and DoD QSM v 5.1 (and PFAS analysis by Method 537, DoD QSM v5.1 Table B-15) Appendix A in a Three Tiered process using a minimum 100% peer review.	PM or QA Manager
Fixed laboratory TSAs	Laboratory Data Package	ELAP audit and internal quality audits.	QA Manager
Fixed laboratory data verification	Data Validation Reports	100% data verification/validation for water and soil.	AECOM Project Chemist
Fixed laboratory data validation	Data Validation Reports	Calculate and assess laboratory DQIs.	QA Manager, or designee

Notes:
DoD = Department of Defense
DQI = Data Quality Indicators
ELAP = Environmental Laboratory Accreditation Program
PFAS = per- and polyfluoralkyl substances
PM = Project Manager
QA = Quality Assurance
QSM = Quality Services Manual
TSAs = Technical System Audit

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Final PQAPP Worksheet #36: Data Validation Procedures

Data Validator: AECOM

Analytical Group/Method	All Analytical Data
Analytical specifications	WS#24, WS #28 & Laboratory SOP
Measurement performance criteria	WS #12, WS#15, and WS#28
Percent of data packages to be validated	100%
Percent of raw data reviewed	100%
Percent of results to be recalculated	0%
Validation procedure and qualification	National Functional Guidelines for Organic Superfund Data Review (January 2017)
Validation code	S2bVEM/S2bVM
Electronic validation program/version	EarthSoft EQuIS™ Automated Validation Assistant

Notes:
SOP = standard operating procedure
WS = worksheet

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Final PQAPP Worksheet #37: Data Usability Assessment

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

The following personnel are responsible for participating in the DUA:

- AECOM Project Manager: Rosa Gwinn
- AECOM Project Chemist: Naoum Tavantzis
- AECOM SI Task Manager: Brooke Perrigo

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 reports. The Data Validation Report will follow the procedures given in **Worksheet #36**.

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

Step 1	**Review the project's objectives and sampling design.** The key components established in the DQOs (**Worksheet #11)** will be reviewed to ensure that they are still applicable. Also, the sampling design and how it was implemented in the field will be reviewed for consistency with the stated objectives. For example, this step in the DUA will: • Reevaluate whether comparison criteria (i.e., PSC; **Worksheet #15**) were updated since Programmatic UFP-QAPP generation and if laboratory quantitation limits (QLs) were sensitive enough for those changes (e.g., QLs remain lower than new criteria). It is important to note several states are in various stages of developing or finalizing limits for PFAS chemicals for different media; therefore, it is critical that PSC are regularly evaluated over the course of the project to ensure the PSC remain current. Additionally, project data must meet the measurement performance criteria (MPC) for sensitivity and project QLs specified in **Worksheets #15 & 28**. • Discuss the limitations and impact on the use of project data if validation reports indicate that project specific sensitivity goals or QLs were not achieved for a specific sampling or laboratory group, data set or sample delivery group (SDG), matrix, analytical group, or concentration level.
Step 2	**Review the data verification and data validation outputs**

	All available Quality Assurance (QA) reports, including both field and laboratory generated forms, will be reviewed for deviations from planned activities identified in Step 1 (e.g., number and locations of samples, holding time exceedances, damaged samples, non-compliant proficiency testing (PT) sample results, and SOP deviations) and determine their impacts on the data usability. Validated data will be summarized and/or compiled to identify patterns, trends, and anomalies as they related to the Data Quality Indicators (DQIs) precision, accuracy/bias, representativeness, comparability, and completeness. Descriptions of each DQI and examples of how each may be incorporated into the usability report follows.
Step 2 (cont.)	**Precision** Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms. QC measures for precision include field duplicates, laboratory duplicates, MSDs, analytical replicates, and surrogates. To meet the needs of the data users, SI project data must meet the MPC for precision specified in **Worksheet #12** of this QAPP. Precision errors may be the result of one or more of the following: PFAS cross-contamination, field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or spatial variation (heterogeneous sample matrices). To identify the cause of imprecision, the field sampling design rationale and sampling techniques will be evaluated by the reviewer, and both field and analytical duplicate/replicate sample results will be compared. For example, if poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the sampling technique, PFAS contamination, field instrument variation, sample transport, medium inhomogeneity, or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular data set or SDG, then the impact of that imprecision on usability will be discussed in the usability report.
Step 2 (cont.)	**Accuracy/Bias** Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) due to sampling and analytical operations. Examples of QC measures for accuracy include Matrix Spikes, Laboratory Control Samples, and equipment blanks. A measurement is accurate when the reported value does not differ from the true value or known concentration of the spike or standard. To meet the needs of the data users, project data must meet the MPC for accuracy/bias specified in **Worksheet #12** of this QAPP. The usability report for each installation will: • Discuss and compare data on contamination and accuracy/bias (when bias is observable) for each matrix, analytical group, and concentration level. • Describe the limitations on the use of project data if extensive contamination, inaccuracy, or bias exists or when inaccuracy is limited to a specific sampling or laboratory group, data set or SDG, matrix, or concentration level. • Discuss the impact of any qualitative and quantitative trends in bias on the sample data.
Step 2 (cont.)	**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. It is achieved through a well-designed sampling program and by using standardized sampling strategies, techniques, and analytical procedures. To meet the needs of the data users, project data must meet the MPC for sample representativeness specified in **Worksheet #12** of this QAPP. **Worksheet #28 & 35** discusses how the QA/QC activities (e.g., review of sampling design and SOPs, field sampling TSAs, analysis audits, etc.) and QC

	sample data will be reviewed to assess sample representativeness. For example, if field duplicate precision checks indicate potential spatial variability, additional scoping meetings and subsequent resampling may be needed to collect data that are more representative of a nonhomogeneous site. The usability report for each installation will: • Discuss the impact of field duplicate imprecision on site representativeness. For example, when data variability is high among field duplicate data sets (i.e., high relative standard deviation) calculation of the 95% upper confidence limit (UCL) of the population mean is more likely to overestimate the true mean and therefore achieve better statistical coverage. • Discuss the impact of laboratory and field sampling methods on sampling results and how they reflect site conditions. • Discuss the effect of site heterogeneity on sampling results in light of sampling methods used. • Describe the limitations on the use of project data when sampling results are non-representative for all data or for a specific sampling, group, data set or SDG, matrix, analytical group, or concentration level.
Step 2 (cont.)	**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 SI results will be used as benchmarks for determining comparability for data collected during any future sampling events at the various installations using the same or similar sampling and analytical SOPs. At this time, data will not be compared to other datasets or data using different sampling or analytical SOPs. To ensure future comparability of data generated for the installations, standard sample collection procedures and approved analytical methods will be used. Sample analyses will be performed by the laboratory using approved methods and procedures. Comparability criteria will be considered met for the project if, based on data reviewed, the sample collection and analytical procedures are determined to have been followed, or defined to show that variations did not affect the values reported. Deviations to sampling scope will be documented in sampling nonconformance reports which may contain some of the discussion of comparability. The usability reports will describe the limitations on the use of project data when project-required data comparability is not achieved for the overall project or is limited to a specific sampling or laboratory group, data set or SDG, matrix, analytical group, or concentration level.
Step 2 (cont.)	**Completeness** Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct, normal circumstances. To meet the needs of the data users, project data must meet the MPC for data completeness. Completeness criteria will be considered met if 100% of all planned sample data are collected. As applicable, the usability report may also: • Describe how the amount of valid data will be determined as a percentage of the number of valid measurements for each matrix, analytical group, and concentration level. • Describe how critical data was assessed for completeness when certain sample locations or analytes and matrices are more critical than others in making project decisions. • Evaluate the impact of missing information. Ensure that enough information was obtained for the data to be usable to meet the DQOs (**Worksheet #11**).
Step 2 (cont.)	**Sensitivity**

	Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a DL study, and Limit of Detection (LOD)/Limit of Quantitation (LOQ) Verifications. To meet the needs of the data users, project data must meet the MPC for sensitivity and project QLs specified in **Worksheets #15 & 28** of this QAPP. If appropriate, the usability report may also: • Discuss and compare sensitivity and DL/LOD/LOQ from the data sets collected for the project for each matrix, analytical group, and concentration level. • Discuss the impact of a lack of sensitivity or higher DL/LOD/LOQ on data usability, if validation reports indicate that sensitivity goals or DL/LOD/LOQ goals were not achieved. Describe the limitations on the use of project data if project-required sensitivity goals and DL/LOD/LOQ are not achieved for all project data, or when sensitivity is limited to a specific sampling or laboratory group, data set or SDG, matrix, analytical group, or concentration level
Step 3	**Verify the assumptions of the selected statistical method** The use of statistical methods for data assessment for this project will be limited to estimating a 95% UCL (or mean as appropriate for the analyte) for the assessment of risks.
Step 4	**Implement the statistical method** Where statistical methods are used, the underlying assumptions will be assessed during the DUA. The consequences of selecting the incorrect alternative will be discussed and uncertainty tolerances will be considered.
Step 5	**Document data usability and draw conclusions** The DUA will determine and document whether the data can be used as intended given any deviations and corrective actions that may have occurred. Limitations on data use will be considered and discussed as appropriate and the performance of the sampling design assessed. Conclusions will be drawn taking any data limitations into consideration and documented in the SI report.

2. References

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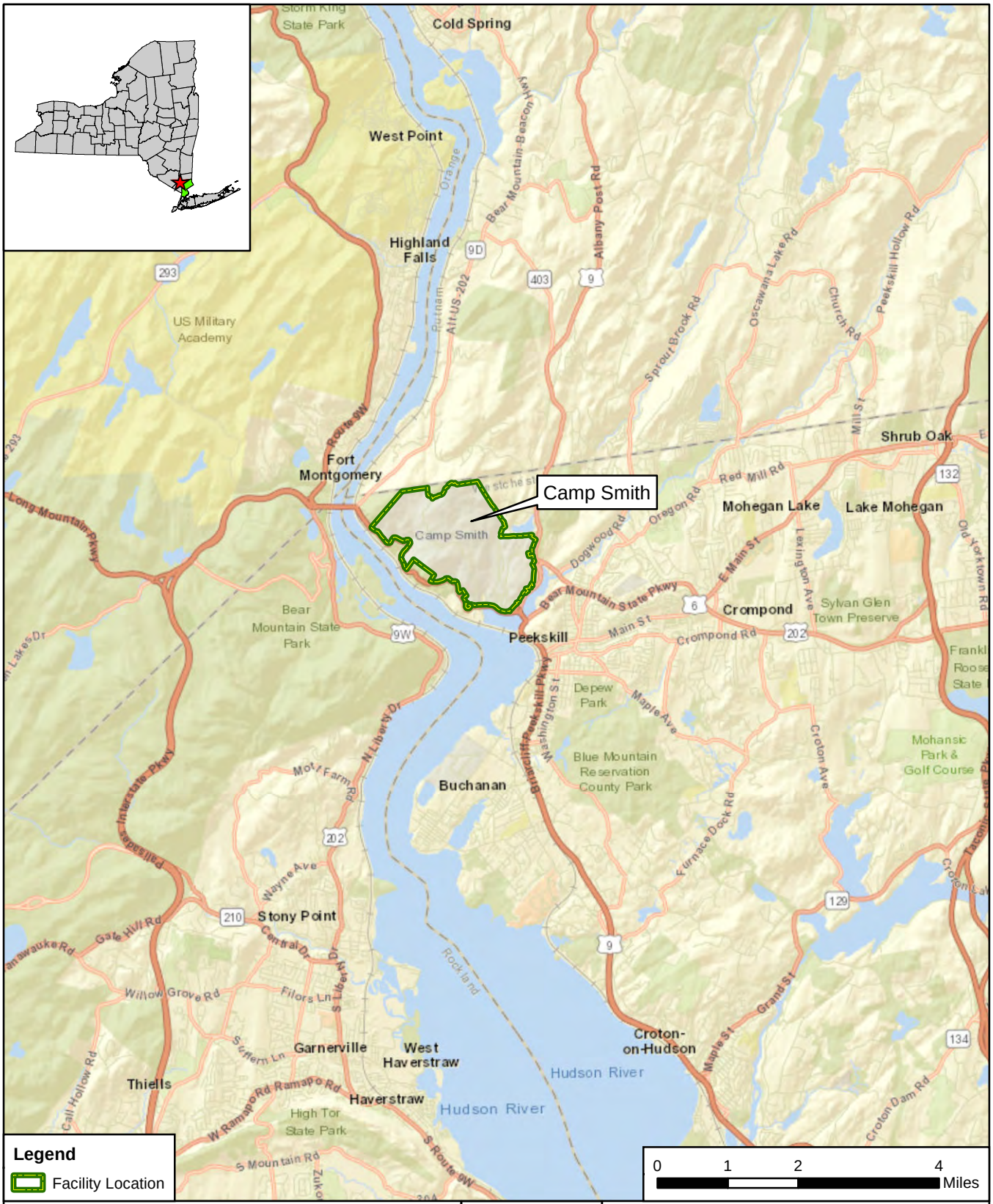
Figures



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Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	RG	9/16/2019

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 10-1

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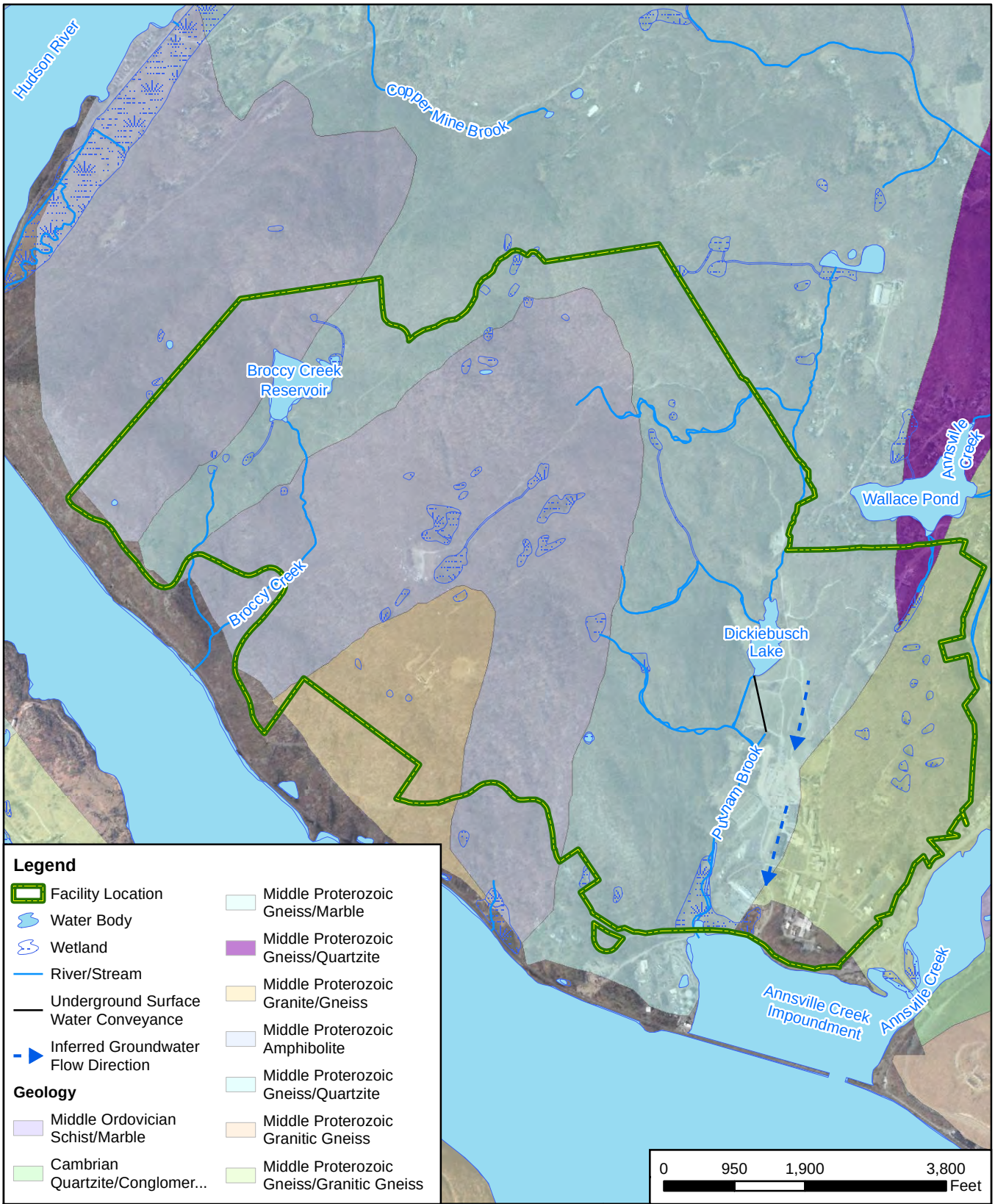

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SCALE	1:22,800	CHK BY	BP	9/24/2019
Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/24/2019

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Groundwater Features

AECOM
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Figure 10-2

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SCALE	1:22,800	CHK BY	BP	9/16/2019
Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/16/2019

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Surface Water Features

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Figure 10-3

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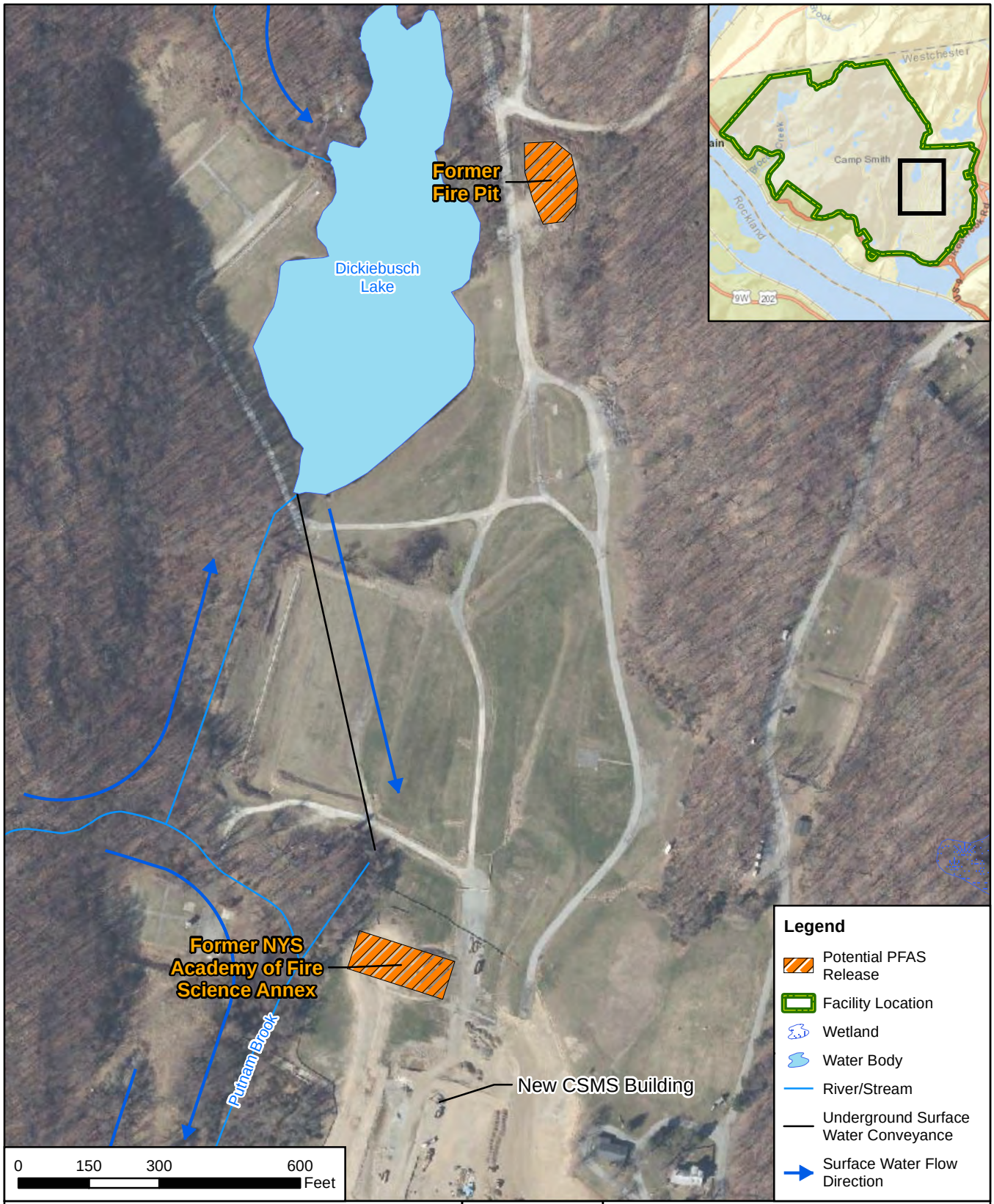

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Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/16/2019

N

Fire Training Areas

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Figure 10-4

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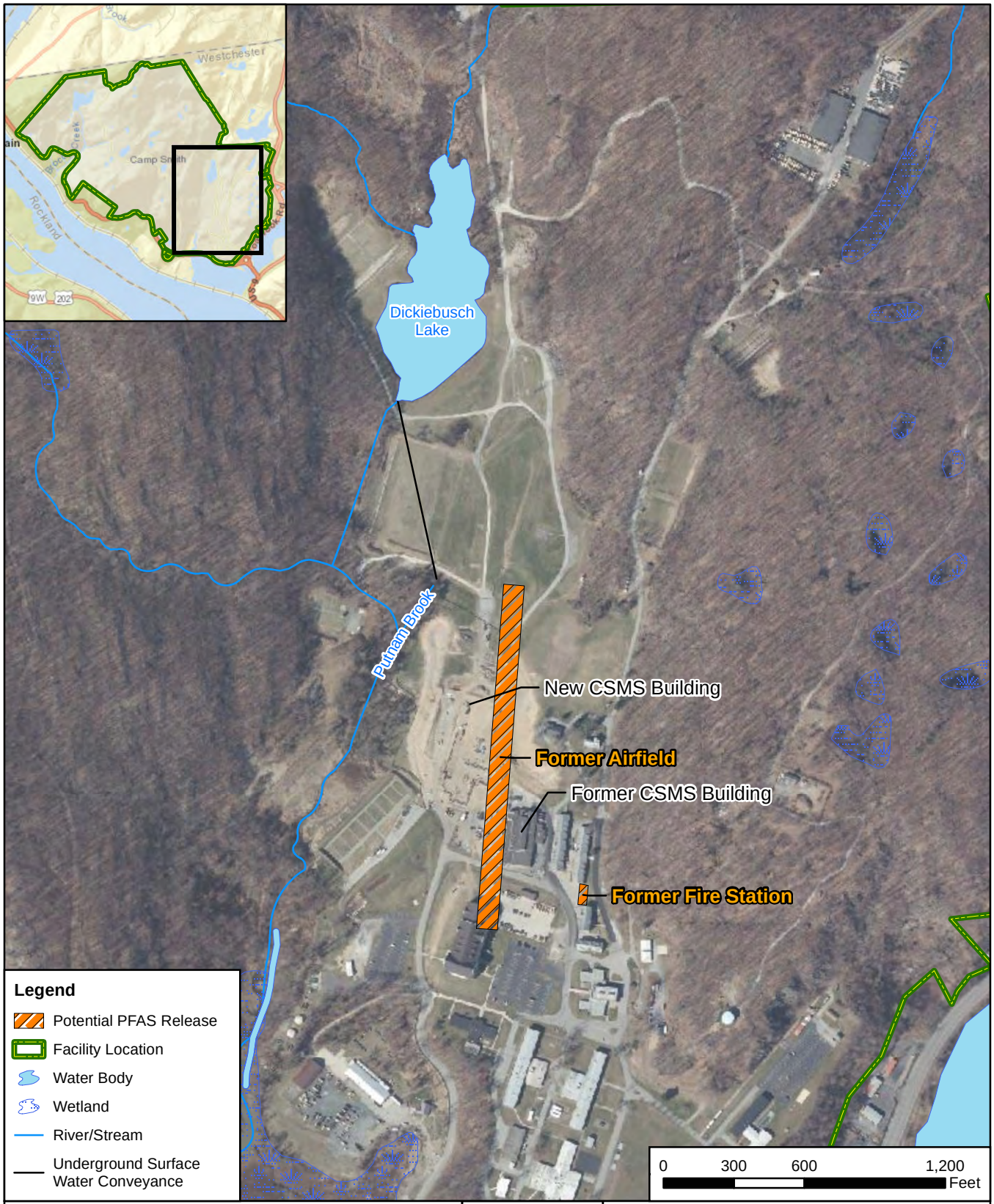

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Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/16/2019

Non-Fire Training Areas

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Figure 10-5

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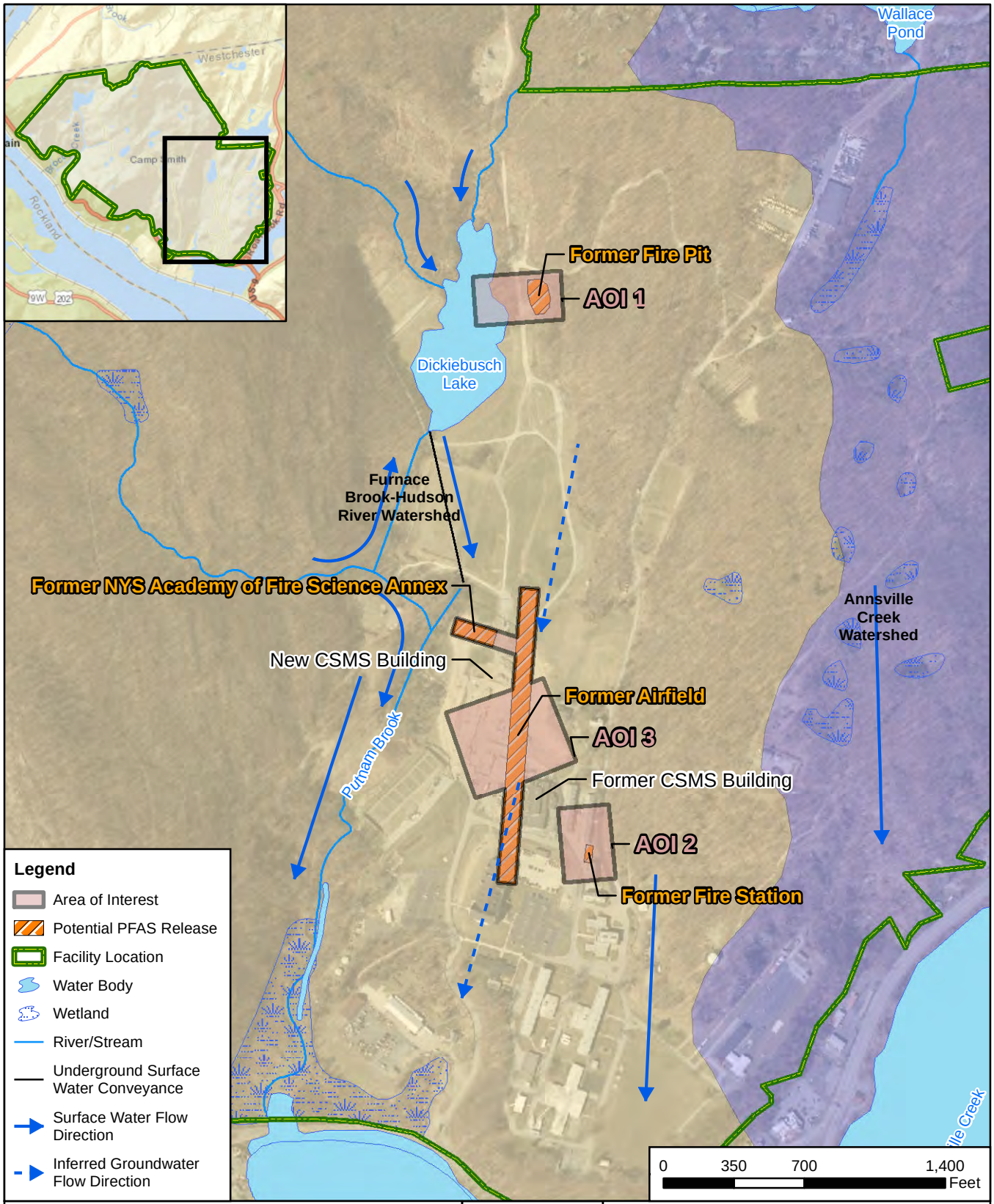

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Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/16/2019

Areas of Interest

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Figure 10-6

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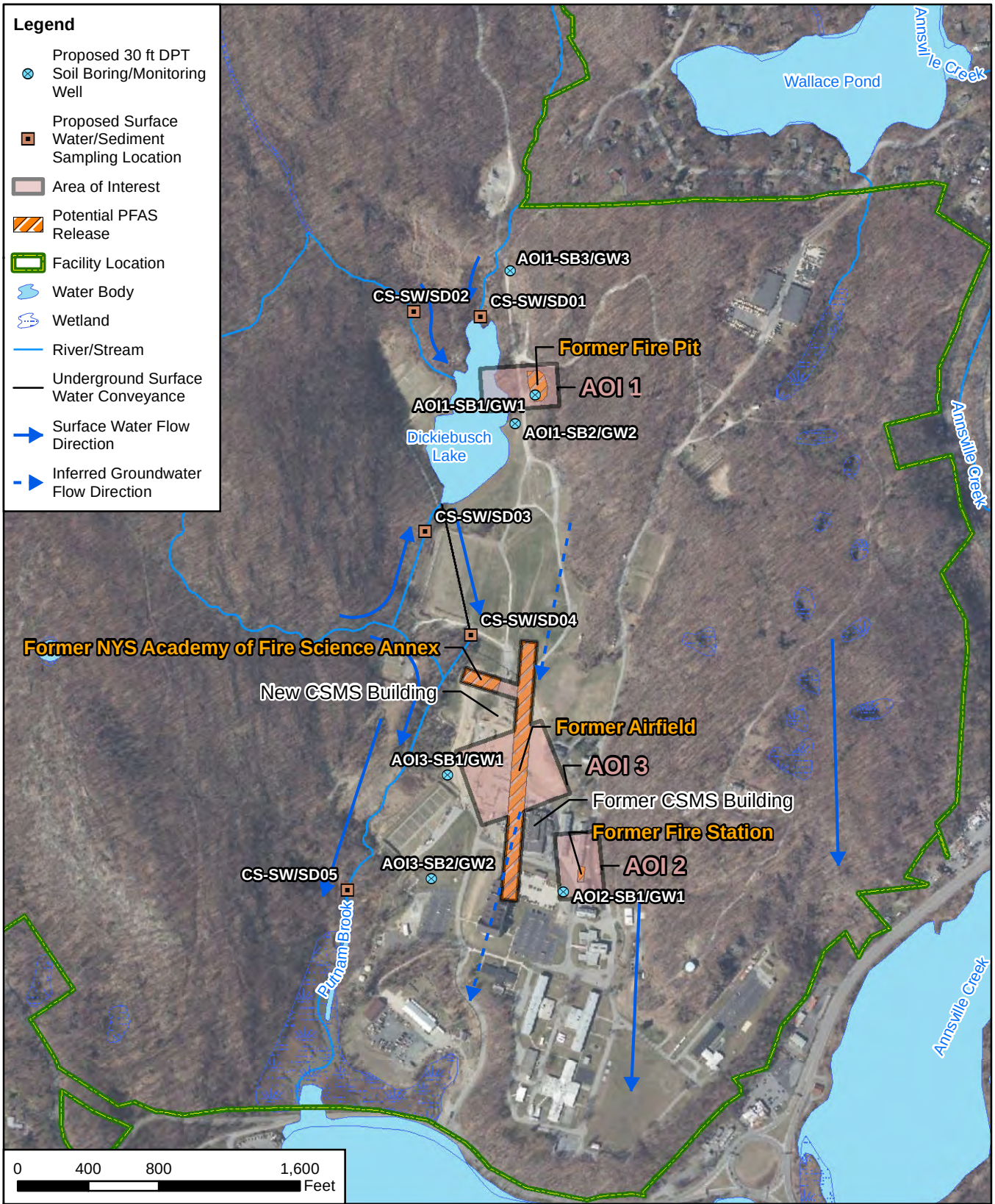

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AOI 1, AOI 2, AOI 3 Proposed Sampling

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Figure 17-1

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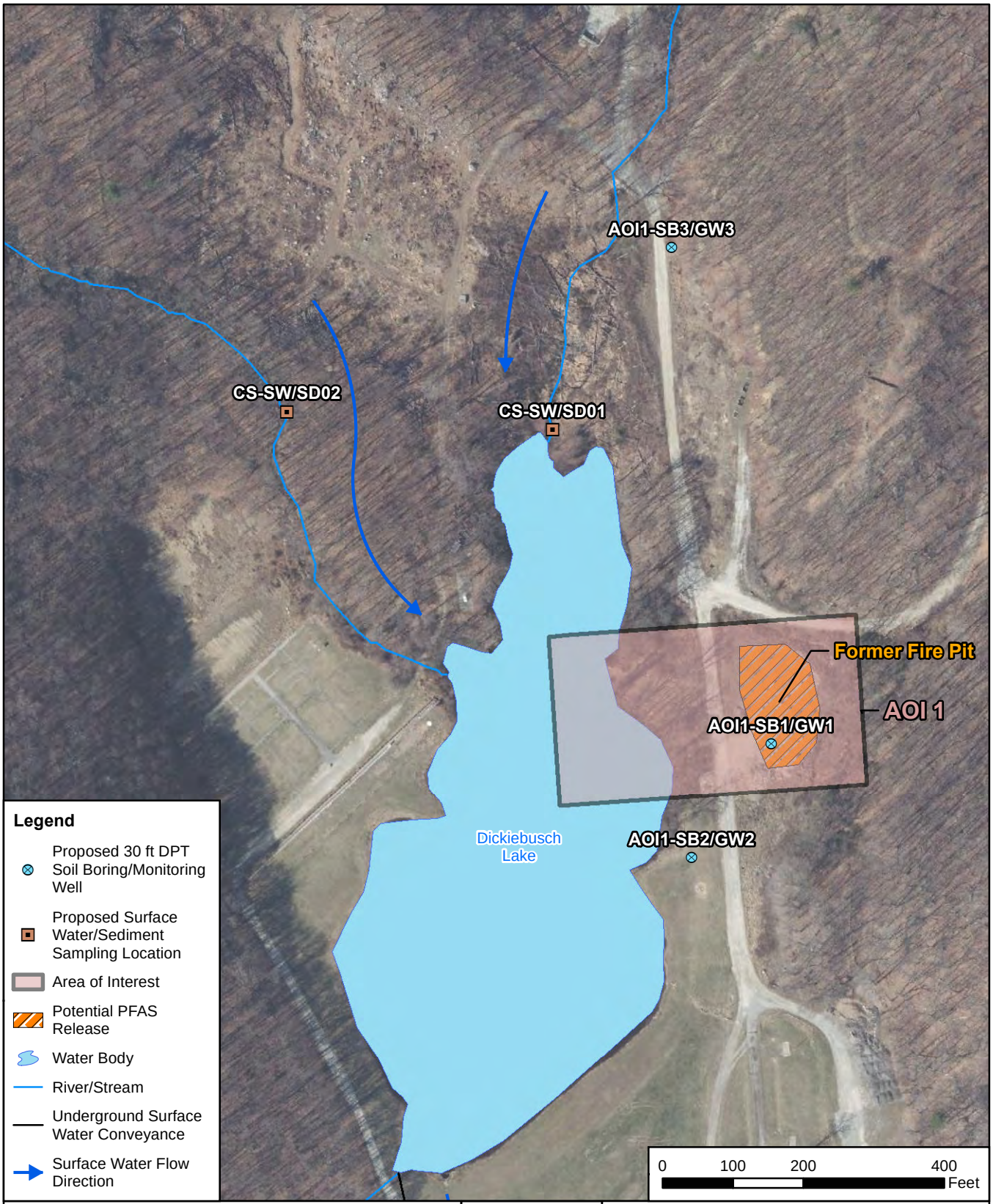

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Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/16/2019

AOI 1 – Former Fire Pit

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Figure 17-2

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Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/16/2019

N

AOI 2 – Former Fire Station

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Figure 17-3

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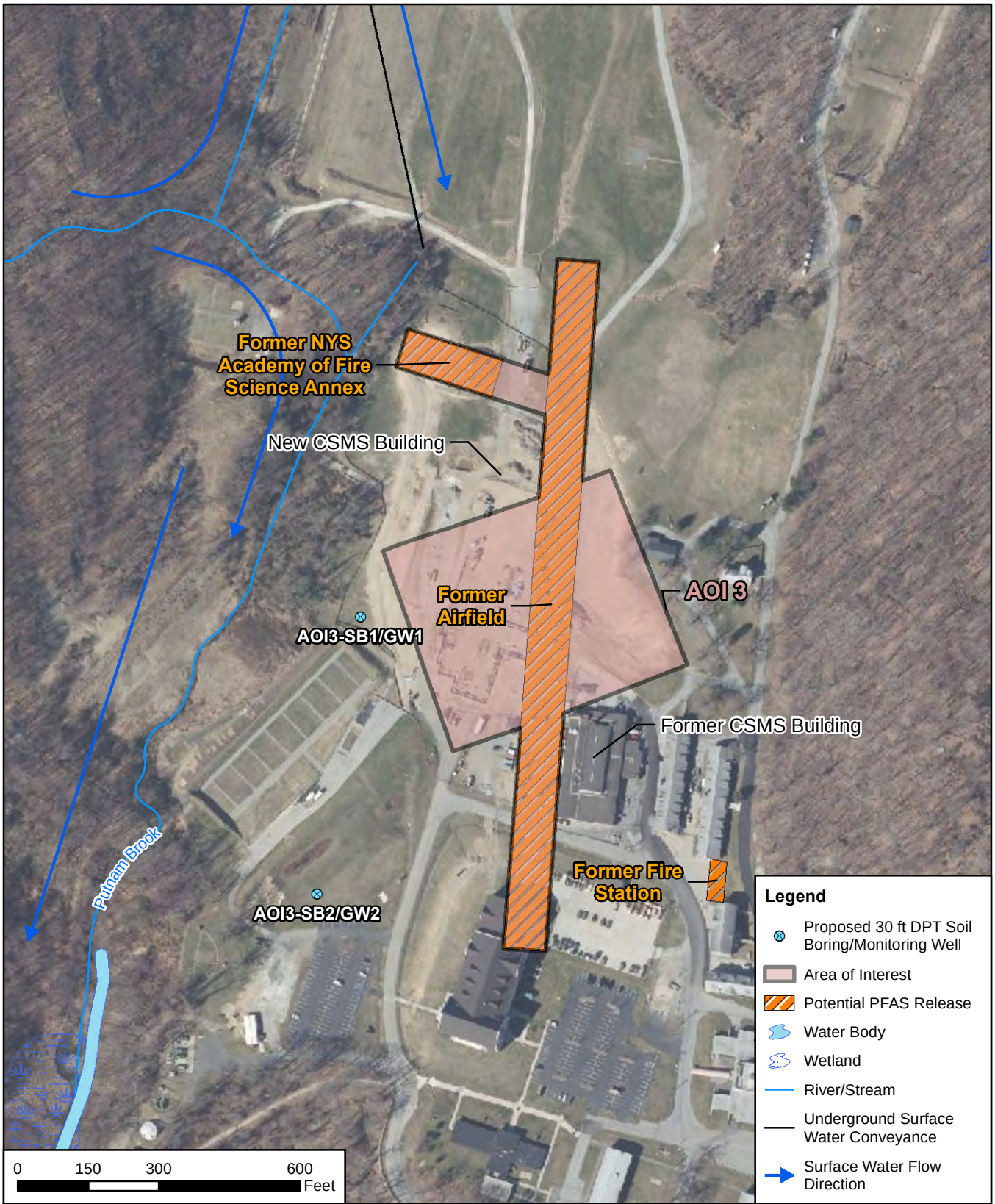

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Base Map: NYS Digital Ortho-imagery Program (NYSDOP), 2016		PM	RG	9/24/2019

N

AOI 3 – Former Airfield/Former NYS Academy of Fire Science Annex

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Figure 17-4

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

Meeting Minutes
Camp Smith Training Site – Site Inspection (SI)
Technical Project Planning (TPP) – Meeting 1 and 2
Preliminary Assessments and Site Inspections (PA/SIs) for Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites
Contract No. W912DR-12-D-0014, DO W912DR17F0192 1707
Wednesday 10, July 2019
1000 to 1200

Participants			
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** Notes: ARNG-Army National Guard; IED-Installation and Environment Directorate; USACE-United States Army Corps of Engineers; NYARNG-New York Army National Guard; NYSDOH – New York State Department of Health; NYSDEC- New York State Department of Environmental Conservation; DMNA- Division of Military and Naval Affairs*

Technical project planning (TPP) participants gathered in Building 501, Conference Room 101. The sign-in sheet was distributed and a roundtable of introductions was given. The sign-in sheet is included as **Attachment A** to these meeting minutes. The meeting was a combination of TPP1 and TPP2 with the purpose of discussing the Army National Guard (ARNG) Preliminary Assessment/Site Investigation (PA/SI) program and proposed SI approach for potential per- and polyfluoroalkyl substance (PFAS) releases at Camp Smith Training Site.

Presentation in-brief slides were provided to participants at the meeting and are included in **Attachment B**. Key points that supplement the presentation are summarized below.

A safety moment was provided to the participants by stating that the SI will follow the safety procedures established in the USACE Engineering Manual (EM) 385-1-1. An Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP) will be prepared in accordance with EM 385-1-1. Additionally, the team discussed site-specific safety concerns of particular note. It was indicated by many around the table

that ticks and the associated illnesses are of particular threat at Camp Smith Training Site. Tick safety considerations will be added to the SSHP.

Programmatic Discussion (Slides 5–8):

- Clarification on point of contact to the state stakeholders (New York State Department of Environmental Conservation [NYSDEC] and New York State Department of Health [NYSDOH]) should be Mr. Dan Lanners of NYSDEC. He will handle the distribution of the draft final documents to all involved reviewers and should be contacted for questions related to response to comments.
- It was noted that all correspondence should include copying the United States Army Corps of Engineers (USACE), Division of Military and Naval Affairs (DMNA) and the New York ARNG (NYARNG).

- The program follows the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process. The PA has been finalized and the current stage of activity is the SI.
- The primary goal of the SI is to determine the presence or absence of PFAS at the source areas and at the facility boundary; nature and extent would be determined during a Remedial Investigation (RI), the next phase in the CERCLA process, if warranted.
- Participants for TPP1 and TPP2 included ARNG-Installation and Environment Directorate (IED), NYARNG, USACE, DMNA, NYSDEC, NYSDOH, and AECOM; the future TPP3 meeting will include the invitation of other local stakeholders such as Westchester County Department of Health. DMNA noted that the local community/public should not be involved until a source could be identified. Strong communication was encouraged between all parties involved.
- Dr. Bonnie Packer (ARNG-IED) spoke to the overall ARNG program. She highlighted the fact that Camp Smith was not originally slated for SI, though the drinking water well sampling results for PFAS from Wells A and B escalated it to that point. Further discussion ensued relating to highlighting the main takeaway of the PA findings: how there was a lack of institutional knowledge on the facility, therefore, any defined “Area of Interest” (AOI) was included in the SI due to the uncertainty related to use or storage of aqueous film forming foam (AFFF) and these areas were identified due to the historic activities using AFFF that generally occurred within AOIs at other facilities.

Camp Smith Training Site PA Findings (Slides 9-21):

- The PA findings for Camp Smith Training Site were presented. PA data were collected through in-person interviews and a visual site inspection during a one-day site visit on 28 June 2018. Three AOIs were identified, which contain four potential PFAS release areas. Two potential fire training areas (FTAs): the former fire pit and the former New York state (NYS) Fire Inspection Agency and the two potential non-FTAs: the former airfield, and the former fire station.
    - Discussion around the table ensued. It was noted that the former fire station only held two pick-up trucks with water tanks in the bed of each truck. Additionally, discussion revealed uncertainty as to whether the former fire pit was used prior to, in conjunction with, or after the NYS Fire Inspection Agency.
    - Dr. Packer requested that participants reach out to see if they could find any additional information regarding the NYS Fire Inspection Agency, since there are many unknowns associated with this potential PFAS release area.
- Mr. Mike Myers (AECOM) reiterated that due to the uncertainty of use, storage, disposal of AFFF on-facility, it was the uncertainty that required defining AOIs.
    - Open discussion occurred at this point. The NYARNG noted that there was a 30% loss in the water distribution system on-facility and questions arose whether faulty or old plumbing could be associated with the PFAS detected in the drinking water wells. Dr. Packer clarified that any work on the plumbing would be done through construction contracting which is not a part of this SI process.
    - Ms. Wendy Kuenher (NYSDOH) indicated that New York State has recommended protective maximum contaminant levels (MCLs) for PFOS and PFOA in drinking water at a concentration of 10 parts per trillion (ppt), each. She also indicated that the 60-day comment period on the recommendation would commence on July 24, 2019.
    - DMNA and NYARNG continued discussions regarding supplying the facility with clean drinking water, outlining that new drinking water wells are to be drilled and tested. The

interim solution that was deployed was to supply filtered water on-facility. Dr. Packer indicated that this, too, would be a construction related project, and therefore is not a part of this SI process.

- The former fire pit was a former live fire training exercise area, dates of use for such activities were unknown, but it was believed that fire training occurred there monthly. The area has been paved over multiple times in the past and the actual presence or use of AFFF during exercises in this location was possible, but not confirmed.
- Activities at the former NYS Fire Inspection Agency were reported to include classroom training, fire services, forensics, and arson investigation. It is unknown if fire training with AFFF occurred at this potential release area. There was no documented storage, discharge, use, incidents or releases of AFFF at this potential release area. Soil from this area was used in the foundation of the new Combined Support Maintenance Shop (CSMS) building.
    - Dr. Packer urged the NYARNG and DMNA to reach out to other retired personnel to try to figure out the dates of use. She stated that Colonel Scott Cleveland's (Construction and Facilities Management Officer) recollection was the only information that was collected during the PA to support the information available on this potential release area. Pete Jensen (DMNA) said that they have reached out and that nobody else knows, and that even Colonel Cleveland's recollection was not firsthand information.
- The former CSMS was located adjacent to the former fire station between 1976 and 2018. There was no documented storage, discharge, use, incidents or releases of AFFF at this potential release area. A 2009 NYARNG standard operating procedure mandated that firefighting equipment be stored on-site and ready for use during refueling activities, though no firefighting equipment was observed during the visual site inspection within the new CSMS.
- The former fire station was active between 1980 and 1996. In 1996, it was torn down and replaced with a parking lot. As previously discussed, two pick-up trucks with water tanks were parked at this fire station. There is no known or documented storage, discharge, use, incidents, or releases of AFFF at this potential release area.
- The former airfield was constructed after 1955 and before 1960 but removed in the late 1970s. It was possibly active during the Korean and Vietnam Wars. There was no documented storage, discharge, use, incidents or releases of AFFF at this potential release area.
- No emergency responses or off-site adjacent sources were identified during the PA interviews.
- It was then summarized that the uncertainty associated with the AOIs is the cause for further investigation.
- The previous investigation of drinking water well PFAS sampling results for Wells A and B were then presented. The main point was to highlight that the highest concentration of PFAS from those sampling events did not exceed the US EPA health advisory limit of 70 ppt: PFOS in the blended sample was detected at 51 ppt.

Camp Smith Training Site SI Overview (Slides 22-30):

- Ms. Brooke Perrigo (AECOM) then presented the data quality objectives (DQOs) for the SI. The primary DQOs were to confirm the presence or absence of a PFAS release above a federal or properly promulgated state standard at a potential source area and to gather data to refine the conceptual site model (CSM). The enhanced DQOs were to confirm the presence/absence at the facility boundary and to check for alternate sources, up- or downgradient.
- The preliminary CSM figure detailed the surface water flowing towards Annsville Creek Impoundment and the Hudson River. Groundwater was inferred to flow similarly, towards south-southwest.
- The current understanding of the CSM is that there are potentially complete pathways between the potential source areas and human receptors.

Camp Smith Training Site SI Approach (Slides 31-36):

- The scope of work for the SI was presented. Soil borings will be installed at locations downgradient of potential source areas. The soil borings will be converted to temporary wells, and both soil and groundwater samples will be collected. Three soil samples will be taken from each boring, one at the

surface, one at the midpoint, and one above the water table. Surface water and sediment samples will be collected from tributaries flowing to Dickiebusch Lake and along Putnam Brook.
    - Discussions regarding influence from Wallace Pond (north of Camp Smith) occurred and whether one of the sampling locations should be re-located in response. Due to a groundwater divide, topography, hydrogeology, and surface water flow in this area, it was determined that Wallace Pond is likely not contributing anything to Camp Smith, as it is downgradient.
    - DMNA asked if sampling could be conducted at Wallace Pond. Dr. Packer responded it could, but not during the SI, as it would be more pertinent information during a potential RI.
    - Pertinent discussions regarding surface water included information provided by Mr. Sean Martin (Camp Smith Training Site): a culvert exists exiting Dickiebusch Lake; a report conducted on-site concluded that water from the Hudson River was not influencing groundwater on the facility. NYARNG has stated that they are working to make the referenced historical report available to AECOM.
    - DMNA asked about possible degradation of PFAS in the environment. Dr. Packer explained that they are extremely persistent due to the strength of the carbon-fluorine bonds. Discussion ensued between participants regarding the persistence.
    - NYSDOH and NYSDEC agreed that they would look for any available PFAS data upgradient of Camp Smith.
- The planning and sampling overview was described. Programmatically, it is standard for each AOI to have two soil borings/temporary monitoring wells. Ms. Perrigo explained that the target depths for borings and groundwater wells were based on what was found in historic records regarding depth to groundwater, and that while it was known that there was a clay confining unit around the southern boundary of the facility, it was unclear how far this unit extended into the facility. Clarification was provided that the field geologist would be able to identify as the soil cores were being pulled if there was a confining layer and that only through drilling the soil borings would we get a better understanding about the potential confining unit's extent.
- The PFAS analyte list, which includes 18 PFAS compounds, was presented. All data will undergo Level IV data review. NYSDEC asked why we were proposing 18 analytes and not 21. The response was that those 18 analytes was sufficient to determine presence/absence of PFAS and that if the site was recommended for RI, 24 analytes would then be included in the analyte list.
- A general outline of the schedule was presented. The Draft Final UFP-QAPP was provided for regulatory review in June 2019. Comments were request by 19 July 2019. The field investigation is tentatively planned for August 2019.
- NYSDOH questioned why the PA identified four wells on the facility but there was only sampling data provided for Wells A and B. It was clarified by Camp Smith staff that the other two wells the PA mentions are not active, potable, wells, but are under ARNG control. It was determined that site reconnaissance and further investigation would be done to identify more about these other two wells. AECOM is to provide clarification in the Final UFP-QAPP.
- Site reconnaissance was proposed following the presentation to review the proposed sampling locations and refine the locations with ARNG, USACE, DMNA, NYARNG, NYSDEC, and NYSDOH concurrence.

Open Discussion:

- Stakeholder involvement and open communication was encouraged through the TPP meeting.
    - NYSDEC verified that submission of documents through AMRDEC-SAFE worked previously and would be sufficient for any additional document submittals.

The presentation ended at 1120. Site reconnaissance was conducted shortly after to review the proposed sampling locations.

Site Reconnaissance:

- During site reconnaissance, several field optimizations were made and sampling locations were shifted. All parties in attendance expressed agreement regarding the proposed changes. All TPP participants joined the site reconnaissance. Due to active live fire arms training, the group's movement was contained to restricted areas during site reconnaissance. AECOM noted that the site

specific health and safety plan would require additional information regarding safety protocols related to restricted areas due to live fire arms training.

- Site reconnaissance commenced south of Dickiebusch Lake to view the surface water inlet and outlet. The inlet was noted to be receiving from an intermittent stream where proposed sampling point CS-SW/SD04 was located. The outlet was noted to release into a culvert that flowed towards proposed sampling point CS-SW/SD03. From there, the group moved to one of the former wells, located east of the southern point of Dickiebusch Lake. The well driller's information was identified on the stickup portion of the well. Major Clark called the number posted, but the number was out of service. Inside the well cap, it was identified that the well was originally drilled to 141 feet deep.
- The group moved north to the former fire pit (AOI 1).
    - During the walk to this location, Ms. Kuehner (NYSDOH) raised questions about drinking water wells A & B. Mr. Martin responded that the two drinking water wells run alternating, and that it is rare that they run at the same time. The water from the wells is chlorinated and softened, but not filtered.
- Visual inspection of AOI 1 showed highly disturbed earth with a small pond with flora and fauna in the center. Wet, vegetated area surrounds the AOI to the north and northeast. Major Clark noted that the highly disturbed area is often used as a training area for engineers: they come out and dig holes and move soil around. Stakeholders agreed that the proposed soil boring/monitoring well location AOI1-SB1/GW1 would be moved southwest of its originally proposed location, into the middle of the former fire pit, based on historic aerial imagery.
- NYSDEC, NYSDOH, DMNA, NYARNG and AECOM moved north towards AOI1-SB3/GW3, CS-SW/SD01 and CS-SW/SD02 but were required to stop at a gate south of these locations and discuss the points from there. It was determined that due to topography, bedrock outcrops and potential access issues, the proposed location of AOI1-SB3/GW3 would be adjusted to a location just east of the access road: south of the sign that could be seen from the gate. In terms of accessibility and scheduling for SI field work, Major Clark said that Mondays are generally quiet and that September 15 – October 15 would probably be best to avoid accessibility and scheduling conflicts.
- The group moved back south and reconvened near the proposed location of AOI1-SB2/GW2. Stakeholders decided that this location would likely need to be adjusted to be downgradient of AOI 1, based on historic aerial imagery of the former fire pit along with the understanding of groundwater flow direction.
- The group then drove down towards proposed sampling location CS-SW/SD04. This location was slightly adjusted to correctly align with the culvert outlet location. Accessibility for obtaining samples was noted to be easier from the east side of the outlet due to surface grade. Surface water was observed to be flowing southeast in the small branch connecting the upstream tributary of Putnam Brook towards Putnam Brook, just west of the proposed location of CS-SW/SD04. This branch, along with the branch flowing north towards Dickiebusch Lake, where proposed sample CS-SW/SD/03 is located, were described by Mr. Martin to be intermittent streams.
    - New stormwater retention basins were noted just east of CS-SW/SD04. The aerial photography did not previously identify these locations. Major Clark indicated that at one point, this area was used to wash field artillery horses.
- Dr. Packer suggested the group drive around to the south of the retention basins in order to assess the potential for placement of a downgradient sampling location from the former NYS Fire Inspection Agency (AOI 3). The group then proceeded to drive around and park east of the new CSMS building and walk between the firing range berm and the fence. All parties agreed that a soil boring/monitoring well sampling location would be best suited within the grassy area just northeast of the berm. This newly proposed location would be AOI3-SB2/GW2. AECOM noted that the drilling subcontractors would need to be contacted to ascertain a rig would be able to fit within the space between the berm and the fence (approximately 10').
- Camp Smith staff identified that the proposed sampling location of AOI3-SB1/GW1 would not be beneficial as a sampling location downgradient of the former airfield, as the airfield's southern boundary was west of Camp Smith Road, not east of Camp Smith Road. Camp Smith staff also noted that the location as proposed would not be possible due to the amount of underground utilities associated with Building 500.

- The group then walked south towards the southern boundary of the former airfield (AOI 3). Major Clark said that southern boundary coordinates of the former airfield were available and that he could provide those in order to appropriately place a downgradient sampling location. In the interim, AOI3-SB1/GW1 was relocated in the grassy area just west of Camp Smith Drive and north of the parking lot.
    - The parking lot west of Camp Smith Drive was indicated by Camp Smith staff as the appropriate staging location for field activities. The proposed decontamination water sample was collected from a hose within this parking lot.
- The group drove to the former fire station location (AOI 2). The area is currently a paved parking lot surrounded by a bedrock outcrop to the northeast and east. Discussion regarding proposed sampling location AOI2-SB1/GW1 resulted in the decision that it was not a viable location for drilling due to the geology. Camp Smith staff indicated that the pavement in this location was thicker than normal roads with rebar underneath in order to support the weight of tanks; therefore drilling through the pavement would not be a viable option either. It was determined and agreed that only one soil boring/monitoring well location was required for this AOI and that the proposed AOI2-SB1/GW1 location would replace the proposed AOI2-SB2/GW2 location.
    - Camp Smith staff indicated that underground utilities existed en masse outside of the fence line near the newly proposed AOI2-SB1/GW1 sampling location and therefore would either require air-knifing, hand-augering, or relocation to inside of the fence line.
- The group then drove to the parking lot west of Camp Smith Drive to visually inspect the stream channel and proposed sampling location CS-SW/SD05. It was noted that access to proposed sampling location would be easiest by going north of and around the northwest side of the firing range berm; following the stream channel to the point of sampling. All parties agreed that surface water and sediment would be collected in a location within the stream channel where smaller sediments, rather than pebbles and rocks, could be collected.
- USACE, Camp Smith staff, and DMNA concluded their portion of the site reconnaissance and left the facility. ARNG-IED, NYSDEC, NYSDOH, and AECOM were led by Mr. Martin to the well located at the Post Office building. The well driller's information was located on the stickup, though no other identifying information was observed.
- ARNG-IED, NYSDEC, NYSDOH and AECOM reconvened with Mr. Martin and Major Clark at Building 501 to summarize the proposed changes discussed in the field.
    - A large-scale map for markup was provided. Ms. Perrigo led the discussion to obtain verbal agreement from all parties on each proposed change, starting from the northern-most proposed sampling point and working southwards. All parties were in agreement on the proposed changes, and NYSDOH took photos of the marked up map. AECOM agreed to provide an updated figure to NYSDOH and NYSDEC by close of business 19 July 2019.
    - Due to the intermittent status of the stream where proposed sample CS-SW/SD03 is located, NYSDEC and NYSDOH agreed that if this sample could not be collected during field activities, they were agreeable to it being passed on for a total of four surface water/sediment sampling locations.
- TPP 1 and 2 and associated site reconnaissance concluded at 1430.

Attachment A - TPP 1 & 2 Sign-In Sheet

SIGN-IN SHEET
Site Inspection - Camp Smith Training Facility
Technical Project Planing Meetings 1 and 2
Cortlandt, New York
Wednesday July 10, 2019

Name	Organization/Role	Phone	Email
Bonnie Packer	ARNG ILE	703 607 7977	bonnie.m.packer.civ@mail.mil
CPT PAMELA HESS	ARNG - ILE	703-601-16819	pamela.s.hess.mil@mail.mil
Daniel Tucholski	NYS DOH	~~518-486-7816~~ ~~861-416-0150~~	daniel.tucholski@health.ny.gov
Wendy Kuehner	NYSDOH	518-402-7860	Wendy.kuehner@health.ny.gov
John Swartwout	NYSDEC	518-402-9620	john.swartwout@dec.ny.gov
Dan Lemmers	NYSDEC	518-402-8452	daniel.lemmers@dec.ny.gov
Pete Jensen	DMNA	518 786 4548	cole.p.jensen.nfg@mail.mil
Greg Austin	DMNA	518-786-4718	gregory.t.austin.nfg@mail.mil
Gary Yaple	DMNA	518 786 4605	gary.s.yaple.nfg@mail.mil
MICHAEL GIERANTOWSKI	CSTS / OC	914 945 7531	MICHAEL.J.GIERANTOWSKI.NFG@MAIL.MIL
TIM CONNORS	CSTS DIRECTOR	914-945-7530	TIMOTHY.P.CONNORS2.NFG@MAIL.MIL
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Brooke Perrigo	AECOM	518-265-0646	brooke.perrigo@aecom.com
Robert Zizolfo	Camp Smith	914-945-7453	robert.zizolfo.mil@mail.mil
Tim Peck	USACE	410-962-3416	timothy.j.peck@usace.army.mil
KIM BERG	USACE	410-962-3656	KIMBERLY.A.BERG@USACE.ARMY.MIL

Attachment B - TPP 1 & 2 Briefing Slides


Camp Smith Training Facility - Site Inspection
New York Army National Guard
Technical Project Planning (TPP) Meeting 1 and 2
Preliminary Assessments and Site Inspections
(PA/SI) for Perfluorooctanesulfonic Acid (PFOS) and
Perfluorooctanoic Acid (PFOA) Impacted Sites
July 10, 2019
AECOM
1
July 2019

Agenda

- Introductions
- Safety Moment
- TPP Meeting Goals
- Army National Guard (ARNG) PA/SI Overview
- Camp Smith PA Findings
- Camp Smith SI Overview
- Stakeholder Involvement
- Sample Location Refinement
- Questions and Open Discussion

Introductions

- ARNG-Installation and Environment Directorate (IED), Cleanup & Restoration Branch
  - Captain Pamela Hess, Toxic Release Program Manager
  - Bonnie Packer, Nationwide Project Manager
- United States Army Corps of Engineers (USACE)
  - Tim Peck, Program Manager (Baltimore District)
- New York Army National Guard (NYARNG)
  - Pete Jensen, Environmental Branch Chief
  - Greg Austin, Senior Environmental Analyst
  - Tim Connors, Camp Smith Director
  - LTC Gieraltowski, Garrison Commander
  - Major Clark, Installation Engineering
  - Sean Martin, Environmental Manager
- New York State Department of Environmental Conservation (NYSDEC)
  - John Swartwout
  - Dan Lanners
- New York State Department of Health (NYSDOH)
  - Wendy Kuehner
- Westchester County Department of Health (DOH)
  - Delroy Taylor
- AECOM Technical Services, Inc.
  - Mike Myers, PA Task Manager
  - Brooke Perrigo, SI Task Manager

Safety Moment

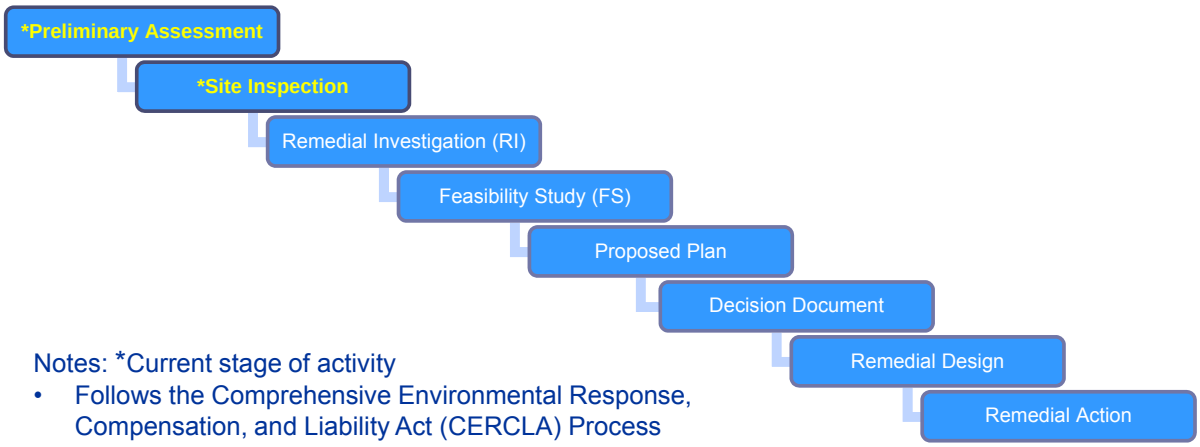
- SI will follow USACE Engineering Manual (EM) 385-1-1 requirements:
  - Accident Prevention Plan (APP) addresses all component plans for EM 385-1-1, including Construction Support during drilling operations
  - Site Specific Health and Safety Plan (SSHP) addresses project participants, training, and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

TPP Meeting Goals

- TPP1: Discuss ARNG PA/SI Program
  - Provide an overview of the ARNG PA/SI Program
  - Define objectives for SI data collection
  - Encourage stakeholder involvement
  - Review project schedule
- TPP2: Discuss proposed SI approach
  - Provide an overview of PA findings
  - Present Conceptual Site Model (CSM) and Data Quality Objectives (DQOs)
  - Present SI approach
- TPP3: Discuss SI findings
- Participants:
  - TPP1 and 2: ARNG-IED, NYARNG, USACE, NYSDEC, NYSDOH, Westchester County DOH, AECOM
  - TPP3: ARNG-IED, USACE, NYARNG, NYSDEC, NYSDOH, Westchester County DOH, AECOM, other local stakeholders

ARNG PA/SI Overview

Work Phases



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
- Restoration Advisory Board is typically solicited at RI/FS Phase
- The steps beyond RI will depend on development of regulatory risk framework for Per- and Polyfluorinated Alkyl Substances (PFAS)

ARNG PA/SI Overview

ARNG Program

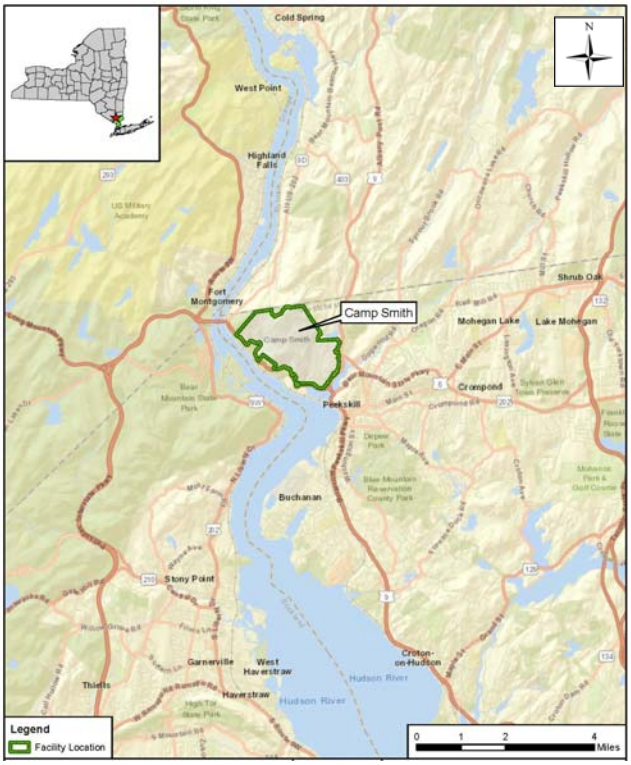
- Activities centrally contracted through USACE and managed by ARNG-IED
  - USACE Baltimore manages the contract, with project support from Sacramento and Omaha Districts
  - Project support: chemistry, geology, risk assessment
- PA ranking (~200 facilities) - state ARNG input
  - Likelihood of release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

ARNG PA/SI Overview

Roles in PA/SI

- State ARNG Role for the PA
  - Identify potential PFAS release locations
  - Provide ARNG personnel and facility access
  - Gather and provide appropriate documents
  - Identify/schedule personnel to interview
  - State ARNG provides final PA to the regulatory agencies
- SI Regulatory Involvement
  - CERCLA SI conducted in conjunction with the appropriate regulatory agency

Camp Smith PA Findings

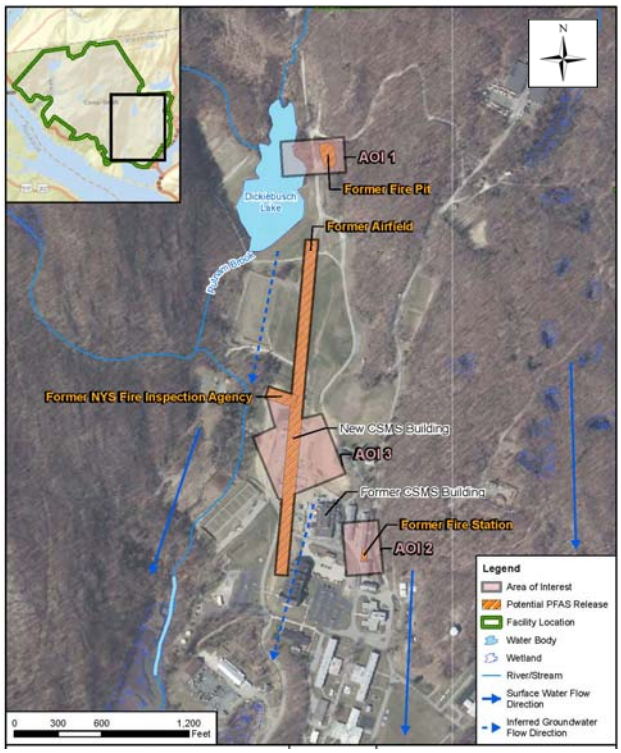


Camp Smith PA Findings

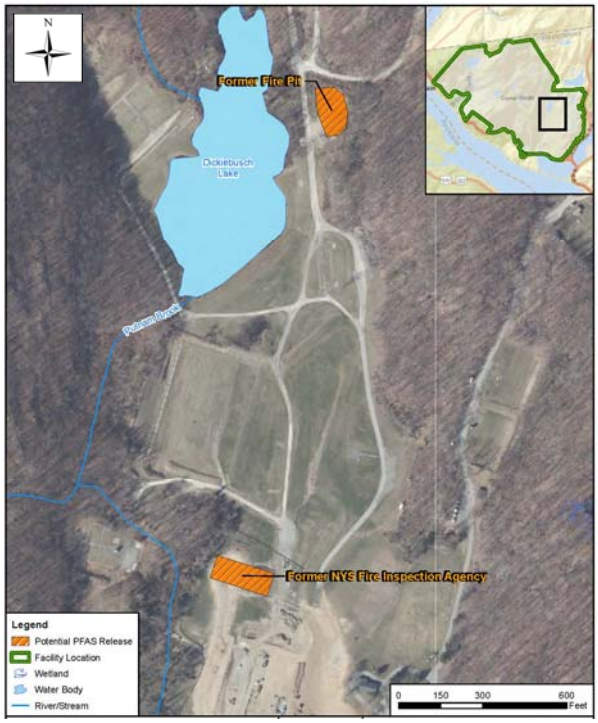
- Reviewed data resources to obtain information relevant to suspected PFAS releases
- Conducted a 1-day site visit that included visual site inspections at known PFAS locations on 28 June 2018, and documented with photographs
- Interviewed current and retired NYARNG Camp Smith personnel during the site visits:
  - Sean Martin (Environmental Manager), Chief Warrant Officer William Viana (Maintenance Supervisor), Colonel Scott Cleveland (Construction and Facilities Management Officer), Michael Morley (Maintenance Equipment Mechanic), Edward Stradford (Sanitation Superintendent) and Tim Connors (Camp Smith Director)
- Identified three AOIs

Camp Smith PA Findings

Summary of Findings and AOIs



Camp Smith – PA Findings
Fire Training Areas



Camp Smith PA Findings
Former Fire Pit

- Former live fire training exercise area
  - Bare earthen patch and paved over multiple times in the past
  - Monthly frequency of fire training
  - Presence/use of aqueous film forming foam (AFFF) during exercises possible, not confirmed

Aerial imagery source:
Google Earth, 2018

Camp Smith PA Findings

Former NYS Fire Inspection Agency

- Activities included: classroom training, fire services, forensics, and arson investigation
  - Unknown if fire training with AFFF occurred
  - No documented storage, discharge, use, incidents or releases of AFFF
  - Soil from this area used in foundation of the new CSMS building

Camp Smith PA Findings
Non-Fire Training Areas

Camp Smith PA Findings

Former Combined Support Maintenance Shop

- Previously located adjacent to the Former Fire Station (1976 – 2018)
- 2009 NYARNG Camp Smith Standard Operating Procedure mandated that firefighting equipment be stored on-site and ready for use during refueling activities, but no firefighting equipment was observed during the visual site investigation
- No documented storage, discharge, use, incidents or releases of AFFF

Camp Smith PA Findings
Former Fire Station

- Active between 1980 – 1996
  - 1996 - Building torn down, replaced with parking lot
- Two fire trucks parked at Former Fire Station
- No documented storage, discharge, use, incidents or releases of AFFF

Camp Smith PA Findings
Former Airfield

- Constructed after 1955 but before 1960 and removed late 1970s
- Possibly active during Korean and Vietnam Wars
- No documented storage, discharge, use, incidents or releases of AFFF
- No suspected releases, although historic aircraft activities occurred

Camp Smith PA Findings

Emergency Response Areas and Adjacent Sources

- No emergency responses identified during PA interviews
  - Since 1996, firefighting support provided by Continental Village Fire Department, ~2.25 miles north of Camp Smith
- Off-site adjacent sources not identified during PA

Camp Smith PA Findings

Uncertainty

Area of Interest	Source of Uncertainty
AOI 1 **Former Fire Pit**	No or limited information was available on type/quantity of AFFF used; dates of operation; frequency of training exercises; whether AFFF was used or just water; and only one person was available for interview during the VSI.
AOI 2 **Former Fire Station**	No or limited information was available on the dates of operation; type of firefighting equipment used; or if AFFF was ever stored, discharged, or used.
AOI 3: **Former Airfield/Former NYS Fire Inspection Agency**	Former Airfield: No or limited information was available during the PA. There are no documented emergency response incidents, crashes/accidents, flight-line fire training, or use of AFFF. Former New York State Fire Inspection Agency: No or limited information was available on dates of operation, frequency of training activities, type/quantity of AFFF use; only one person had any knowledge that this facility ever existed.
General	A previous investigation (NYARNG, 2015) indicates that there may be a clay confining layer separating surface water from the deep water aquifer. The deep water aquifer is used at Camp Smith as a drinking water source. This confining unit, acting as a natural aquitard may prevent the migration of potential PFAS contamination to the confined deep aquifer. However, the extent of the confining layer is unknown.
	The PFAS detections in drinking water wells may be from an upgradient source (on-site or off-site).

Camp Smith PA Findings

Previous Investigations

- Drinking water wells: Well A & Well B
  - 4 rounds of quarterly sampling for PFAS (April 2017, August 2017, November 2017, February 2018) from spigot and tap of buildings within 100 ft of wells
- PFAS consistently detected below USEPA Drinking Water HA of 70 ppt
  - Highest detection in individual well samples: 49.9 ppt (PFOS, August 2017); in blended well samples: 51 ppt (PFOS, November 2017)

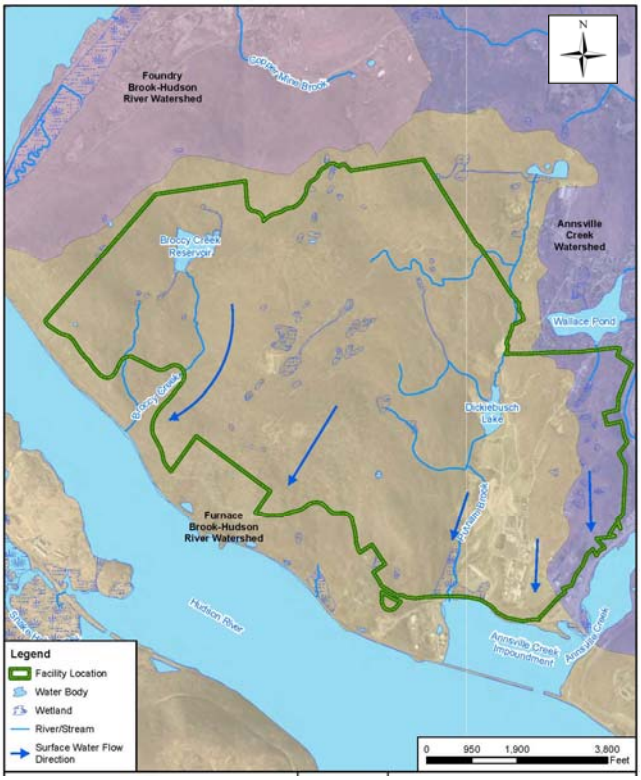
	Highest Quarterly Concentration in ppt	
	PFOS	PFOA
Well A	49.9	4.35 J
Well B	49.6	3.76 J
Blended Sample	51	5.22 J

Camp Smith SI Overview
Data Quality Objectives

- Primary SI DQOs
  - Determine the presence / absence of a release
  - Gather data for conceptual site model
    - Source-Pathway-Receptor relationships
- Enhanced SI DQOs
  - Check for the presence/ absence at facility boundary
  - Check for alternate sources, up- or downgradient

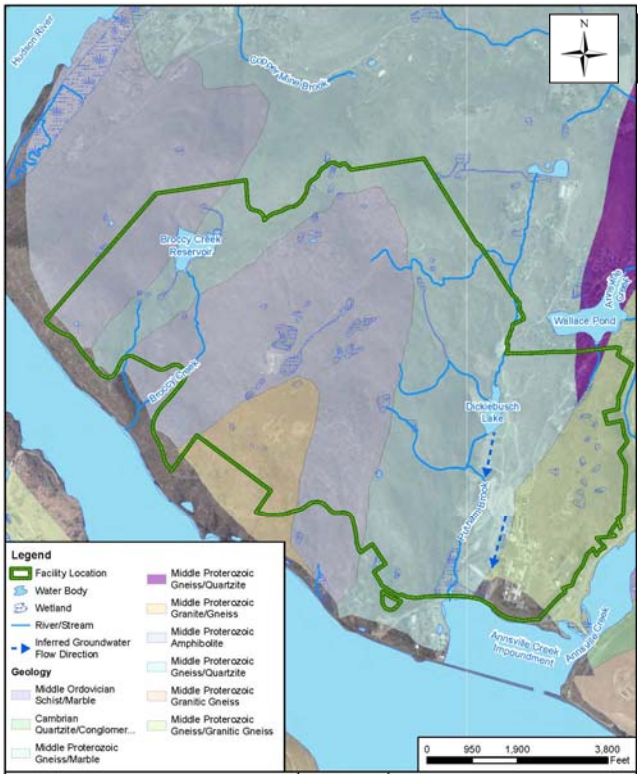
Camp Smith SI Overview

Conceptual Site Model - Surface Water Features



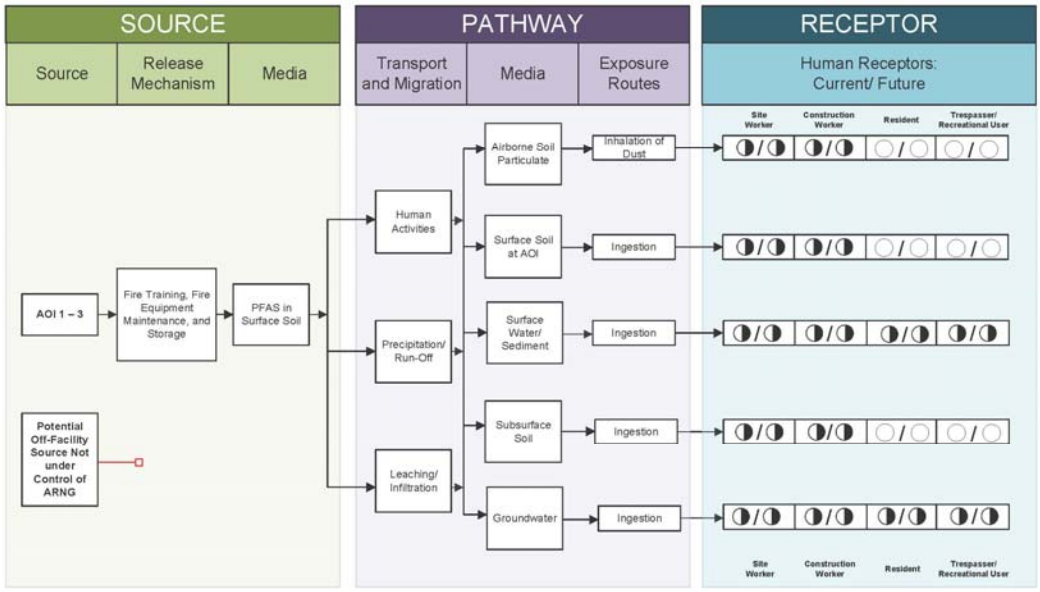
Camp Smith SI Overview

Conceptual Site Model - Groundwater Features



Camp Smith SI Overview

Conceptual Site Model



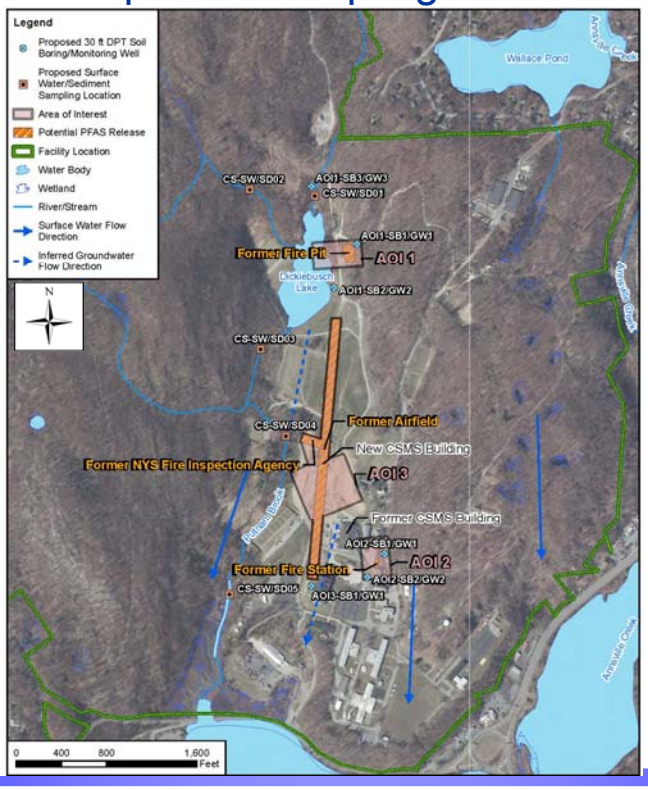
Camp Smith SI Overview

Planning and Sampling

- Finalize Work Plan and Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP)
- Install temporary monitoring wells downgradient of potential source areas and/or at the facility boundary
- Continuous soil cores to target depth (soil samples collected at surface, mid point, above water table)
- Collect surface water and sediment samples in surface water flowing into and out of Dickiebusch Lake and along Putnam Brook

Camp Smith SI Approach

Proposed Sampling Locations



Camp Smith SI Overview

Planning and Sampling

AOI	# of Boring Locations	Target Depth(s) for Borings (ft)	Soil Samples (3 per boring)	Target Interval(s) for GW samples (ft)	Grab Groundwater Samples (1 per boring)	Surface Water Samples	Sediment Samples
1	3	30	9	25-30	3	0	0
2	2	30	6	25-30	2	0	0
3	1	30	3	25-30	1	0	0
Various (Upgradient & Downgradient)	-	-	-	-	-	5	5

Camp Smith 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 (PFPA)
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)

- All data will undergo Level IV data validation

Stakeholder Involvement

- Use TPPs and open communication to encourage involvement
- Key involvement topics
  - Proposed approaches
  - Document review time for NYSDEC and other stakeholders
- Schedule:
  - UFP-QAPP: Draft-Final for regulatory review in June 2019
  - Comments requested: 19 July 2019
  - Field Investigation: August 2019

Sample Location Refinement

- Visual reconnaissance of sample locations
- Confirm placement is accessible and will meet DQOs
- Relocate if required, with ARNG-IED, USACE, NYARNG, and NYSDEC concurrence

Questions and Open Discussion

- Coordination
  - Data transfer
  - Report distribution (paper, electronic, portable document format)
- Schedule
  - Revision and finalization of UFP-QAPP (July 2019)
  - Field execution (August 2019)
  - Data validation of sampling results (October 2019)
  - SI Report preparation and review
  - TPP 3: discussion of field results with stakeholders

Acronyms

- AFFF – aqueous film forming foam
- AOI – area of interest
- APP – Accident Prevention Plan
- ARNG – Army National Guard
- ARNG-IED – ARNG Compliance & Cleanup Branch
- CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
- CSM – Conceptual Site Model
- CSMS – Combined Support Maintenance Shop
- DOH – Department of Health
- DQO – Data Quality Objective
- EM – Engineering Manual
- NYARNG – New York ARNG
- 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
- SSHP – Site Specific Health and Safety Plan
- TPP – Technical Project Planning
- UFP-QAPP – Uniform Federal Policy Quality Assurance Project Plan
- USACE – United States Army Corps of Engineers