FINAL
PRELIMINARY ASSESSMENT AND SITE INSPECTION OF PER- AND POLYFLUOROALKYL SUBSTANCES

Camp Frank D. Merrill, Georgia

Prepared For:
U.S. Army Corps of Engineers, Baltimore District
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Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

Camp Frank D. Merrill, Georgia

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CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

The United States Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The PA identifies areas of potential interest (AOPIs) where PFAS-containing materials were used, stored, and/or disposed, or areas where known or suspected releases to the environment occurred. The SI includes multi-media sampling at AOPIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required. This Camp Frank D. Merrill (Camp Merrill) PA/SI was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, National Oil and Hazardous Substances Pollution Contingency Plan, and Army/Department of Defense policy and guidance.

Camp Merrill occupies 282 acres within the Chattahoochee National Forest, in Lumpkin County, Georgia near the southern tip of the Appalachian Trail. The property is bounded on all sides by undeveloped land within the Chattahoochee-Oconee National Forests. The installation lies approximately 10 miles northwest of the city of Dahlonega and approximately 75 miles northeast of Atlanta, Georgia.

The Camp Merrill PA identified two AOPIs for investigation during the SI phase. SI sampling results from the two AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, and PFBS. PFOS, PFOA, and/or PFBS were detected in soil and/or groundwater at all of the AOPIs; one of the two AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The Camp Merrill PA/SI identified the need for further study in a Comprehensive Environmental Response, Compensation, and Liability Act of 1980 remedial investigation. **Table ES-1** below summarizes the PA/SI sampling results and provides recommendations for further study in a remedial investigation or no action at this time at each AOPI.

Table ES-1. Summary of AOPIs Identified during the PA, PFOS, PFOA, and PFBS Sampling Camp Merrill, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND)			Recommendation
	GW	SO	SW	
Building 2 – Fire Station #7	Yes	No	ND	Further study in a remedial investigation
Building 125 and Former Sewage Lagoon	No	ND	ND	No action at this time

Notes:
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
ND – non-detect
SO – soil
SW – surface water

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12580 and is conducting the PA/SI consistent with its authority under CERCLA, 42 U.S. Code §§ 9600, et seq. (as amended), and the Defense Environmental Restoration Program, 10 U.S. Code §§ 2701, et seq. The PFAS PA/SI included two distinct efforts. The PA identified locations that are areas of potential interest (AOPIs) at Camp Frank D. Merrill (Camp Merrill) based on the use, storage and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of PFAS (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the PFOS, PFOA, and PFBS results were compared to the Office of the Secretary of Defense (OSD) PFOS, PFOA, and PFBS risk screening levels to determine whether further investigation is warranted. This report provides the PA/SI for Camp Merrill and was completed in accordance with CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan.

1.1 Project Background

PFAS are a class of compounds that have been used in a wide range of industrial applications and commercial products due to their unique surface tension/leveling properties. Due to industry and regulatory concerns about the potential health effects and adverse environmental impacts, there has been a reduction in the manufacture and use of PFAS worldwide. In the U.S., significant reductions in the production, importation, and use of PFOS and PFOA (two individual compounds in the PFAS class) occurred between 2001 and 2015 (Interstate Technology Regulatory Council 2017). PFBS replaced PFOS in some applications and is currently used and manufactured in the U.S.

In 2016, the U.S. Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016). On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water and soil, calculated using the USEPA's Regional Screening Level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 08 April 2021, USEPA published an updated toxicity assessment for PFBS (USEPA 2021). Based on the updated toxicity assessment for PFBS, the OSD issued a memorandum on 15 September 2021 to include updated PFBS risk screening levels (OSD 2021). The September 2021 Memorandum: Investigating PFAS within the DoD Cleanup Program is provided for reference as **Appendix A**. The OSD risk screening levels for tap water (also used to evaluate groundwater or surface water used as drinking water sources) are 40 ng/L for PFOS and PFOA, and 600 ng/L for PFBS. The PFOS and PFOA soil screening levels for the residential and industrial/commercial scenarios are 0.13 milligrams per kilogram (mg/kg; residential) and

1.6 mg/kg (industrial/commercial). The soil screening levels for PFBS are 1.9 mg/kg (residential) and 25 mg/kg (industrial/commercial). These screening criteria are discussed further in **Section 6.5**.

1.2 PA/SI Objectives

This PA/SI was conducted consecutively because the results of the PA yielded AOPIs that necessitated continuing onto the SI phase in accordance with CERCLA. Consequently, this report provides the combined objectives of both PA and SI reports.

1.2.1 PA Objectives

During the PA, investigators collect readily available information and conduct site reconnaissance. This PA will evaluate and document areas where PFAS-containing materials were used, stored, and/or disposed, so the Army can distinguish between sites that pose little or no threat to human health and the environment and sites that require further investigation.

1.2.2 SI Objectives

An SI is conducted when the PA determines an AOPI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at AOPIs to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required.

Installation-specific data quality objectives (DQOs) and the sampling design and rationale are summarized in **Sections 6.1** and **6.2**, respectively.

1.3 PA/SI Process Description

For Camp Merrill, PA/SI development followed the process as described below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for Camp Merrill. The PA and SI processes are documented in the PA/SI Quality Control (QC) Checklist included as **Appendix B**.

1.3.1 Pre-Site Visit

First, an installation kickoff teleconference was held between applicable points of contact (POCs) from U.S. Army Environmental Command (USAEC), U.S. Army Corps of Engineers (USACE), Camp Merrill, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 30 April 2020, four months before the site visit to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

Records review was conducted before the site visit to obtain electronically available documents from the installation and external sources for review. The purpose of the records research was to identify any area on the installation that may have been a location where PFAS-containing materials were used, stored, and/or disposed, as well as to gather information on the physical setting and site history at Camp Merrill.

A read-ahead package was prepared and submitted to the appropriate POCs two months before the site visit. The read-ahead package contains the following information:

- The Installation Management Command operation order.
- The Army PA Operations Security requirements package, which includes the antiterrorism/operations security review cover sheet (**Appendix C**).
- The PFAS PA kickoff call minutes.
- An information paper on the PA portion of the Army's PFAS PA/SI.
- Contact information for key POCs.
- A list of the data sources requested and reviewed.
- A list of preliminary locations identified during the kickoff call and pre-site visit records review to be evaluated for use, storage, and/or disposal of PFAS-containing materials, where additional information on those areas will be collected through personnel interviews, additional document review, and site reconnaissance.
- A list of roles for the installation POC to consider when recommending potential interviewees.

1.3.2 Preliminary Assessment Site Visit

The site visit was conducted on 25 August 2020. An in-brief meeting was held to provide installation staff with the objectives of the site visit and team introductions. **Section 3.2** includes information regarding personnel interviewed.

Personnel interviews were conducted with individuals having significant historical knowledge at Camp Merrill. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, and corroborating other interviewees' information.

Site reconnaissance included visual surveys that assessed the points of potential use, storage, and/or disposal of PFAS-containing materials, as well as potential secondary impacts, and the migration potential from each AOPI (e.g., stormwater drains, building drains and sumps, cracks in the floor/pavement). Physical attributes of the preliminary locations were documented, including local slope and ground and floor conditions (i.e., paved, unpaved, visual staining), surface water bodies and surface flow, potential receptors, and the distance to the installation boundary. Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for SI sampling. Photo documentation of the preliminary locations was collected, and access limitations or advantages related to potential future sampling activities were noted.

An exit briefing was offered to installation personnel at the conclusion of the site visit to raise any items identified during the site visit, discuss any follow-up items, and review the schedule for submitting deliverables. The installation declined an exit briefing.

1.3.3 Post-Site Visit

Information collected before, during, and after the site visit was reviewed and corroborated by cross-referencing records and reviewing interview details and observations noted during site visit reconnaissance. A site visit trip report was completed and provided to the installation POC, applicable USAEC POCs, and USACE regional POCs following the site visit. The information collected during the pre-site visit and site visit activities was compiled to develop the installation-specific PA portion of the PA/SI report (**Section 3**). Site data obtained during the PA were used to develop preliminary conceptual site models (CSMs) for each AOPI, which serve as the basis for developing the SI scope of work presented in an installation-specific Quality Assurance Project Plan (QAPP) Addendum.

1.3.4 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFOS, PFOA, and PFBS presence or absence at each AOPI and determine whether further investigation is warranted. First, an SI kickoff teleconference was held between the Army PA team and Camp Merrill.

The objectives of the SI kickoff teleconference were to:

- Discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI
- Gauge regulatory involvement requirements or preferences
- Identify overlapping cultural resource areas
- Confirm the plan for investigation derived waste (IDW) handling and disposal
- Identify specific installation access requirements and potential schedule conflicts
- Discuss general SI deliverable and field work schedule information and logistics

Following development of the SI sampling technical approach, an SI scoping teleconference was held to obtain concurrence on the SI sampling plan from USAEC, USACE, and the installation. Additional discussion topics included:

- Provide an updated SI deliverable and field work schedule

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 2019). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and QC activities for the SI portion for Army installations nationwide. Additionally, an installation-specific QAPP Addendum was developed to define the DQOs, present the sampling design and rationale, and provide qualifications for project personnel. The SI field work was completed in accordance with the PQAPP (Arcadis 2019) and the approved installation-specific QAPP Addendum. A Site Safety and Health Plan (SSHP) was also developed as an attachment to the QAPP Addendum to identify specific health and safety hazards that may be encountered at the installation during sampling. The SSHP was designed to supplement the Accident Prevention Plan (Arcadis 2018), which was developed for Army installations nationwide. The QAPP Addendum and SSHP were submitted to the installation and finalized before commencement of field work.

The DQOs, sampling design and rationale, and field methods employed for the SI are summarized from the QAPP Addendum developed for Camp Merrill (Arcadis 2021) in **Sections 6.1** through **6.3**.

After finalization of the QAPP Addendum and SSHP, field planning and coordination with the installation and subcontractors was completed. Once the schedule was determined, field teams mobilized to the installation to complete the scope of work defined in the QAPP Addendum.

1.3.5 Data Analysis, Validation, and Reporting

Environmental samples collected during the SI were submitted to a laboratory which is DoD Environmental Laboratory Accreditation Program (ELAP)-accredited for PFOS, PFOA, and PFBS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.3 (DoD and Department of Energy 2019). Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of OSD risk screening levels (defined in **Section 6.5**).

2 INSTALLATION OVERVIEW

The following subsections provide general information about Camp Merrill, including the location and layout, the installation mission(s) over time, a brief site history, current and projected land use, climate, topography, geology, hydrogeology, surface water hydrology, potable wells within a 5-mile radius of the installation, and applicable ecological receptors.

2.1 Site Location

Camp Merrill occupies 282 acres within the Chattahoochee National Forest in Lumpkin County, Georgia, near the southern tip of the Appalachian Trail. The property is bounded on all sides by undeveloped land within the Chattahoochee-Oconee National Forests. The installation lies approximately 10 miles northwest of the city of Dahlonega and approximately 75 miles northeast of Atlanta, Georgia. The site location is shown on **Figure 2-1** and the installation layout, including approximate groundwater and surface water flow directions is shown on **Figure 2-2**.

2.2 Mission and Brief Site History

Since 1951, the U.S. Army has occupied the property and used the land for training purposes under a Memorandum of Understanding and Special Use Permit between the U.S. Forest Service and the Department of Agriculture. For approximately the past 50 years, Fort Benning has operated Camp Merrill for mountain Ranger training. In 2015, Fort Benning took over ownership of the 282 acres known as Camp Merrill from the U.S. Forest Service. The transfer of the property was part of the National Defense Authorization Act for Fiscal Year 2015 (Public Law 113-291, Section 2836).

Camp Merrill became the home to the second phase, or Mountain Phase, of the U.S. Army Ranger training and is a sub-installation to Fort Benning, Georgia known as the 5th Ranger Training Battalion. The Mountain phase, the second of three Ranger training phases, is designed to enhance the soldiers' ability to plan and execute small unit combat missions in mountainous terrain. This phase covers mountaineering, small unit tactics, patrol infiltration, raids, ambushes, and other skills required for close combat and direct fire missions. The Ranger Camp and the Ranger personnel reside in Porter village, a military housing area, just west of the city of Dahlonega outside of the installation.

The primary mission of Camp Merrill is to serve as a major training area for the 5th Ranger Training Battalion, the U.S. Army Ranger School, other military units, civilian government agencies, and youth groups (Army 2020).

2.3 Current and Projected Land Use

The land use at Camp Merrill consists of a cantonment area, support facilities, a fire station, a drinking water treatment plant, a wastewater treatment plant, and dining facilities. Camp Merrill is home to the 5th Ranger Training Battalion and is utilized for a portion of the training requirements for the U.S. Army Ranger School. The surrounding area is heavily wooded and mountainous (TerraXplorations 2015).

2.4 Climate

The average annual temperature at Camp Merrill is a high of 69 degrees Fahrenheit (°F) and a low of 57°F. The warmest month is July averaging 75.5°F, the coldest is January averaging 39.2°F. Overall, it is a very moderate climate with four distinct seasons. The average annual rainfall is 64.29 inches, with the wettest month being in March with an average rainfall of 7.87 inches and the driest being October with an average of 3.48 inches (Army 2020).

2.5 Topography

Camp Merrill's topography is characterized by the Blue Ridge Mountains, located to the eastern and front range of the Appalachian Mountains. The highest elevations generally occur in the northwestern portion of the installation, with a gradual decrease in elevation towards the east, west, and south. Elevations at the site range from 1,640 to 1,900 feet above mean sea level (Directorate of Public Works [DPW] 2004). The topography at Camp Merrill is illustrated on **Figure 2-3**.

2.6 Geology

Camp Merrill lies within the Blue Ridge physiographic province of the Appalachian Mountains range, a mountainous belt stretching from Pennsylvania southwest to Georgia. The Blue Ridge mountains began forming during the Silurian Period. The basement complex of the Blue Ridge province is made compositionally of granitic intrusions, metamorphosed volcanic formations (gneisses and granitoids), overlain by sedimentary limestone in some areas (Leighty 2001). Soils identified at Camp Merrill are comprised of Tusquitee Series loam soils, which are characterized by deep, well drained soils formed in colluvium derived from materials weathered from igneous and high-grade metamorphic crystalline (U.S. Department of Agriculture 2015).

2.7 Hydrogeology

Based on analysis of topographic and elevation/contour maps, general groundwater flow on the subject property appears to be directed south, although the area in close proximity to the Etowah River likely drains into this river before moving southward.

2.8 Surface Water Hydrology

Surface water runoff on the Camp Merrill property flows towards the Etowah River. The Etowah River runs from north to south along the east site of Mosby Airfield toward the south end of the property. Surrounding watershed just outside of the Camp Merrill property include West Fork Montgomery Creek to the east, Montgomery Creek to the southeast, and Ward, Edmunston, and Two Run Creeks to the east-southeast (DPW 2004).

2.9 Relevant Utility Infrastructure

The following subsections provide general information regarding the installation's stormwater and wastewater management systems, as well as information on how the utility infrastructures may influence the fate and transport of PFAS constituents at Camp Merrill.

2.9.1 Stormwater Management System Description

Stormwater drainage at Camp Merrill is controlled through an extensive network of surface and subsurface conduits and culverts. All principal drainage channels flowing through the installation eventually discharge into the Etowah River. No documentation exists regarding stormwater outfalls in a 5-mile radius of Camp Merrill.

2.9.2 Sewer System Description

Wastewater generated at Camp Merrill is treated at the Camp Merrill Wastewater Treatment Plant (WWTP), Building 125. Sludge from the WWTP was historically disposed of at the Former Sewage Lagoon up until 2010 when the sludge and underlying native soils were removed from the lagoon and disposed of off-site, at the Advanced Disposal, Eagle Point Landfill. Since 2010, all biosolids from the Camp Merrill WWTP have been disposed of at the off-site Advanced Disposal, Eagle Point Landfill in Ball Ground, Georgia. The WWTP potentially received PFAS-containing waste drainage from the fire station. Discharge from the WWTP is used for land application and truck washing within the Building 2 - Fire Station #7 and the Former Sewage Lagoon AOPIs. Reuse water and pretreated processed wastewater discharge is regulated by the Georgia Department of Natural Resources, Environmental Protection Division under Land Application System Permit Number GAJ030727.

2.10 Potable Water Supply and Drinking Water Receptors

Drinking water at Camp Merrill is supplied by an onsite water treatment plant that surface extracts from the Etowah River. The water intake dam is just west and upstream of the water treatment plant as shown on **Figure 2-2**. This plant is government owned and operated. There are no on-post drinking water wells.

An Environmental Data Resources, Inc. (EDR) report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. An EDR report was generated for Camp Merrill, which along with state and county geographic information system provided by the installation identified one off-post public well within 5 miles of the installation boundary (**Figure 2-4**). The EDR report providing well search results provided as **Appendix E**.

2.11 Ecological Receptors

The PA team collected information regarding ecological receptors that was available in the installation documents. The following information is provided for future reference should the Army decide to evaluate exposure pathways relevant to the ecological receptors.

Camp Merrill and the surrounding forest lands form a core habitat area for many species of plants and animals, including state and federally threatened, endangered, and protected species. There are three

federal threatened or endangered species that have the potential to occur within Camp Merrill including: the Indiana Bat (*Myotis sodalis*), Etowah Darter (*Etheostoma etow ahae*), and Northern Long-eared Bat (*Myotis septentrionalis*) (DPW 2004).

Although Camp Merrill is located within the Chattahoochee-Oconee National Forests, many of the species that inhabit the area are unlikely to be found on Camp Merrill due to lack of suitable habitat (DPW 2004).

2.12 Previous PFAS Investigations

No previous (i.e., pre-PA) PFAS investigations relative to Camp Merrill, including both those conducted and not conducted by the Army, were conducted. Regardless, only data collected by the Army will be used to make recommendations for further investigation.

In response to the third Unregulated Contaminant Monitoring Rule (UCMR3) and Installation Management Command Operations Order 16-088, Army installations began initial PFAS sampling in 2015. The Army performed PFAS sampling in 2015 using method USEPA 537 at two locations taken post treatment at the Cherokee County Water Plant and the Hightower Water Treatment Facility; PFOS, PFOA, and PFBS were not detected. The laboratory which analyzed samples under UCMR3 met the USEPA's UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1. The UCMR3 data indicate that PFOS, PFOA, and/or PFBS were not detected in public water systems above the USEPA lifetime health advisory within a 20-mile radius of the facility.

3 SUMMARY OF PA ACTIVITIES

To document areas where any potential current and/or historical PFAS-containing materials were used, stored and/or disposed at Camp Merrill, data was collected from three principal sources of information and are described in the subsections below:

1. Records review
2. Personnel interviews
3. Site reconnaissance

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during records review, personnel interviews, and/or site reconnaissance) and were categorized as AOPIs or as areas not retained for further investigation at this time based on a combination of information collected (e.g., records reviewed, personnel interviews, internet searches). A summary of the observations made, and data collected through records reviews (**Appendix F**), installation personnel interviews (**Appendix G**), site reconnaissance photos (**Appendix H**), and site reconnaissance logs (**Appendix I**) during the PA process for Camp Merrill is presented in **Section 3**. Further discussion regarding rationale for not retaining areas for further investigation is presented in **Section 5.1**, and further discussion regarding categorizing areas as AOPIs is presented in **Section 5.2**.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program administrative record documents, compliance documents, Camp Merrill fire department documents, Camp Merrill DPW documents, and geographic information system files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for Camp Merrill is provided in **Appendix F**.

3.2 Personnel Interviews

Interviews were conducted during the site visit. The list of roles for the installation personnel interviewed during the PA process for Camp Merrill is presented below (affiliation is with Camp Merrill unless otherwise noted).

- District Fire Chief
- Fire Chief
- Restoration PM/Installation Restoration Program Manager
- Chief Water System/WWTP Operator, Jarrard Water Services
- Water/WWTP Operator, Jarrard Water Services
- Chief of Operations and Maintenance, DPW
- Hazard Officer

The compiled interview logs are provided in **Appendix G**.

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at Camp Merrill during the records review process, the installation in-brief meeting, and/or during the installation personnel interviews. A photo log from the site reconnaissance is provided in **Appendix H**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix I**.

Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for SI sampling.

4 POTENTIAL PFAS USE, STORAGE, AND/OR DISPOSAL AREAS

Camp Merrill was evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. There are a variety of PFAS-containing materials used in relation to current and historical Army operations. However, the use, storage, and/or disposal of aqueous film-forming foam (AFFF) is the most prevalent potential source of PFAS chemicals at DoD facilities. As such, this section is organized to summarize the AFFF-related uses first, and all remaining potential PFAS-containing materials in the subsequent section.

4.1 AFFF Use, Storage, and Disposal Areas

AFFF was developed in the mid-1960s in response to a need for firefighting foams better suited to extinguish Class B, fuel-based fires. AFFF formulations consist of water, an organic solvent, up to 5 percent (%) hydrocarbon surfactants, and 1 to 3% PFAS (Interstate Technology Regulatory Council 2020). AFFF concentrate is designed to be diluted with water to become a 1, 3, or 6% foam. AFFF releases at DoD facilities may have occurred during firefighter training, emergency response actions, equipment testing, or accidental releases. The military still primarily uses AFFF for Class B fires; however, the current formulations of AFFF contain significantly lower amounts of PFOS, PFOA, and their precursors, and significant operational changes have been implemented to restrict uncontrolled releases and non-essential use of PFAS-containing foams. Army installations may still house AFFF, commonly stored in closed containers (e.g., 55-gallon drums, 5-gallon buckets), within designated storage buildings or at firehouses.

Findings from personnel interviews, site reconnaissance, and document research indicate the use and storage of AFFF at Camp Merrill has been primarily associated with Camp Merrill Fire Department operations, including vehicle washing and fire training exercises.

AFFF was stored historically to clean vehicles and flooring in and outside the Camp Merrill Fire Department building (Building 2 – Fire Station #7). Personnel interviews suggest historical storage of 40–50-gallon containers of AFFF in the main bay of the Camp Merrill Fire Department building. This is also where all maintenance of fire trucks occurred.

For emergency preparedness, installation/fire department personnel were trained to performed nozzle testing with AFFF to ensure optimal flow and use of the AFFF mixture. Nozzle testing involved spraying AFFF through fire equipment. AFFF was reportedly deployed during routine nozzle testing on the grassy knoll to the west of the station, as well as on the asphalt next to the grassy knoll.

4.2 Other PFAS Use, Storage, and/or Disposal Areas

Following document research, personnel interviews, and site reconnaissance at Camp Merrill, multiple vehicle maintenance buildings, a short-term storage building, and a water treatment plant were also identified as preliminary locations for potential use, storage, and/or disposal of PFAS-containing materials. These areas were not retained for further investigation as there was no evidence of PFAS-containing materials used, stored, and/or disposed of at the locations. Additionally, waste drainage from

the fire station at the installation had historically been treated at the WWTP and potentially PFAS-containing materials in waste sludge were transferred to the Former Sewage Lagoon up until 2010 when sludge and underlying native soils were removed from the lagoon. A summary of information gathered in the PA for each of these preliminary locations is described in **Section 5**. Specific discussion regarding areas not retained for further investigation is presented in **Section 5.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.2**.

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at Camp Merrill) is not part of the PA/SI. However, no potential off-post PFAS sources within a 5-mile radius of the installation were identified during the records search and site visit.

5 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage, and/or disposal of PFAS-containing materials at Camp Merrill, were further refined during the PA process and identified either as an area not retained for further investigation or as an AOPI. In accordance with the established process for the PA/SI, two areas have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**, below.

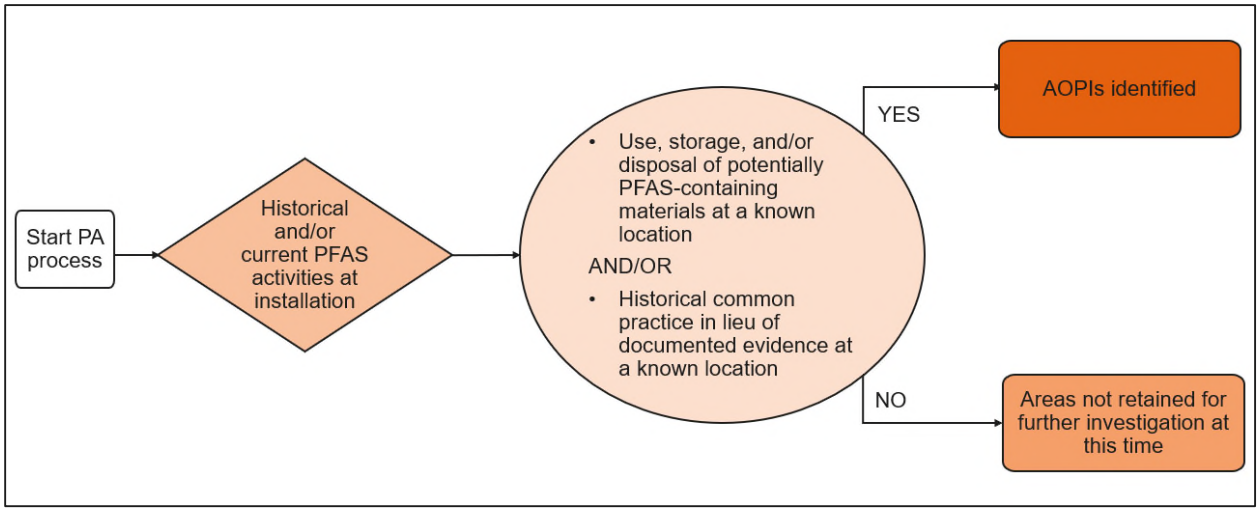

Figure 5-1. AOPI Decision Flowchart

The areas not retained for further investigation are presented in **Section 5.1**. The areas retained as AOPIs are presented in **Section 5.2**.

Data limitations for this PA/SI at Camp Merrill are presented in **Section 8**.

5.1 Areas Not Retained for Further Investigation

Through the evaluation of information obtained during records review, personnel interviews, and/or site reconnaissance, the areas described below were categorized as areas not retained for further investigation at this time.

A brief site history and rationale for areas not retained for further investigation are presented in **Table 5-1**, below.

Table 5-1. Installation Areas Not Retained for Further Investigation

Area Description	Dates of Operation	Relevant Site History	Rationale
Building 6 & 7 – DPW	Unknown	Building 6 is used for vehicle maintenance for the U.S. Army Reserve vehicles on-site, while Building 7 is utilized as tool storage for the installation.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at this location.
Building 20 – 5 Ranger Training Battalion Motor Pool	Unknown	Building 20 operates as a vehicle maintenance building for the U.S. Army Reserve vehicles as well as storage for equipment and other maintenance supplies. During the Arcadis site visit interviews, it was confirmed there have been no PFAS-containing materials stored at Building 20.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at this location.
Building 48 – 90-day	Unknown	Building 48 is utilized for short-term storage of flammable materials, as well as materials for disposal including vehicle maintenance supplies such as antifreeze and motor oil.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at this location.
Building 60 – Water Treatment Plant	Unknown	Building 60 is a water treatment plant for the installation that is located upgradient of historical PFAS use/storage/disposal. There is no historical record of PFAS-containing compounds at Building 60.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at this location.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. The AOPI locations are shown on **Figure 5-2**. Aerial photographs of each AOPI that also show the approximate extent of AFFF use (if applicable) are presented on **Figures 5-3** through **5-4**.

5.2.1 Building 2 – Fire Station #7

The Building 2 – Fire Station #7 AOPI is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to the historical use of AFFF to clean vehicles and flooring in and outside the building (on the driveway) at an unknown frequency. AFFF was stored in 40-50-gallon containers in the main bay of the building. All fire truck maintenance at the installation occurred here. There was also historic evidence of a sewage line that led to the WWTP – Building 125, located at the northern portion of Building 2 – Fire Station #7. Additional potential releases of PFAS-containing materials took place outside on the grassy knoll to the west of the station where nozzle testing occurred outside of the building at an unknown frequency. AFFF use and storage was discontinued at the Building 2 – Fire Station #7 between 1990-2010.

5.2.2 Building 125 and Former Sewage Lagoon

The Building 125 and Former Sewage Lagoon AOPI is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to the historical treatment of wastewater that could have potentially contained PFAS-containing materials. Building 125 consists of the wastewater and sewage treatment plants for the installation and are near the former sewage lagoon. Drains in the main bay of Building 2 – Fire Station #7 leading to the WWTP, Building 125, could have potentially transferred PFAS-containing materials to Building 125 and the Former Sewage Lagoon up until 2010 when sludge and underlying native soils were removed from the Sewage Lagoon.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at Camp Merrill, an SI for PFOS, PFOA, and PFBS was conducted in accordance with CERCLA. SI sampling was completed at Camp Merrill at all two AOPIs to evaluate presence or absence of PFOS, PFOA, and PFBS in comparison with the OSD risk screening levels. As such, an installation-specific QAPP Addendum (Arcadis 2021) was developed to supplement the general information provided in the PQAPP (Arcadis 2019) and to detail the site-specific proposed scopes of work for the SI. A preliminary CSM was prepared for each of the installation's AOPIs in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-1-12 (USACE 2012). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonably anticipated future land uses. The preliminary CSMs identified soil, groundwater, surface water, and/or sediment pathways as potentially complete which guided the SI sampling. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI scope of work was completed in November 2021 through the collection of field data and analytical samples.

The SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addendum (Arcadis 2021) and PQAPP (Arcadis 2019). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at Camp Merrill. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the site-specific QAPP Addendum (Arcadis 2021), the objective of the SI is to identify whether there has been a release to the environment at the AOPIs identified in the PA and to determine if further investigation is warranted. This SI evaluated groundwater, soil, and surface water for PFOS, PFOA, and PFBS presence or absence at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

The rationale for sampling at each AOPI is illustrated on **Figure 6-1** below.

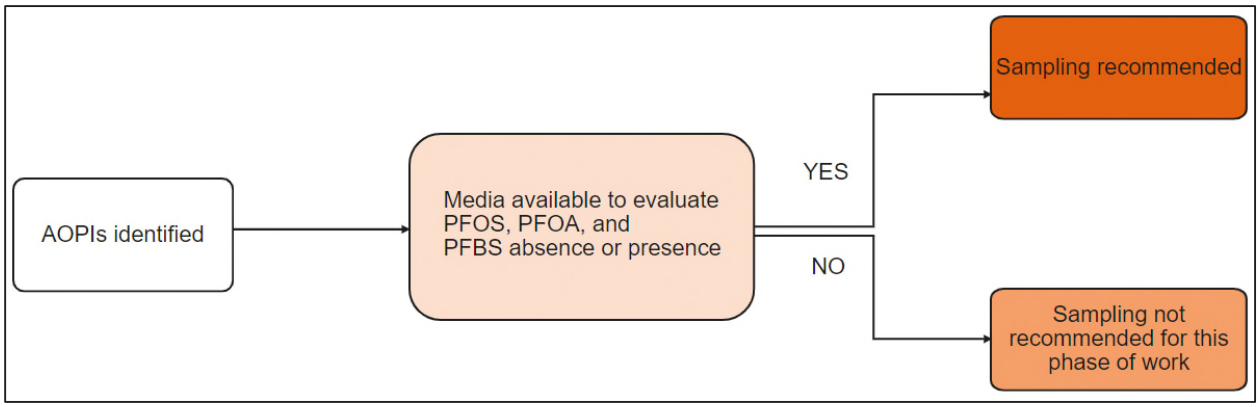

Figure 6-1. AOPI Sampling Decision Tree

The sampling design for SI sampling activities at Camp Merrill is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2021). Briefly, groundwater, soil, and surface water samples were collected from discrete direct-push points, soil borings, and surface water sources at and downgradient of areas with known or suspected use, storage, and/or disposal of PFAS-containing materials. Sample locations were chosen based on suspected groundwater, surface water, and stormwater flow directions. Sample media types (e.g., surface soil, groundwater, surface water) collected for each AOPI were based on media most likely to confirm the presence or absence of PFOS, PFOA, and PFBS directly related to the nature of the suspected use, storage, and/or disposal at each AOPI.

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), the SOPs and TGIs included as Appendix A to the PQAPP, the QA/QC requirements identified in Worksheet #20 of the PQAPP, the approved scope and sampling methods outlined in the site-specific QAPP Addendum (Arcadis 2021), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2021). The sampling methods described in the SOPs and TGIs establish equipment requirements, procedures for preparing equipment and containers before sampling, sampling procedures under various conditions, and procedures for storing samples to ensure that sample contamination does not occur during collection, and transport. In general, sampling techniques used in the SI were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2019) and QAPP Addendum (Arcadis 2021). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes and field forms (i.e., soil boring logs, groundwater purging logs, equipment calibration forms, tailgate health and safety forms, and sample collection logs) documenting the SI sampling activities are included in **Appendices J** and **K**, respectively.

6.3.1 Field Methods

Groundwater samples were from boreholes advanced using direct push technology (DPT) methods using a top-down sampling method to minimize cross-contamination at depth. Shallow (first encountered) groundwater was sampled at each of these sampling points. DPT borings were advanced to groundwater using a drill rig. DPT boring advancement and sampling was completed in accordance with TGI P-12 in Appendix A to the PQAPP (Arcadis 2019).

Shallow soil samples (0 to 2 feet below ground surface [bgs]) were collected using hand auger methods, in accordance with the TGI P-12 in Appendix A to the PQAPP (Arcadis 2019). Decontaminated stainless-steel trowels were used to collect soil from the borehole walls in the 0 to 2 feet bgs interval. In locations collocated with groundwater samples, borings were then advanced via DPT drilling methods until groundwater was encountered. Upon completion of sampling, the boreholes were backfilled with the augured cuttings. Depending on field conditions, groundwater samples were collected with either a portable bladder pump with PFAS-free disposable high-density polyethylene tubing or a PFAS-free disposable bailer through a screen-point sampler (Arcadis 2021).

Surface water samples were collected using direct-fill methods just below the water surface in accordance with the TGI P-15 in Appendix A to the PQAPP (Arcadis 2019). Surface water samples were collected from downstream to upstream to reduce siltation in sequential samples and from the upper 6 inches of water. Field parameters, including temperature, pH, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential, were measured during surface water sampling.

Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 6.3.4**.

6.3.2 Quality Assurance/Quality Control

Worksheets #20 of the PQAPP and QAPP Addendum provide QA/QC requirements for field duplicates, matrix spike/matrix spike duplicates, equipment blanks (EBs), source blanks for water used in the initial decontamination step for drill tooling, and field blanks for laboratory-supplied water used in the final decontamination step.

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2021), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, and PFBS, and total organic carbon (TOC) only. EBs were collected for media sampled for PFOS, PFOA, and PFBS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2021). The decontaminated reusable equipment from which EBs were collected include tubing, drill casing and cutting shoes, hand augers, water-level meters, and stainless-steel trowels as applicable to the sampled media. Source blanks were collected from the water used to pressure-wash drill tooling. Analytical results for blank samples are discussed in **Section 7.5**.

6.3.3 Field Change Reports

No minor or major modifications or non-conformances to the approved sampling scope and/or procedures occurred during the sampling events.

6.3.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., stainless-steel trowels, hand augers, drill cutting shoes and casing, screen-point samplers, water-level meters) that came into direct contact with sampling media was decontaminated before first use, between sampling locations/intervals, and before demobilization in accordance with P-09, TGI - Groundwater and Soil Sampling Equipment Decontamination (Arcadis 2019, Appendix A).

6.3.5 Investigation-Derived Waste

IDW, including soil cuttings, groundwater, surface water, decontamination fluids, and disposable equipment were collected and placed in Department of Transportation-approved 55-gallon drums, labeled as non-hazardous, segregated by medium: waters and soil, and transported to a staging area in a covered pole barn for storage until disposal. Equipment IDW was collected in bags and disposed in municipal waste receptacles. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, Lexan tubes, and high density polyethylene and

silicon tubing) that may come in contact with sampling media. Analytical results for IDW samples collected during the SI are discussed in **Section 7.3**.

6.4 Data Analysis

The subsections below summarize the laboratory analytical methods and the methodology used to evaluate data collected during the SI through data verification and usability assessments (as completed by a project chemist, independent of the project team).

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Pace South Carolina (formerly Shealy Environmental Services, Inc.), an ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, and PFBS, by liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). A total of 18 PFAS-related compounds, including PFOS, PFOA, and PFBS, were analyzed for in groundwater, soil, and surface water samples using an analytical method that is ELAP-accredited and compliant with QSM 5.3 (DoD and Department of Energy 2019), Table B-15.

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil and sediment samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2021) by the analytical method noted:

- TOC by Solid Waste Test Method 846 9060A
- Grain size analysis by American Society for Testing and Materials D422-63
- pH by Solid Waste Test Method 846 9045D

These data are collected as they may be useful in future fate and transport studies.

The laboratory limit of detection (LOD) is defined as “the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific matrix with a specific method at 99 percent confidence” (DoD 2017). The lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias is known as the limit of quantitation (LOQ; DoD 2017). Concentrations detected between the LOD and LOQ, therefore, are considered estimates and are qualified as such on laboratory analytical reports. Instrument-specific detection limits (e.g., the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence; DoD 2017), as provided for each analyte by the laboratory, are reported along with the LODs and LOQs in the laboratory analytical reports included in the Data Usability Summary Report (DUSR; **Appendix L**).

6.4.2 Data Validation

All analytical data generated during the SI, except grain size and data generated from IDW profiling, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.3 (DoD and Department of Energy 2019). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation

reports for each sample delivery group are included as attachments to the DUSR in **Appendix L**. The Level IV analytical reports are included within **Appendix L** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with SI sampling at Camp Merrill. Documentation generated during the data usability assessments, which were compiled into a DUSR (**Appendix L**), was prepared in accordance with the USACE Engineer Manual 200-1-10 (USACE 2005), the Final DoD General Data Validation Guidelines (DoD 2019) and the Final DoD Data Validation Guidelines Module 3: Data Validation Procedure for Per-and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (DoD 2020), that reviewed precision, accuracy, completeness, representativeness, comparability, and sensitivity. A statement of overall data usability is included in the DUSR.

Based on the final data usability assessment, the environmental data collected at Camp Merrill during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix L**), and as indicated in the full analytical tables (**Appendix M**) provided for the SI results. These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019) and Camp Merrill QAPP Addendum (Arcadis 2021). Data qualifiers applied to laboratory analytical results for samples collected during the SI at Camp Merrill are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-1**.

Table 6-1. OSD Risk Screening Levels Calculated for PFOS, PFOA, and PFBS in Tap Water and Soil Using USEPA's Regional Screening Level Calculator

Chemical	Residential Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator		Industrial/Commercial Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator
	Tap Water (ng/L or ppt) [1]	Soil (mg/kg or ppm) [1,2]	Soil (mg/kg or ppm) [1,2]
PFOS	40	0.13	1.6
PFOA	40	0.13	1.6
PFBS	600	1.9	25

Notes:
1. Risk screening levels for tap water and soil provided by the OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15 (**Appendix A**).
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet bgs), regardless of the current and projected land use of the AOPI.
mg/kg = milligram per kilogram ppm = parts per million
ng/L = nanograms per liter ppt = parts per trillion

The OSD residential tap water risk screening levels will be used to compare all groundwater and surface water data (because surface water is used as a drinking water source nearby) for this Army PFAS PA/SI. While the current and most likely future land uses of the AOPIs at Camp Merrill are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, and PFBS will be used to evaluate detected soil concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, or PFBS are detected greater than the applicable OSD risk screening levels, further study in a remedial investigation is recommended in **Section 8**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at Camp Merrill (field duplicate results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addendum (Arcadis 2021). The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

Tables 7-1 through **7-3** provide a summary of the groundwater, soil, and surface water analytical results for PFOS, PFOA, and PFBS. **Table 7-4** summarizes AOPIs and whether their SI results exceed the OSD risk screening levels. **Appendix M** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at Camp Merrill with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** and **7-3** show the PFOS, PFOA, and PFBS analytical results in groundwater, soil, and surface water for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, and/or PFBS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. Final qualifiers applied to the data by the laboratory and the project chemist (as defined in **Section 6.4.3**) are presented on the analytical tables. Groundwater and surface water data collected during the SI are reported in ng/L, or parts per trillion, and soil data is reported in mg/kg, or parts per million.

Field parameters measured for groundwater during low-flow purging and sample collection and for surface water during sample collection are provided on the field forms in **Appendix K**. Soil descriptions are provided on the field forms in **Appendix K**. The results of the SI are grouped by AOPI and discussed for each medium as applicable. Groundwater was generally first encountered at depths of approximately 2.5 to 11.32 feet bgs.

Table 7-4. AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No)
Building 2 – Fire Station #7	Yes
Building 125 and Former Sewage Lagoon	No

7.1 Building 2 – Fire Station #7

The subsections below summarize the groundwater, soil, and surface water PFOS, PFOA, and PFBS analytical results associated with Building 2 – Fire Station #7 AOPI.

7.1.1 Groundwater

Groundwater samples were collected from one boring via DPT at first-encountered groundwater at the Building 2 – Fire Station #7 AOPI (CM-BLDG2-GW-01 [duplicate sample collected at DUP-GW-01]; **Figure 7-2**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS was detected at concentrations greater than the OSD risk screening level of 40 ng/L in the groundwater sample CM-BLDG2-GW-01 (22,000 J ng/L).

PFOA was detected at concentrations greater than the OSD risk screening level of 40 ng/L in the groundwater sample CM-BLDG2-GW-01 (970 J ng/L).

PFBS was detected at concentrations less than the OSD risk screening level of 600 ng/L in the groundwater sample CM-BLDG2-GW-01 (230 J ng/L).

7.1.2 Soil

Soil samples were collected from three locations at the Building 2 – Fire Station AOPI (CM-BLDG2-SO-01 [duplicate sampled collected at DUP-SO-01], CM-BLDG2-SO-02, and CM-BLDG2-SO-03; **Figure 7-2**). A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS was detected at concentrations less than the residential OSD risk screening level of 0.13 mg/kg in soil samples: CM-BLDG2-SO-01 (0.11 J mg/kg), CM-BLDG2-SO-02 (0.046 mg/kg), and CM-BLDG2-SO-03 (0.019 mg/kg).

PFOA was detected at concentrations less than the residential OSD risk screening level of 0.13 mg/kg in soil samples: CM-BLDG2-SO-01 (0.00097 J mg/kg), CM-BLDG2-SO-02 (0.00066 J mg/kg), and CM-BLDG2-SO-03 (0.0016 mg/kg).

PFBS was not detected in the soil samples collected at the Building 2 – Fire Station AOPI.

7.1.3 Surface Water

One surface water sample was collected at the Building 2 – Fire Station AOPI (CM-BLDG2-SW-01; **Figure 7-2**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-3**.

PFOS, PFOA, and PFBS were not detected in the surface water sample.

7.2 Building 125 and Former Sewage Lagoon

The subsections below summarize the groundwater, soil, and surface water PFOS, PFOA, and PFBS analytical results associated with Building 125 and Former Sewage Lagoon AOPI.

7.2.1 Groundwater

Groundwater samples were collected from three borings via DPT at first-encountered groundwater at the Building 125 and Former Sewage Lagoon AOPI (CM-WWTP-GW-01, CM-WWTP-GW-02, and CM-WWTP-GW-03; **Figure 7-3**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-1**.

PFOS was detected at concentrations less than the OSD risk screening level of 40 ng/L in the groundwater samples CM-WWTP-GW-01 (20 ng/L), CM-WWTP-GW-02 (2.1 J ng/L), and CM-WWTP-GW-03 (9.2 ng/L).

PFOA was detected at concentrations less than the OSD risk screening level of 40 ng/L in the groundwater samples CM-WWTP-GW-01 (16 ng/L), CM-WWTP-GW-02 (25 ng/L), and CM-WWTP-GW-03 (21 ng/L).

PFBS was detected at concentrations less than the OSD risk screening level of 600 ng/L in the groundwater sample CM-WWTP-GW-01 (11 ng/L) and CM-WWTP-GW-03 (85 ng/L).

7.2.2 Soil

A soil sample was collected from one location at the Building 125 and Former Sewage Lagoon AOPI (CM-WWTP-SO-01; **Figure 7-3**). A summary of PFOS, PFOA, and PFBS soil analytical results is provided in **Table 7-2**.

PFOS, PFOA, and PFBS were not detected in the soil sample collected at the Building 125 and Former Sewage Lagoon AOPI.

7.2.3 Surface Water

One surface water sample was collected at the Building 125 and Former Sewage Lagoon AOPI (CM-WWTP-SW-01; **Figure 7-3**). A summary of PFOS, PFOA, and PFBS groundwater analytical results is provided in **Table 7-3**.

PFOS, PFOA, and PFBS were not detected in the surface water sample.

7.3 Investigation Derived Waste

Composite samples were collected from each of the 55-gallon drums currently in storage. The results indicated the following concentrations for PFOS: 520 J ng/L PFOS in water IDW and 0.0032 mg/kg in soil IDW. The results indicated non-detect for PFOA and PFBS in both media. The PFOS concentrations observed exceeded the OSD risk screening levels in the water IDW. The PFOA and PFBS concentrations observed did not exceed the OSD risk screening levels. The full analytical results for IDW samples collected during the SI are included in **Appendix M**. Based on the IDW analytical results, the IDW will be picked up by a qualified waste disposal company and disposed of at an off-post Subtitle C landfill that accepts PFAS-containing waste, as agreed upon by the installation.

7.4 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, and PFBS, one soil sample per AOPI was analyzed for TOC, pH, moisture content, and grain size data as they may be useful in future fate and transport studies. The TOC in the soil samples ranged from 2,080 to 17,600 mg/kg. The TOC at this installation was within range of what is typically observed in topsoil (5,000 to 30,000 mg/kg). The combined percentage of fines (i.e., silt and clay) in soils at Camp Merrill ranged from 47.6 to 57.6% with an average of 52.6%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The average percent moisture of the soil (17.6%) was typical for clay (0 to 20%). The pH of the soil was slightly acidic (4 to 6 standard units). Based on these geochemical and physical soil characteristics observed underlying the installation during the SI, PFAS constituents are expected to be relatively more mobile at Camp Merrill than in soils with greater percentages of fines and TOC.

7.5 Blank Samples

PFOS, PFOA, and PFBS were not detected in any of the blank samples collected during the SI work. The full analytical results for blank samples collected during the SI are included in **Appendix M**.

7.6 Conceptual Site Models

The preliminary CSM presented in the QAPP Addendum (Arcadis 2021) was re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-4** and **7-5** and in this section therefore represent the current understanding of the potential for human exposure.

Many of the PFAS constituents found in AFFF are surfactants (which do not volatilize) and are found in a charged or ionic state at environmentally-relevant pH (i.e., pH 5 to 9 standard units). PFOS, PFOA, and PFBS are each negatively charged at environmentally-relevant pH. The media potentially affected by PFOS, PFOA, PFBS releases at Army installations are soil, groundwater, surface water, and sediment. Once released to the environment, a primary factor that inhibits the movement of PFAS constituents is the presence of organic matter and organic co-constituents in soils and sediments. Generally, PFAS constituents are mobile in the potentially affected media, and they are not known to be fully broken down by natural processes.

Based on the use, storage, and/or disposal of PFAS-containing materials at the AOPIs, affected media are likely to consist of soil, groundwater, surface water, and sediment.

Release and transport mechanisms include dissolution/desorption from soil to groundwater, transport via sediment carried in and dissolution to stormwater and surface water, discharge/recharge between groundwater and surface water, and adsorption/desorption between surface water and sediment. Generic categories of potential human receptors and their associated exposure scenarios that are typically evaluated in a CERCLA human health risk assessment were considered and include on-installation site workers (e.g., industrial/commercial workers, utility workers, or future construction workers who could be exposed to chemicals in soil at an AOPI or to chemicals in tap water in an industrial/commercial building), on-installation residents (e.g., adults and children who could be exposed to chemicals in tap water in a residence), and on-installation recreational users (e.g., hikers or hunters who could be exposed to chemicals in waterways at an installation). Off-installation receptor types could include drinking water receptors (i.e., commercial/industrial workers or residents) and recreational users.

Human exposure pathways are shown as “complete”, “potentially complete”, or “incomplete” on the CSM figures. A complete exposure pathway consists of a constituent source and release mechanism, a transport or retention medium, an exposure point where human contact with the contaminated medium could occur, and an exposure route at the exposure point. If any of these elements is missing, the exposure pathway is incomplete. Pathways are “potentially complete” where data are insufficient to conclude the pathway is either “complete” or “incomplete”. Additionally, the CSMs do not include ecological receptors and exposure pathways. The potential for ecological exposures to PFOS, PFOA, and PFBS may be evaluated at a future date if those pathways warrant further consideration.

CSMs were developed for each individual AOPI. The following exposure pathway determinations apply to both CSMs:

- There are no on-installation residents and recreational use of the installation is highly unlikely. Therefore, all exposure pathways for on-installation residents and recreational users are incomplete.
- The AOPIs are wholly located within the installation boundaries. Therefore, the soil exposure pathway for off-installation receptors is also incomplete.
- PFOS, PFOA, and PFBS were detected in groundwater samples at both AOPIs. There are no drinking water wells at Camp Merrill. However, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for on-installation site workers is potentially complete to account for potential future use of the downgradient on-post groundwater as a potable water source.
- Groundwater originating at the AOPIs flows off-post through the installation's southwestern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is potentially complete.
- Drinking water at Camp Merrill is supplied by an onsite water treatment plant that surface extracts from the Etowah River. This plant is government owned and operated. The surface water intake is upgradient from the AOPIs. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for on-installation site workers is incomplete.
- PFOS, PFOA, and PFBS were not detected in surface water samples collected at the AOPIs. Based on these SI sample results, the surface water and sediment exposure pathways for on-installation site workers and off-installation receptors are incomplete.

Figure 7-4 shows the CSM for the Building 2 – Fire Station #7 AOPI, where AFFF was used to clean vehicles and flooring in and outside the building (on the driveway). Additional potential releases of PFAS-containing materials took place outside on the grassy knoll to the west of the station, as well as on the asphalt next to the grassy knoll where nozzle testing occurred outside of the building.

- PFOS and PFOA were detected in soil at Building 2 – Fire Station #7 and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.

Figure 7-5 shows the CSM for the Building 125 and Former Sewage Lagoon AOPI. Drains in the main bay of Building 2 – Fire Station #7 leading to the WWTP could have potentially transferred PFAS-containing materials to Building 125 and the Former Sewage Lagoon up until 2010 when native soils were removed from the Sewage Lagoon.

- PFOS, PFOA, and PFBS were not detected in soil at this AOPI. Therefore, the soil exposure pathway for on-installation site workers is incomplete.

Following the SI sampling, both AOPIs were considered to have complete or potentially complete exposure pathways. Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for remedial investigation is based on the comparison of analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-1**).

8 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA/SI included two distinct efforts. The PA identified AOPIs at Camp Merrill based on the use, storage, and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of PFAS (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release of PFOS, PFOA, and PFBS to the environment occurred.

OSD provided residential risk screening levels based on the USEPA oral reference dose for PFOS, PFOA, and PFBS in soil and groundwater (tap water) and industrial/commercial risk screening levels for PFOS, PFOA, and PFBS in soil (**Appendix A**). A combination of document review, internet searches, interviews with installation personnel, and an installation site visit were used to identify specific areas of suspected PFOS, PFOA, and PFBS use, storage, and/or disposal at Camp Merrill. Following the evaluation, two AOPIs were identified.

Drinking water at Camp Merrill is supplied by an onsite water treatment plant that extracts surface water from the Etowah River, however, the current surface water intake is upgradient from the AOPIs. This plant is government owned and operated. There are no on-post drinking water wells. Surface water bodies flow off-post through the Etowah River southeast toward the City of Dahlonega, however Dahlonega sources their water via the Yahoola Creek Reservoir, which is not supplied by the Etowah River.

Both AOPIs were sampled during the SI at Camp Merrill to identify presence or absence of PFOS, PFOA, and PFBS at each AOPI. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the Camp Merrill QAPP Addendum (Arcadis 2021).

Both AOPIs had detections of PFOS, PFOA, and/or PFBS in groundwater and/or soil samples, and one AOPI exceeded OSD risk screening levels.

The maximum concentrations of PFOS, PFOA, and PFBS detected in soil and groundwater at Camp Merrill are summarized below by media:

Groundwater

- PFOS was detected at 22,000 J ng/L, above the OSD risk screening level (40 ng/L), in sample CM-BLDG2-GW-01 at the Building 2 – Fire Station #7 AOPI.
- PFOA was detected at 970 J ng/L, above the OSD risk screening level (40 ng/L), in sample CM-BLDG2-GW-01 at the Building 2 – Fire Station #7 AOPI.
- PFBS was detected at 230 J ng/L, below the OSD risk screening level (600 ng/L), in sample CM-BLDG2-GW-01 at the Building 2 – Fire Station #7 AOPI.

Soil

- PFOS was detected at 0.11 J mg/kg, below the OSD risk screening level for soil (0.13 mg/kg), in sample CM-BLDG2-SO-01 at the Building 2 – Fire Station #7 AOPI.
- PFOA was detected at 0.0016 mg/kg, below the OSD risk screening level for soil (0.13 mg/kg), in sample CM-BLDG2-SO-03 at the Building 2 – Fire Station #7 AOPI.
- PFBS was not detected in any of the soil samples collected.

Surface Water

- PFOS, PFOA, and PFBS were not detected in any of the surface water samples collected.

Following the SI sampling, both AOPIs were considered to have complete or potentially complete exposure pathways. The soil exposure pathway for on-installation site workers is complete at the Building 2 – Fire Station #7 AOPI, where PFOS, PFOA, and/or PFBS were detected in soil. Although there are no on-installation drinking water wells, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for on-installation site workers is potentially complete at both AOPIs to account for the potential future use of downgradient on-post groundwater as a potable water source. Due to a lack of land use controls off-installation and downgradient of Camp Merrill, the groundwater exposure pathway for off-installation drinking water receptors is also potentially complete for both AOPIs.

Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for future study in a remedial investigation or no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-1**). **Table 8-1** below summarizes the AOPIs identified at Camp Merrill, PFOS, PFOA, and PFBS sampling and recommendations for each AOPI; further investigation is warranted at Camp Merrill. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

Table 8-1. Summary of AOPIs Identified during the PA, PFOS, PFOA, and PFBS Sampling at Camp Frank D. Merrill, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND)			Recommendation
	GW	SO	SW	
Building 2 – Fire Station #7	Yes	No	ND	Further study in a remedial investigation
Building 125 and Former Sewage Lagoon	No	ND	ND	No action at this time

Notes:
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
ND – non-detect
SO – soil
SW – surface water

Data collected during the PA (**Sections 3** through **5**) and SI (**Sections 6** through **7**) were sufficient to draw conclusions and recommendations summarized above. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, and PFBS at Camp Merrill are discussed below.

Records gathered for the use, storage and/or disposal of PFAS-containing materials were reviewed during the PA process. Documentation specific to AFFF may have been limited (e.g., each AFFF use;

procurement records, documentation of AFFF used during crash responses or fire training activities) due to lack of recordkeeping requirements for the full timeline of common AFFF practices. Anecdotal accounts of AFFF use (and therefore likely PFOS, PFOA, and PFBS use) were limited to available installation personnel, whose knowledge of AFFF use may have been restricted by their time spent at the installation or previous roles held that limited their relevant knowledge of potential AFFF (or other PFAS-containing material) use.

A comprehensive well survey was not completed as part of this PA; therefore, the information reviewed regarding off-post wells is limited to what is contained in the off post well search results (**Appendix E**).

The searches for ecological receptors and off-post PFOS, PFOA, and PFBS sources were not exhaustive and were limited to easily identifiable and readily available information evaluated during the relevant documents research, installation personnel interviews, and site reconnaissance.

Finally, the available PFOS, PFOA, and PFBS analytical data is limited to results from on-post well sources. Available data, including PFOS, PFOA, and PFBS, is listed in **Appendix M**, which were analyzed per the selected analytical method.

Results from this PA/SI indicate further study in a remedial investigation is warranted at Camp Merrill in accordance with the guidance provided by the OSD.

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ACRONYMS

°F	degrees Fahrenheit
%	percent
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
Camp Merrill	Camp Frank D. Merrill
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
DPT	direct-push technology
DPW	Directorate of Public Works
DQO	data quality objective
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
GW	groundwater
IDW	investigation-derived waste
installation	United States Army or Reserve installation
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram (parts per million)
ND	non-detect
ng/L	nanograms per liter (parts per trillion)
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances

PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SW	surface water
TGI	technical guidance instruction
TOC	total organic carbon
UCMR3	Third Unregulated Contaminant Monitoring Rule
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
WWTP	wastewater treatment plant

TABLES

Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Camp Frank D. Merrill, Georgia

					Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
					OSD Tapwater RiskScreening Level	40		40		600	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Building 125 and Former Sewage Lagoon	Monitoring Well	CM-WWTP-01	CM-WWTP-GW-01	11/16/2021	N	**20**		**16**		**11**	
Building 125 and Former Sewage Lagoon	Monitoring Well	CM-WWTP-02	CM-WWTP-GW-02	11/16/2021	N	**2.1**	J	**25**		4.0	U
Building 125 and Former Sewage Lagoon	Monitoring Well	CM-WWTP-03	CM-WWTP-GW-03	11/16/2021	N	**9.2**		**21**		**85**	
Building 2 – Fire Station #7	Monitoring Well	CM-BLDG2-01	CM-BLDG2-GW-01	11/17/2021	N	**22000**	J	**970**	J	**230**	J
			DUP-GW-01 / CM-BLDG2-GW-01	11/17/2021	FD	**20000**	J	**910**	J	**220**	J

Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Camp Frank D. Merrill, Georgia

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Grey shaded values indicate the result was detected greater than the 2021 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program.September).

Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier

Qualifier	Description
J	The analyte was positively identified; however the associated numerical value is an estimated concentration only
U	The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ).

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Camp Frank D. Merrill, Georgia

					Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
					OSD Industrial/Commercial Risk Screening Level	1.6		1.6		25	
					OSD Residential RiskScreening Levels	0.13		0.13		1.9	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Building 125 and Former Sewage Lagoon	Soil	CM-WWTP-01	CM-WWTP-SO-01	11/16/2021	N	0.001	U	0.001	U	0.001	U
Building 2 – Fire Station #7	Soil	CM-BLDG2-01	CM-BLDG2-SO-01	11/17/2021	N	**0.11**	J	**0.00097**	J	0.0011	U
			DUP-SO-01 / CM-BLDG2-SO-01	11/17/2021	FD	**0.05**	J	**0.0014**		0.0012	U
Building 2 – Fire Station #7	Soil	CM-BLDG2-02	CM-BLDG2-SO-02	11/17/2021	N	**0.046**		**0.00066**	J	0.0011	U
Building 2 – Fire Station #7	Soil	CM-BLDG2-03	CM-BLDG2-SO-03	11/17/2021	N	**0.019**		**0.0016**		0.0011	U

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Camp Frank D. Merrill, Georgia

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Data are compared to the 2021 Office of the Secretary of Defense (OSD) risk screening levels for the residential and commerical/industrial scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.).
3. Grey shaded values indicate the result was detected greater than or equal to the OSD risk screening level for the residential scenario. Italicized values indicate the result was detected greater than the OSD risk screening level for the industrial/commercial and residential scenario.

Acronyms/Abbreviations:
AOPI = Area of Potential Interest
DPT = Direct-Push Technology
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier

Qualifier	Description
J	The analyte was positively identified; however the associated numerical value is an estimated concentration only
U	The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ).

Table 7-3 - Surface Water PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Camp Frank D. Merrill, Georgia

					Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
					OSD Tapwater Risk Screening Level	40		40		600	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
Building 125 and Former Sewage Lagoon	Surface Water/Seep	CM-WWTP-01	CM-WWTP-SW-01	11/16/2021	N	3.6	U	3.6	U	3.6	U
Building 2 – Fire Station #7	Surface Water/Seep	CM-BLDG2-01	CM-BLDG2-SW-01	11/17/2021	N	3.4	U	3.4	U	3.4	U

Table 7-3 - Surface Water PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Camp Frank D. Merrill, Georgia

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Grey shaded values indicate the result was detected greater than the 2021 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program.September).

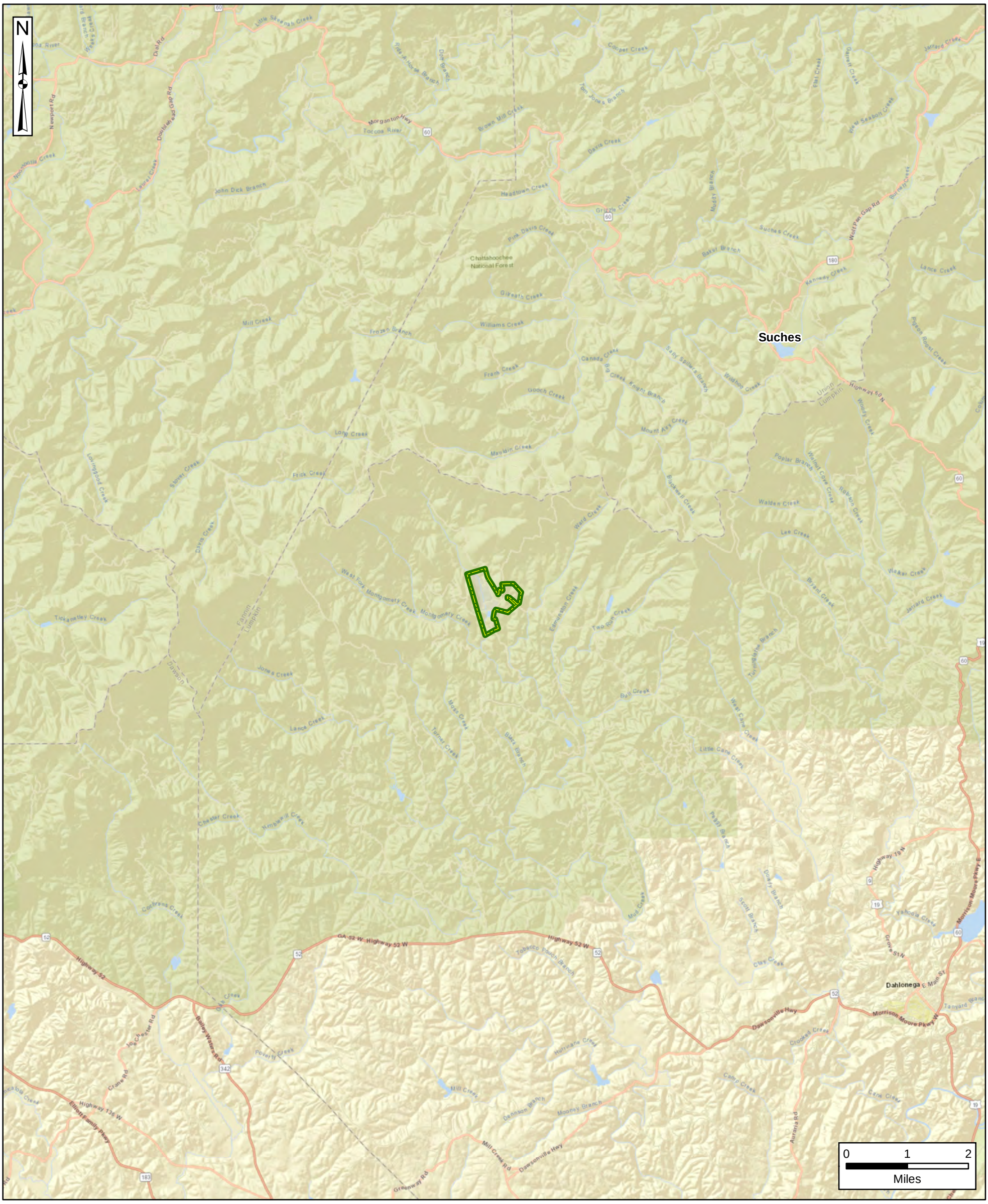
Acronyms/Abbreviations:
-- = not applicable
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
Qual = qualifier

Qualifier	Description
U	The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ).

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

Figure 2-1
Site Location



Installation Boundary

Data Sources:
USACE, GIS Data, 2020
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

Figure 2-2
Site Layout

Installation Boundary
River/Stream (Perennial)
Surface Water Flow Direction *
Inferred Groundwater Flow Direction *

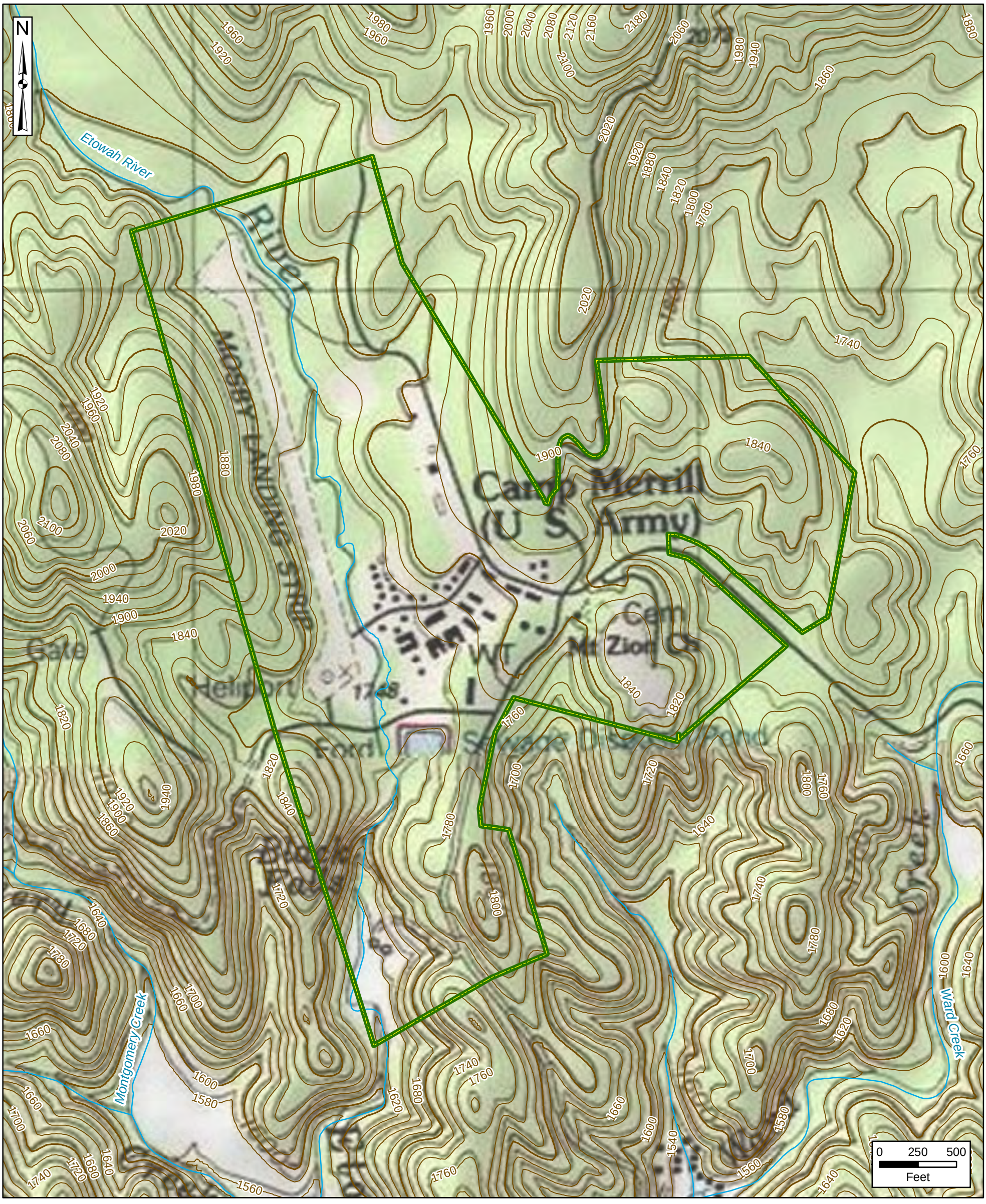
* Based on analysis of topographic and elevation/contour maps, general groundwater and surface water flow appears to be directed south, although the area in close proximity to the Etowah River likely drains into this river before moving southward.

Data Sources:
USACE, GIS Data, 2020
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

Figure 2-3
Topographic Map



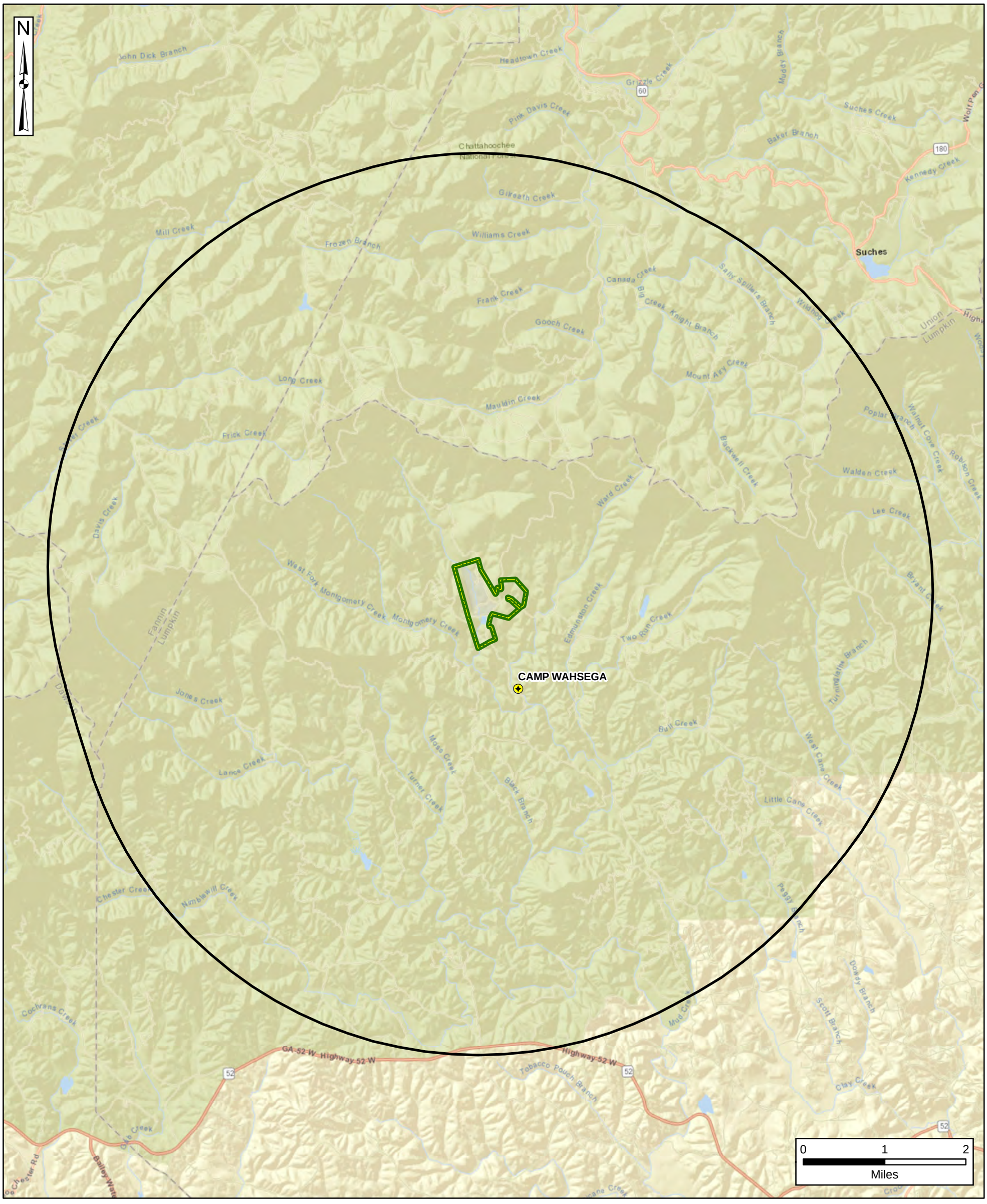
Installation Boundary
River/Stream (Perennial)
Elevation Contour (index) (feet)
Elevation Contour (intermediate) (feet)

Data Sources:
USACE, GIS Data, 2020
ESRI ArcGIS Online, USA Topo Maps

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Merrill, GA

Figure 2-4
Off-Post Potable Supply Wells



Installation Boundary

5-Mile Radius

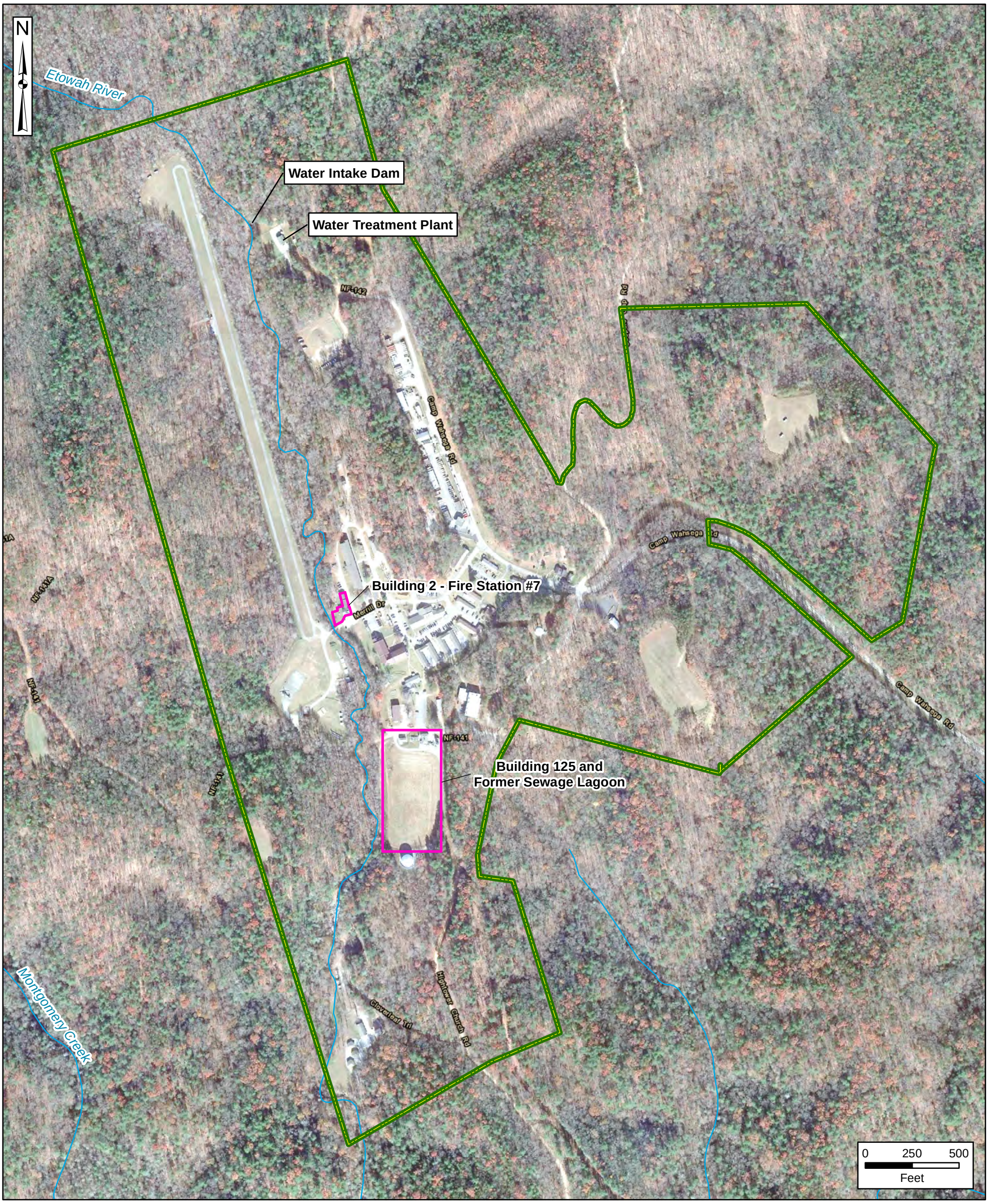
Public Water System Supply Well

Data Sources:
USACE, GIS Data, 2020
EDR, Well Data, 2020
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

Figure 5-2
AOPI Locations



Installation Boundary

AOPI

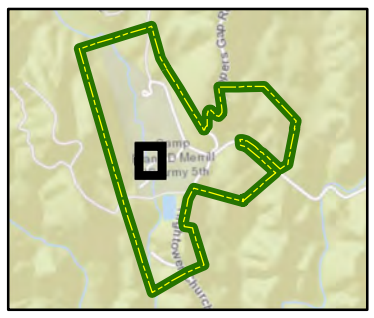
River/Stream (Perennial)

AOPI = area of potential interest

Data Sources:
USACE, GIS Data, 2020
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA



Figiure 5-3
Aerial Photo of Building 2 - Fire Station #7 AOPI

Installation Boundary
AOPI
River/Stream (Perennial)
Surface Water Flow Direction
Inferred Groundwater Flow Direction *

* Based on analysis of topographic and elevation/contour maps, general groundwater flow appears to be directed south, although the area in close proximity to the Etowah River probably drains into this river before moving southward.

AOPI = area of potential interest

Data Sources:
USACE, GIS Data, 2020
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

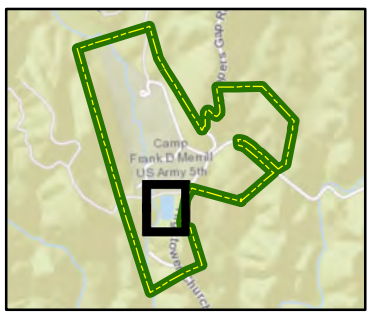
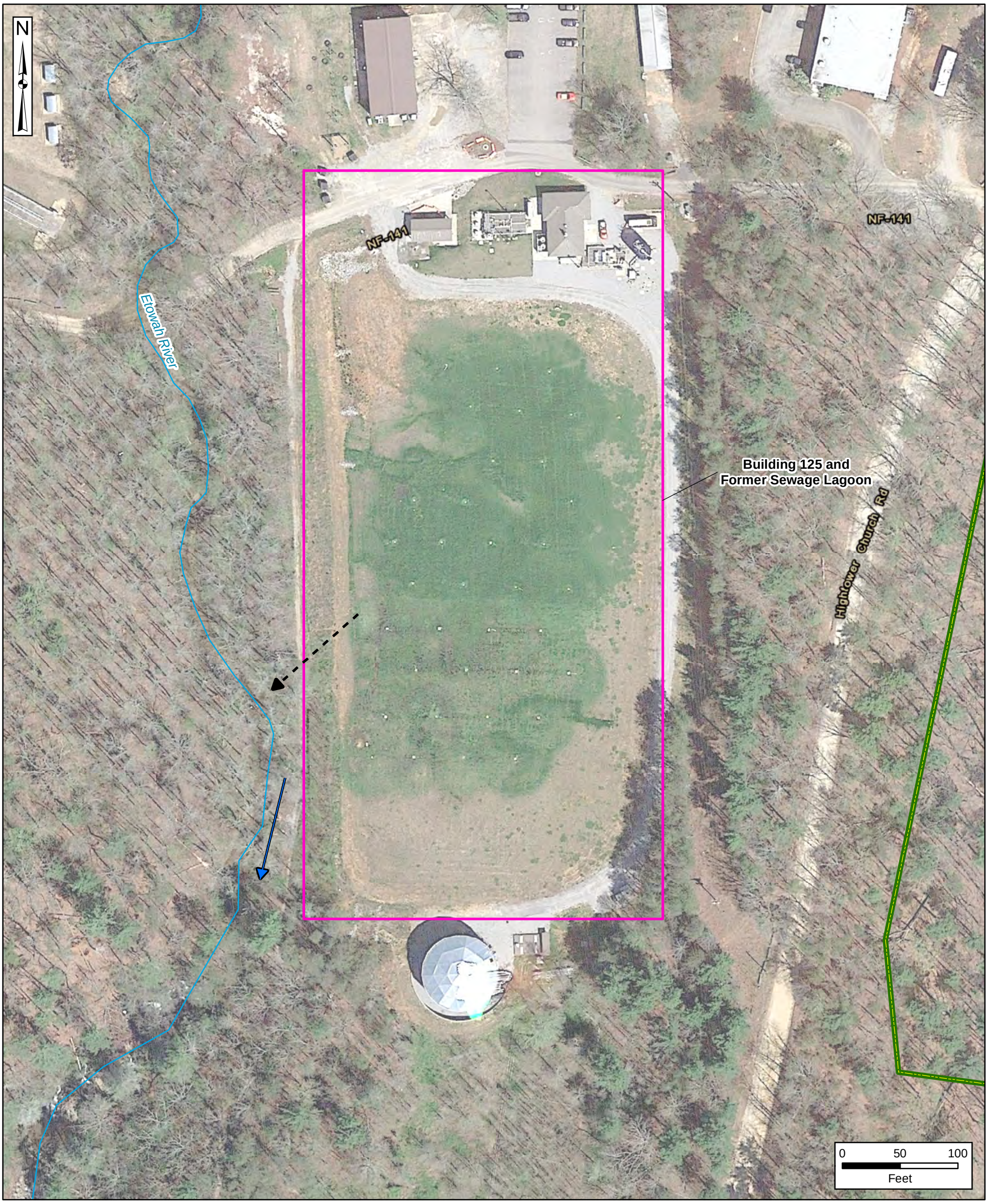


Figure 5-4
Aerial Photo of Building 125 and
Former Sewage Lagoon AOPI



Installation Boundary
AOPI
River/Stream (Perennial)
Surface Water Flow Direction
Inferred Groundwater Flow Direction *

* Based on analysis of topographic and elevation/contour maps, general groundwater flow appears to be directed south, although the area in close proximity to the Etowah River probably drains into this river before moving southward.

AOPI = area of potential interest

Data Sources:
USACE, GIS Data, 2020
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

Figure 7-1
AOPI Locations and
OSD Risk Screening Level Exceedances

Installation Boundary

AOPI

AOPI with OSD Risk Screening Level Exceedance

River/Stream (Perennial)

AOPI = area of potential interest
OSD = Office of the Secretary of Defense

Data Sources:
USACE, GIS Data, 2020
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

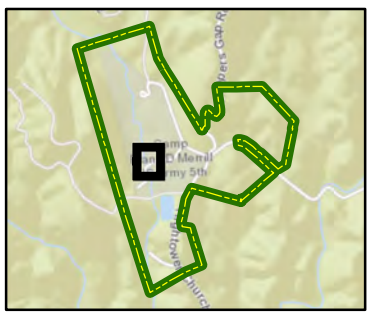


Figure 7-2
Building 2 - Fire Station #7 AOPI
PFOS, PFOA, and PFBS Analytical Results

CM-BLDG2-SO-03	
Date	11/17/2021
Depth	0-2 ft
PFOS	**0.019**
PFOA	**0.0016**
PFBS	0.0011 U

CM-BLDG2-SO-02	
Date	11/17/2021
Depth	0-2 ft
PFOS	**0.046**
PFOA	**0.00066 J**
PFBS	0.0011 U

CM-BLDG2-SO-01	
Date	11/17/2021
Depth	0-2 ft
PFOS	**0.11 J [0.050 J]**
PFOA	**0.00097 J [0.0014]**
PFBS	0.0011 U [0.0012 U]

CM-BLDG2-SW-01	
Date	11/17/2021
PFOS	3.4 U
PFOA	3.4 U
PFBS	3.4 U

CM-BLDG2-GW-01	
Date	11/17/2021
PFOS	**22,000 J [20,000 J]**
PFOA	**970 J [910 J]**
PFBS	**230 J [220 J]**

Building 2 - Fire Station #7

Etowah River

Merrill Dr

0 25 50
Feet

Notes:
1. Groundwater and surface water results are reported in nanograms per liter (ng/L).
2. Soil results are reported in milligrams per kilogram (mg/kg).
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate detections.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
River/Stream (Perennial)
Surface Water Flow Direction
Inferred Groundwater Flow Direction *

Soil Sample Location
Soil and Groundwater Sample Location
Surface Water Sample Location

AOPI = area of potential interest
ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil
SW = surface water

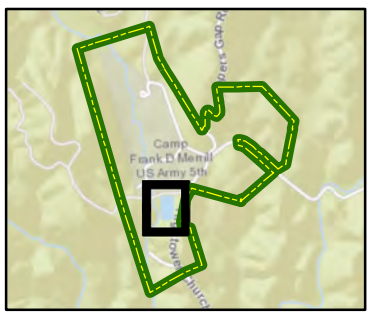
* Based on analysis of topographic and elevation/contour maps, general groundwater flow appears to be directed south, although the area in close proximity to the Etowah River probably drains into this river before moving southward.

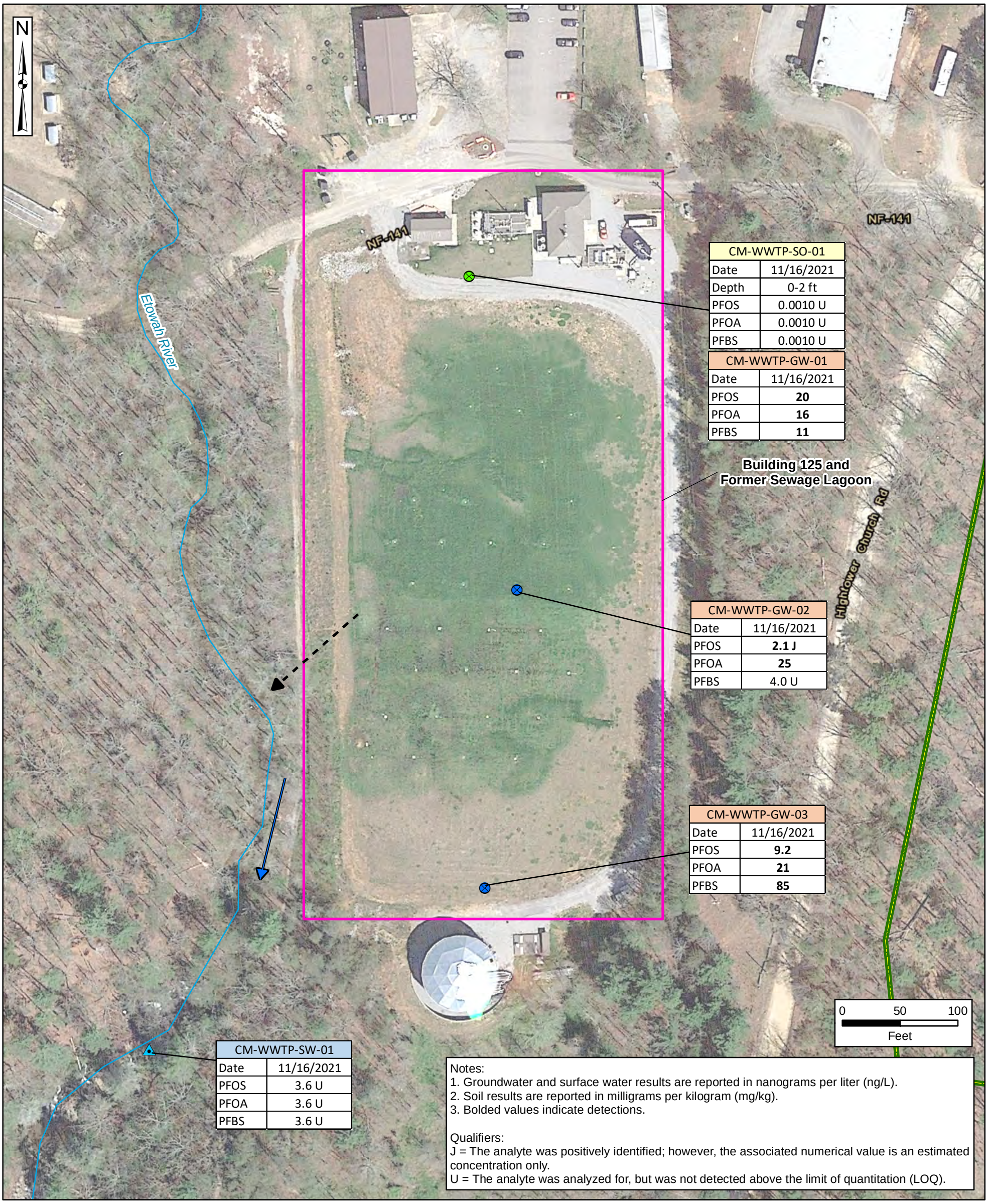
Data Sources:
USACE, GIS Data, 2020
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 16N

USAEC PFAS Preliminary Assessment / Site Inspection
Camp Frank D. Merrill, GA

Figure 7-3
Building 125 and Former Sewage Lagoon AOPI
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater and surface water results are reported in nanograms per liter (ng/L).
2. Soil results are reported in milligrams per kilogram (mg/kg).
3. Bolded values indicate detections.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
River/Stream (Perennial)
Surface Water Flow Direction
Inferred Groundwater Flow Direction *

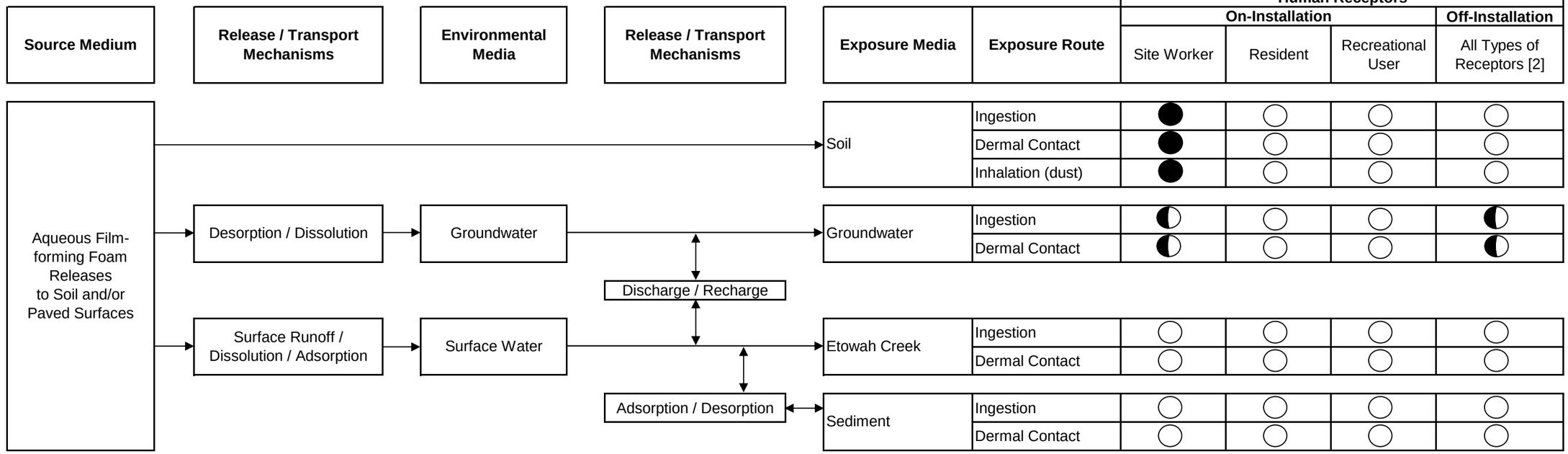
Groundwater Sample Location
Soil and Groundwater Sample Location
Surface Water Sample Location

AOPI = area of potential interest
ft = feet
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil
SW = surface water

* Based on analysis of topographic and elevation/contour maps, general groundwater flow appears to be directed south, although the area in close proximity to the Etowah River probably drains into this river before moving southward.

Data Sources:
USACE, GIS Data, 2020
Google Earth, Aerial Imagery, 2018

Coordinate System:
WGS 1984, UTM Zone 16N



Legend:

- ● = Complete Exposure Pathway
- ◐ = Potentially Complete Exposure Pathway
- ○ = Incomplete Exposure Pathway

Notes:
[1] Surface water and Sediment exposure pathways for Site Workers describe incidental ingestion and dermal contact during outdoor maintenance activities, and for Recreational Users describe incidental ingestion and dermal contact during outdoor recreational activities.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

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Conceptual Site Model for Building 2 - Fire Station #7 AOPI
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Figure 7-4

Source Medium	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	On-Installation: Resident	On-Installation: Recreational User	Off-Installation: All Types of Receptors [2]
Aqueous Film-forming Foam Releases to Wastewater Treatment Plant and Sewage Lagoon				Former Lagoon Sediment/Soil	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○
					Inhalation (dust)	○	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◐	○	○	◐
					Dermal Contact	◐	○	○	◐
			Discharge / Recharge						
	Surface Runoff / Dissolution / Adsorption	Surface Water		Etowah Creek	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○
			Adsorption / Desorption	Sediment	Ingestion	○	○	○	○
					Dermal Contact	○	○	○	○

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:

[1] Surface water and Sediment exposure pathways for Site Workers describe incidental ingestion and dermal contact during outdoor maintenance activities, and for Recreational Users describe incidental ingestion and dermal contact during outdoor recreational activities.

[2] All types of off-installation human receptors include drinking water receptors and recreational users.

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Figure 7-5