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

Fort Campbell, Kentucky

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Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

Fort Campbell, Kentucky

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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 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 Fort Campbell (FTC) PA/SI was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, National Oil and Hazardous Substances Pollution Contingency Plan, and Army/Department of Defense policy and guidance.

FTC is located in southwestern Kentucky and northcentral Tennessee, approximately 8 miles north of Clarksville, Tennessee, and 17 miles south of Hopkinsville, Kentucky. The installation is comprised of approximately 105,347 acres of land; approximately 14,000 acres of the installation comprises the built-up cantonment area, including Campbell Army Airfield (CAAF) and Sabre Heliport. The predominant geomorphic features at FTC are sinkholes and drainage systems associated with karst terrane; the bedrock comprises a karst aquifer, through which movement of groundwater can be extremely complex.

The FTC PA identified 30 AOPIs for investigation during the SI phase. All 30 AOPIs were sampled as part of the SI. SI sampling results 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 29 of the 30 AOPIs; 26 of the 30 AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The FTC PA/SI identified the need for further study in a CERCLA 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 at FTC; and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels (Yes/No/ND/NS)?			Recommendation
	GW	SO	SW/SP	
Current Fire Training Area (FTA) Building 7237	Yes	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
Destiny Heliport Wash Rack Building 7243	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
Destiny Heliport Wash Rack Building 7251	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels (Yes/No/ND/NS)?			Recommendation
	GW	SO	SW/SP	
Fire Station #4 Building 7241	Yes[1]	Yes	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7272	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7273	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7274	Yes[1]	NS	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7262	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7264	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7268	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF FTA and Retention Pond	NS	Yes	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7166	Yes[1]	NS	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Clamshell	Yes	NS	NA (Dry Fork Creek)	Future study in a remedial investigation
Fire Station #3 Building 7160	Yes[1]	Yes	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Former FTA	Yes	No	NA (Dry Fork Creek)	Future study in a remedial investigation
Old FTAs, Solid Waste Management Units 12/15	Yes	NS	NA (Dry Fork Creek)	Future study in a remedial investigation
Fire Station #5 Building 4099	Yes	No	NS	Future study in a remedial investigation
Former Fire Truck Maintenance Shop Building 5737	No	No	Yes (sinkhole)	Future study in a remedial investigation
Former Fire Station #1 Building 2575	NS	Yes	NS	Future study in a remedial investigation

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels (Yes/No/ND/NS)?			Recommendation
	GW	SO	SW/SP	
Aqueous Film-Forming Foam (AFFF) Rinse-Out Building 6310	Yes	No	NS	Future study in a remedial investigation
Old Clarksville Base FTA, Solid Waste Management Unit 148	No	NS	NA (Little West Fork Creek)	No action at this time
Legacy Fire Truck Repair Shop Building 5124	Yes[1]	No	Yes[1] (Beaver Spring)	Future study in a remedial investigation
Conex Containers 40 and 41 AFFF Storage	NS	ND	NS	No action at this time
Building 5121 AFFF Storage	Yes[1]	No	Yes[1] (Beaver Spring)	Future study in a remedial investigation
Fire Station #1 Building 1747	No	Yes	Yes[1] (Beaver Spring)	Future study in a remedial investigation
Training Area 03 Crash Site	NS	Yes[2]	No (Dennis Spring)	Future study in a remedial investigation
Wastewater Treatment Plant	Yes	No	NA (Little West Fork Creek)	Future study in a remedial investigation
Sabre Airfield Hangar 6627	No[1]	No	No[1] (SP-126L)	No action at this time
Fire Station #2 Building 6634 and Wash Rack	No[1]	Yes	No[1] (SP-126L)	Future study in a remedial investigation
Bradley Tank Fire	No	No	NA (stormwater)	No action at this time

Notes and Acronyms:

1. Results from some groundwater and spring samples that were used to make recommendations for the AOPIs were collected at locations downgradient of multiple AOPIs (i.e., downgradient groundwater or springs that may drain groundwater from beneath multiple AOPIs within that spring's basin). The source(s) of PFOS, PFOA, and PFBS in groundwater and/or surface water associated with the AOPI should be discerned during a future investigation.
2. Historical (March 2019) data collected by the Army

Light gray shading – detection greater than the OSD risk screening level

GW – groundwater
NA – not applicable (surface water or stormwater data collected in association with/downgradient of the AOPI were not compared to the OSD risk screening levels as the feature sampled was not an expression of groundwater [i.e., seeps/springs])
ND – not detected

NS – not sampled (for surface water, NS indicates that no relevant surface water features exist near the AOPI to sample)
SO – soil
SP – spring
SW – surface water or stormwater
TBD – to be determined

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 United States Code §§ 9600, et seq. (as amended), and the Defense Environmental Restoration Program, 10 United States Code §§ 2701, et seq. The PFAS PA/SI included two distinct efforts. The PA identified locations that are areas of potential interest (AOPIs) at Fort Campbell, Kentucky (FTC) based on the use, storage, and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (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 FTC 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 associated with some PFAS, 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 United States Environmental Protection Agency (USEPA) established a lifetime health advisory (LHA) 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 or 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. The September 2021 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense 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 (commercial/industrial). 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**.

1.3 PA/SI Process Description

For FTC, PA and SI development followed the process described below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for FTC. The PA and SI processes are documented in the PA/SI Quality Control 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 United States Army Environmental Command (USAEC), United States Army Corps of Engineers (USACE), FTC, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 06 September 2018, approximately 6 weeks 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 FTC.

A read-ahead package was prepared and submitted to the appropriate POCs 2 weeks before the site visit. The read-ahead package contains the following information:

- The Installation Management Command (IMCOM) 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 16 to 18 October 2018. An in-brief meeting was held to provide installation staff with the objectives of the site visit and team introductions. **Section 3** includes information regarding personnel interviewed and areas where site reconnaissance was performed during the site visit.

Personnel interviews were conducted with individuals having significant historical knowledge at FTC. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, 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), proximity to surface water bodies and likely surface water flow pathways, potential receptors, and the distance to the installation boundary. Access to existing groundwater monitoring wells, if present, was 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 (i.e., with existing monitoring wells) 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 exit briefing was conducted on 18 October 2018 with the installation and USAEC to discuss preliminary findings of the PA site visit.

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 and scoping teleconference was held between the Army PA team and FTC.

The objectives of the SI kickoff and scoping 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 unexploded ordnance or 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

The SI sampling technical approach was further refined during follow-on meetings and based on direction from the Army.

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 2019a). The PQAPP details general planning processes for collecting data and describes the implementation of quality assurance (QA) and quality control (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 2019a) 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 FTC (Arcadis 2019b) 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) 5.1.1 (i.e., for the SI data collected in December 2019; DoD 2018) or 5.3 (i.e., for the SI data collected in August 2020, March 2021, December 2021, and January 2022; 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 FTC, 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

FTC is located in southwestern Kentucky and north-central Tennessee in portions of four counties: Montgomery and Stewart counties in Tennessee and Christian and Trigg counties in Kentucky (**Figure 2-1**). The installation is approximately 8 miles north of Clarksville, Tennessee, and 17 miles south of Hopkinsville, Kentucky, and is comprised of approximately 105,347 total acres of land. Approximately two-thirds of the acreage is located in Tennessee with the remainder in Kentucky. The built-up cantonment area in Montgomery and Christian counties consists of 14,000 acres, including the Army's largest airfield, Campbell Army Airfield (CAAF), along the eastern boundary of the reservation adjacent to U.S. Highway 41-A (FTC 2017). The site layout of FTC's cantonment area is shown on **Figure 2-2a**, and historical solid waste management units (SWMUs) are shown on **Figure 2-2b**. The remainder of the installation consists of agricultural fields and forested or grassland areas used for training and maneuvers, and range and impact areas.

2.2 Mission and Brief Site History

The following information about FTC's mission and site history is excerpted from the 2016 Installation Action Plan (FTC 2017) and Stormwater Management Plan (FTC Directorate of Public Works [DPW] 2018). Camp Campbell was commissioned in March 1942 and was re-designated as FTC in April 1959. FTC is an active IMCOM installation. The mission of FTC is to support and train the 101st Airborne Division (Air Assault), the 5th Special Forces Group, and other units located on the installation in preparation for a variety of assigned combat and combat-related missions. FTC houses CAAF and Sabre Heliport. The mission also includes the support and training of U.S. Army Reserve and National Guard units. A secondary mission includes providing housing and medical and dental care for active duty military, their family members, and retired military personnel (FTC 2017). FTC is home to 28,000 active duty personnel; 4,000 U.S. Army Reserve personnel; 45,000 family members; 4,600 civilian employees; and 4,000 contractor employees (FTC DPW 2018). An additional mission is to train noncommissioned officers in the fundamentals of leadership. Critical to the military operation are provisions for the safety and security of all personnel.

2.3 Current and Projected Land Use

The following information regarding the current and projected land use at FTC is excerpted from the 2014 to 2018 Integrated Natural Resources Management Plan (FTC DPW 2013). Wooded or barren grassland ranges for training and maneuvering make up the majority of the installation acreage (approximately 85,347 acres). Approximately 6,000 acres on FTC are leased to farmers in the local community to grow

crops including hay, wheat, corn, grain sorghum, and soybeans. FTC provides opportunities for general public hunting, fishing, and other recreation (FTC DPW 2013).

The FTC cantonment area is largely covered with asphalt and buildings, including housing units. FTC provides a full range of services to its residents, so environmental impacts are similar to that of civilian communities (i.e., resulting from underground storage tanks, landfills, and pesticide mixing areas). Several sites which were investigated under the Installation Restoration Program (IRP; i.e., SWMUs shown on **Figure 2-2b**) require long-term monitoring and/or land use controls. Remediation activities at the FTC sites in Kentucky are performed pursuant to the Resource Conservation and Recovery Act, as specified in correspondence from the Kentucky Department for Environmental Protection. In Tennessee, remediation activity requirements are specified in a Resource Conservation and Recovery Act Corrective Action Permit with the Tennessee Department of Environment and Conservation, renewed effective 29 September 2017. While land use in the cantonment area, training/range areas, and agricultural areas is expected to remain the same as current for the foreseeable future, facility changes have been proposed to include renovation of existing training facilities, construction of new training facilities, conversion of certain habitat types to support training, and improvements in efficiency (FTC DPW 2013).

The area surrounding FTC consists of natural woodlands, farmlands, and some urban development. Urban development is concentrated in Clarksville (8 miles southeast of the installation), Oak Grove (adjacent to the northeast border of the installation), Hopkinsville (about 14 miles northeast), and along U.S. Route 41A (adjacent to the eastern boundary), which connects those communities. Primary land uses directly south of FTC in Montgomery County are agriculture and rural residential. The portion of Christian County immediately adjacent to the northeast of FTC is also primarily farmland. The areas east and south of FTC contain substantial urban commercial and residential development, which is concentrated along U.S. Route 41A and within the city limits of Clarksville. Land adjacent to the installation to the northwest, west, and southwest in Trigg and Stewart counties is mostly forested to the banks of the Cumberland River. Land in the far western portion of Montgomery County adjacent to FTC is planned to remain forested or agricultural. Land use planning and regulation for off-post areas in Tennessee is done by the Clarksville-Montgomery County Regional Planning Commission and for off-post areas in Kentucky by the Hopkinsville-Christian County Planning Commission (FTC DPW 2013).

2.4 Climate

The following information regarding the climate of FTC is excerpted from the 2014 to 2018 Integrated Natural Resources Management Plan (FTC DPW 2013) and the Installation Assessment of the United States Army Headquarters 101st Airborne Division (Air Assault) and Fort Campbell, Kentucky (United States Army Toxic and Hazardous Materials Agency 1982). The climate of FTC and vicinity is characterized by hot, humid summers and cool winters. The mean temperature ranges from 68 to 89 degrees Fahrenheit during summer and 28 to 45 degrees Fahrenheit during winter. Extreme temperatures are possible but rare.

The average annual precipitation is about 50 inches with the wettest months occurring in spring (March through May) and the driest month in fall (October). An average year will have snowfall on 11 days (accumulating an average of 14 inches), generally coming from systems of low pressure and associated cold fronts that produce widespread and uniform areas of precipitation (FTC DPW 2013). Summer rainfall occurs mainly in the form of localized, short-duration scattered convective showers. Prevailing winds are

typically from the south throughout the year, with the exception of February and October when the prevailing wind direction is more from the north (FTC DPW 2013).

2.5 Topography

The following information regarding the topography at FTC is excerpted from the Resource Conservation and Recovery Act Facility Investigation Report (Arthur D. Little, Inc. [ADL] 2002). FTC is located near the boundary of the Lexington Plain of southwestern Kentucky and the Highland Rim Plateau of northwestern Tennessee. The predominant geomorphic features are sinkholes and drainage systems associated with karst terrane. Erosion and weathering of the soluble limestone bedrock has formed low rolling hills (ADL 2002). FTC is within the Interior Low Plateaus physiographic province, and more specifically within the western Highland Rim surrounding the Nashville Basin (often called the Pennyroyal Plateau). The terrain at the installation is gently rolling, with the exception of a comparatively flat area along the eastern boundary and approximately 5,000 acres of steep, highly dissected, hilly land along the far western boundary (**Figure 2-3a**). Surface slopes are quite variable, but the regional relief is low to moderate with elevations ranging from 700 feet in the western uplands to 400 feet in the valley of Little West Fork Creek to the east. Much of the lower land (less than 600 feet in elevation) contains collapse basins and sinkholes (most without water). This karst topography is especially prevalent in the more gently rolling areas and extends throughout the main cantonment area on the east side of the installation (ADL 2002). **Figure 2-3b** shows the site topography for the cantonment area.

2.6 Geology

The following information regarding the geologic setting of FTC is excerpted from the Resource Conservation and Recovery Act Facility Investigation Report (ADL 2002) unless otherwise noted. FTC is located in the Mississippian Geologic Province of west central Kentucky and Tennessee. It is characterized by horizontal to slightly dipping limestone strata (Solutions to Environmental Problems, Inc. 1999, as cited in ADL 2002). It is also located in the stable Nashville Dome Tectonic Province, which has experienced few earthquakes in historical time and no major faulting since early Cretaceous and perhaps late Paleozoic times (ADL 2002).

The erosional base elevation at FTC exposes two Mississippian-age limestone formations: the Ste. Genevieve Limestone and the St. Louis Limestone. The Ste. Genevieve Limestone (approximately 110 to 185 feet thick), the younger of the formations, is characterized by the presence of a chert-rich zone about 80 feet thick in the lower part of the formation and is mapped as the stratigraphically highest bedrock unit beneath most of FTC. The underlying St. Louis Limestone is mapped as the bedrock in the major waterways at FTC, including the Dry Fork and Little West Fork creeks. The St. Louis Limestone can be thin- to thick-bedded, dolomitic, argillaceous, silty, fossiliferous, and clastic (ADL 2002). Structural contours of the area mapped by the United States Geologic Survey indicate that the bedrock is slightly undulating, but there is a regional dip that averages approximately 15 feet per mile to the northeast. Sinkholes are a common feature at FTC, especially in the main cantonment area. Major voids in the upper 10 feet of bedrock are particularly well developed along the Little West Fork Creek (ADL 2002).

Unconsolidated material consists of a reddish-brown residuum, developed in place by the weathering of the limestone. The residuum consists of an upper layer of lean-to-fat silty clay (0 to 92 feet thick) and an

underlying layer of gravelly clay (0 to 40 feet thick), with a gradational boundary between the two stratigraphic units (ADL 2002). The silty clay is thinnest in areas near stream valleys and on hilltops and thickest in flat areas such as at CAAF (up to 100 feet thick); the average thickness of residuum is 20 to 50 feet. The gravelly clay is characterized by large amounts of limestone and chert fragments (greater than 30 percent [%] gravel) in a silty clay matrix; the gravel occurs in thin layers that become more frequent closer to the bedrock surface. The residuum mantles bedrock across the CAAF, the main cantonment area, and most of the Old Clarksville Base area (south of the main cantonment area); however, bedrock does outcrop along some of the beds of perennial streams and along some of the slopes of steep hillsides in the Old Clarksville Base area. The thickness of the residuum at FTC is highly variable (for example, changes in residuum thickness of greater than 30 feet have been observed to occur across horizontal distances of less than 100 feet; ADL 2002), due largely to differential weathering of bedrock. Voids occasionally occur in the residuum near the contact with bedrock and are often filled with water or very loose, wet sand (ADL 2002).

2.7 Hydrogeology

The information in this section regarding hydrogeologic conditions at FTC is excerpted from the various reports cited within. Groundwater beneath FTC has been segregated into two hydrogeologic units: the uppermost unit consists of isolated areas of saturated residuum (primarily in the lower gravelly-clay unit), and the lower unit comprises the regional bedrock aquifer, which is a karst aquifer. Collectively, these water-bearing zones comprise one aquifer.

The ways by which groundwater is stored in and moves through karst aquifers are different from most other aquifers. The majority of groundwater that is drained by karst aquifers moves through conduit networks where the directions that groundwater moves are governed by the architecture of the networks. Groundwater moving through the conduit networks typically discharges at the land surface, or subaqueously into surface water bodies, through springs (Ford and Williams 2007); that is, springs are the primary outflow points of karst aquifers. The common practice of estimating groundwater-flow directions using potentiometric maps is not very reliable in karst due to the conduit networks. If the conduit network(s) extend beyond the source of contamination, which is often the case, contaminant concentrations in groundwater moving through the network(s) can be diluted as tributary conduits carrying clean groundwater join the network. Borings drilled in karst aquifers are not likely to intercept important elements of the permeability structure draining the aquifer.

The residuum is variably saturated, largely depending on the depth to bedrock (which generally ranges from 20 to 130 feet at FTC). In areas where the bedrock is shallow, and on the slopes of hills, the residuum is often dry (ADL 2002). Where bedrock is deeper (e.g., at CAAF), perched groundwater is occasionally encountered above low-permeability soils as shallow as 10 feet below ground surface (bgs). Perched groundwater zones at CAAF are not laterally continuous, that is, there is no continuous aquifer within the residuum at the site. The primary aquifer consists of the underlying Ste. Genevieve and St. Louis Limestones (A.T. Kearney, Inc. 1990).

Recharge to the aquifer is both diffuse and focused. Groundwater in the residuum provides diffuse recharge to the underlying bedrock aquifer. The bedrock aquifer also receives focused recharge from openings at the surface, such as sinkholes and intermittent stream beds (A.T. Kearney, Inc. 1990). Groundwater in the bedrock is primarily stored in the rock matrix (Worthington 1999).

The potentiometric surface of the regional bedrock aquifer generally ranges between 480 and 485 feet above mean sea level. Surface water features and the large springs (Quarles [off post], Boiling, Gordon, Beaver, Dennis, and Blue Springs) serve as the primary groundwater discharge boundaries for the aquifer (ADL 2002).

Movement of groundwater through the conduits is rapid. Tracer-tests yielded mean velocities ranging from 383 to 6,284 feet per day. Distances between where tracer dyes were injected and where they were recovered ranged from about 0.5 mile to more than 5 miles (ICF Consulting 2004). Groundwater discharge rates at springs can also fluctuate seasonally.

Considerable data have been collected at and near FTC, including through tracer studies, to characterize groundwater movement. Analysis of those data has identified several groundwater basins, each that drains to a particular spring or group of springs (ICF Consulting 2004). Tracer-study results indicate that groundwater beneath CAAF discharges to Quarles Spring (off post), Gordon Spring, and Blue Spring (**Figure 2-2a**). Available data collected at other previously investigated SWMUs indicate that groundwater beneath the mid-cantonment area discharges to Millstone Spring (off post, east of the installation) and Boiling Spring (on post); groundwater beneath the south cantonment area discharges to Boiling Spring, Beaver Spring, and Dennis Spring or Little West Fork Creek on post (**Figure 2-2a**; ICF Consulting 2004).

2.8 Surface Water Hydrology

The information in this section regarding surface water hydrology conditions at FTC is excerpted from the Resource Conservation and Recovery Act Facility Investigation Report (ADL 2002) and the Integrated Natural Resources Management Plan, 2014-2018 (FTC DPW 2013). The surface water systems on FTC include approximately 700 watercourses, totaling approximately 453 stream miles. The installation is divided into nine subwatersheds (FTC DPW 2013). Dry Fork Creek drains the CAAF area as well as all areas to the west of A Shau Valley Road and to the north of Air Assault Street. Dry Fork Creek flows to the south, where it joins with Noahs Spring Branch (which drains north-central portions of the installation), and eventually Little West Fork Creek approximately 0.5 mile upstream from Boiling Spring. Most of the water in Dry Fork Creek is supplied by Blue Spring, located in the center of the Small Arms Impact area, and Quarles Spring, located on private property immediately to the west of CAAF (ADL 2002).

The largest stream on the installation is Little West Fork Creek. The headwaters of the Little West Fork Creek occur at the confluence of the Piney Fork Branch and the Noahs Spring Branch located approximately 0.5 mile upstream of Boiling Spring. The Little West Fork Creek flows to the east (into the Red River off post) and represents the base of the surface water hydrologic system at FTC, draining much of the Old Clarksville Base area and significant portions of the main cantonment area. The Little West Fork Creek receives significant amounts of water from several major springs, including Boiling, Dennis, Eagle, Beaver, and Gate One Springs. The creek also receives effluent from the wastewater treatment system, many intermittent streams, and smaller springs (ADL 2002).

Surface water on the installation drains into the groundwater system via sinkholes and disappearing streams, or eventually drains into the Cumberland River. Flooding is a minor problem, and of short duration. In addition, four small, shallow man-made lakes are also present on FTC and are used for training or recreational purposes (ADL 2002).

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 FTC. The information in the subsections below is as provided in the Integrated Natural Resources Management Plan, 2014 to 2018 (FTC DPW 2013).

2.9.1 Stormwater Management System Description

Stormwater management and permitting is handled by the FTC Environmental Division, Compliance Branch. Stormwater is managed using natural limestone sinkholes and man-made collection basins via storm drains to direct runoff into storm sewers and open, unlined ditches. Stormwater runoff from CAAF drains to Dry Fork Creek (a primary tributary to Little West Fork Creek), and stormwater runoff from the cantonment area drains into Little West Fork Creek (FTC DPW 2013). The stormwater management system is maintained by the FTC DPW through monthly and yearly inspections; infrastructure is inspected once every 5 years by a professional engineer.

2.9.2 Sewer System Description

Sewage collection and treatment is provided exclusively by FTC through one system that serves the main cantonment area, CAAF, and Sabre Heliport. Both domestic and industrial wastewater are collected and treated at the wastewater treatment plant (WWTP) in the Old Clarksville Base area (**Figure 2-2a**), which provides both primary and secondary treatment and has a capacity of 4.0 million gallons per day. The WWTP does not receive stormwater. Effluent is discharged to Little West Fork Creek (FTC DPW 2013). Central vehicle wash facilities operate on a closed-loop system in which known contaminants are removed and wash water is recycled rather than discharged to the sewer system (FTC DPW 2013). Evidence of the use of PFAS-containing products were not identified during the PA at the vehicle wash facilities. PFAS removal processes have not been implemented at the WWTP or vehicle wash facilities.

The FTC WWTP operator (Jacobs Engineering Group) maintains records of the system's age, materials, size, and improvements for pipe segments in the inventory. The FTC sewer system integrity is of varying condition, and some components may be aged beyond useful service life and in need of rehabilitation.

2.10 Potable Water Supply and Drinking Water Receptors

The information in this section regarding the potable water supply and drinking water receptors at FTC is excerpted from the various reports cited within and as provided by the installation. Drinking water at FTC is supplied through a privatized entity (Jacobs Engineering Group, which began operating the system in 2003); as such, the installation is not currently included in the drinking water sampling conducted by the U.S. Army Public Health Command (Waterbury 2019). The installation's water supply is sampled as required for a community water system in accordance with the Safe Water Drinking Act. Historical sampling of the installation's water supply for analysis of PFAS constituents is described further in **Section 2.12**.

Drinking water is sourced from a spring on post. Potential receptors utilizing this drinking water source include installation personnel and families, visitors, and contractors. Potable water supplied to the

cantonment area is drawn from a spring, which has a pumphouse constructed over the spring. The potential yield of this system is 24.65 million gallons per day (FTC DPW 2013, 2018). The spring emerges at about 440 feet above mean sea level from the St. Louis Limestone. It is located in the Tennessee portions of the installation, south of Mabry Road on Little West Fork Creek (**Figure 2-2a**), which is a tributary of the Red River and lies approximately 2.5 linear miles west of the main cantonment area. The groundwater basin feeding the spring covers approximately 50 square miles on FTC and underlies much of the surface drainage of Piney Fork (FTC DPW 2013). An area of approximately 126 square miles surrounding the spring and encompassing its groundwater basin is designated as a wellhead protection area (FTC DPW 2018).

Current use of potable water ranges between 4 to 5 million gallons per day (FTC DPW 2013); the capacity of the pumping and distribution system is rated at 10 million gallons per day. The installation's water source is also the supplemental water supply for Oak Grove, Kentucky, east of the installation (ADL 2002). Raw water from the installation's water source is treated in a rapid sand filter treatment plant. The potable water storage system consists of one 0.25-million gallon, one 1.0-million gallon, and three 0.5 million-gallon elevated steel storage tanks, all located within the cantonment area.

Surface water is not used as a source of drinking water at FTC (the pumphouse constructed over the spring that supplies potable water withdraws the groundwater before it discharges from the spring). The Hopkinsville Water-Environment Authority can provide up to 500,000 gallons per day of drinking water for potential emergency use only. The USEPA's third Unregulated Contaminant Monitoring Rule occurrence data indicate that the Hopkinsville Water Environmental Authority public water supply system was sampled for PFAS in January, March, and October of 2015; results were non-detect for all six PFAS constituents analyzed, including PFOS, PFOA, and PFBS (USEPA 2017; Eurofins Eaton Analytical 2015). These data are discussed further in **Section 2.12**.

Additionally, on 23 July 2020, the DoD issued a policy on monitoring PFAS constituents at military installations where drinking water is provided by a non-DoD purveyor (OSD 2020). Part of DoD's PFAS strategy is to ensure drinking water provided to the installation does not contain PFOS and/or PFOA at concentrations greater than the 70 ng/L USEPA LHA (i.e., for either compound or combined total). As a result of the referenced DoD policy (OSD 2020), FTC requested that Jacobs Engineering Group provide finished drinking water sampling data for PFAS constituents in Summer 2021. The data from the 2021 finished drinking water sampling indicate that PFOS and PFOA are present in the FTC finished drinking water supply at concentrations less than the USEPA LHA. These data are discussed further in **Section 2.12**.

Supply wells at CAAF and the Sabre Army Heliport are used only for sanitary purposes at the signal tower facilities and are not used for drinking water.

Off post, both wells and springs are used for water supply and for irrigation. Hunters Spring, located east of the Main Cantonment Area, is used as a water supply for the town of Oak Grove. Quarles Spring, located west of CAAF, was historically used to supply drinking water to several households off post until 1998 (ADL 2002), but is currently used for agricultural (irrigation) purposes only (i.e., not for watering livestock). The Red River also provides a source of drinking water to communities downstream of FTC.

There are numerous off-post water supply wells surrounding FTC which have various uses and owners. An Environmental Data Resources, Inc. (EDR) Survey Report was generated for FTC. An EDR report

includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. The EDR report along with state and county GIS provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-4**). The EDR Report for well search results at FTC is provided as **Appendix E**; however, designations of the wells' use as drinking water supply or other may not be documented. Other wells installed in the area with use designations other than water supply (i.e., monitoring, piezometer, observation, geothermal, or exploratory wells) are not shown on the figure. Data limitations for information about the off-post water supply wells are discussed in **Section 9**.

2.11 Ecological Receptors

The PA team collected information regarding ecological receptors that was available in installation documents. The following information is provided for future reference should the Army decide to evaluate exposure pathways relevant to the ecological receptors. The information in this section is excerpted from the Integrated Natural Resources Management Plan, 2014 to 2018 (FTC DPW 2013). The inventory of rare, threatened, and endangered species was conducted from 1993 to 1994 for animal species (Scott et al. 1995) and for vascular plant species (Chester et al. 1995). Additionally, FTC wildlife biologists routinely survey game mammals, birds, and fish to monitor trends.

Habitat types at FTC include grassland barrens, agricultural fields, upland and bottomland hardwood forest, pine plantation, and riparian zones. The United States Fish and Wildlife Service is the primary federal agency with which FTC cooperates on fish and wildlife management, though many other state (Kentucky and Tennessee) agencies are involved with resource management at FTC. The United States Fish and Wildlife Service officers enforce federal and state laws protecting natural and cultural resources on FTC, as well as enforcing FTC hunting regulations and curtail illegal taking of wildlife and plants outside established seasons. The Kentucky Department of Fish and Wildlife Resources is the primary state agency in Kentucky for issues regarding fish and wildlife management, as well as the regulatory authority behind the rules and regulations for hunting, fishing, and trapping (FTC DPW 2013).

Historical surveys have indicated more than 420 plant species on the installation. Vegetation in the cantonment area is primarily ornamental lawns, shrubs, and trees cultivated for aesthetic purposes. Fauna surveys at FTC have indicated more than 40 species of mammals, 214 species of birds (year-round and migratory), 51 species of reptiles and amphibians, and 60 species of fish. Game birds present at FTC include wild turkey, mourning dove, northern bobwhite, common crow, American woodcock, and several waterfowl. Game mammals found at FTC include white-tailed deer (the only large game mammal hunted recreationally on the installation) and small species such as coyote, gray fox, groundhog, opossum, eastern cotton tail, racoon, gray squirrel, and fox squirrel (FTC DPW 2013).

Federally-listed endangered species found at FTC include the Indiana and grey bats; however, no critical habitat for these species exist on FTC. The bald eagle, a federally protected species, occasionally is observed at FTC in winter. FTC is also home to 21 other wildlife species listed as threatened or endangered by the states of Kentucky or Tennessee, and 23 species considered special concern, in need of management, rare, or declining by one or both states (FTC DPW 2013).

2.12 Previous PFAS Investigations

Previous (i.e., pre-PA) PFAS investigations relative to FTC, including both those conducted and not conducted by the Army, are summarized to provide full context of available PFAS data for FTC. The historical data described below were not validated as part of this SI and are reported as provided in the laboratory reports or historical documents provided during the PA. Therefore, only data collected by the Army will be used to make recommendations for further investigation.

In response to the third Unregulated Contaminant Monitoring Rule and IMCOM Operations Order 16-088, Jacobs Engineering Group (the water treatment plant operator at FTC) conducted quarterly analytical sampling for six PFAS constituents (including PFOS, PFOA, and PFBS) during 2015 at the FTC water treatment plant's entry point to the distribution system at Building 1746 (i.e., finished water). All PFOS, PFOA, and PFBS results from these 2015 sampling events were non-detect and reported as less than the laboratory's reporting limits (0.040 micrograms per liter [µg/L; 40 ng/L], 0.020 µg/L [20 ng/L], and 0.090 µg/L [90 ng/L] respectively; **Table 2-1**). The laboratory that analyzed samples under UCMR3 met the USEPA's UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

Additionally, as discussed in **Section 2.10**, FTC requested data regarding PFAS constituents in the installation's finished drinking water. Jacobs Engineering Group conducted sampling of the installation's finished water on 12 July 2021. FTC received the requested data from this sampling on 04 August 2021, which indicated that both PFOS and PFOA are present in the drinking water at concentrations less than the USEPA LHA of 70 ng/L. Specifically, the PFOS and PFOA concentrations measured in the finished drinking water were 13 ng/L PFOS and 2.5 to 2.8 ng/L PFOA.

The only other PFAS sampling data available prior to the initial December 2019 SI event for FTC were from soil samples collected by FTC in March 2019 at the Training Area 03 Crash Site. Samples were collected near the ground surface to a depth of up to 6 inches. Five samples were collected within the footprint of the UH60 helicopter crash site, and a sixth sample was collected about 100 yards downgradient in a low spot. The samples were analyzed for metals and PFOS and PFOA only (via USEPA Modified Method 537 by Eurofins TestAmerica, Nashville). Within the crash site footprint, PFOS concentrations ranged from 308 micrograms per kilogram (µg/kg [parts per billion]; 0.308 mg/kg) to 2,150 µg/kg (2.150 mg/kg), exceeding the residential OSD risk screening level of 130 µg/kg (or 0.13 mg/kg) at all five sampling locations; PFOS concentrations also exceed the industrial/commercial OSD risk screening level of 1,600 µg/kg (or 1.6 mg/kg) at two of the five soil sampling locations. PFOA concentrations ranged from 11.3 µg/kg (0.0113 mg/kg) to 99 µg/kg (0.099 mg/kg, less than the residential OSD risk screening levels). At the downgradient sampling location, PFOS and PFOA concentrations were 5.83 µg/kg (0.00583 mg/kg) and 0.387 µg/kg (0.000387 mg/kg), respectively (**Table 2-2**; Eurofins TestAmerica 2019). Coordinates for the exact soil sampling locations were not provided.

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 FTC, data were collected from three principal sources of information which 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**), and site reconnaissance (**Appendix I**) during the PA process for FTC is presented in **Section 4**. 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 IRP administrative record documents, compliance documents, FTC fire department documents, FTC DPW documents, and GIS files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for FTC is provided in **Appendix F**.

3.2 Personnel Interviews

Interviews were conducted during the site visit and during follow-up telephone conversations. If a previously identified interviewee was not available during the site visit, attempts were made to complete the interview via telephone before or following the site visit or by contacting an alternate interviewee identified by the installation POC.

The list of roles for the installation personnel interviewed during the PA process for FTC is presented below (affiliation is with FTC unless otherwise noted).

- Environmental Chief
- Pollution Prevention Branch Chief
- Current and former IRP Managers
- Environmental Water Quality Manager
- Current and former Fire Chiefs
- Assistant Fire Chief

- Former FTC Firefighter
- Project Manager for fire suppression system maintenance (International Systems of America, LLC [ISA])
- Airfield Managers for CAAF and Sabre Heliport
- Instructor Pilot at CAAF
- Water Treatment Plant and WWTP Operator (Jacobs Engineering Group, who also maintains the pumphouse for the installation's water supply)
- Chief of Engineering
- Mechanical Engineering Design personnel
- Engineering Design Branch Chief
- Master Planner Division Chief
- Chief of Training for the Directorate of Plans, Training, Mobilization, and Security
- Hazardous Waste Program Manager
- Wildlife Biologists
- Pesticide Application Managers/Coordinators
- Range Control Installation Program Manager
- Chief of Maintenance
- Weapons/Electronics Lead for Logistics Readiness Center (DynCorp International)
- Environmental Conservation personnel
- Environmental Hazardous Materials Education Coordinator
- GIS Coordinator
- Safety and Occupational Health Specialist
- Public Affairs Office personnel
- Historian (Pratt Museum)
- DPW's Contractor for data management (i.e., Environmental Consultants and Contractors, Inc.)

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 FTC 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

FTC was evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials areas. 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 sections.

4.1 AFFF Use, Storage, and/or Disposal at FTC

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% 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 and/or cleaning, 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.

AFFF has been used, stored, and disposed at FTC, as described below, in association with firefighter training activities, hangar suppression systems equipped with AFFF, storage in fire equipment and warehouses (including at fire stations), fire equipment testing and vehicle maintenance, and fire responses.

Firefighter training activities: Fire training activities at FTC involve ignition of off-specification fuels (on the ground and/or dispensed via props) at designated burn locations. Five fire training areas (FTAs) have historically operated at FTC from the 1970s to present. FTAs at which AFFF use has been documented or is likely include: the CAAF FTA and Retention Pond southeast of the runways, the CAAF Former FTA and the Old FTA (SWMU 12/15) southwest of the runways, the Current FTA (Building 7237) northwest of the runways, and the Old Clarksville Base FTA (SWMU 148). The use of AFFF is confirmed or suspected at each of these areas given their periods of operation (i.e., between the mid-1960s to present). The site histories, approximate period of operation, and approximate volumes of AFFF used (if known) at these areas are further described in **Section 5.2**. No FTAs have been reported at the Sabre Heliport.

Hangar suppression systems equipped with AFFF: While specific historical documentation is not available for every instance, the fire department indicated that each of the hangars equipped with AFFF fire suppression systems at FTC should be presumed to have accidentally discharged at least once (**Appendix G**). The fire department indicated that these systems would have also been tested and would have released AFFF during initial system testing after their construction. The building numbers, type, and capacity are listed below for each of the hangars equipped with AFFF suppression systems. Notes from

inspections conducted in 2019 regarding the contents of each tank are included. The AFFF tanks/suppression systems' piping are not equipped with flow totalizers, according to the contractor (ISA) who conducts routine maintenance and inspection of the systems. The hangars' fire suppression systems are reportedly not tested by flowing AFFF from the piping at FTC; however, it is common for these types of systems to be periodically tested by allowing deployment of the foams (which may include a full evacuation) to test the system. The list of hangars with current AFFF fire suppression systems includes:

- CAAF Hangar 7272: The system includes a 1,000-gallon tank. At the time of the 2019 inventory, the tank contained Arrow 3% AFFF; the volume of AFFF in the tank was not noted during the 2019 inspections (ISA 2019).
- CAAF Hangar 7273: The system includes a 500-gallon tank, which was observed to be full of Chemguard MS-3% AFFF in August 2019 (ISA 2019).
- CAAF Hangar 7274: The system includes an 800-gallon tank which contains Chemguard 3% AFFF. The volume of AFFF in the tank could not be discerned in August 2019 due to a broken sight glass on the tank (ISA 2019). In addition, a standby supply of three 55-gallon drums of AFFF are reportedly stored in this building according to a 2017 inventory provided by the Army; the type of AFFF in these drums was not noted (IMCOM 2017).
- CAAF Hangar 7166: The system includes a 150-gallon tank filled with Ansul 3% AFFF. The volume of AFFF in the tank was not noted during the 2019 inspections (ISA 2019).
- Destiny Heliport Wash Rack Building 7243 at CAAF: The system includes a 1,000-gallon tank. The tank contained Ansul 3% AFFF at the time of the PA site visit; the tank was observed to be low, containing approximately 400 gallons of AFFF concentrate in July 2019 (ISA 2019).
- Destiny Heliport Wash Rack Building 7251 at CAAF: The system includes a 1,000-gallon tank. The tank contained Ansul 3% AFFF at the time of the PA site visit; the tank was observed to be nearly empty in July 2019 (ISA 2019).
- Sabre Heliport Hangar 6627: The system includes a 1,000-gallon tank, which was observed to be full of Ansul 3% AFFF in June 2019 (ISA 2019). During the PA site visit, the operator of the WWTP (which has received AFFF-containing wastewater from hangars on multiple occasions) provided an incident description for AFFF release at this hangar in June 2009. A contractor had been tasked with removing 1,000 gallons of expired 3% AFFF and replacing it with new AFFF. Initially, some of the old AFFF was removed and applied to the ground along fences to kill weeds during the 2009 AFFF removal event.

According to a 2016 inventory provided by the Army (IMCOM 2016), a total of approximately 2,900 gallons of 3% AFFF remained in the FTC hangars at the time of the PA site visit. However, another inventory sheet provided by FTC during the PA site visit (**Appendix G**) indicates that a total of approximately 5,450 gallons of AFFF remains in the hangars described above. Other hangars at CAAF and the Sabre Heliport currently have either high-expansion foams (Chemguard or Jet-X: at Buildings 7262, 7264, 7268, 7227, 7257, 66002, and 66015) or water-only (Hangar 7176) deluge fire suppression systems. The high-expansion fire suppression systems in these buildings contain 400- or 450-gallon tanks containing Chemguard 2% C2 high-expansion foams (ISA 2019; **Appendix G**).

In a follow-up interview, the current contractor (ISA) who maintains the AFFF systems in the hangars indicated that a previous contractor (Premier Fire and Safety) reportedly changed out foam systems in Hangars 7262, 7264, and 7268 from AFFF-equipped systems to (non PFAS-containing) high-expansion foam-equipped systems. The timeline of completion and procedures followed (i.e., flushing practices and/or AFFF and system component disposal) for these change-outs is not known. The contractor noted that at least partial replacement of the system infrastructure (i.e., piping) would have had to be completed. If system transitions only involved water rinses between the change-out from PFAS-containing foams to non PFAS-containing foams, or from C8 dominant AFFF to C6 dominant AFFF (and system infrastructure was not completely replaced), it is likely that residual PFAS (or C8 PFAS) remain in components of the system.

The WWTP at FTC has received wastewater/AFFF mixture from discharge events at AFFF- and high-expansion foam-equipped systems (**Appendix G**). In some cases, this has caused the wastewater to foam at the headworks, and foam has been observed overtopping the treatment system basins and blowing across the WWTP property. Assuming that the wastewater piping was installed at the time of the hangar construction, the age of the wastewater lines at the hangars varies, and this infrastructure may also contain residual PFAS. The dates of completion of the hangars range from 1989 (CAAF Hangar 7272) to 2014 (CAAF Hangar 7257).

Storage in fire equipment (including at fire stations): A 2016 inventory of AFFF storage at FTC provided by the Army (IMCOM 2016) indicated that approximately 2,845 gallons of 3M 3% AFFF remained in the fire apparatus, 725 gallons of 3M 3% AFFF remained in the engine test cell, and 725 gallons of 3M 3% AFFF remained in the fuel blivet storage cell at the time of the inventory (IMCOM 2016). These apparatuses are under the control of the DPW. Another inventory sheet provided by FTC indicated that approximately 2,615 gallons of 3M 3% AFFF remained on hand in 11 fire trucks (2,115 gallons) and a 1,000-gallon foam trailer (500 gallons in the apparatus). The fire department concurred with this latter inventory during the PA site visit, however they noted only about 450 gallons remained in the foam trailer.

The FTC fire department reported that historically, AFFF stored in various equipment may have been transferred and reused in other equipment. The AFFF stocked in the fire trucks and foam trailer was reportedly a mixture of military specification foams manufactured by 3M (batch date April 2000) and National Foam (batch date February 2004). Five fire stations are present at FTC. Fire trucks and equipment containing AFFF may have been stored at all five fire stations present at FTC over the years since AFFF use at the installation began. Nozzle testing or other AFFF use has reportedly not occurred at any of the Fire Stations #1 through #5; fire equipment testing was reportedly conducted at other facilities adjacent to or associated with the fire stations as noted below. Fire Stations #1 and #5 are the newer of the stations, constructed in 2005.

Since the PA site visit, the AFFF contained in the fire trucks and the foam trailer has been changed out to newer C6 AFFF. According to the fire department, the procedure for this change-out was: the fire department offloaded the old AFFF from the trucks and foam trailer into a mobile plastic and rubber container provided by a contractor. The trucks and foam trailer were pulled into the bermed container, the AFFF was drained from the apparatuses, and the trucks and trailer were triple rinsed with water within the container. The AFFF and rinse solution was extracted from the container with a portable pump and transferred into a 36,000-gallon holding tank. This was completed at Building 6310 (in the mid-cantonment area) over two separate events to accommodate the 36,000-gallon limit of the holding tank.

The holding tank containing AFFF and rinse solution was taken offsite and incinerated. Similar to hangar fire suppression system infrastructure, it is likely that residual C8 PFAS may remain in the fire truck infrastructure that is now reconfigured to deploy C6 AFFF.

Storage in warehouses: A 2017 inventory provided by the Army also indicated a total of approximately 9,916 gallons of AFFF was stored at the installation between hangars, fire trucks/equipment, and in warehouse storage (IMCOM 2017). Approximately eighty 5-gallon pails of AFFF were reported in this inventory; however, the location of its storage was not noted or observed during the PA site visit. Only sixteen 6-gallon pails of AFFF were present at Building 5121 during the PA site visit in October 2018; by the August 2020 field event, these containers had been removed from the building. Conex Containers 40 and 41 (near Building 5121) were noted as historical AFFF storage locations; however, the volume of AFFF stored and time period of its storage was not provided and AFFF was not present in the Conex containers during the October 2018 PA site visit.

Fire equipment testing and vehicle maintenance: Several areas at FTC have been used to conduct fire equipment testing and/or maintenance. Former Fire Station #1 was historically located at Building 2575 (now the Emergency Medical Services building). The fire department reportedly conducted nozzle testing and crash truck washing/tank flushing activities at the station prior to 1995 and through 2002. Runoff from these activities was directed into an unlined stormwater ditch running southerly and parallel to Indiana Avenue. The clamshell building adjacent to Fire Station #3 (Building 7152) and the Destiny Heliport Wash Racks Buildings 7243 and 7251 near Fire Station #4 were used during this same period for nozzle testing and cleaning of fire trucks; storm drains in the vicinity of these facilities potentially received runoff from AFFF mixtures. Stormwater outfalls are located along Dry Fork Creek and Little West Fork Creek; in some cases, stormwater is directed to natural sinkholes.

Additional maintenance shops the FTC fire department utilized for fire equipment were located across from the current Fire Station #1 at Building 1747 (Legacy Fire Truck Repair Shop at Building 5124, which is now a gravel covered area, used prior to 2010 for fire truck repair including possible tank rinsing and nozzle testing of AFFF-containing trucks) and Building 5737 (used from 2010 to 2018 for maintenance of AFFF-containing trucks).

Direct input of PFAS-containing material (AFFF) to storm water ditches has reportedly occurred at FTC. An Illicit Discharge Report provided by the installation from October 2014 specifically noted that AFFF flushed from an FTC fire department crash rescue truck tank had discharged onto the pavement outside of Building 5737 (the former fire truck maintenance shop) and down 29th Street to a trench drain at Wickham Avenue. The flow drained to the stormwater drainage inlet to the south of the area; flow entering this stormwater drainage inlet flows north approximately 300 feet to a perpendicular pipe under Wickham Avenue and the railroad. The drainage pipe daylights from a headwall on the west side of the rail berm. FTC personnel observed water with some foam in the conveyance extending approximately 50 feet through the adjacent wooded area west of the railroad following the October 2014 release.

Fire responses: Several aircraft (typically helicopter) crash/fire response incidents in the Training Areas (including Training Areas 03, 17, 25, 41, 44, 54, and 56) and combat vehicle fire responses across the installation were noted by installation personnel during the PA site visit and interviews. However, it was not verified that these crashes and vehicle fires were responded to with AFFF (personnel reported that fires would typically burn out before the fire department could arrive), and exact locations of the incidents were not provided except for an approximate location provided for the crash in Training Area 03 which

occurred in 2016. The March 2019 PFAS detections in soil at the Training Area 03 area indicate that the crash in this area was likely responded to with AFFF. Training Area 03 is located south of the small arms impact area, and west of the cantonment area (likely downgradient of Boiling Spring). The CAAF airfield manager reported that no aircraft fires have been responded to at CAAF since at least 2008.

Additionally, on 14 February 2021, a Bradley Tank caught fire along Angels Road (near the intersection of Grant Road) west of the cantonment area in Training Area 26. The fire was responded to with AFFF, which was observed covering a stretch of asphalt approximately 100 feet long. The AFFF was also observed on soil adjacent to the vehicle, and it flowed further to the west on the asphalt and to the north of Angels Road to a culvert. After extinguishing the fire, the tank was driven to a pull-out spot along Grand Road to the west. During site reconnaissance in March 2021, char marks were visible on Angels Road at the location where the vehicle was on fire.

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

Following document research, personnel interviews, and site reconnaissance at FTC, additional areas were identified as preliminary locations where potentially PFAS-containing materials were used, stored, or disposed. A summary of information gathered during the PA for each of these preliminary locations is described below. 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**.

The FTC WWTP has received discharges from hangars equipped with AFFF fire suppression systems. Since 2003, a few instances of larger volumes of foam (i.e., instances where the entire hangar fire suppression system discharged) and several instances (approximately 10) of smaller volumes of foam (i.e., leaks from the systems) received at the WWTP have occurred. The microbial film on the trickling filters and the ultraviolet disinfection system are impaired when the WWTP receives AFFF-containing wastewater from hangars. Lift stations can also become impaired and stop functioning properly when AFFF-containing waste moves through the system; several hundred thousand gallons of water are required to remove the foam and restore lift stations to operational status. Slurry generated from the treatment of wastewater is aerated in digesters for approximately 90 days, pressed into a sludge, and then taken to the Camden Municipal Landfill or Bi-County Solid Waste Management landfills off post in Tennessee on a quarterly basis. This type of aerobic wastewater treatment would not remove PFAS, but it would enable the biological transformation of some PFAS precursors into PFAS detectable by USEPA Method 537. If PFAS are present in the influent, they would be concentrated in the biosolids and sludges that are ultimately produced.

Potential PFAS use associated with metal plating activities may also be relevant to Army installations (as PFAS have been known to be used in some mist suppressants). However, review of data collected from site reconnaissance, installation personnel interviews, and historical documents did not identify any historical metal plating operations at FTC. While historical IRP site FCPB-43 (SWMU 140) is named the “Chromium Plating Shop,” chromium plating reportedly did not occur at this site (near Building 7811) according to historical documents (FTC 2017) and personnel interviews (**Appendix G**). In 1965, the use of the facility changed to weapons refurbishing and metal cleaning, and the facility was closed in 1993 (FTC 2017). Historical chemical usage at Building 7811 included spray paints, enamels, lacquers, and primers (FTC 2017); it was not indicated if these materials were PFAS-containing.

During a telephonic interview with the IMCOM Pest Management Consultant, it was noted that products containing Sulfluramid (i.e., associated with insecticides) may have contained PFAS and were phased out in 1996. During the PA records review, the IMCOM Pest Management Consultant provided records of potentially PFAS-containing pesticides and insecticides used and/or stored at Army installations, and did not identify FTC as an installation having used or stored PFAS-containing pesticides/insecticides. Additionally, the PA team reviewed available pesticide use inventory documentation provided by the installation and did not identify PFAS-containing pesticides use, storage, or disposal.

While a car wash facility does exist on-post, the use of PFAS-containing products (i.e., Simoniz®) could not be confirmed; several attempts were made to obtain product inventory information from the facility. However, there is no evidence that Simoniz products were used at this this facility. Other potential PFAS source types were either not identified at the installation or did not prompt further research or evaluation. Further discussion regarding areas not retained for further investigation at this time is presented in **Section 5.1**.

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 FTC) is not part of the PA/SI. However, potential off-post PFAS sources within a 5-mile radius of the installation that were identified during the records search and site visit are described below.

The FTC fire department reported supplying approximately 750 gallons of AFFF in response to an off-post mine fire in Kentucky sometime between 2006 and 2008. The exact location of the mine fire response was not provided. The FTC fire department has also reportedly supplied AFFF for other small fire responses in the community (including crash/fire responses along Interstate-24), but exact locations of these responses were not provided.

The Clarksville Regional Airport (or Outlaw Field Airport) is located southeast of FTC across U.S. Highway 41 and has two asphalt runways over its 450 acres. It is owned by the city of Clarksville and Montgomery County, Tennessee. The airport opened in 1930 and serves privately owned and operated aircraft and supports military operations and independent charters. The airport is also open to the public for storage of aircraft in hangars. Military pilot training was a principal activity at the Clarksville Regional Airport during World War II in the early 1940s until approximately 1960, when it returned to public use. The airport currently provides fuel services, flight training, maintenance, and aircraft sales services (Clarksville Regional Airport 2013). Whether airfield operations at this airport involved the use or storage of AFFF once the airport returned to public use is unknown; however, it is not likely that PFAS-containing AFFF was used by the military at this airport, given the timeframe of military operation of the airfield (e.g., predates entry of AFFF into the DoD inventory).

In addition, two fire stations are located east of the FTC cantonment area: the Clarksville Fire Rescue Station 7 (located on Tiny Town Road just north of the Clarksville Regional Airport), and the Oak Grove Fire Department Station (located on Hugh Hunter Road east of CAAF). Whether AFFF was used during fire response, fire training, or fire equipment maintenance by these facilities is unknown. Operations associated with several other facilities (i.e., those types listed in **Section 4.2**) east of FTC may also contribute to impacts to environmental media off post. Based on the surface water flow directions and inferred groundwater flow directions (i.e., based on historical dye tracer studies; **Figure 2-2a**), potential

off-post impacts are not likely to migrate on-post; however, they could impact the same springs where groundwater ultimately flows and discharges from on post.

5 SUMMARY AND DISCUSSION OF PA RESULTS

The preliminary locations evaluated for potential use, storage and/or disposal of PFAS-containing materials at FTC 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, 30 of these areas have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1**, below.

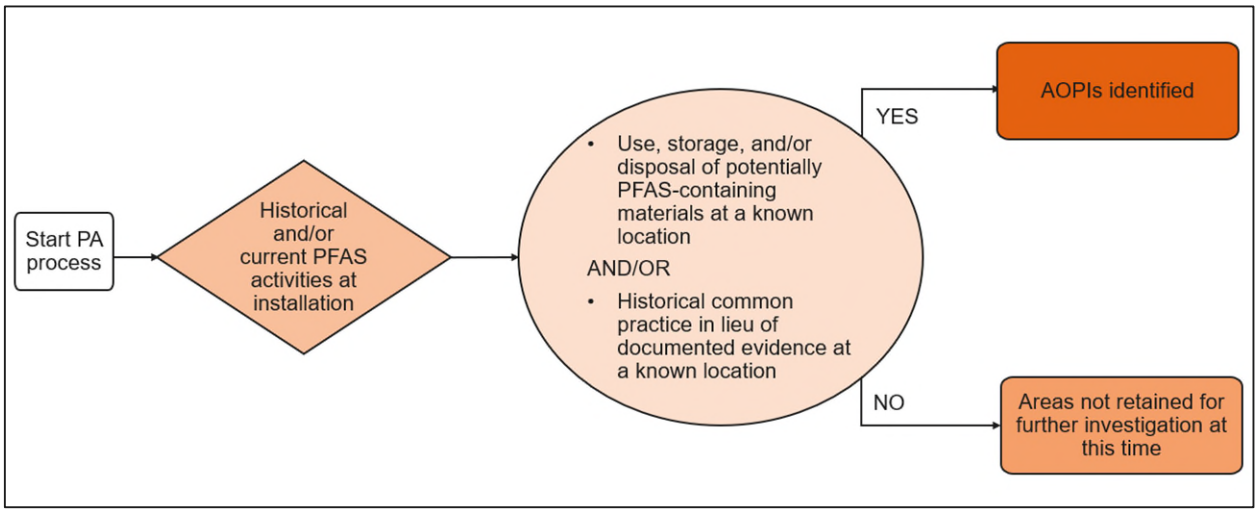

Figure 5-1: AOPI Decision Flowchart

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 FTC are presented in **Section 9**.

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. While the operations and facility types noted below can sometimes involve use, storage, and/or disposal of PFAS-containing material, information obtained during the PA (i.e., personnel interviews and/or records) regarding the associated materials did not indicate that PFAS-containing materials were used, stored, or disposed.

A brief site history and rationale for areas not retained for further investigation is presented in **Table 5-1**. Some of the areas overlap with FTC IRP sites and/or Headquarters Army Environmental System (HQAES) sites historically investigated (i.e., not for PFAS). The area name and overlapping IRP site identifier and/or HQAES number are included in the table below if applicable/available.

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

Area Description	Dates of Operation	Relevant Site History	Rationale
Current Pesticide Storage and Mixing Facility (Building 5112)	2010 to present	Building 5112 is the current storage and mixing facility; the building and adjacent mixing area had no evidence of spills or leaks. Mixing is done outside Building 5112 directly into containers for use. The facility floor is a 4-inch-thick concrete pad with no floor drains (i.e., spills would have been contained inside the building). Pesticides are stored in small closed-drainage sheds adjacent to the mixing pad, which has a concrete containment structure.	No evidence of use, storage, and/or disposal of PFAS-containing chemicals (i.e., Sulfluramid).
Historical Pesticide Storage and Mixing Facilities (demolished site SWMU 33/34; FCPB-07 and -14; HQAES Site 21145.1007 and .1011)	Unknown to 2010	The historical storage and mixing facility (SWMU 33/34) was located near Building 7604; this particular area was used as a mixing area until approximately 2010. The site is mostly demolished but reportedly had concrete containment structures; only the mixing rack structure remains onsite. Any spills in this former mixing area would have drained to closed-system oil/water separators.	No evidence of use, storage, and/or disposal of PFAS-containing chemicals.
Conservation Management Building 7604	Unknown to present	Building 7604 stores Class A foams for wildland forest fire fighting in 5-gallon containers and on a skid.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing materials.
Chromium Plating Shop FCPB-43 (SWMU 140; HQAES 21145.1040)	Unknown	A chromium plating shop was noted in historical documents; however, chromium plating operations reportedly did not occur at FTC. Chemical usage in adjacent Building 7811 included spray paints, enamels, lacquers, and primers. The area currently houses a weapon refurbishing facility.	No evidence of metal plating activities or use, storage, and/or disposal of other PFAS-containing materials.

Area Description	Dates of Operation	Relevant Site History	Rationale
Landfills (FCPB-02, -03, -26 through -34, -37, and -57; HQAES 21145.1002, 1003, 1023 through 1031, 1034, and 1054)	1950s to present	Sanitary, construction debris, and demolition landfills on-post have received paint, trichloroethene- and fuel-impacted sludge.	No documented evidence of receipt of PFAS-containing materials.
Paint Booths	1963 and 1978 to at least 1990	Building 6490 is a drive-through for vehicle paint removal and repainting. Building 7154 (Hangar 3) is an enclosed steel building for helicopters. Building 7156 is a paint spray booth.	No evidence of use, storage, and/or disposal of PFAS-containing materials.
Nuclear, Biological and Chemical Warfare FTA FCPB-09 (SWMU-21, HQAES 21145.1009)	1980 to 1990	This area was reportedly used for fire training west of the former nuclear, biological, and chemical training staging area and east of Range Road (adjacent to FCPB-2 Landfill). Petroleum products were ignited in metal troughs or on the ground to train soldiers to use fire as a weapon. The fires were reportedly allowed to burn out.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing materials. Given the objective of activities to train soldiers to use fire as a weapon, AFFF use is unlikely.
CAAF Hangars 7227 and 7257	2015 and 2014 to present	It is unknown if AFFF was ever used in fire suppression systems in these hangars; however, based on their construction dates, it is unlikely the systems in these hangars contained AFFF. These airfield hangars currently have high-expansion foam in their fire suppression systems.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing materials.
Army Materiel Command-operated Hangar 7176	Unknown to present	This hangar at CAAF is a water-only deluge system and has not contained AFFF. Engine testing is conducted in this building.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing materials.
Sabre Army Heliport Hangars 66002 and 66015	2013 and 2015 to present	The Sabre Airfield Hangars 66002 and 66015 were completed in 2013 and 2015, respectively. Their fire suppression systems have reportedly only ever contained high-expansion foams.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing materials.

Area Description	Dates of Operation	Relevant Site History	Rationale
Training Areas (including numbers 17, 25, 41, 44, 54, and 56)	Various	Combat vehicle fire responses were noted in these Training Areas across the installation during the PA site visit. However, exact locations of the incidents could not be provided, and it was not verified that these crashes and vehicle fires were responded to with AFFF. Personnel reported that fires would typically burn out before the fire department could arrive.	No evidence of use, storage, or disposal of AFFF or other PFAS-containing material based on site history descriptions.
Sukchon Drop Zone (Training Area 21)	Early 2010s to present	Small flight line facility in a drop zone, used for training. Personnel interviews with range control and fire department staff did not indicate any use of AFFF at this facility.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing materials.
Post Exchange Car Wash	At least 1990s to present	The use of PFAS-containing products, particularly Simoniz®, is common at car wash facilities. There is no evidence that Simoniz products were used at this this facility. An oil water separator (facility number 2906B) and SWMU 155B is associated with this area. The SWMU was granted a no further action decision in December 2006; additional information was not provided regarding the nature of the SWMU investigation.	No evidence of use, storage, and/or disposal of PFAS-containing materials.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. Several of the AOPIs overlap with FTC IRP sites and/or HQAES sites historically investigated (i.e., not for PFAS), shown on **Figure 2-2b** (several of the SWMUs are points rather than areas as they are oil/water separator, lube rack, or storage tank sites). The AOPI, overlapping IRP site identifier (if applicable), HQAES number (if available), and current site status are discussed within each AOPI subsection presented below. At the time of this PA, only one of the AOPIs had historically been investigated for the possible presence of PFAS (i.e., Training Area 03 Crash Site, where soil samples were collected for analysis of PFOS and PFOA).

The AOPI locations are shown on **Figure 5-2a** and **Figure 5-2b** and are discussed by five major geographical groupings: CAAF (17 AOPIs), mid-cantonment (three AOPIs), south cantonment (seven AOPIs), Sabre Army Heliport (two AOPIs), and training ranges (one AOPI). Aerial photographs of each AOPI that also show the inferred area where AFFF was potentially released to the environment (if applicable) are presented on **Figures 5-3** through **5-7** by geographical grouping and include active monitoring wells in the vicinity of each AOPI.

5.2.1 Campbell Army Airfield AOPIs

CAAF contains several environmental sites that have been investigated under individual and collective site names. Collectively, the environmental sites historically investigated (i.e., not for PFAS) in the broader CAAF area are part of AOC-A (also referred to as FCPB-38, and HQAES site 21145.1035). Seventeen AOPIs were identified at CAAF; these AOPIs are located within the installation's water supply wellhead protection area (**Figure 5-3**). Specific AOPIs and their associations with historically investigated sites (if applicable) are described in each AOPI subsection below.

5.2.1.1 Current Fire Training Area Building 7237

The Current FTA at Building 7237 was identified as an AOPI following document research and personnel interviews, due to reports of historical fire training activities at the site during the 2000s and 2010s. Approximately 55 gallons of 3% to 6% AFFF concentrate (Ansulite®) would be used on the grassy area over 2 to 3 days of training activities consisting of simulated car and helicopter fires. The current and expected future land use of this area is industrial.

Ground cover at this area includes an asphalt pad, gravel, and grass. Training structures (e.g., small building, helicopter fuselage simulator) are located on the asphalt pad. Several storm drains exist in the area and outfall at Dry Fork Creek; runoff from the area also flows to Dry Fork Creek to the northwest. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.2 Destiny Heliport Wash Rack Building 7243

The Destiny Heliport Wash Rack Building 7243 was identified as an AOPI following document research and personnel interviews due to reported historical crash truck tank flushing in the area from prior to 1995 to 2002/2003, during which AFFF use/disposal was likely, given the period of operation of the site. The wash rack is located near Fire Station #4. Potentially AFFF-containing (and PFAS-containing) equipment was rinsed on the concrete pad at this location, and runoff would have been directed toward the storm drains. In addition, the building is equipped with a 1,000-gallon AFFF tank and fire suppression system. Personnel indicated that every AFFF-containing fire suppression system at FTC has likely had a release of AFFF to the environment (i.e., during initial system testing or accidental). AFFF releases from the fire suppression system would have drained to the wastewater lines, which flow to the WWTP. The current and expected future land use of this area is industrial.

Construction of Building 7243 was completed in April 1991. The area is mostly asphalt-covered with some grassy areas between other administrative buildings in the area. Several storm drains exist in the area, and asphalt generally slopes towards these drains. The grassy areas are generally separated from the asphalt by a raised curb. Storm drains in the vicinity of Building 7243 may have received AFFF-containing runoff; storm drains in the area outfall to Dry Fork Creek. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.3 Destiny Heliport Wash Rack Building 7251

The Destiny Heliport Wash Rack Building 7251 was identified as an AOPI following document research and personnel interviews due to reported historical crash truck tank flushing in the area from prior to 1995 to 2002/2003, during which AFFF use/disposal was likely given the period of operation of the site. The

wash rack is located near Fire Station #4. AFFF-containing equipment was rinsed on the concrete pad at this location, and runoff would have been directed to toward the storm drains. In addition, the building is equipped with a 1,000-gallon AFFF tank and fire suppression system. Personnel indicated that every AFFF-containing fire suppression system at FTC has likely had a release of AFFF to the environment (i.e., during initial system testing or accidental). AFFF releases from the fire suppression system would have drained to the wastewater lines, which flow to the WWTP. The current and expected future land use of this area is industrial.

Construction of Building 7251 was completed in June 1991. The area is mostly asphalt-covered with some grassy areas between other administrative buildings in the area. Several storm drains exist in the area, and asphalt generally slopes towards these drains. The grassy areas are generally separated from the asphalt by a raised curb. Storm drains in the vicinity of Building 7251 may have received AFFF-containing runoff; storm drains in the area outfall to Dry Fork Creek. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.4 Fire Station #4 Building 7241

Fire Station #4 Building 7241 was identified as an AOPI following personnel interviews. The fire station historically stored AFFF in an aircraft rescue and firefighting vehicle. The building is adjacent to the Destiny Heliport Wash Racks Buildings 7243 and 7251 where truck washout or nozzle testing activities were conducted at the northwest corner of the airfield. The Current Fire Training Area Building 7237 is also located in this vicinity (which is inferred to be upgradient of the fire station). While AFFF was historically stored here in the aircraft rescue and firefighting vehicle, no use or disposal of AFFF was reported at the actual Fire Station #4 Building 7241.

Fire Station #4 Building 7241 is largely surrounded by asphalt lots and concrete (including the hangar aprons) with some grassy areas. The current and expected future land use of this area is industrial.

5.2.1.5 CAAF Hangar 7272

The CAAF Hangar Building 7272 was identified as an AOPI following document research and personnel interviews, as WWTP and FTC fire department personnel indicated that the AFFF-fire suppression system released AFFF to the environment on multiple occasions. Construction of Building 7272 was completed in January 1989. The building is equipped with a 1,000-gallon AFFF tank. AFFF release dates for this hangar specifically are estimated to be in 2009, 2012, and 2015. Other AFFF releases may have occurred at this hangar as well (i.e., if the AFFF system has been accidentally discharged in additional instances or has been evacuated during system testing). The current and expected future land use of this area is industrial.

The hangar is on a large, mostly asphalt-covered area with some grassy areas between the other hangars. Several storm drains exist in the area and drain to a marshy area that flows into Dry Fork Creek. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.6 CAAF Hangar 7273

The CAAF Hangar Building 7273 was identified as an AOPI following document research and personnel interviews, as FTC fire department personnel indicated that it is likely that each hangar equipped with an

AFFF-fire suppression system has had a release of AFFF to the environment. While a specific AFFF release occurrence was not noted by personnel at this hangar, it is presumed that the AFFF fire suppression system has accidentally discharged or has been evacuated during system testing at least once. Construction of Building 7273 was completed in February 1993. The building is equipped with a 500-gallon AFFF tank. The current and expected future land use of this area is industrial.

The hangar is on a large, mostly asphalt-covered area with some grassy areas between the other hangars. Several storm drains exist in the area and drain to a marshy area that flows into Dry Fork Creek. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.7 CAAF Hangar 7274

The CAAF Building 7274 was identified as an AOPI following personnel interviews, as FTC fire department personnel indicated that it is likely that each hangar equipped with an AFFF fire suppression system has had a release of AFFF to the environment. While a specific AFFF release occurrence was not noted by personnel at this hangar, it is presumed that the AFFF fire suppression system has accidentally discharged or has been evacuated during system testing at least once. Construction of Building 7274 was completed in August 2001. The building is equipped with an 800-gallon AFFF tank. The current and expected future land use of this area is industrial.

The hangar is on a large, mostly asphalt-covered area with some grassy areas between the other hangars. Several storm drains exist in the area and drain to a marshy area that flows into Dry Fork Creek. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.8 CAAF Hangar 7262

The CAAF Hangar 7262 is currently equipped with a high-expansion foam fire suppression system. However, after the PA site visit and initial SI sampling event, follow-up personnel interviews with ISA indicated that the hangar's fire suppression system once contained AFFF but was changed out to high-expansion foam systems by Premier Fire and Safety. The timeline of completion and procedures followed (i.e., flushing practices and/or AFFF and system component disposal) for these change-outs is not known. No accidental releases or system testing was reported for the former AFFF systems. However, as noted in **Section 4.1**, the fire department indicated that each of the hangars equipped with AFFF fire suppression systems at FTC should be presumed to have accidentally discharged or been evacuated during system testing at least once; it is therefore assumed that an AFFF release likely occurred at CAAF Hangar 7262 when its fire suppression system contained AFFF. The building (and presumably its associated wastewater lines) were constructed in 1992. The current and expected future land use of this area is industrial. Installation personnel indicated that the ground has been significantly reworked in the last 5 years in the area west of the hangar where a former wash rack was located.

Installation utility maps indicate that the stormwater drainage from this hangar is directed to the southeast and discharges to a grassy area in the middle of the airfield. **Figure 5-3** shows the location of the AOPI.

5.2.1.9 CAAF Hangar 7264

The CAAF Hangar 7264 is currently equipped with a high-expansion foam fire suppression system. However, after the PA site visit and initial SI sampling event, follow-up personnel interviews with ISA

indicated that the hangar's fire suppression system once contained AFFF but was changed out to high-expansion foam systems by Premier Fire and Safety. The timeline of completion and procedures followed (i.e., flushing practices and/or AFFF and system component disposal) for these change-outs is not known. No accidental releases or system testing was reported for the former AFFF systems. However, as noted in **Section 4.1**, the fire department indicated that each of the hangars equipped with AFFF fire suppression systems at FTC should be presumed to have accidentally discharged or been evacuated during system testing at least once; it is therefore assumed that an AFFF release likely occurred at CAAF Hangar 7264 when its fire suppression system contained AFFF. The building (and presumably its associated wastewater lines) were constructed in 1990. The current and expected future land use of this area is industrial.

Installation utility maps indicate that the stormwater drainage from this hangar is directed to the southeast and discharges to a grassy area in the middle of the airfield. **Figure 5-3** shows the location of the AOPI.

5.2.1.10 CAAF Hangar 7268

The CAAF Hangar 7268 is currently equipped with a high-expansion foam fire suppression system. However, after the PA site visit and initial SI sampling event, follow-up personnel interviews with ISA indicated that the hangar's fire suppression system once contained AFFF but was changed out to high-expansion foam systems by Premier Fire and Safety. The timeline of completion and procedures followed (i.e., flushing practices and/or AFFF and system component disposal) for these change-outs is not known. No accidental releases or system testing was reported for the former AFFF systems. However, as noted in **Section 4.1**, the fire department indicated that each of the hangars equipped with AFFF fire suppression systems at FTC should be presumed to have accidentally discharged or been evacuated during system testing at least once; it is therefore assumed that an AFFF release likely occurred at CAAF Hangar 7268 when its fire suppression system contained AFFF. The building (and presumably its associated wastewater lines) were constructed in 1990. The current and expected future land use of this area is industrial.

Installation utility maps indicate that the stormwater drainage from this hangar is directed to the southeast and discharges to a grassy area in the middle of the airfield. **Figure 5-3** shows the location of the AOPI.

5.2.1.11 CAAF Fire Training Area and Retention Pond

The CAAF FTA and Retention Pond was identified as an AOPI following personnel interviews and site reconnaissance due to reported historical fire training activities, during which PFAS was likely released during the use of AFFF, given the period of operation of the site. This FTA located to the southeast of the CAAF runways was used during the 1990s to 2000 for monthly mock drills where an H1 Cobra helicopter simulator was ignited on an asphalt pad. The current and expected future land use of this area is industrial.

The asphalt pad remains at this site, and the ground surface drains to a retention pond to the southwest; therefore, the retention pond may have received runoff of AFFF from the FTA. No outfall was observed at the retention pond. There is a paved access road between the CAAF FTA and the retention pond. The ground surrounding the asphalt and pond is grass-covered. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.12 CAAF Hangar 7166

The CAAF Hangar 7166 was identified as an AOPI following personnel interviews, as FTC fire department personnel indicated that it is likely that each hangar equipped with an AFFF-fire suppression system has had a release of AFFF to the environment. While a specific AFFF release occurrence was not noted by personnel at this hangar, it is presumed that the AFFF fire suppression system has accidentally discharged or has been evacuated during system testing at least once. Construction of Hangar 7166 was completed in February 1998; wastewater from the hangar is directed to the WWTP. The current and expected future land use of this area is industrial.

The area is mostly asphalt-covered with some grassy areas between other administrative buildings in the area. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.13 CAAF Clamshell

The CAAF Clamshell (a temporary tent-like structure near Fire Station #3) was identified as an AOPI following personnel interviews and site reconnaissance due to reported historical fire training activities and AFFF nozzle testing in the area. AFFF was likely released to the environment during these activities given the period of operation of the site from at least 1995 to 2002 or 2003. There was also a reported wash rack in the area and there are storm drains that potentially received AFFF runoff from the nozzle testing activities. The current and expected future land use of this area is industrial.

The area is mostly asphalt-covered, with grassy areas adjacent across the road from the administrative buildings. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.14 Fire Station #3 Building 7160

Fire Station #3 Building 7160 was identified as an AOPI following personnel interviews. The fire station historically stored AFFF in a foam trailer apparatus, which contained 450 gallons of AFFF (1,000 gallon-capacity) at the time of the PA site visit in October 2018; however, the apparatus was drained of AFFF along with other firefighting equipment and vehicles in 2019 (**Section 4.1**). The routine truck washout or nozzle testing activities conducted prior to the draining of the vehicles in 2019 and associated with this fire station were reportedly conducted at the CAAF Clamshell (**Section 5.2.1.13**) and at the Former Fire Station #1 Building 2575 (**Section 5.2.2.2**). AFFF was historically stored at the Fire Station #3 Building 7160 in the foam trailer, in 55-gallon drums, and in 5-gallon containers. While no use or disposal of AFFF was reported at the actual Fire Station #3 Building 7160, a Google satellite image (Google Maps 2021) has shown apparent truck washout at the end of the station's truck pull-out near the hangar apron.

Fire Station #3 Building 7160 is largely surrounded by asphalt lots and concrete (including the hangar aprons). The current and expected future land use of this area is industrial.

5.2.1.15 CAAF Former Fire Training Area

The CAAF Former FTA, located south of Runway 36 in the southwest corner of the airfield, was identified as an AOPI following personnel interviews and site reconnaissance trips due to reported historical fire

training activities reported in the area. AFFF use was likely during these training activities given the period of operation of the site during the 1970s and 1980s. Additionally, the use of AFFF during a training exercise on 08 April 2006, was documented in a memorandum provided by the installation. During the 2006 training exercise, approximately 150 gallons of 3% AFFF concentrate was used to mix 5,000 gallons of foam which was expelled to the ground, and then flushed with an additional 4,000 gallons of water. The area consists of concrete-lined pits and gravel pads surrounded by grassy areas in a relatively low point and inwardly sloping topography. Stormwater in this area is directed to an unnamed vegetated drainageway which flows to Dry Fork Creek.

The area appears to fall within the footprint of SWMU 41 (also referred to as FCPB-19), the temporary rapid oasis refueling area. The HQAES site identifier for SWMU-41 is 21145.1016. The current and expected future land use of this area is industrial, and much of the site has no-dig restrictions in place. **Figure 5-3** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.1.16 Old Fire Training Areas SWMU 12/15

The Old FTAs (SWMU 12/15) south of CAAF were identified as an AOPI following document research, personnel interviews, and site reconnaissance due to reported historical fire training activities in the area. During these activities, AFFF was likely released to the environment given the period of operation of the site. A personnel interview with the former FTC fire department chief indicated limited use of AFFF in the area from 1995 to 2001 (approximately one time per year) and noted that protein foams have been used in the area as well. However, during a personnel interview with a former firefighter (who was on-post in 1976), it was indicated that fire training activities would take place at these SWMUs once or twice a month from the mid-1970s to mid-1990s. The former firefighter estimated that at least 150 to 200 gallons of AFFF concentrate was used in the area during that period.

The SWMU 12/15 sites were investigated under the IRP with site identifications also corresponding to FCPB-35/36 and HQAES site numbers 21145.1032 and 21145.1033. Previous investigations of the SWMUs identified contamination from volatile organic compounds, total petroleum hydrocarbons, and lead. SWMU 12 consisted of three burn pits (spanning approximately 60 feet in diameter total), and SWMU 15 consisted of a circular concrete pad. The two areas were used for burning fuels and vehicles for fire training activities.

SWMUs 12/15 were addressed together under the IRP. Previous interim removal actions included a 1996 removal and treatment of surface (pond) water and removal of the concrete pad and soil within the pad footprint to a maximum depth of 8 feet. In 1998, the prop vehicles (two fuel tankers, a bus, and a small helicopter fuselage) were removed from the area and properly disposed. A soil removal action was also completed in 2002 at two additional areas within the SWMU 12/15 footprint to address lead contamination. Injections of Hydrogen Release Compound® were also completed in the area in 2002 to aid in the biodegradation of chlorinated solvents. In 2010, microorganisms and nutrients were injected in one well in the area for enhanced in situ bioremediation. Monitored natural attenuation of chlorinated solvents is planned to continue at the site. The site was partially redeveloped in 2016 (FTC DPW 2012). The volumes of soil removed during the various removal actions at this site were not reported in available documents.

Figure 5-3 shows the inferred area where AFFF was potentially released to the environment at this AOPI. The area is currently flat and grass-covered, with buildings surrounding the area. Stormwater in this area

is directed to an unnamed vegetated drainageway which flows to Dry Fork Creek. Historical dye tracer studies indicate that dye was detected from monitoring well 015-MW-005 (south of the pad) at Gordon and Blue Springs which flow to Dry Fork Creek. The current and expected future land use of this area is industrial, and much of the site has no-dig restrictions in place.

5.2.1.17 Fire Station #5 Building 4099

Fire Station #5 Building 4099 was identified as an AOPI following personnel interviews. The fire station was constructed in 2005, and no use or disposal of AFFF was reported at the actual Fire Station #5 Building 4099. However, some vehicles potentially containing AFFF have been periodically stored here, including a rescue truck which carried 55 gallons of AFFF and an aerial rescue truck that carried 5-gallon containers. The aerial rescue truck was reportedly never used.

Fire Station #5 Building 4099 is located southeast of the CAAF area, and south of a residential area, and is surrounded by grassy areas and a tree stand to the east. The current and expected future land use of this area is industrial.

5.2.2 Mid-Cantonment AOPIs

Three AOPIs were identified in the mid-cantonment area; historical activities at each of the AOPIs are described in the subsections below (**Figure 5-4**).

5.2.2.1 Former Fire Truck Maintenance Shop Building 5737

The Former Fire Truck Maintenance Shop Building 5737 was identified as an AOPI following document research, personnel interviews, and site reconnaissance due to reports of historical use of the building and area for fire truck repair from 2010 to 2018 in the rectangular, warehouse-like structure. Additionally, in 2014, an illicit discharge report noted that AFFF from a crash truck was flushed and discharged onto the pavement in the area, down 29th Street to a trench drain at Wickham Avenue. Foam was reportedly seen in the wooded stormwater collection area just west of the facility during the 2014 release of AFFF to the environment; stormwater pools in this topographic low, marshy area. Historical dye tracer studies indicate that groundwater in this area discharges at Millstone Spring off post. However, this AOPI is also located along the eastern border of the installation's water supply wellhead protection area. The current and expected future land use of this area is industrial.

The area was under construction for building and surface grading improvements at the time of the PA site visit and was mostly asphalt- and grass-covered. There is little to no topographic relief. **Figure 5-4** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.2.2 Former Fire Station #1 Building 2575

The Former Fire Station #1 Building 2575 was identified as an AOPI following document research, personnel interviews, and site reconnaissance due to reports of historical use of the building and area for nozzle testing and crash truck tank flushing from prior to 1995 to 2002. The area is asphalt-covered where fire trucks were historically parked for tank-flushing activities. Runoff from tank flushing activities was reportedly directed into the stormwater drainage ditch running parallel to Indiana Avenue, flowing southerly from the building; the stormwater drainage is unlined with a rip-rap bottom. Areas around the

ditch and asphalt lots in front of and behind the building are grass-covered manicured lawns. Stormwater from this area flows to Little West Fork Creek. Historical dye tracer studies indicate that groundwater in this area discharges at Millstone Spring off post. The current and expected future land use of this area is industrial. This AOPI is located outside of the installation's water supply wellhead protection area.

Figure 5-4 shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.2.3 AFFF Rinse-Out Building 6310

The AFFF Rinse-Out Building 6310 area was identified as an AOPI based on follow-up personnel interviews due to use of the area in 2019 for the draining and rinse-out of AFFF-containing fire equipment. As described in **Section 4.1**, the fire department offloaded old AFFF from trucks and the foam trailer into a mobile plastic and rubber container provided by a contractor at this location. The trucks and foam trailer were pulled into the bermed container, the AFFF was drained from the apparatuses, and the trucks and trailer were triple rinsed within the container. The AFFF and rinse solution was extracted from the container with a portable pump and transferred into a 36,000-gallon holding tank. This was completed at Building 6310 (in the mid-cantonment area) over two separate events to accommodate the 36,000-gallon limit of the holding tank. The holding tank containing AFFF and rinse solution was taken offsite and incinerated. Additionally, fire trucks were observed in the building bays during the SI field event in March 2021, and it is likely fire trucks were historically serviced here too when they may have contained AFFF in their tanks.

The area is asphalt-covered where the draining and rinse-out activities were completed in secondary containments. The events were completed on a dry, hot day, and minimal rinse-out water was reported leaking out of the containment structures; the leaked water pooled in the lot southeast of Building 6310. The current and expected future land use of this area is industrial. This AOPI is located inside the installation's water supply wellhead protection area. **Figure 5-4** shows the estimated area of where AFFF rinse-out activities occurred and where water may have leaked out of the secondary containment structure at this AOPI.

5.2.3 South Cantonment AOPIs

Six AOPIs were identified in the south cantonment area. These AOPIs are located outside of the installation's water supply wellhead protection area (**Figure 5-5**). Historical activities at each of the AOPIs and their associations with historically investigated sites (if applicable) are described in the subsections below.

5.2.3.1 Old Clarksville Base Fire Training Area (SWMU-148)

The Old Clarksville Base FTA was identified as an AOPI following document research due to reported historical fire training activities in the area. During these activities, AFFF was likely released to the environment given the period of operation of the site (estimated to be prior to 1991 based on vegetative re-growth observed at the time of other environmental investigations). Installation personnel could not confirm fire training activities in this area; however, the AOPI has been investigated for fuel-related contaminants under site identification FCPB-51 and SWMU 148 and HQAES site 21145.1048. The area was reportedly used to ignite props with fuels on the ground in a bermed pit area approximately 130 feet

in diameter. The fires were reportedly extinguished, and the use of AFFF is likely given the use of fuel products. The current and expected future land use of this area is industrial, and the extent of the site and surrounding areas have no-dig restrictions in place. The site is located adjacent to Landfill #8 (FCPB-33, SWMU 8).

The area has been heavily revegetated since its discontinued use. As of a 2000 investigation at the area, the berm structure remained in place (Solutions to Environmental Problems, Inc. 2001). Surface water runoff from this area flows to an intermittent tributary of Little West Fork Creek. Four monitoring wells remain active in the area. **Figure 5-5** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.3.2 Legacy Fire Truck Repair Shop Building 5124

The Legacy Fire Truck Repair Shop Building 5124 was identified as an AOPI following document research, personnel interviews, and site reconnaissance due to reports of historical use of the gravel area for fire truck repair, possible nozzle testing and crash truck tank rinsing prior to 2010. The Legacy Fire Truck Repair Shop Building 5124 is a rectangular, warehouse structure located across from the current Fire Station at Building 1747. The current and expected future land use of this area is industrial.

The area was under construction at the time of the PA site visit; the area surrounding the building is mostly asphalt- and gravel-covered. Some other storage and administrative structures are located on the same gravel and asphalt lot. There is little to no topographic relief; stormwater in this area is directed to Little West Fork Creek. **Figure 5-5** shows the inferred area where AFFF was potentially released to the environment at this AOPI. The AOPI is located within the Pollution Prevention Operations Center (PPOC) complex, which encompasses several IRP sites.

5.2.3.3 Conex Containers 40 and 41 AFFF Storage

The Conex Containers 40 and 41 AFFF Storage area was identified as an AOPI following personnel interviews due to reports of historical storage of AFFF. Conex Containers numbered 40 and 41 between Buildings 5136 and 5133 have previously stored AFFF for the FTC fire department; both Conex containers have secondary containment structures. No AFFF was in storage at these buildings at the time of the PA site visit in October 2018, and the timeline of when AFFF was in storage here was not indicated during personnel interviews. However up to eighty 5-gallon pails were reported to be in storage in 2017 when inventories showed 9,916 gallons of AFFF on post; the Conex Containers 40 and 41 may have been where some or all of this inventory was stored. No spills or leaks were reported at this location. The Conex containers are situated on a sloping concrete strip which drains to the east-northeast toward a small area where sediments and soil has accumulated; the area is vegetated with grass.

Figure 5-5 shows the location of this AOPI within the PPOC complex, which encompasses several IRP sites. The current and expected future land use of this area is industrial.

5.2.3.4 Building 5121 AFFF Storage

The Building 5121 AFFF Storage area was identified as an AOPI following personnel interviews and site reconnaissance due to historical storage of AFFF. At the time of the PA site visit in October 2018, sixteen 5-gallon containers of Ansulite® 6% AFFF were observed in storage on a pallet inside Building 5121; the

AFFF has likely been stored here for 7 to 8 years. No leaks or spills were reported at this location. A concrete ramp goes up into the building which has a secondary containment structure and a concrete floor. A gravel lot surrounds Building 5121. Surface water runoff drains to the south-southwest to an area where ponding of water is observed after heavy rain events before it is directed to a rip-rap lined stormwater drainage ditch.

Figure 5-5 shows the location of this AOPI within the PPOC complex, which encompasses several IRP sites. The current and expected future land use of this area is industrial.

5.2.3.5 Fire Station #1 Building 1747

Fire Station #1 Building 1747 was identified as an AOPI following personnel interviews. The fire station historically stored AFFF on a fire truck engine with 55 gallons of AFFF concentrate; however, the apparatus was drained of AFFF along with other firefighting equipment and vehicles in 2019 (**Section 4.1**). The truck maintenance activities associated with this fire station were reportedly conducted at Building 5124 (**Section 5.2.3.2**), prior to 1995. The fire station also stored AFFF in 55-gallon drums at Building 5121 (**Section 5.2.3.4**) and the Conex Containers 40 and 41 (**Section 5.2.3.3**). No use or disposal of AFFF was reported at the actual Fire Station #1 Building 1747.

Fire Station #1 Building 1747 is located near the PPOC complex and is largely surrounded by grassy areas with some asphalt lots. The current and expected future land use of this area is industrial.

5.2.3.6 Training Area 03 Crash Site

The Training Area 03 Crash Site was identified as an AOPI following personnel interviews and follow-up communications and laboratory reports provided due to reported historical aircraft crash response activities in the area. While response records are not available to confirm use of AFFF for the aircraft crash response, the laboratory reports provided by FTC confirmed the presence of PFAS in soil in the area. The March 2019 soil data indicate the presence of PFOS and PFOA in five surficial soil samples at the crash site and one surficial soil sample approximately 100 feet downslope of the crash site in a topographic low area (i.e., where surface water drainage could have pooled). Historical dye tracer studies indicate that groundwater from beneath this area discharges at Dennis Spring (which flows to Little West Fork Creek). The current and expected future land use of this area is industrial.

Photographs provided by FTC of the soil sampling locations completed within this AOPI indicate the area is forested with canopy cover and limited understory. **Figure 5-5** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.3.7 Wastewater Treatment Plant

The FTC WWTP was identified as an AOPI following document research, personnel interviews, and site reconnaissance due to reports of historical receipt of AFFF-containing wastewater from accidental releases at various hangars (CAAF Hangars 7272, 7273, 7274, 7166, 7243, and 7251, Sabre Heliport Hangar 6627, and potentially CAAF hangars 7262, 7264, and 7268 prior to their change-outs from AFFF to high-expansion foam) since installation and initial testing of AFFF fire suppression systems in the buildings (**Section 4.1**). At least four occurrences of large AFFF releases (i.e., more than 100 gallons of AFFF) and receipt of such wastewater at the WWTP have been reported, with several other smaller

releases. Larger AFFF releases from hangars and subsequent receipt of the waste at the WWTP occurred in at least 2009, 2012, and 2015. The receipt of AFFF-containing wastewater at the WWTP caused foaming of the turbulent water of the headworks, and foam was observed in other downstream components of the treatment system to the outfall at Little West Fork Creek (approximately 300 yards from the headworks). Foam was observed to overtop other treatment stage components and came to rest on the ground and dissipated or was carried in the wind (including down to Little West Fork Creek). As described in **Section 4.3**, the microbial film on the trickling filters and the ultraviolet disinfection system are impaired when the WWTP receives AFFF-containing wastewater from hangars. Lift stations can also become impaired and stop functioning properly when AFFF-containing waste moves through the system. The current and expected future land use of this area is industrial. The WWTP encompasses several IRP sites including SWMUs 43-48 and 51.

The area has several concrete structures for water containment and treatment on a manicured grassy lawn. The plant outfall discharges to Little West Fork Creek. The FTC sewer system integrity is of varying condition, and some components may be aged beyond useful service life and in need of rehabilitation. Potential leaks in the wastewater lines may present potential for PFAS transport and secondary sources of PFAS. Slurry generated from the treatment of wastewater is aerated in digesters for approximately 90 days, pressed into a sludge, and then taken to the Camden Municipal Landfill or Bi-County Solid Waste Management landfills off post in Tennessee on a quarterly basis. As discussed in **Section 4.2**, if PFAS were present in the WWTP influent, it would be concentrated in the biosolids/sludge produced. **Figure 5-5** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.4 Sabre Heliport AOPIs

Two AOPIs were identified at the Sabre Heliport: Hangar 6627 and Fire Station #2 (Building 6634) as described below (**Figure 5-6**).

5.2.4.1 Sabre Heliport Hangar 6627

Sabre Heliport Hangar 6627 was identified as an AOPI following personnel interviews; fire department personnel indicated that it is likely that each hangar equipped with an AFFF-fire suppression system at FTC has had a release. A release date for this hangar was estimated to be in either 2008 or 2009 according to interviewed personnel. The construction of the hangar was completed in February 1991 and reportedly had approximately 5,450 gallons of PFAS-containing AFFF remaining in the fire suppression system at the time of the PA site visit. In addition, an incident report provided by the installation indicated that during June 2009 when a contractor was tasked with removing and replacing 1,000 gallons of 3% AFFF at the hangar, some of the AFFF was initially discarded to the ground along the fence to kill weeds. Subsequently, the operations were halted, and the fire department directed the contractor to containerize the remainder of the AFFF to be shipped off post. The fire department did not directly observe the tanker truck being filled with the AFFF to be disposed; however, a leak from the AFFF tank in the mechanical room was later observed. During a response to foam observed at the WWTP later in June 2009, another contractor traced the source of this foam back to Hangar 6627 as evidenced by foam in the manholes outside of the building. Other AFFF releases may have occurred at this hangar as well (i.e., if the AFFF system has been accidentally discharged in additional instances or has been evacuated during system testing).

Hangar 6627 is on a large, mostly asphalt-covered area with some grassy areas between adjacent hangars. The current and expected future land use of this area is industrial. This AOPI is located outside of the installation's water supply wellhead protection area. **Figure 5-6** shows the inferred area where AFFF was potentially released to the environment at this AOPI.

5.2.4.2 Fire Station #2 Building 6634 and Wash Rack

Fire Station #2 Building 6634 and Wash Rack was identified as an AOPI following personnel interviews. The fire station historically stored AFFF in 5-gallon containers. The building is adjacent to an open wash rack (between Buildings 6634 and 6629; **Figure 5-6**), at which truck servicing or nozzle testing activities were conducted in association with this fire station. The AOPI is also located upgradient of the Sabre Heliport Hangar 6627 AOPI. No use or disposal of AFFF was reported at the actual Fire Station #2 Building 6634; these activities all reportedly occurred at the adjacent Wash Rack.

The Fire Station #2 Building 6634 and Wash Rack AOPI is largely surrounded by asphalt lots and concrete (including the hangar aprons) with some grassy areas. The current and expected future land use of this area is industrial.

5.2.5 Training Area 26 AOPI

One AOPI (the Bradley Tank Fire area) was identified in Training Area 26 during the continuous PA process in February 2021, as described below.

5.2.5.1 Bradley Tank Fire

The Bradley Tank Fire area was identified as an AOPI following personnel interviews and review of photographs related to a spill incident based on reported use of AFFF. On 14 February 2021, a Bradley Tank caught on fire in Training Area 26 on Angels Road east of its intersection with Grant Road (**Figure 5-7**). The fire was responded to with AFFF, which was observed covering a stretch of asphalt approximately 100 feet long. The AFFF was also observed on soil adjacent to the vehicle, and it flowed further to the west on the asphalt and to the north of Angels Road to a culvert. The type and volume of AFFF used were not indicated. After extinguishing the fire, the tank was driven to a pull-out spot along Grand Road to the west (**Figure 5-7**). During site reconnaissance in March 2021 (i.e., during the utility mark-out event for the drilling work to be completed in March 2021), char marks were visible on Angels Road where the vehicle was on fire (**Appendix J**).

The area is surrounded by grass and fields to the south of Angels Road, and forested land to the north of Angels Road. Stormwater from this area flows west to a culvert, and then north to a low-lying wooded area which has some sinkhole features further north. No dye tracer studies are available for this specific area; however, based on historical spring basin maps, the AOPI appears to be located within the Noah Spring Branch basin (ADL 2002) and groundwater flow direction is inferred to be to the northeast in the area (EA Engineering, Science, and Technology, Inc. 2014). The current and expected future land use of this area is industrial; the area is used for training exercises.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at FTC, an SI for PFOS, PFOA, and PFBS was conducted in accordance with the CERCLA process. SI sampling was completed at FTC at all 30 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 2019b) was developed to supplement the general information provided in the PQAPP (Arcadis 2019a) 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 stormwater), and/or sediment exposure pathways as potentially complete at the AOPIs, which guided the SI sampling. Sediment sampling was not conducted at FTC; however, surface water and stormwater samples were collected at pertinent features to assess presence or absence of PFOS, PFOA, and PFBS in the water features. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI scope of work was completed in December 2019, August 2020, March 2021, December 2021 and January 2022 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 2019b) and PQAPP (Arcadis 2019a). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at FTC. Field changes to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.3**. 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 2019b), 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/or PFBS presence or absence at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

The rationale used to determine whether sampling should be conducted at each AOPI during this SI is illustrated on **Figure 6-1** below.

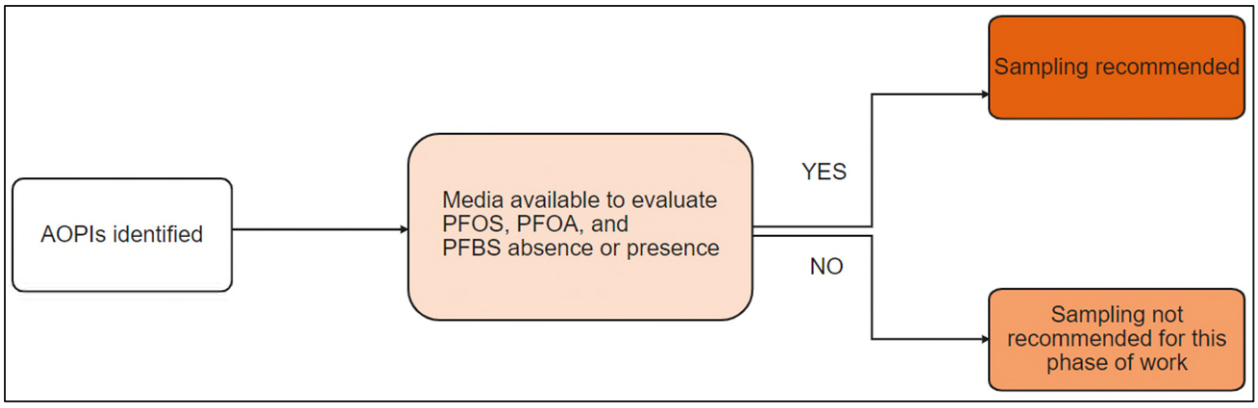

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at FTC is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2019b) and the associated field change reports (FCRs; **Section 6.3.3**) for additional sampling. A summary of the Phase I and Phase II sampling design is provided below.

6.2.1 Phase I (December 2019, August 2020, December 2021 and January 2022)

The AOPIs sampled during the SI were grouped into five sampling areas (i.e., CAAF, mid-cantonment area, south cantonment area, Sabre Heliport and Training Area 26) based on the understood groundwater and surface water flow paths in the areas as indicated during historical dye tracer studies. Groundwater flow beneath the AOPIs or surface water flow from the AOPIs converges at discharge points (i.e., springs) or streams. Springs are expressions of groundwater, as each spring has a "groundwater basin" analogous to a surface water drainage basin, from which its water is derived. A sample collected from a spring, therefore, represents a composite sample of the groundwater contained within the spring's basin. Discharge points and streams were sampled during the SI to evaluate the potential contribution of PFOS, PFOA, and PFBS in groundwater from multiple AOPIs, which, to a varying degree, likely discharge to the same surface location(s). Groundwater and/or shallow soil samples were also collected at select AOPIs to evaluate PFOS, PFOA, and PFBS presence or absence at individual AOPIs. Phase I of the SI includes the initial sampling performed at 19 AOPIs. The Phase I work was completed in December 2019, August 2020, December 2021 and January 2022. The second mobilization in August 2020 was performed based on identification of five additional AOPIs (i.e., AFFF storage locations and hangars which previously had AFFF fire suppression systems). A third mobilization in December 2021 and January 2022 was performed to address an additional AOPI identified after a February 2021 vehicle fire was responded to with AFFF at Training Area 6. More details on the additional mobilizations are discussed further in **Section 6.3.3**.

A total of 44 shallow soil samples were collected from 0 to 2 feet bgs via hand auger. These soil samples were analyzed for PFOS, PFOA, and PFBS at each borehole location. Additionally, soil samples were collected for analysis of total organic carbon (TOC), grain size, and pH at one borehole per AOPI (i.e., typically the sample identified with a "-1-"). The boreholes were positioned at a known or likely downgradient or cross-gradient position from the suspected use, storage, or disposal area of PFOS, PFOA, and PFBS or in stormwater drainageways where runoff potentially containing PFOS, PFOA, and PFBS may have been intercepted.

Groundwater samples were collected at 14 existing monitoring wells and one temporary monitoring well; 11 of the existing monitoring wells are located at CAAF and three are located near the Old Clarksville Base FTA. The sampled existing monitoring wells were selected based on proximity to and inferred downgradient position of the AOPIs (based on historical dye tracer studies) with some selected wells screened in the overburden and other selected wells screened in the limestone bedrock. The temporary monitoring well location (installed by sonic drilling methods) was selected based on soil the maximum soil PFOS, PFOA, and/or PFBS concentrations observed. A grab groundwater sample was collected from a depth interval near the overburden/bedrock interface. Samples were analyzed for PFOS, PFOA, and PFBS.

Surface water samples were collected at springs and along creeks/streams and stormwater samples were collected along drainage features to evaluate potential PFOS, PFOA, and PFBS presence in the waters from individual AOPIs or groups of AOPIs. Surface water samples were determined based on the understood discharge points of groundwater beneath AOPIs (i.e., springs, as indicated by results of dye tracer studies) or surface water flow convergence points (i.e., creeks/streams). During initial planning stages of the SI sampling design, three additional springs (Blue Spring, Gordon Spring, and Millstone Spring) had also been proposed for sampling. These springs are understood discharge points of groundwater from beneath AOPIs at CAAF (i.e., Blue and Gordon Springs) and from beneath the mid-cantonment area (i.e., Millstone Spring). However, Blue and Gordon Springs were removed from the sampling plan at the installation's request due to safety and access concerns as the springs are located within areas with known unexploded ordnance hazards. Millstone Spring was removed from the sampling plan at the request of USAEC since the spring is located off post and presented access challenges.

6.2.2 Phase II (March 2021)

Based on the results of the initial phase of sampling, a second phase of work was completed to collect groundwater and surface water samples at or at an inferred downgradient location of AOPIs where only soil and/or surface water samples were collected during Phase I events, or where no samples had yet been collected at six new AOPIs identified through the ongoing investigative process of the PA.

Groundwater was sampled at two existing monitoring wells and at 10 temporary monitoring wells (installed by sonic drilling methods). An eleventh temporary well location was attempted at the Former Fire Truck Maintenance Shop Building 5737; however, groundwater was not encountered in the overburden or within the first 20 feet of bedrock (discussed further in **Section 6.3.3**). Therefore, a groundwater sample could not be collected at that location. In some cases, the groundwater samples collected at the sonic drilling locations evaluated groundwater downgradient of multiple AOPIs. Groundwater samples were analyzed for PFOS, PFOA, and PFBS.

In addition, five grab stormwater samples were collected along stormwater drainages downgradient of six CAAF Hangars, one stormwater sample was collected at a stormwater drainage collection basin (i.e., a sinkhole), and one surface water sample was collected at a spring that is understood to be a discharge point of groundwater beneath some AOPIs. Surface water samples were analyzed for PFOS, PFOA, and PFBS.

Soil samples were also collected at five new AFFF storage (fire station) AOPIs (i.e., where soil or downgradient groundwater data had not already been collected during previous phases of the SI). Three soil samples were collected at each of these five AOPIs. Two soil samples were also collected at a sixth new AOPI, the AFFF Rinse-Out Building 6310. Expedited analytical results for soil samples collected at Fire Station #5 Building 4099 and at AFFF Rinse-Out Building 6310 were evaluated to determine the location of the temporary borehole for grab groundwater sample collection at those AOPIs. Soil samples were analyzed for PFOS, PFOA, and PFBS. Additionally, soil samples were collected for analysis of TOC, grain size, and pH at one borehole per AOPI (i.e., typically the sample identified with a "-1-"). The boreholes were positioned at a known or likely downgradient or cross-gradient position from the suspected use, storage, or disposal area of PFOS, PFOA, and PFBS or in stormwater drainageways where runoff potentially containing PFOS, PFOA, and PFBS may have been intercepted.

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019a), 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 2019b), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2019b, Attachment 4). 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 during the SI field work 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 2019a) and QAPP Addendum (Arcadis 2019b). 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., tailgate health and safety forms, equipment calibration logs, soil boring logs, groundwater purging logs, and sample collection logs) documenting the SI sampling activities are included in **Appendices J** and **K**, respectively. Photographs of the sampling activities are included with the respective sample collection logs.

6.3.1 Field Methods

Field methods employed during the SI sampling are described in Worksheet #17 of the FTC QAPP Addendum (Arcadis 2019b). Groundwater samples were collected from approximately the center of the saturated screened interval at existing and temporary monitoring wells via low-flow methods using either a peristaltic pump or a portable bladder pump; via no-flow purge methods using a PFAS-free disposable bailer; or from a sampling port. PFAS-free disposable high-density polyethylene (HDPE) and silicone tubing was used for the peristaltic and bladder pump apparatuses during low-flow purging. New disposable bladders or bailers were used at each well if used. During low-flow purging, field parameters (temperature, dissolved oxygen, oxidation/reduction potential, pH, and conductivity) were measured approximately every three minutes and allowed to stabilize prior to collection of the sample. Construction

details (including the screened lithologic unit of limestone or overburden) for the existing monitoring wells sampled during the Phase I and II events are provided in **Table 6-1**.

The 12 temporary wells completed during the Phase I and Phase II events were installed by sonic drilling methods. The temporary wells consisted of pre-packed screens (to reduce turbidity) and riser casing. **Appendices J** and **K** include details regarding the depth intervals where the temporary screens were installed for the grab groundwater sample collection during the Phase I and Phase II events. Grab groundwater samples were collected at first encountered groundwater from 11 of the 12 attempted temporary borehole locations; first groundwater was encountered in the overburden at the 11 sampled locations. At the twelfth location, a grab groundwater sample could not be collected because water was not encountered in the overburden (at the primary location) or within bedrock (at the step-out location), as described further in **Section 6.3.3**.

At soil sampling locations, shallow boreholes were advanced via hand-augering methods. Samples were collected from approximately 0 to 2 feet bgs in the auger bucket and homogenized on clean HDPE sheeting before containerizing.

Surface water and stormwater samples were collected via direct-fill methods just below the water surface. No other non-dedicated or disposable equipment was used for surface water and stormwater sample collection. Field parameters (temperature, dissolved oxygen, oxidation/reduction potential, pH, and conductivity) were measured in the water body following sample collection.

All non-dedicated equipment (i.e., water level meters, bladder pumps, stainless steel hand auger, drill bit and casing) used during sampling were decontaminated between sample locations as described in **Section 6.3.4**.

6.3.2 Quality Assurance/Quality Control

Worksheets #20 of the PQAPP and FTC 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, and field blanks (FBs) for laboratory-supplied water used in the final decontamination step.

QA/QC samples were collected at the frequencies specified in the FTC QAPP Addendum (Arcadis 2019b), during the FTC SI field events. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, and PFBS only at a rate of 1 per 20 parent samples per medium. EBs were collected for media sampled for PFOS, PFOA, and PFBS at a frequency of one per piece of relevant equipment type for each sampling event. The decontaminated equipment from which EBs were collected include one from each water-level meter, bladder pump, tubing setup (one from the thick diameter HDPE used to purge water with the bladder pump, and one from the thin-diameter HDPE/silicon combination used to purge water with the peristaltic pump), drill bit and casing, bailer, and hand auger as applicable to the sampled media, per event. FBs were collected using laboratory-supplied, PFAS-free water. A source blank was also collected in December 2019 from the water tote used, in some cases, for the initial decontamination step during the initial SI field event; this water was obtained at the standpipe on Market Garden Road and Screaming Eagle Boulevard, across from Building 6088. The same water was used for decontamination of the drill tooling during the March and January 2021 field

events, and the source blank was collected from the driller's water tote. Analytical results for QA/QC samples are discussed in **Section 7.6**.

6.3.3 Field Change Reports

No instances of major scope modifications (i.e., those that may have had a significant impact on the project scope and/or data usability/quality, or required stop-work, and warranted discussion with USACE) from the agreed upon scope of work (Arcadis 2019b) were encountered during the Phase I SI field work. However, as described below, a significant follow-on scope (Phase II) was agreed upon based on the results from the Phase I data.

In some cases, clarifications to the established scope of work may have been needed but did not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum (or follow-on sampling plan reported in the FCRs). Modifications from and clarifications for the procedures and scope of work detailed in the QAPP Addendum (Arcadis 2019b) and that did not affect DQOs are documented in FCRs included as **Appendix L**, FCR-1, and are summarized below:

- During the SI field work conducted in December 2019, due to refusal with the hand auger at approximately 5 inches bgs, a soil sample could not be collected at location FTC-LFTRS-1 (west of the Legacy Fire Truck Repair Shop [Building 5124]) as planned in the QAPP Addendum (Arcadis 2019b). One attempt was made to sample a step-out location and refusal was encountered again at approximately 5 inches bgs. Due to heavy utility markings in the area, the installation declined authorizing additional step-out attempts. Installation personnel were onsite during the soil sampling attempts and called stop-work due to refusal and the presence of heavy subsurface utilities in the area. The change was communicated to the project team and the installation at the time of the work on 19 December 2019.

  The other two soil samples planned at this AOPI were collected to the south (FTC-LFTRS-2) and east (FTC-LFTRS-3) of the Legacy Fire Truck Repair Shop Building 5124. The FTC-LFTRS-1 location was originally planned to be sampled for PFOS, PFOA, and PFBS and additional analytes TOC, pH, and grain size; since the sample could not be collected at this location, samples for these additional analytes (TOC, pH, and grain size) were collected at FTC-LFTRS-2 instead. In addition, the planned surface water sample was collected at Beaver Spring (FTC-BEAVERSP-SW, where historical dye tracer studies have indicated that groundwater from the area surrounding this AOPI discharges) to evaluate PFOS, PFOA, and PFBS presence or absence at this AOPI.

After the initial December 2019 SI field event, the Army provided direction to sample for PFOS, PFOA, and PFBS at any area which had previously stored or currently stores AFFF (regardless of whether a confirmed release was documented during the PA process) as part of the SI, to evaluate if a release had occurred. Additionally, following the initial December 2019 SI field event, it was discovered that three additional CAAF Hangars previously had AFFF suppression systems, prior to being transitioned to high-expansion foam suppression systems. The follow-on sampling scope for Phase I was as agreed upon as detailed in **Appendix L**, FCR-02.

- Building 5121 AFFF Storage and the Conex Containers 40 and 41 AFFF Storage areas (which were initially categorized as areas not retained for further investigation) were added as AOPIs in July 2020.

Shallow soil samples were collected via hand auger at each of the new AOPIs in August 2020 to evaluate PFOS, PFOA, and PFBS presence or absence.

- CAAF Hangars 7262, 7264, and 7268 previously had AFFF suppression systems that have been changed out to high-expansion foam systems; these areas were also added as AOPIs in July 2020. Shallow soil samples were collected via hand auger at each of the new AOPIs in August 2020 to evaluate PFOS, PFOA, and PFBS presence or absence.

Based on the results of the December 2019 and August 2020 sampling events, the Army provided direction in October 2020 to collect groundwater samples at AOPIs or groups of AOPIs at which only soil or surface water samples were originally collected during the Phase I sampling events, and at new AOPIs (AFFF storage areas at fire stations). The follow-on sampling scope was as agreed upon as detailed in **Appendix L**, FCR-03.

- In March 2021, temporary boreholes were completed via sonic drilling to collect grab groundwater samples at first encountered groundwater (i.e., whether in overburden or in bedrock).
    - Groundwater was sampled at 10 temporary borehole locations; at the eleventh location at the Former Fire Truck Maintenance Shop Building 5737, water was not encountered in overburden (at the primary location) or within bedrock (at the step-out location) even after allowing the boreholes to remain open for 5 days. The field conditions were communicated with USAEC and USACE, and at the direction of USAEC, the boreholes were not advanced further and were abandoned at the end of the event since no groundwater had filled the boreholes. Surface water and soil samples were collected in association with the AOPI to evaluate presence or absence of PFOS, PFOA, and PFBS.
- In addition, stormwater samples were collected at stormwater drainage features downgradient of the new CAAF Hangars 7262, 7264, and 7268 AOPIs. One surface water (spring) sample was collected at a spring which is understood to be a discharge point for groundwater from the Sabre Heliport area, according to historical dye tracer studies. One stormwater sample was collected at a stormwater drainage collection basin (i.e., a sinkhole).

Finally, an additional AOPI was identified after a February 2021 Bradley Tank fire in Training Area 26. The Army directed sampling of the AOPI in July 2021. The sampling scope was as agreed upon as detailed in **Appendix L**, FCR-04, the sampling scope was completed in December 2021 (soil) and January 2022 (groundwater and stormwater).

- Five surface soil samples, one stormwater sample, and one groundwater sample were collected. Rush analysis results for soil samples collected at the Bradley Tank Fire AOPI were used to determine where the temporary borehole should be advanced at the AOPI for grab groundwater collection.

  The grab groundwater sample was collected from a depth interval near the overburden/bedrock interface via a temporary well installed by sonic drilling methods. The temporary borehole was located based on the maximum soil PFOS, PFOA, and/or PFBS concentrations observed. The groundwater sample was collected via low-flow methods using a portable pump. Following sample collection, the borehole was grouted from the bottom of the borehole up to the ground surface in accordance with state regulations for well abandonment.

6.3.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., hand augers, drill cutting shoes and casing, screen-point samplers, water-level meters, portable bladder pumps) 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 2019a, Appendix A). EB samples were collected as described in **Section 6.3.2**, and the data from those samples are discussed in **Section 7.6**.

6.3.5 Investigation-Derived Waste

IDW included soil cuttings, purged groundwater, decontamination fluids, and disposable equipment (e.g., tubing, plastic sheeting, gloves). All IDW was disposed in accordance with the practices of the installation.

Soil cuttings from the shallow (hand-augered) boreholes were returned to their respective boreholes following sample collection, and sand was used to fill the remainder of the hole as needed. Soil cuttings from the boreholes advanced via sonic drilling methods were spread at the point of collection, and bentonite grout was used to plug and abandon the boreholes after groundwater sample collection and removal of the temporary casing. Purged groundwater and decontamination fluids were temporarily containerized during the field events. At the conclusion of each event and at the direction of the installation, the liquid IDW (approximately 28 gallons in total from the Phase I events and 75 gallons from the Phase II event) was transported to the WWTP and emptied into the headworks for treatment. One 55-gallon drum and one 300-gallon water tote which had been used to containerize the liquid IDW during the events were given to the DPW staff. Disposable equipment IDW was bagged and disposed of in appropriate waste receptacles on post.

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 Eurofins Lancaster Laboratories Environmental (December 2019 data) and Pace South Carolina (formerly Shealy Environmental Services, Inc.; August 2020, March 2021, December 2021, and January 2022 data), ELAP-accredited laboratories 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 2019a). Eighteen 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 5.1.1 (i.e., for the SI data collected in December 2019; DoD 2018) or 5.3 (i.e., for the SI data collected in August 2020, March 2021, December 2021, and January 2022; DoD and Department of Energy 2019), Table B-15.

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2019b) 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 percent 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 M**).

6.4.2 Data Validation

All analytical data generated during the SI, except grain size, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019a). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.1.1 (i.e., for the SI data collected in December 2019; DoD 2018) or 5.3 (i.e., for the SI data collected in August 2020, March 2021, December 2021, and January 2022; 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 M**. The Level IV analytical reports are included within **Appendix M** 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 FTC. Documentation generated during the data usability assessments, which were compiled into a DUSR (**Appendix M**), 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 upon the Stage 3 and Stage 4 data validation, the analytical results from environmental samples collected at FTC are considered valid and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix M**) and as indicated in the full analytical tables (**Appendix N**) provided for the SI results, except for seven results qualified as "R" or "X".

Otherwise, these data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019a) and FTC QAPP Addendum (Arcadis 2019b). Data qualifiers applied to laboratory analytical results for samples collected during the SI at FTC are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. The results that are qualified as estimated (i.e., with a "J") are usable with caution. Qualifiers for data shown on figures are defined in the notes of figures.

The results that are qualified with an "R" or an "X" are considered unusable. The qualifications of one surface water result and two soil results from the December 2019 sampling event with an "R" are due to extracted internal standards recoveries less than 10%; the data are considered unusable due to gross non-conformances discovered during data validation. The qualifications of four groundwater results from the March 2021 sampling event with an "X" are due to extracted internal standards recovery less than 20%. Since the X-flagged results were non-detect, these results are recommended to be rejected and are considered unusable to determine presence or absence of the analytes due to serious deficiencies in the ability to analyze the sample and to meet published method and project QC criteria. The "X" data qualifiers have been updated to an "R" qualifier in the full analytical tables (**Appendix M**) to indicate the rejection of these data (four results for groundwater samples, one result for a surface water sample, and two results for soil samples). None of the seven rejected results were for PFOS, PFOA, or PFBS.

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 6-2**.

Table 6-2 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) [1,2]	Soil (mg/kg or ppm) [1,3]	Soil (mg/kg or ppm) [1,3]
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 groundwater data are screened against the Residential Scenario tap water risk screening level. Surface water that is an expression of groundwater (i.e., seeps/springs that are discharge points for groundwater) or are focused points of groundwater recharge (e.g., sinkholes) are also compared to the Residential Scenario tap water risk screening level. Otherwise, the surface water samples are collected only to re-evaluate the CSMs and are not compared to the tap water OSD risk screening level.
3. All soil data are screened against both the Residential Scenario and Industrial/Commercial risk screening levels (since the soil samples were all collected from less than 2 feet bgs at FTC), regardless of the current and projected land use of the AOPI.

mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

The OSD residential tap water risk screening levels will be used to compare all groundwater data and surface water that is an expression of groundwater (i.e., seeps/springs that are discharge points for groundwater) or are focused points of groundwater recharge (e.g., sinkholes) for this Army PFAS PA/SI. Otherwise, the surface water samples are collected only to re-evaluate the CSMs and are not compared to the tap water OSD risk screening level. While the current and most likely future land uses of the AOPIs at FTC 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 9**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at FTC (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 2019b). The 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 criteria.

Tables 7-1 through **7-3** summarize 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 N** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at FTC with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2a** through **7-6** show the PFOS, PFOA, and PFBS analytical results for groundwater, soil, and/or surface water for each AOPI. Non-detected results are reported less than the LOQ. Detections of PFOS, PFOA, and PFBS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. The OSD risk screening levels for tap water (used to evaluate groundwater) 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 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 (commercial/industrial).

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 are reported in mg/kg, or parts per million. Soil analytical results were originally reported in nanograms per gram (or parts per billion) by the laboratory for the December 2019 data (**Appendix M**) and were converted to mg/kg for ease of comparison to the OSD risk screening levels (**Table 6-2**). Soil analytical results for subsequent events completed in August 2020 and March 2021 (**Appendix M**) are reported in mg/kg.

Field parameters measured for groundwater during low-flow purging 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 discussed by AOPI group (i.e., CAAF, mid-cantonment, south cantonment, and Sabre Heliport) and discussed for each medium as applicable.

Presence of PFOS and/or PFOA was identified in soil at 26 of the 27 AOPIs where soil samples were collected during the SI (i.e., excluding the Conex Containers 40 and 41 AFFF Storage AOPI). Soil samples were not collected at the Old Fire Training Area (SWMU 12/15), CAAF Clamshell, and CAAF Hangar 7166; only groundwater was sampled at these three AOPIs. Where PFOS, PFOA, and/or PFBS were detected in groundwater and spring surface water (i.e., groundwater discharge points), the detected concentrations may be attributed to multiple upgradient AOPIs to a varying degree. The subsections below discuss those instances where multiple AOPIs may be contributing to detected concentrations of PFOS, PFOA, and PFBS in groundwater and/or surface water (including seeps/springs that discharge groundwater from beneath multiple AOPIs and creeks/streams to which runoff from multiple AOPIs flows).

Table 7-4 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No)
Current FTA Building 7237	Yes
Destiny Heliport Wash Rack Building 7243	Yes
Destiny Heliport Wash Rack Building 7251	Yes
Fire Station #4 Building 7241	Yes
CAAF Hangar 7272	Yes
CAAF Hangar 7273	Yes
CAAF Hangar 7274	Yes
CAAF Hangar 7262	Yes
CAAF Hangar 7264	Yes
CAAF Hangar 7268	Yes
CAAF FTA and Retention Pond	Yes
CAAF Hangar 7166	Yes
CAAF Clamshell	Yes
Fire Station #3 Building 7160	Yes
CAAF Former FTA	Yes
Old FTAs SWMUs 12/15	Yes
Fire Station #5 Building 4099	Yes
Former Fire Truck Maintenance Shop Building 5737	Yes
Former Fire Station #1 Building 2575	Yes
AFFF Rinse-Out Building 6310	Yes
Old Clarksville Base FTA, SWMU 148	No
Legacy Fire Truck Repair Shop Building 5124	Yes
Conex Containers 40 and 41 AFFF Storage	No
Building 5121 AFFF Storage	Yes
Fire Station #1 Building 1747	Yes
Training Area 03 Crash Site	Yes
Wastewater Treatment Plant	Yes
Sabre Airfield Hangar 6627	No
Fire Station #2 Building 6634 and Wash Rack	Yes

AOPI Name	OSD Exceedances (Yes/No)
Bradley Tank Fire	No

7.1 CAAF Area AOPIs

The subsections below summarize the analytical results for PFOS, PFOA, and PFBS in groundwater, soil, and surface water associated with the 17 CAAF Area AOPIs. The maximum PFOS, PFOA, and PFBS concentrations observed during the SI in groundwater and surface water at FTC were observed in samples collected at or in association with the CAAF Area AOPIs. CAAF AOPIs are located in the northeast corner of the installation, upstream of the on-post potable water supply and within the installation's water supply wellhead protection area. Groundwater beneath CAAF has been demonstrated to discharge at three springs: Gordon Spring, Blue Spring, and Quarles Spring. Gordon and Blue Springs are located on post and Quarles Spring is located off post. Groundwater discharged from all three springs feeds Dry Fork Creek, which later joins Little West Fork Creek upstream of the installation's potable water pump house (**Figure 7-1**). Additionally, stormwater runoff from the CAAF area is directed to Dry Fork Creek (see **Figure 5-3** for the stormwater drainage features in the area).

Generally, the greatest PFOS, PFOA, and PFBS concentrations in groundwater were observed at a location inferred to be downgradient of the CAAF Hangar 7166 and Fire Station #3 Building 7160 AOPIs (i.e., at existing well CAAF-9) and at a location inferred to be downgradient of the Destiny Heliport Washrack Buildings 7243 and 7251 and Fire Station #4 Building 7241 (at temporary well location FTC-DHWRs-1-OBGW). Exceedances of the OSD risk screening levels for PFOS and PFOA were observed in groundwater at 16 of the CAAF AOPIs (one CAAF AOPI was not sampled for groundwater). The greatest PFOS and PFOA concentrations in soil were also observed at the Fire Station #3 Building 7160 AOPI; exceedances of the OSD risk screening levels for PFOS in soil were observed at three of the CAAF AOPIs. PFOS, PFOA, and PFBS were also detected in stream surface water features downgradient of multiple AOPIs (i.e., stream features that eventually flow to Little West Fork Creek); surface water data for samples collected at stream features were not compared to the OSD risk screening levels. Additionally, PFOS, PFOA, and PFBS were detected at Quarles Spring, a discharge point for groundwater originating beneath multiple AOPIs in the CAAF area; the PFOS concentration in Quarles Spring exceeded the OSD risk screening level. Detected concentrations of PFOS, PFOA, and PFBS observed in the groundwater and surface water samples collected in the CAAF area may be attributed to multiple upgradient AOPIs. The current and expected future land use of the AOPIs at CAAF is industrial.

7.1.1 Current Fire Training Area Building 7237

The subsections below detail the groundwater, surface water, and soil sampling results for the Current FTA Building 7237 AOPI.

7.1.1.1 Groundwater

One temporary borehole (FTC-FTA-7237-1-OBGW) was completed at a location inferred to be downgradient of this AOPI (**Figure 7-2a**) for grab groundwater sample collection at first encountered groundwater (which was at the overburden/bedrock interface at approximately 54 feet bgs). PFOS was

detected at a concentration of 98 J- ng/L, exceeding the OSD risk screening level (**Table 7-1**; the J- qualifier indicates the result is estimated and may be biased low). PFOA and PFBS were also detected in the sample (26 J- ng/L and 56 J- ng/L, respectively), less than the OSD risk screening levels.

7.1.1.2 Surface Water

One surface water sample (FTC-DFC-1-SW) was collected along the intermittent tributary to Dry Fork Creek, located north of the Current FTA Building 7237. The tributary receives stormwater runoff from this AOPI, the Destiny Heliport Wash Rack Building 7251 AOPI, and potentially from the Destiny Heliport Wash Rack 7243 AOPI (see **Figure 5-3** for the stormwater drainage features in the area). Detections of PFOS (45 ng/L), PFOA (6.1 ng/L) and PFBS (5.7 ng/L) were all observed in the sample (**Figure 7-2a**; **Table 7-2**). Note that this sampling location is downgradient of six other CAAF Hangars (7262, 7264, 7268, 7272, 7273, and 7274) which may contribute to the impacts observed in surface water at the FTC-DFC-1-SW sampling location. This surface water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.1.1.3 Soil

Three soil samples were collected in the grassy areas off the gravel pad used for fire training activities at this AOPI (**Figure 7-2b**). PFOS was detected in all three samples with concentrations ranging from 0.0028 mg/kg (FTC-FTA-7237-1-SO) to 0.120 J mg/kg (FTC-FTA-7237-2-SO; the J qualifier indicates that the reported value is an estimated quantity), less than the 0.13 mg/kg residential OSD risk screening level. PFOA was detected in two of the three samples with concentrations ranging from 0.0011 mg/kg (FTC-FTA-7237-3-SO) to 0.0022 mg/kg (FTC-FTA-7237-2-SO), less than the OSD risk screening levels. PFBS was not detected in the soil samples (**Table 7-3**).

7.1.2 Destiny Heliport Wash Rack Building 7243

The subsections below detail the groundwater, surface water, and soil sampling results for the Destiny Heliport Wash Rack Building 7243 AOPI.

7.1.2.1 Groundwater

One temporary borehole (FTC-DHWRs-1-OBGW) was completed at a location inferred to be downgradient of this AOPI, the Destiny Heliport Wash Rack Building 7251 AOPI, and the Fire Station #4 Building 7241 AOPI (**Figure 7-2a**) for grab groundwater sample collection at first encountered groundwater (which was at approximately 65 feet at the overburden/bedrock interface). Detected concentrations of PFOS (2,200 J ng/L) and PFOA (380 ng/L) exceeded the OSD risk screening levels (**Table 7-1**). PFBS was detected in the sample (280 ng/L) at a concentration less than the OSD risk screening level. Impacts observed in groundwater inferred to be downgradient of these three AOPIs may be attributed to multiple AOPIs, based on PFOS, PFOA, and/or PFBS detections in soil at all three AOPIs. The individual AOPIs' contributions to impacts in groundwater downgradient of the AOPIs should be discerned during a future study.

7.1.2.2 Surface Water

One surface water sample (FTC-DFC-1-SW) was collected along the intermittent tributary to Dry Fork Creek (**Figure 7-2a**; **Table 7-2**). The sampled location is potentially downgradient of multiple AOPIs (see **Figure 5-3** for the stormwater drainage features in the area); stormwater that drains from the Destiny Heliport Wash Rack Building 7243 area may convey water to Dry Fork Creek upstream of the surface water sample location. PFOS, PFOA, and PFBS were all detected in the sample and may be attributed to multiple upstream AOPIs. The results from this surface water sample are discussed in **Section 7.1.1.2**.

7.1.2.3 Soil

Two soil samples were collected outside of the hangar in an area where AFFF may have flowed out of the building during accidental releases from the fire suppression system (**Figure 7-2b**). PFOS was detected in both samples with concentrations ranging from 0.0060 mg/kg (FTC-DHWR-7243-1-SO) to 0.036 mg/kg (FTC-DHWR-7243-2-SO), less than the OSD risk screening levels. PFOA was detected in one of the samples (FTC-DHWR-7243-2-SO) at a concentration of 0.0020 mg/kg, less than the OSD risk screening levels. PFBS was not detected in the samples (**Table 7-3**).

7.1.3 Destiny Heliport Wash Rack Building 7251

The subsections below detail the groundwater, surface water, and soil sampling results for the Destiny Heliport Wash Rack Building 7251 AOPI.

7.1.3.1 Groundwater

As discussed in **Section 7.1.2**, one temporary borehole (FTC-DHWRs-1-OBGW) was completed at a location inferred to be downgradient of this AOPI, the Destiny Heliport Wash Rack Building 7243 AOPI, and the Fire Station #4 Building 7241 AOPI (**Figure 7-2a**) for grab groundwater sample collection. The results from this groundwater sample are discussed in **Section 7.1.2**. Exceedances of the OSD risk screening levels were observed in the groundwater sample.

7.1.3.2 Surface Water

One surface water sample (FTC-DFC-1-SW) was collected along the intermittent tributary to Dry Fork Creek (**Figure 7-2a**; **Table 7-2**). The sampled location is potentially downgradient of multiple AOPIs (see **Figure 5-3** for the stormwater features in the area); stormwater that drains from the Destiny Heliport Wash Rack Building 7251 may convey water to Dry Fork Creek upstream of the surface water sample location. PFOS, PFOA, and PFBS were all detected in the sample and may be attributed to multiple upstream AOPIs. The results from this surface water sample are discussed in **Section 7.1.1.2**.

7.1.3.3 Soil

Two soil samples were collected outside of the hangar in an area where AFFF may have flowed out of the building during accidental releases from the fire suppression system (**Figure 7-2b**). PFOS was detected in both samples with concentrations ranging from 0.0022 mg/kg (FTC-DHWR-7251-1-SO) to 0.0037 mg/kg (FTC-DHWR-7251-2-SO), less than the OSD risk screening level. PFOA was detected in both

samples with concentrations ranging from 0.00055 J mg/kg (FTC-DHWR-7251-1-SO) to 0.0019 mg/kg (FTC-DHWR-7251-2-SO), less than the OSD risk screening levels. PFBS was not detected in the samples (**Table 7-3**).

7.1.4 Fire Station #4 Building 7241

The subsections below detail the groundwater and soil sampling results for the Fire Station #4 Building 7241 AOPI. No surface water features are present adjacent to the AOPI. However, Dry Fork Creek was sampled downstream of multiple CAAF AOPIs and the data for the general surface water evaluation for CAAF AOPIs are discussed later in **Section 7.1.18**. PFOS, PFOA, and PFBS were detected in Dry Fork Creek downstream of multiple CAAF AOPIs.

7.1.4.1 Groundwater

The location of the groundwater sample (FTC-DHWRs-1-OBGW) collected in association with the Fire Station #4 Building 7241 AOPI was also downgradient of the Destiny Heliport Wash Racks Buildings 7243 and 7251 AOPIs, as discussed in **Section 7.1.2.1**. Exceedances of the OSD risk screening levels were observed in the groundwater sample.

7.1.4.2 Soil

Three soil samples were collected outside of the Fire Station #4: two adjacent to the driveway ramp, and one northeast of the storage shed that sits along the driveway (**Figure 7-2b**). PFOS and PFOA were detected in all three samples. PFOS concentrations ranged from 0.051 mg/kg (at FTC-FS4-2-SO) to 0.13 mg/kg (FTC-FS4-1-SO), the latter of which is equal to the residential OSD risk screening level (**Table 7-3**). PFOA concentrations ranged from 0.00096 J mg/kg (at FTC-FS4-2-SO) to 0.0023 mg/kg (in the field duplicate at FTC-FS4-1-SO), all less than the OSD risk screening levels. PFBS was not detected in any of the three soil samples collected at this AOPI.

7.1.5 CAAF Hangar 7272

The subsections below detail the groundwater, stormwater, and soil sampling results for the CAAF Hangar 7272 AOPI.

7.1.5.1 Groundwater

One temporary borehole (FTC-H7270s-1-OBGW) was completed at a location inferred to be downgradient of this AOPI and the CAAF Hangar 7273 and CAAF Hangar 7274 AOPIs (**Figure 7-2a**) for grab groundwater sample collection at first encountered groundwater (which was at the overburden/bedrock interface at approximately 55 feet bgs). Detected concentrations of PFOS (1,400 J ng/L) and PFOA (45 ng/L) exceeded the OSD risk screening levels (**Table 7-1**). PFBS was also detected in the sample (76 ng/L), less than the OSD risk screening level.

7.1.5.2 Surface Water and Stormwater

One surface water sample (FTC-160H-1-SW) was collected along the headwaters of the intermittent tributary to Dry Fork Creek, located north of the hangars. The tributary receives stormwater runoff from the CAAF Hangars 7272, 7273, and 7274 AOPIs (see **Figure 5-3** for stormwater drainage features). Detections of PFOS (9.8 ng/L), PFOA (2.1 ng/L) and PFBS (2.1 ng/L) were all observed in the sample. In addition, a stormwater sample was collected from the stormwater drainage feature southeast of CAAF Hangar 7272 (FTC-H7272-1-SW) as utility maps from the installation (**Figure 5-3**) indicate that stormwater from around the hangar apron is directed to this ditch. Detections of PFOS (340 ng/L), PFOA (9.8 ng/L), and PFBS (14 ng/L) were observed in the sample (**Table 7-2**). These water samples do not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.1.5.3 Soil

One soil sample (FTC-160H-7272-1-SO) was collected outside of the hangar in an area where AFFF may have flowed out of the building during accidental releases from the fire suppression system (**Figure 7-2b**). PFOS was detected in the sample at a concentration of 0.0050 mg/kg, less than the OSD risk screening level. PFOA and PFBS were not detected in the sample (**Table 7-3**).

7.1.6 CAAF Hangar 7273

The subsections below detail the groundwater, surface water and stormwater, and soil sampling results for the CAAF Hangar 7273 AOPI.

7.1.6.1 Groundwater

One temporary borehole was completed at a location inferred to be downgradient of this AOPI and downgradient of the CAAF Hangar 7272 and CAAF Hangar 7274 AOPIs (**Figure 7-2a**) for grab groundwater sample collection at first encountered groundwater. The groundwater results for this sampling location are discussed in **Section 7.1.5.1**. Exceedances of the OSD risk screening levels were observed in the groundwater sample.

7.1.6.2 Surface Water and Stormwater

One surface water sample (FTC-160H-1-SW) was collected along the intermittent tributary to Dry Fork Creek, located north of the CAAF Hangars 7272, 7273, and 7274 AOPIs. These results are discussed in **Section 7.1.5.2**. In addition, a stormwater sample was collected from the stormwater drainage feature southeast of the hangar (FTC-H7270s-1-SW). Utility maps from the installation (**Figure 5-3**) indicate that stormwater from around both the CAAF Hangar 7273 and 7274 aprons is directed to this ditch. PFOS and PFOA were detected at 4.3 J+ ng/L and 2.0 J ng/L, respectively (**Figure 7-2a**; the J+ qualifier indicates that the result is estimated and may be biased high). PFBS was not detected in the sample (**Table 7-2**). These water samples do not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.1.6.3 Soil

Two soil samples were collected outside of the hangar in an area where AFFF may have flowed out of the building during accidental releases from the fire suppression system (**Figure 7-2b**). PFOS was detected in both samples with concentrations ranging from 0.0057 mg/kg (FTC-160H-7273-2-SO) to 0.0077 mg/kg (FTC-160H-7273-1-SO), less than the OSD risk screening levels. PFOA was detected in one of the two soil samples (FTC-160H-7273-2-SO) at a concentration of 0.0038 mg/kg, less than the OSD risk screening level. PFBS was not detected in either of the samples (**Table 7-3**).

7.1.7 CAAF Hangar 7274

The subsections below detail the groundwater and surface water sampling results for the CAAF Hangar 7274 AOPI. No soil samples were collected in association with this AOPI due to concrete surrounding the area which presented difficulty in obtaining a sample via hand auger in an area where AFFF would have likely been flowed outside the hangar during an accidental release from the fire suppression system.

7.1.7.1 Groundwater

One temporary borehole was completed at a location inferred to be downgradient of this AOPI and the CAAF Hangars 7272 and 7273 AOPIs (**Figure 7-2a**) for grab groundwater sample collection The groundwater results for this sampling location are discussed in **Section 7.1.5.1**. Exceedances of the OSD risk screening levels were observed in the groundwater sample.

7.1.7.2 Surface Water

One surface water sample (FTC-160H-1-SW) was collected along the intermittent tributary to Dry Fork Creek, located north of the CAAF Hangars 7272, 7273, and 7274 AOPIs. These results are discussed in **Section 7.1.5.2**. In addition, the stormwater drainage feature sampled southeast of the hangar which collects stormwater from around both the CAAF Hangar 7273 and 7274 aprons is directed to this ditch. The results from the sampled stormwater feature are discussed in **Section 7.1.6.2**.

7.1.8 CAAF Hangar 7262

The subsections below detail the groundwater, stormwater, and soil sampling results for the CAAF Hangar 7262 AOPI.

7.1.8.1 Groundwater

One temporary borehole (FTC-H7260s-1-OBGW) was completed at a location inferred to be downgradient of this AOPI and the CAAF Hangar 7264 and CAAF Hangar 7268 AOPIs (**Figure 7-2a**) for grab groundwater sample collection at first encountered groundwater (which was at the overburden/bedrock interface at approximately 46 feet bgs). PFOS was detected at a concentration of 47 ng/L, exceeding the OSD risk screening level (**Table 7-1**). PFOA and PFBS were also detected in the sample (4.9 ng/L and 5.4 ng/L, respectively), less than the OSD risk screening levels (**Table 7-1**). Groundwater sampled at this temporary borehole location (FTC-H7260s-1-OBGW) is also inferred to be downgradient of the CAAF Hangars 7272, 7273, and 7274 group of AOPIs. The sample collected

downgradient of these three hangars (i.e., at FTC-H7270s-1-OBGW) also exhibited exceedances of the OSD risk screening levels for PFOS and PFOA. Impacts observed at the FTC-H7260s-1-OBGW location may also be, in part, attributed to use, storage, or disposal of AFFF at the CAAF Hangars 7264, 7268, 7272, 7273, and 7274 AOPIs.

7.1.8.2 Stormwater

A stormwater sample was collected from the stormwater drainage ditch southeast of the hangar (FTC-H7262-1-SW) (**Figure 7-2a**). Utility maps from the installation (**Figure 5-3**) indicate that stormwater from around the hangar apron is directed to this ditch. PFOS was detected at a concentration of 2.0 J ng/L. PFOA and PFBS were not detected in the sample. This water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.1.8.3 Soil

Three soil samples were collected in association with this AOPI: one outside of the hangar in an area where AFFF may have flowed out of the building during accidental releases from the fire suppression system, and two along the stormwater drainage features southeast of the building (**Figure 7-2b**). Utility maps from the installation indicate that stormwater from around the hangar apron is directed to these ditches (**Figure 5-3**). PFOS, PFOA, and PFBS were not detected in the sample collected outside of the hangar (FTC-H7262-1-SO). However, PFOS was detected in both soil samples collected along the stormwater drainage ditches with concentrations ranging from 0.0073 mg/kg (FTC-H7262-3-SO) to 0.019 mg/kg (FTC-H7262-2-SO), less than the OSD risk screening levels. In one stormwater ditch sample (FTC-H7262-2-SO), PFOA and PFBS were also detected (0.0033 mg/kg and 0.0013 mg/kg, respectively) (**Table 7-3**).

7.1.9 CAAF Hangar 7264

The subsections below detail the groundwater, stormwater, and soil sampling results for the CAAF Hangar 7264 AOPI.

7.1.9.1 Groundwater

One temporary borehole was completed at a location inferred to be downgradient of this AOPI and the CAAF Hangars 7262 and 7268 AOPIs (**Figure 7-2a**) for grab groundwater sample collection. The groundwater results for this sampling location are discussed in **Section 7.1.8**. Exceedances of the OSD risk screening levels were observed in the groundwater sample.

7.1.9.2 Stormwater

A stormwater sample was collected from the stormwater drainage ditch southeast of the hangar (FTC-H7264-1-SW). Utility maps from the installation (**Figure 5-3**) indicate that stormwater from around the hangar apron is directed to this ditch. This water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels. However, PFOS, PFOA, and PFBS were not detected in the sample (**Figure 7-2a**; **Table 7-2**).

7.1.9.3 Soil

Two soil samples were collected in association with this AOPI: one outside of the hangar in an area where AFFF may have flowed out of the building during accidental releases from the fire suppression system (FTC-H7264-1-SO), and one along the stormwater drainage feature southeast of the building (FTC-H7262-2-SO; **Figure 7-2b**). Utility maps from the installation indicate that stormwater from around the hangar apron is directed to this ditch (**Figure 5-3**). PFOS was detected in both soil samples with concentrations ranging from 0.0066 mg/kg in the ditch (FTC-H7264-2-SO) to 0.0089 mg/kg near the hangar (FTC-H7264-1-SO), less than the OSD risk screening levels. PFOA and PFBS were not detected in either soil sample (**Table 7-3**).

7.1.10 CAAF Hangar 7268

The subsections below detail the groundwater, stormwater, and soil sampling results for the CAAF Hangar 7268 AOPI.

7.1.10.1 Groundwater

One temporary borehole was completed at a location inferred to be downgradient of this AOPI and the CAAF Hangar 7262 and CAAF Hangar 7264 AOPIs (**Figure 7-3**) for grab groundwater sample collection. The groundwater results for this sampling location are discussed in **Section 7.1.8.1**. Exceedances of the OSD risk screening levels were observed in the groundwater sample.

7.1.10.2 Stormwater

A stormwater sample was collected from the stormwater drainage ditch southeast of the hangar (FTC-H7268-1-SW). Utility maps from the installation (**Figure 5-3**) indicate that stormwater from around the hangar apron is directed to this ditch. PFOS was detected at a concentration of 4.9 ng/L. PFOA and PFBS were not detected in the sample (**Figure 7-2a**; **Table 7-2**). This water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.1.10.3 Soil

Three soil samples were collected in association with this AOPI: one outside of the hangar in an area where AFFF may have flowed out of the building during accidental releases from the fire suppression system (FTC-H7268-1-SO), and two along the stormwater drainage features southeast of the building (FTC-H7268-2-SO and FTC-H7268-3-SO; **Figure 7-2b**). Utility maps from the installation indicate that stormwater from around the hangar apron is directed to these ditches (**Figure 5-3**). PFOS was detected in all three soil samples with concentrations ranging from 0.0017 mg/kg in the stormwater ditch (FTC-H7268-2-SO) to 0.029 mg/kg near the hangar (FTC-H7268-1-SO), all less than the OSD risk screening levels. PFOA and PFBS were not detected in any of the three soil samples (**Table 7-3**).

7.1.11 CAAF Fire Training Area and Retention Pond

The subsections below detail the surface water and soil sampling results for the CAAF Fire Training Area and Retention Pond AOPI. No groundwater samples were collected during the Phase II sampling event based on the OSD risk screening level exceedance observed in soil samples collected during the Phase I sampling event (i.e., sufficient data were obtained during the Phase I sampling event to make a recommendation for the AOPI).

7.1.11.1 Surface Water

One water sample (FTC-CFTA-4-SW) was collected at the retention pond which may have received runoff from the fire training area. Detections of PFOS (2.7 ng/L) and of PFOA (1.1 J ng/L) were observed in the sample (**Figure 7-2a**; **Table 7-2**). PFBS was not detected in the sample (**Table 7-2**). This water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.1.11.2 Soil

Three soil samples were collected off the concrete pad used for fire training activities (**Figure 7-2b**). PFOS was detected in all three samples with concentrations ranging from 0.080 mg/kg (FTC-CFTA-3-SO) to 0.170 J mg/kg (FTC-CFTA-2-SO); the latter concentration exceeds the residential OSD risk screening level. PFOA was detected in one of the three samples (FTC-CFTA-2-SO) at a concentration of 0.00047 J mg/kg, less than the OSD risk screening level. PFBS was not detected in any of the three samples (**Table 7-3**).

7.1.12 CAAF Hangar 7166

The subsections below detail the groundwater sampling results for the CAAF Hangar 7166 AOPI. No soil or surface water samples were collected in association with this AOPI. Groundwater data were prioritized for the evaluation of PFOS, PFOA, and PFBS presence or absence at the AOPI given the existing downgradient wells. The area of inferred AFFF release is paved and soil samples were not proposed to be collected through the hangar apron. No surface water features are present adjacent to the AOPI.

7.1.12.1 Groundwater

Three groundwater samples were collected in association with this AOPI at existing monitoring wells CAAF-9, CAAF-51, and CAAF-55 (**Figure 7-2a**). PFOS, PFOA, and PFBS were detected in all three samples, with exceedances of the OSD risk screening levels observed for PFOS and PFOA in all three samples. Concentrations of PFOS ranged from 1,100 J- ng/L (CAAF-55) to 5,700 J ng/L (CAAF-9). Concentrations of PFOA ranged from 49 ng/L (CAAF-55) to 2,200 J ng/L (CAAF-51). Concentrations of PFBS ranged from 25 ng/L (CAAF-55) to 460 J ng/L (CAAF-51), less than the OSD risk screening levels (**Table 7-1**). The monitoring wells sampled in association with this AOPI (particularly CAAF-9) are also inferred to be downgradient of the Fire Station #3 Building 7160 AOPI.

7.1.13 Fire Station #3 Building 7160

The subsections below detail the groundwater and soil sampling results for the Fire Station #3 Building 7160 AOPI. No surface water bodies are present adjacent to the AOPI. However, runoff from multiple CAAF AOPIs is directed to Dry Fork Creek, which flows to Little West Fork Creek. Groundwater from beneath multiple CAAF AOPIs may discharge at springs which flow to Little West Fork Creek. Little West Fork Creek was sampled at a location downstream of Boiling Spring and the tributaries originating at CAAF. The data for the general surface water evaluation for CAAF AOPIs are discussed in **Section 7.1.18**.

7.1.13.1 Groundwater

Groundwater samples collected at existing monitoring wells CAAF-9, CAAF-51, and CAAF-55 in association with the CAAF Hangar 7166 AOPI were also used to evaluate groundwater at this AOPI (**Section 7.1.12.1**). In particular, CAAF-9 is located at an inferred downgradient location from the Fire Station #3 Building 7160 (CAAF-51 and CAAF-55 may be located at a more cross-gradient position from the AOPI). Exceedances of the OSD risk screening level for PFOS and PFOA in these wells (**Figure 7-2a**, **Table 7-1**) are likely in part attributed to potential AFFF use at Fire Station #3 Building 7160, based on PFOS and PFOA detections observed in soil at the AOPI as described below.

7.1.13.2 Soil

Three soil samples were collected outside of Fire Station #3 adjacent to the driveway ramp (**Figure 7-2b**). PFOS was detected in all three samples; concentrations were equal to or exceeded the OSD risk screening levels in two of the three samples (0.13 mg/kg at FTC-FS3-3-SO and 0.42 J mg/kg at FTC-FS3-1-SO). PFOA was detected in all three samples; concentrations, which ranged from 0.0011 mg/kg (FTC-FS3-2-SO) to 0.0022 mg/kg (FTC-FS3-3-SO), were less than the OSD risk screening levels. PFBS was not detected in any of the three samples (**Table 7-3**).

7.1.14 CAAF Clamshell

The subsection below details the groundwater sampling results for the CAAF Clamshell AOPI. No soil or surface water samples were collected in association with this AOPI; groundwater data were prioritized to evaluate PFOS, PFOA, and PFBS presence or absence at the AOPI given the existing downgradient monitoring wells. The area of inferred AFFF release is paved and soil samples were not proposed to be collected through the concrete. No surface water features are present adjacent to the AOPI.

7.1.14.1 Groundwater

Three groundwater samples were collected in association with this AOPI at existing monitoring wells CAAF-32, CAAF-52, and CAAF-53 (**Figure 7-2a**). PFOS and PFOA were detected in all three samples. PFOS concentrations ranged from 3.3 ng/L (CAAF-32, an upgradient well) to 600 J ng/L (CAAF-53); exceedances of the OSD risk screening level for PFOS were observed in two of the three wells. PFOA concentrations ranged from 1.6 J ng/L (CAAF-32) to 340 J ng/L (CAAF-53); an exceedance of the OSD risk screening level for PFOA was observed in one of the three wells (CAAF-53). PFBS was detected in two of the wells (5.6 ng/L at CAAF-52 and 54 ng/L at CAAF-53) at concentrations less than the OSD risk

screening level (**Table 7-1**). Exceedances in these wells may be in part attributed to other upgradient AOPIs as well.

7.1.15 CAAF Former Fire Training Area

The subsections below detail the groundwater and soil sampling results for the CAAF Former Fire Training Area AOPI. No surface water features are present adjacent to the AOPI, and no stormwater was present in the runoff ditch at the time of the sampling event.

7.1.15.1 Groundwater

Two existing monitoring wells (41MW006 and 41MW004) were sampled downgradient of this AOPI (**Figure 7-2a**). PFOS was detected in well 41MW006 at a concentration of 160 J ng/L, greater than the OSD risk screening level. PFOA and PFBS were also detected in the well (7.6 ng/L and 4.9 ng/L, respectively), less than the OSD risk screening levels. At well 41MW004, PFBS was detected at a concentration of 1.3 J ng/L, less than the OSD risk screening level; PFOS and PFOA were not detected at the well (**Table 7-1**).

7.1.15.2 Soil

One soil sample was collected on the gravel pad near the fire training area (FTC-FFTA-2-SO), and one soil sample was collected along a stormwater drainage feature downgradient of the gravel pad (FTC-FFTA-1-SO) (**Figure 7-2b**). PFOS was detected in both soil samples with concentrations ranging from 0.0039 mg/kg at the gravel pad to 0.0053 mg/kg along the stormwater drainage feature, both less than the OSD risk screening levels. PFOA and PFBS were not detected in either soil sample (**Table 7-3**).

7.1.16 Old Fire Training Area (SWMU 12/15)

The subsections below detail the groundwater sampling results for the Old Fire Training Area (SWMU 12/15) AOPI. No soil samples were collected at this AOPI as the ground has been reworked and excavated, and no surface water or stormwater samples were collected at the AOPI as there were no relevant features to sample at the AOPI.

7.1.16.1 Groundwater

Three existing monitoring wells (12MW00100, 12MW012, and 15MW00500) were sampled at this AOPI (**Figure 7-2a**); no soil samples or surface water samples were collected as monitoring wells were available and the land surface/shallow soils have been reworked during previous environmental investigations and removal actions (**Section 5.2.1.16**). PFOS, PFOA, and PFBS were detected in all three wells with PFOS and PFOA exceedances of the OSD risk screening levels in two of the wells (15MW00500 and 12MW012). PFOS concentrations ranged from 5.8 ng/L (12MW00100) to 2,600 J ng/L (12MW012). PFOA concentrations ranged from 3.6 ng/L (12MW00100) to 1,200 J ng/L (12MW012). PFBS concentrations ranged from 1.1 J ng/L (12MW00100) to 180 J ng/L (12MW012) (**Table 7-1**).

7.1.17 Fire Station #5 Building 4099

The subsections below detail the groundwater and soil sampling results for the Fire Station #5 Building 4099 AOPI. No surface water features are present adjacent to the AOPI.

7.1.17.1 Groundwater

One grab groundwater sample was collected via a temporary borehole (FTC-FS5-1-OBGW) completed at the AOPI for grab groundwater sample collection at first encountered groundwater (which was at the overburden/bedrock interface at approximately 49 feet bgs). The sampling location (**Figure 7-2a**) was determined after evaluation of expedited analysis of soil samples collected at the AOPI (see **Section 7.1.17.2** below). PFOS and PFOA were detected at concentrations of 980 J ng/L and 71 ng/L, both exceeding the OSD risk screening levels. PFBS was detected at 160 ng/L, less than the OSD risk screening level (**Table 7-1**).

7.1.17.2 Soil

Three soil samples were collected outside of the fire station. Two of the locations (FTC-FS5-1-SO and FTC-FS5-2-SO) were placed near the shed structure to the southeast of the station where AFFF storage is suspected, and one location (FTC-FS5-3-SO) was placed along the stormwater drainage to the north of the driveway (**Figure 7-2b**). PFOS and PFOA were detected in all three samples at concentrations less than the OSD risk screening levels (**Table 7-3**). PFOS concentrations ranged from 0.0019 mg/kg (FTC-FS5-3-SO) to 0.091 mg/kg (at FTC-FS5-2-SO). PFOA concentrations ranged from 0.00097 J mg/kg (FTC-FS5-2-SO) to 0.0027 mg/kg (FTC-FS5-1-SO). PFBS was not detected in any of the three samples.

7.1.18 General Surface Water Evaluation for CAAF AOPIs

Other surface water features were sampled downgradient of or in association with multiple AOPIs.

An off-post spring (Quarles Spring) is understood to be a discharge point for groundwater originating beneath many of the AOPIs in the CAAF area (**Figures 2-2a** and **7-2a**; i.e., CAAF Hangars 7272, 7273, 7274, 7268, 7264, 7262; Current Fire Training Area Building 7237, Destiny Heliport Wash Racks Buildings 7251 and 7243, Fire Station #4 Building 7241, CAAF Fire Training Area and Retention Pond, CAAF Hangar 7166, and Fire Station #3 Building 7160). The spring is an expression of groundwater, as each spring has a “groundwater basin” analogous to a surface water drainage basin, from which its water is derived. A sample collected from a spring, therefore, represents a composite sample of the groundwater contained within the spring’s basin. The spring has historically been sampled in association with other environmental investigations at CAAF. Detections of PFOS (180 ng/L), PFOA (9.8 ng/L) and PFBS (9.8 ng/L) were observed in the sample (FTC-QUARLESSP-SW). Concentrations were compared to the OSD risk screening level because springs are an expression of groundwater discharging to the land surface. The PFOS concentration at Quarles Spring exceeded the OSD risk screening level (**Table 7-2**).

An on-post spring (Boiling Spring) is also understood to be a discharge point for groundwater from the surrounding Boiling Spring Basin (**Figure 2-2a**) and may include groundwater originating beneath the CAAF and mid-cantonment AOPIs. A sample was collected at Boiling Spring, and PFOS, PFOA, and PFBS were all detected in the sample at concentrations less than the OSD risk screening levels.

Concentrations observed were 13 ng/L PFOS, 2.3 J ng/L PFOA, and 2.1 ng/L PFBS (FTC-BOILINGSP-1-GW; **Figure 7-2a** and **Table 7-2**).

Additionally, a stream sample was collected along Dry Fork Creek at a location downgradient of where several drainage features from CAAF and Quarles Spring flow to the creek (FTC-DFC-2-SW; **Figure 7-2a**). Detections of PFOS (54 ng/L), PFOA (3.8 ng/L), and PFBS (4.8 ng/L) were observed in the sample (**Table 7-2**). Further downgradient of where additional springs flow to Dry Fork Creek (i.e., Blue Spring and Gordon Spring which may discharge groundwater from additional AOPIs in the CAAF area) and Little West Fork Creek (i.e., Boiling Spring, which may discharge groundwater originating at all AOPIs in the CAAF area and mid-cantonment area), another surface water sample was collected along Little West Fork Creek (FTC-LWFC-1-SW). Detected concentrations of PFOS (15 ng/L), PFOA (2.2 ng/L), and PFBS (1.6 J ng/L) were observed in the sample (**Figure 7-2a**; **Table 7-2**). The FTC-DFC-2-SW and FTC-LWFC-1-SW surface water samples do not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.2 Mid-Cantonment AOPIs

The subsections below summarize the soil PFOS, PFOA, and PFBS analytical results associated with the three mid-cantonment AOPIs: the Former Fire Truck Maintenance Shop (Building 5737), the Former Fire Station #1 (Building 2575), and the AFFF Rinse-Out Building 6310 (**Figure 7-3**). Of these three AOPIs, only the Former Fire Station #1 (Building 2575) is located outside of the installation's water supply wellhead protection area. There are no flowing surface water bodies near these AOPIs; therefore, surface water samples were not collected in association with the AOPIs at the Former Fire Station #1 (Building 2575), and the AFFF Rinse-Out Building 6310. However, sinkholes are present in the area and may be utilized as part of FTC's stormwater management practices (**Section 2.9.1**); for example, pooled stormwater was observed in a mapped sinkhole in the wooded area west of the Former Fire Truck Maintenance Shop (Building 5737) during the SI sampling, and a sample was collected at the sinkhole. Millstone Spring, a groundwater discharge point for groundwater originating beneath the mid-cantonment area as demonstrated during historical dye tracer studies, was not sampled as part of the SI because the spring is located off post and presented access challenges. Millstone Spring discharges to the West Fork of the Red River off post (**Figure 7-3**); the Red River is known to be used as a source of potable water off post. The mid-cantonment AOPIs are designated for industrial land use and are anticipated to remain as such for the foreseeable future.

Of the three mid-cantonment AOPIs, the greatest concentrations of PFOS and PFOA were observed at the Former Fire Station #1 Building 2575, with exceedances of the OSD risk screening level for PFOS in soil (this AOPI was not sampled for groundwater). Exceedances of the OSD risk screening levels were not observed in soil at the other two AOPIs. Groundwater was only sampled at one of the three mid-cantonment AOPIs (i.e., the AFFF Rinse-Out Building 6310), where an exceedance of the OSD risk screening level was observed for PFOS. Additionally, a stormwater sample collected in association with the Former Fire Truck Maintenance Shop Building 5737 exhibited an exceedance of the OSD risk screening level for PFOS (the data from this sample were compared to the OSD risk screening levels because the associated sample was collected from a sinkhole which represents a direct recharge point for groundwater). The current and expected future land use of the AOPIs in the mid-cantonment area is industrial.

7.2.1 Former Fire Truck Maintenance Shop (Building 5737)

The subsections below detail the groundwater, stormwater, and soil sampling results for the Former Fire Truck Maintenance Shop (Building 5737) AOPI.

7.2.1.1 Groundwater

A temporary borehole was completed at a location inferred to be downgradient of this AOPI (FTC-FTMS-1a-OBGW; **Figure 7-3**) for planned groundwater sample collection at first encountered groundwater (which was anticipated to be at the overburden/bedrock interface). At the first borehole inside the motor pool complex fence (FTC-FTMS-1a), the borehole was advanced to bedrock to a total depth of approximately 45 feet. A temporary wellpoint screened just above bedrock was installed in the borehole. However, after 5 days, no water accumulated. A step-out borehole (FTC-FTMS-1b) was advanced approximately 20 feet into bedrock to a depth of 75 feet; however, after 4 days no water accumulated (**Section 6.3.3**). Existing monitoring well 144-M02-E, located about 1 mile southeast of the AOPI, was sampled. While this well was not sampled for tracer dye itself, results of historical dye-trace studies conducted in the area show that this well is located between tracer introduction locations and Millstone Spring. As such, it is possible that the well may intercept groundwater flowing from the AOPI (**Figure 7-3**). However, since this well was not sampled for dye during the tracer study, it cannot be confirmed that the well is monitoring groundwater sourced from the AOPI. PFOS, PFOA, or PFBS were not detected in the sample collected from monitoring well 144-M02-E (**Table 7-1**).

7.2.1.2 Stormwater

Pooled water was present in a closed topographic depression (i.e., sinkhole) west-southwest of the AOPI (**Figure 7-3**) at the time of the Phase II sampling event. Stormwater drainage maps show that stormwater is routed to this feature. A stormwater sample was collected and PFOS, PFOA, and PFBS were detected in the sample at concentrations of 280 ng/L, 3.9 ng/L, and 7.4 ng/L (**Table 7-2**). Concentrations were compared to the OSD risk screening levels because the sinkhole represents a direct recharge point for groundwater. The PFOS concentration in surface water at this location exceeds the OSD risk screening level (**Table 7-2**).

7.2.1.3 Soil

Three soil samples were collected at this AOPI (**Figure 7-3**). PFOS was detected in two of the three soil samples collected, ranging from 0.0020 mg/kg (FTC-FTMS-1-SO near the building where the AFFF release was reported) to 0.0097 mg/kg (FTC-FTMS-3-SO, which was collected near the stormwater drainage basin to which runoff from the AOPI would drain). These detected concentrations of PFOS are less than the residential OSD risk screening level. Neither PFOA nor PFBS were detected in soil samples at the Former Fire Truck Maintenance Shop AOPI (**Table 7-3**).

7.2.2 Former Fire Station #1 Building 2575

The subsections below detail the soil sampling results for the Former Fire Station #1 Building 2575 AOPI. No groundwater samples were collected during the Phase II sampling event based on the OSD risk screening level exceedance observed in soil samples collected during the Phase I sampling event (i.e.,

sufficient data were obtained during the Phase I sampling event to make a recommendation for the AOPI). No surface water or stormwater samples were collected as no relevant features exist in the area to sample.

7.2.2.1 Soil

PFOS was detected in all three soil samples collected at this AOPI, with exceedances of the residential OSD risk screening level observed in two of the three samples. PFOS concentrations ranged from 0.039 mg/kg (FTC-FFS-2-SO) to 0.37 J mg/kg (FTC-FFS-3-SO) (**Figure 7-3**). PFOA was also detected in all three soil samples at the Former Fire Station #1 with concentrations ranging from 0.00082 mg/kg (FTC-FFS-1-SO) to 0.0089 mg/kg (FTC-FFS-3-SO); these PFOA concentrations are less than the OSD risk screening levels (**Table 7-3**). PFBS was not detected in soil samples from this AOPI.

7.2.3 AFFF Rinse-Out Building 6310

The subsections below detail the groundwater and soil sampling results for the AFFF Rinse-Out Building 6310 AOPI. No surface water or stormwater samples were collected as no relevant features exist in the area to sample.

7.2.3.1 Groundwater

Based on the expedited soil analytical results (discussed in **Section 7.2.3.2** below), a groundwater sample was collected from a temporary borehole advanced through the asphalt at the FTC-B6310-1-SO location (**Figure 7-3**). Groundwater was encountered at approximately 30 feet bgs. PFOS was detected in the groundwater sample at 220 ng/L, exceeding the OSD risk screening level. PFOA and PFBS were also detected in the sample (6.9 ng/L and 12 ng/L, respectively), less than the OSD risk screening level (**Table 7-1**).

7.2.3.2 Soil

Two soil samples were collected at this AOPI (**Figure 7-3**): one beneath the asphalt and within the area noted during personnel interviews that rinse water had pooled on the asphalt (FTC-B6310-1-SO), and one to the east of the rinse-out area where field personnel observed runoff would also pool during heavy rain (FTC-B6310-2-SO). Laboratory analysis was expedited to aid in the decision of whether it was necessary to obtain a groundwater sample at the location. PFOS was detected in both samples, with concentrations of 0.012 mg/kg (at FTC-B6310-2-SO) to 0.082 mg/kg (at FTC-B6310-1-SO), less than the OSD risk screening level. PFOA was also detected in the FTC-B6310-2-SO sample (0.00063 J mg/kg), less than the OSD risk screening level. PFBS was not detected in either sample (**Table 7-3**).

7.3 South Cantonment AOPIs

The subsections below summarize the groundwater, soil, and surface water PFOS, PFOA, and PFBS analytical results associated with the seven south cantonment AOPIs: the Legacy Fire Truck Repair Shop Building 5124, Old Clarksville Base FTA (SWMU 148), the Conex Containers 40 and 41 AFFF Storage area, Building 5121 AFFF Storage area, Fire Station #1 Building 1747, WWTP, and Training Area 03 Crash Site (**Figure 7-4**). These AOPIs are located outside of the installation's water supply wellhead

protection area. The current and future expected land use for the south cantonment AOPIs is industrial. Groundwater beneath or nearby some of the AOPIs has been demonstrated to discharge at Beaver Spring (i.e., near the Legacy Fire Truck Repair Shop Building 5124, Fire Station #1 Building 1747, Building 5121 AFFF Storage, and Conex Containers 40 and 41 AFFF Storage AOPIs) and Dennis Spring (i.e., near the Training Area 03 Crash Site), which both discharge to Little West Fork Creek downstream of the installation's on-post potable supply.

Of the seven south cantonment AOPIs, the greatest PFOS concentrations in soil were observed at Fire Station #1 Building 1747 during the SI; however, historical concentrations of PFOS at the Training Area 03 Crash Site were greater than those observed at Fire Station #1 Building 1747. PFOS concentrations in soil exceed the OSD risk screening levels at both AOPIs. PFOS and/or PFOA concentrations in groundwater (and/or spring water [Beaver Spring]) were observed in samples associated with four of the south cantonment area AOPIs: three AOPIs located in or near the PPOC (i.e., the Legacy Fire Truck Repair Shop Building 5124, Building 5121 AFFF Storage, and Fire Station #1 Building 1747) and the WWTP. The detected concentrations of PFOS, PFOA, and/or PFBS in groundwater and spring water collected in association with the PPOC AOPIs may be attributed to all three AOPIs, located upgradient of the groundwater sample and within the same spring basin (i.e., for Beaver Spring). Additionally, PFOS, PFOA, and PFBS were detected in Little West Fork Creek at locations downstream of all seven south cantonment area AOPIs.

7.3.1 Old Clarksville Base Fire Training Area (SWMU 148)

The subsections below detail the groundwater and surface water sampling results for the Old Clarksville Base FTA (SWMU148) AOPI. Soil sampling was prohibited at the Old Clarksville Base FTA due to no-dig restrictions in the area, which extend past the adjacent landfill, based on the GIS information provided by FTC.

7.3.1.1 Groundwater

Groundwater was sampled at three existing monitoring wells (008-MW-002, 008-M04-E, and 008-M03-E) at the Old Clarksville Base FTA (SWMU 148), downgradient of the area of potential AFFF use or release (**Figure 7-4**). PFOS was detected in groundwater at two of the three sampled wells at this AOPI; detected concentrations ranged from 1.8 ng/L (008-M04-E) to 8.7 ng/L (008-MW-002), less than the OSD risk screening level. PFOA was only detected in one of the three sampled wells (8.6 J ng/L at 008-MW-002), less than the OSD risk screening level. PFBS was detected in two of the three sampled wells; detected concentrations ranged from 0.91 J ng/L (008-M04-E) to 2.7 ng/L (008-M04-E), less than the OSD risk screening level (**Table 7-1**).

It is unknown if AFFF was used at the Old Clarksville Base FTA AOPI during historical fire training activities. Typically for sources associated with older AFFF, the dominant constituent observed is PFOS with a lesser contribution from PFOA. However, in groundwater at this AOPI, other PFAS constituents were detected at concentrations greater than those observed for either PFOS or PFOA (**Appendix M**). Based on the limited data collected from the three monitoring wells, detected concentrations of PFAS at this AOPI may be attributed to other PFAS-containing materials potentially disposed in the nearby Landfill #8 (the monitoring wells sampled at this AOPI are associated with the landfill [FCPB-33]).

7.3.1.2 Surface Water

A surface water sample was collected along Little West Fork Creek, downgradient of the Old Clarksville Base FTA and WWTP AOPIs (FTC-LWFC-2-SW). Detections of PFOS (15 ng/L), PFOA (2.7 ng/L) and PFBS (1.8 J ng/L) were observed in the sample (**Figure 7-4**). These concentrations were similar to those observed in the surface water samples collected upgradient (FTC-LWFC-1-SW, as discussed above in **Section 7.1.18**; **Figure 7-2a**) and further downgradient (FTC-LWFC-3-SW, as discussed below in **Section 7.3.8**; **Figure 7-4**) along the creek. The FTC-LWFC-2-SW surface water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.3.2 Legacy Fire Truck Repair Shop Building 5124

The subsections below detail the groundwater, surface water, and soil sampling results for the Legacy Fire Truck Repair Shop Building 5124 AOPI.

7.3.2.1 Groundwater

One grab groundwater sample (FTC-PPOC-1-OBGW) was collected via a temporary borehole completed at a location inferred to be downgradient of the AOPI; first encountered groundwater was at the overburden/bedrock interface at approximately 47 feet bgs. Note that the sampling location is also inferred to be downgradient of the Building 5121 AFFF Storage and Conex Containers 40 and 41 AOPIs (which are also located in the PPOC complex) and may also be downgradient of the Fire Station #1 Building 1747 AOPI (**Figure 7-4**). PFOS was detected in the groundwater sample at a concentration of 670 ng/L, greater than the OSD risk screening level. PFOA and PFBS were also detected in the sample (12 ng/L and 13 ng/L, respectively), less than the OSD risk screening levels (**Table 7-1**).

7.3.2.2 Surface Water

A surface water sample (i.e., at Beaver Spring) was collected in association with the Legacy Fire Truck Repair Shop Building 5124, the Building 5121 AFFF Storage Area, the Conex Containers 40 and 41 AFFF Storage Area, and the Fire Station #1 Building 1747 AOPIs in the mid-cantonment area. The spring location was selected for sampling based on results of historical dye tracer studies which indicated that groundwater from around the AOPIs discharges at the spring (**Figure 7-4**) and flows into Little West Fork Creek. The spring is an expression of groundwater, as each spring has a “groundwater basin” analogous to a surface water drainage basin, from which its water is derived. A sample collected from a spring, therefore, represents a composite sample of the groundwater contained within the spring’s basin. PFOS was detected in the Beaver Spring sample at a concentration of 130 ng/L, greater than the OSD risk screening level. Detections of PFOA (8.5 ng/L) and PFBS (8.4 ng/L) were also observed in the sample, at concentrations less than the OSD risk screening levels (**Table 7-2**). The data are compared to the OSD risk screening levels as the spring is an expression of groundwater.

7.3.2.3 Soil

Two soil samples were collected within the inferred area of AFFF use or release at the Legacy Fire Truck Repair Shop Building 5124 AOPI (**Figure 7-4**). Three soil samples were originally planned to be collected

at the Legacy Fire Truck Repair Shop Building 5124, but the third soil sample could not be collected during the SI field work (see **Section 6.3.3**). PFOS and PFOA were detected in both samples at concentrations less than the residential OSD risk screening levels. PFOS concentrations ranged from 0.012 mg/kg (FTC-LFTRS-3-SO) to 0.034 mg/kg (FTC-LFTRS-2-SO). PFOA concentrations ranged from 0.00057 J mg/kg (FTC-LFTRS-3-SO) to 0.0045 mg/kg (FTC-LFTRS-2-SO). PFBS was not detected in either sample (**Table 7-3**).

7.3.3 Conex Containers 40 and 41 AFFF Storage

The subsection below details the soil sampling results for the Conex Containers 40 and 41 AFFF Storage AOPI.

7.3.3.1 Soil

One soil sample was collected from the small runoff accumulation area east of the former AFFF storage area at the Conex Containers 40 and 41 AOPI. PFOS, PFOA, and PFBS were not detected in the sample.

Based on no detected PFOS, PFOA, or PFBS observed in soil (i.e., no evident source) this AOPI was not evaluated further for presence or absence of PFOS, PFOA, or PFBS in groundwater or surface water. This AOPI is not considered a potential contributing source to the exceedances of the OSD risk screening levels observed in groundwater sample FTC-PPOC-1-OBGW or the surface water sample (i.e., at Beaver Spring), both discussed in **Section 7.3.2**.

7.3.4 Building 5121 AFFF Storage

The subsections below detail the groundwater, surface water, and soil sampling results for the Building 5121 AFFF Storage AOPI.

7.3.4.1 Groundwater

One temporary borehole was completed at a location inferred to be downgradient of this AOPI and other AOPIs in the PPOC complex (**Figure 7-4**) for grab groundwater sample collection. The groundwater results for this sampling location are discussed in **Section 7.3.2.1**. Exceedances of the OSD risk screening levels were observed in the groundwater sample.

7.3.4.2 Surface Water

A surface water sample was collected at Beaver Spring in association with multiple AOPIs in the mid-cantonment area, including the Building 5121 AFFF Storage AOPI. The results for this sample (which exhibited an exceedance of the OSD risk screening level for PFOS) are discussed in **Section 7.3.2.2**.

7.3.4.3 Soil

Two soil samples were collected in association with the Building 5121 AFFF Storage Area: one adjacent to the loading ramp that leads into the storage building and one at a runoff accumulation area south of the building (**Figure 7-4**). PFOS was detected in both samples with concentrations ranging from 0.011 mg/kg

(FTC-B5121-2-SO) to 0.085 mg/kg (FTC-B5121-1-SO), less than the residential OSD risk screening levels. PFOA and PFBS were not detected in the samples (**Table 7-3**).

7.3.5 Fire Station #1 Building 1747

The subsections below detail the groundwater, surface water, and soil sampling results for the Fire Station #1 Building 1747 AOPI.

7.3.5.1 Groundwater

One grab groundwater sample was collected via a temporary borehole completed at a location inferred to be downgradient of this AOPI (**Figure 7-4**); first encountered groundwater was at the overburden/bedrock interface at approximately 67 feet bgs. PFOS, PFOA, and PFBS were detected at low concentrations (3.6 J ng/L, 4.5 J- ng/L, and 5.2 ng/L, respectively) less than the OSD risk screening levels (**Table 7-1**). Data limitations of this groundwater sample are discussed in **Section 9**. However, concentrations of PFOS, PFOA, and PFBS observed in the groundwater sampled downgradient of the AOPIs that are located within the PPOC complex (i.e., FTC-PPOC-1-OBGW; **Section 7.3.2**) may also be partially attributed to the Fire Station #1 Building 1747 AOPI (based on the concentrations observed in soil at the AOPI which exceed the OSD risk screening levels) and should be discerned during a future investigation.

7.3.5.2 Surface Water

A surface water sample was collected at Beaver Spring in association with multiple AOPIs in the mid-cantonment area, including the Fire Station #1 Building 1747 AOPI. The results for this sample (which exhibited an exceedance of the OSD risk screening level for PFOS) are discussed in **Section 7.3.2**.

7.3.5.3 Soil

Three soil samples were collected outside of the fire station adjacent to the driveway ramp along stormwater drainage features (**Figure 7-4**). PFOS was detected in all three samples; concentrations ranged from 0.0041 mg/kg (FTC-FS1-2-SO) to 0.30 J mg/kg (FTC-FS1-3-SO), the latter of which exceeded the residential OSD risk screening level. PFOA was detected in two of the three samples with concentrations ranging from 0.00096 J mg/kg (FTC-FS1-2-SO) to 0.0033 mg/kg (FTC-FS1-3-SO), less than the OSD risk screening level. PFBS was not detected in any of the three samples (**Table 7-3**).

7.3.6 Training Area 03 Crash Site

The subsections below detail the surface water and historical soil sampling results for the Training Area 03 Crash Site AOPI. Groundwater was not sampled at the AOPI based on the OSD risk screening level exceedances observed in soil samples collected by the Army in March 2019 (i.e., the data previously collected by the Army and reviewed for this PA/SI were deemed sufficient to make a recommendation for the AOPI).

7.3.6.1 Soil

As discussed in **Section 2.12**, soil samples collected by the Army from the Training Area 03 Crash Site AOPI in March 2019 exhibited detectable concentrations of PFOS and PFOA; the samples were not analyzed for PFBS. PFOS concentrations observed in soil at this AOPI exceeded the residential OSD risk screening level at the five soil sampling locations collected within the AFFF use area. PFOS concentrations in two of these samples also exceeded the industrial/commercial OSD risk screening level; the maximum PFOS concentration observed was 2.150 mg/kg (or 2,150 µg/kg, as shown in **Table 2-2**).

7.3.6.2 Surface Water

A surface water sample was collected at Dennis Spring in association with this AOPI. The spring location was selected for sampling based on results of historical dye tracer studies which indicated that groundwater from near the AOPI discharges at the spring (**Figure 7-4**) and flows into Little West Fork Creek. PFOS was detected at 1.2 J ng/L at FTC-DENNISSP-SW, less than the OSD risk screening level. PFOA and PFBS were not detected in the sample (**Table 7-2**). The data are compared to the OSD risk screening levels as Dennis Spring is an expression of groundwater.

7.3.7 Wastewater Treatment Plant

The subsections below detail the groundwater, surface water, and soil sampling results for the WWTP AOPI.

7.3.7.1 Groundwater

One grab groundwater sample (FTC-WWTP-1-OBGW) was collected via a temporary borehole completed at a location inferred to be downgradient of the AOPI (**Figure 7-4**); first encountered groundwater was in the overburden at this location at approximately 5 feet bgs. PFOS and PFOA were detected at concentrations of 410 ng/L and 330 ng/L, respectively, both exceeding the OSD risk screening levels. PFBS was also detected in the sample (54 ng/L), less than the OSD risk screening level (**Table 7-1**).

7.3.7.2 Surface Water

A surface water sample (FTC-LWFC-2-SW) was collected along Little West Fork Creek, downgradient of the Old Clarksville Base FTA and WWTP AOPIs (and downgradient of the WWTP outfall). The results for this sample are discussed in **Section 7.3.1**. While PFOS, PFOA, and PFBS were detected in the sample, the surface water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels.

7.3.7.3 Soil

Two soil samples were collected at the AOPI within the area of AFFF release (i.e., after the WWTP received AFFF-containing waste from hangars). PFOS and PFOA were detected both samples at concentrations less than the residential OSD risk screening levels. PFOS concentrations ranged from 0.0086 mg/kg to 0.100 mg/kg. PFOA concentrations ranged from 0.0014 mg/kg to 0.00077 J mg/kg. PFBS was not detected in either soil sample (**Figure 7-4**, **Table 7-3**).

7.3.8 General Surface Water Evaluation for South Cantonment AOPIs

A stream surface water sample (FTC-LWFC-3-SW) was collected along Little West Fork Creek in the south cantonment area downstream of all FTC AOPIs, before the creek flows off post (**Figure 7-4**). The FTC-LWFC-3 surface water sampling location is also downstream of groundwater discharge points (i.e., springs that discharge water from areas at or near AOPIs). This sampling location was located near the installation boundary before Little West Fork Creek flows off post.

PFOS, PFOA, and PFBS were detected in the sample (17 ng/L, 2.3 ng/L, and 1.8 J ng/L, respectively) (**Table 7-2**). This surface water sample does not meet the criteria described in **Section 6.5**; therefore, the analytical data were not compared to OSD risk screening levels. PFOS, PFOA, and PFBS concentrations in Little West Fork Creek on-post appear to remain consistent from upstream near Boiling Spring (FTC-LWFC-1-SW; **Figure 7-2a** and as discussed in **Section 7.1.18**) down to where the creek flows off post (FTC-LWFC-3-SW; **Figure 7-4** and as discussed in **Section 7.3.1**).

7.4 Sabre Heliport AOPIs

The subsections below summarize the groundwater, soil, and surface water PFOS, PFOA, and PFBS analytical results associated with the two south cantonment AOPIs: Sabre Heliport Hangar 6627 and Fire Station #2 Building 6634 and Wash Rack.

The maximum PFOS, PFOA, and PFBS concentrations in soil at the Sabre Heliport AOPIs were observed at the Fire Station #2 Building 6634 and Wash Rack, including one exceedance of the OSD risk screening level for PFOS. Groundwater sampled in association with both AOPIs (i.e., at an inferred downgradient location from both AOPIs) did not exhibit exceedances of the OSD risk screening levels. The current and expected future land use of the AOPIs in the Sabre Heliport area is industrial.

7.4.1 Sabre Heliport Hangar 6627

The subsections below detail the groundwater, surface water, and soil sampling results for the Sabre Heliport Hangar 6627 AOPI.

7.4.1.1 Groundwater

One grab groundwater sample (FTC-SHH-1-OBGW) was collected via a temporary borehole completed at a location inferred to be downgradient of the AOPI (**Figure 7-5**); the sample location is also inferred to be located downgradient of the Fire Station #2 Building 6634 and Wash Rack AOPI. Groundwater was encountered at the overburden/bedrock interface at approximately 47 feet bgs. PFOS, PFOA, and PFBS were not detected in the sample (**Table 7-1**).

In addition, a groundwater sample was collected from the existing groundwater monitoring well (147-M05-S) that is inferred to be upgradient of this AOPI and the Fire Station #2 AOPI. PFOS, PFOA, and PFBS were detected in the sample at concentrations of 11 ng/L, 5.0 ng/L, and 3.6 ng/L, respectively (**Figure 7-5**, **Table 7-2**); these detected concentrations are less than the OSD risk screening levels. The source of PFOS, PFOA, and PFBS detected in the groundwater sample at this location is unknown.

7.4.1.2 Surface Water

One surface sample was collected at a seep (SP-126L; **Figure 7-5**) inferred to be downgradient of the AOPI according to historical dye tracer studies. High river stage conditions at Racoon Branch limited the ability to discern clearly where the seep was flowing into the creek, but the sampling location was characterized as a small seep rather than a spring. The sample was collected along the bank of Racoon Branch where a small amount of water appeared to be coming out of a rock outcrop on the bank barely above the elevation of the creek. PFOS, PFOA, and PFBS were detected in the sample at concentrations of 11 ng/L, 2.0 J ng/L, and 5.1 ng/L, respectively (similar concentrations to those observed in the 147-M05-S well). These detected concentrations are less than the OSD risk screening levels (**Table 7-2**). The data were compared to the OSD risk screening levels as the seep is an expression of groundwater.

7.4.1.3 Soil

Three soil samples were collected at the Sabre Heliport Hangar 6627 AOPI (**Figure 7-5**). PFOS was detected in all three soil samples collected at this AOPI with concentrations ranging from 0.00049 J mg/kg (FTC-SHH-3-SO) to 0.0066 mg/kg (FTC-SHH-2-SO, which was from the sample collected near the fence line where AFFF was reportedly historically sprayed to kill weeds). PFOA was detected in two of the three soil samples collected here, including 0.00092 mg/kg (FTC-SHH-3-SO) and 0.0074 mg/kg (FTC-SHH-2-SO). PFOS and PFOA concentrations detected in soil at the Sabre Heliport Hangar 6627 were less than the residential OSD risk screening levels. PFBS was not detected in any of the three soil samples collected at this AOPI (**Table 7-3**).

7.4.2 Fire Station #2 Building 6634 and Wash Rack

The subsections below detail the groundwater, surface water, and soil sampling results for the Fire Station #2 Building 6634 and Wash Rack AOPI.

7.4.2.1 Groundwater

The groundwater sample collected in association with the Sabre Heliport Hangar 6627 (as discussed in **Section 7.4.1.1**) was also inferred to be located downgradient of the Fire Station #2 and Wash Rack AOPI. However, PFOS, PFOA, and PFBS were not detected in that sample. Data limitations of this groundwater sample are discussed in **Section 9**.

7.4.2.2 Surface Water

The seep surface water sample collected in association with the Sabre Heliport Hangar 6627 (as discussed in **Section 7.4.1.2**) was also downgradient of the Fire Station #2 and Wash Rack AOPI. Impacts observed in the groundwater and surface water downgradient of the two AOPIs may be attributed to either or both AOPIs, based on PFOS, PFOA, and/or PFBS detections in soil at both AOPIs. The individual AOPIs contribution to impacts in groundwater and surface water downgradient of the AOPIs should be discerned during a future study.

7.4.2.3 Soil

Three soil samples were collected at this AOPI (**Figure 7-5**). PFOS was detected in all three soil samples; concentrations ranged from 0.0037 mg/kg (FTC-FS2-3-SO) to 0.48 J mg/kg (FTC-FS2-2-SO), the latter of which exceeds the OSD risk screening level. PFOA and PFBS were also detected in one of the three samples (i.e., at FTC-FS2-2-SO) with concentrations of 0.0023 mg/kg and 0.00077 J mg/kg, respectively, less than the OSD risk screening levels (**Table 7-2**).

7.5 Training Area 26

The subsections below summarize the groundwater, soil, and stormwater PFOS, PFOA, and PFBS analytical results for the Bradley Tank Fire AOPI in Training Area 26.

7.5.1 Bradley Tank Fire

Soil, groundwater, and stormwater samples were collected during the Phase I sampling at the Bradley Tank Fire AOPI as detailed below; the sampling locations are shown on **Figure 7-6**.

7.5.1.1 Groundwater

The soil samples collected at this AOPI were submitted for an expedited laboratory analysis to determine the location of the grab groundwater sample (FTC-BTF-1-OBGW) collected via a temporary well installed by sonic drilling methods. Groundwater was encountered at the overburden/bedrock interface at approximately 24 feet bgs. PFOS was detected in the sample (13 J+ ng/L [17 J+ ng/L in the field duplicate]) at concentrations less than the OSD risk screening levels. PFOA and PFBS were not detected in the sample (**Table 7-1**).

7.5.1.2 Soil

Four shallow soil samples were collected from the area where AFFF runoff would have flowed along Angels Road following the vehicle fire response. Additionally, one shallow soil sample was collected from the small gravel parking area where the Bradley Tank was temporarily parked, southwest of the intersections of Angels Road and Grant Road after the vehicle fire was extinguished with AFFF. PFOS was detected in three of the five samples with concentrations ranging from 0.00066 J mg/kg (FTC-BTF-2-SO) to 0.0032 mg/kg (FTC-BTF-4-SO), all less than the residential OSD risk screening level. PFOA and PFBS were not detected in any of the five samples (**Table 7-3**).

7.5.1.3 Stormwater

Stormwater was present in the lowland drainage northwest of the tank fire area at the time of the January 2022 sampling event, therefore one stormwater runoff sample was collected from where AFFF runoff would have flowed following the fire response. PFOS, PFOA, and PFBS were not detected in the sample (**Table 7-2**).

7.6 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 907 mg/kg (at the Sabre Heliport Hangar Building 6627, FTC-SHH-1-SO) to 52,500 mg/kg (at the Conex Containers 40 and 41 AFFF Storage AOPI, FTC-CONEX-1-SO). The TOC at this installation was generally within range of what is typically observed in topsoil (i.e., 5,000 mg/kg to 30,000 mg/kg). The combined percentage of fines (i.e., silt and clay) in soils at FTC ranged from 16.5% to 97.9% with an average of 62.4%. In general, thick stiff clays were observed underlying topsoil at the temporary boreholes completed across the installation during the Phase I and Phase II sampling events. PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent moisture of the soil (average of 18.4%) was typical for clay (0 to 20%). The average pH of the soil (7.6 standard units) was neutral (approximately 7 standard units) to slightly alkaline (approximately 7 to 9 standard units).

Transport of PFAS constituents through the residuum in karst terranes has not been systematically studied; however, the movement of water through residuum has. While the fine-grained nature of the residuum might suggest that the rate of movement of groundwater through it would be slow, potentially enhancing sorption of PFAS constituents, studies have shown that flow of water through karst residuum is several orders of magnitude faster than would be expected. This is attributed to macropores (e.g., root channels, cracks or fissures, texture transitions) (Quinlan and Aley 1987).

7.7 Blank Samples

Detections of PFOS, PFOA, and PFBS constituents are summarized below for QA/QC samples. Most detected concentrations were low-level. Other than those noted below, concentrations of PFOS, PFOA, and/or PFBS in all other QA/QC samples were not detected.

EBs were collected on the following pieces of non-dedicated equipment which were utilized during the SI: drill tooling, bladder pumps, water level meters, HDPE and silicon tubing, hand auger buckets, and PFAS-free bailers. PFOS, PFOA, and PFBS were not detected in any EBs collected. PFOS was detected in one EB collected off a water level meter during the January 2022 drilling event (19 ng/L); the results were used to qualify the associated groundwater sample (FTC-BTF-1-GW). PFOS, PFOA, and PFBS were not detected in any of the other EBs or FBs collected during the SI sampling events. The FBs were collected using laboratory-supplied deionized water.

PFOS, PFOA, and PFBS were detected in the Phase I (December 2019) source blank, collected from water used during the initial decontamination step (as sourced from the standpipe on Market Garden Road), which included PFOS (17 ng/L), PFOA (3.3 ng/L), and PFBS (2.3 ng/L). This source blank water comes from the installation's potable water supply. The source blank was not used to qualify any data since this water was only used during the initial decontamination step, and subsequent blank samples (i.e., the EBs) served to evaluate potential PFOS, PFOA, and PFBS cross-contamination on the final decontaminated equipment and in the laboratory-supplied deionized, PFAS-free water used in the final decontamination step (i.e., the FBs). PFOS, PFOA, and PFBS were also detected at similar concentrations in the Phase II (March/April 2021) source blank (39 ng/L, 2.6 J ng/L, and 1.9 J ng/L, respectively), collected from the driller's water tote. The water was sourced from the same standpipe on

Market Garden Road and was used during the decontamination of drill tooling using a steam/pressure washer. The drill tooling traveled 5 to 65 feet in soil before encountering groundwater. EB sample FTC-EB-2-032321 was collected on the drill tooling after decontamination. Since these compounds were not detected in the EB, there is no effect on the data.

The full analytical results for blank samples collected during the SI are included in **Appendix N**.

7.8 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2019b) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-7** through **7-14** and in this section therefore represent the current understanding of the potential for human exposure to PFOS, PFOA, and PFBS. For some AOPIs, the CSM is the same and thus shown on the same figure.

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, and/or 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 consist of dissolution/desorption from soil to groundwater; transport via sediment carried in and dissolution to stormwater, surface water, and groundwater, discharge/recharge between groundwater and surface water; and adsorption/desorption between surface water and sediment and groundwater 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, hunters, or fishers 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 and were combined where source media, potential migration pathways and exposure media, and human exposure pathway determinations are congruent. The following exposure pathway determinations apply to all CSMs:

- There are no residences in the vicinity of the AOPIs, and the AOPIs are not likely to be accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathway for these receptors is incomplete for all AOPIs.
- PFOS, PFOA, and/or PFBS were detected in groundwater downgradient of all AOPIs where groundwater samples (or spring surface water samples, i.e., discharged groundwater) were collected. The groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater at all AOPIs except the Conex Containers 40 and 41 AFFF Storage AOPI, where PFOS, PFOA, and PFBS were not detected in soil (i.e., no evident source). Additionally, the 17 CAAF AOPIs, the AFFF Rinse-Out Building 6310, Former Fire Truck Maintenance Shop Building 5737, and Bradley Tank Fire AOPIs are within the wellhead protection area for the installation's potable water supply, and PFOS, PFOA, and/or PFBS are present in groundwater and/or soil (i.e., where sampled) at these 20 AOPIs. The groundwater exposure pathways are therefore potentially complete.
- Groundwater originating at the AOPIs flows off post and could be used as a source of drinking water. Therefore, the groundwater exposure pathway for off-installation receptors is potentially complete for all AOPIs except the Conex Container 40 and 41 AFFF Storage AOPI where PFOS, PFOA, and PFBS were not detected in soil (i.e., no evident source).
- Recreational users are not likely to contact groundwater. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.[1]
- Surface water bodies on post are not used for drinking water. On-installation residents are not likely to otherwise contact surface water and sediment in the on-post surface water bodies; therefore, these exposure pathways are incomplete.

Figure 7-7 shows the CSM for the following 18 AOPIs: Current Fire Training Area Building 7237; CAAF Fire Training Area and Retention Pond; Fire Station #3 Building 7160; Destiny Heliport Washrack Buildings 7243 and 7251; Fire Station #4 Building 7241; CAAF Hangars 7262, 7264, 7268, 7272, and 7273; Fire Station #5 Building 5099; Former Fire Station #1 Building 2575; Building 5121 AFFF Storage; Legacy Fire Truck Repair Shop Building 5124; Fire Station #1 Building 1747; Fire Station #2 Building 6634 and Wash Rack; and Sabre Heliport Hangar 6627. AFFF was historically released to soil and paved surfaces during fire training exercises, nozzle testing, crash truck tank flushing, AFFF storage, and accidental releases from hangars.

- Soil was sampled at all of these AOPIs, and PFOS, PFOA, and/or PFBS was detected in soil at all of these AOPIs. Site workers (i.e., installation personnel) could contact constituents in soil via incidental

[1] While springs are points where groundwater (and any sediment transported with it) discharges at the surface, spring water and associated sediment are considered to be surface water for the purposes of assessing potential human exposure risks.

ingestion, dermal contact, and inhalation of dust; therefore, the soil exposure pathway for on-installation site workers is complete.

- Runoff from CAAF AOPIs drains to Dry Fork Creek, which flows into Little West Fork Creek and eventually off post to the Red River. PFOS, PFOA, and PFBS were detected downgradient of the AOPIs in Dry Fork Creek and Little West Fork Creek, which may be accessed by on-installation site workers or recreational users. Impacts observed in the surface water bodies may be from multiple AOPIs. Additionally, based on observations from historical dye tracer studies, groundwater from beneath the listed CAAF AOPIs discharges at springs which flow to Little West Fork Creek. Site workers and recreational users could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water exposure pathways for on-installation site workers and recreational users are complete and the sediment exposure pathways for on-installation site workers and recreational users are potentially complete.
- Off-post receptors could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-post receptors are potentially complete.
    - For the listed CAAF AOPIs (i.e., Current Fire Training Area Building 7237; CAAF Fire Training Area and Retention Pond; Fire Station #3 Building 7160; Destiny Heliport Washrack Buildings 7243 and 7251; Fire Station #4 Building 7241; CAAF Hangars 7262, 7264, 7268, 7272, and 7273; and Fire Station #5 Building 5099), surface water flow enters Dry Fork Creek but must travel a distance greater than 5 miles downstream to reach the Red River. However, historical dye tracer studies have indicated that groundwater beneath the listed CAAF AOPIs may discharge at Quarles Spring on Dry Fork Creek off post. PFOS, PFOA, and PFBS were detected in the surface water sample collected at Quarles Spring. Quarles Spring has historically been used as a drinking water source but is reportedly used currently only for irrigation.
    - For the listed mid-cantonment AOPI (i.e., the Former Fire Station #1 Building 2575), historical dye tracer studies have indicated that groundwater beneath the AOPI may flow off post to Millstone Spring.
    - For the listed south cantonment AOPIs (i.e., Building 5121 AFFF Storage; Legacy Fire Truck Repair Shop Building 5124; and Fire Station #1 Building 1747), surface water flows to Little West Fork Creek, which flows a distance less than 5 miles before flowing off post.
    - For the Sabre Heliport AOPIs (i.e., Fire Station #2 Building 6634 and Wash Rack; and Sabre Heliport Hangar 6627), surface water flows to streams (and springs that flow to streams) that flow less than 5 miles before flowing off post.

Figure 7-8 shows the CSM for the CAAF Hangar 7274 and Old Clarksville Base FTA (SWMU 148) AOPIs. AFFF was historically released to soil and paved surfaces during accidental releases from the hangar and potentially during fire training exercises.

- Soil was not sampled at these two AOPIs (concrete structures inhibited sampling around the hangar, and no-dig restrictions inhibited sampling at the FTA). However, PFOS, PFOA, and/or PFBS were detected in groundwater samples collected in association with these AOPIs, indicating a potential source. Site workers (i.e., installation personnel) 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 potentially complete.

- Runoff from CAAF AOPI drains to Dry Fork Creek, which flows into Little West Fork Creek and eventually off post to the Red River. Runoff from the Old Clarksville Base FTA (SWMU 148) flows to Little West Fork Creek. PFOS, PFOA, and PFBS were detected downgradient of the AOPIs in Dry Fork Creek and Little West Fork Creek, which may be accessed by site workers or recreational users. Impacts observed in the surface water bodies may be from multiple AOPIs. Additionally, based on observations from historical dye tracer studies, groundwater from beneath the hangar discharges at springs that flow to Little West Fork Creek. Site workers and recreational users could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water exposure pathways for on-installation site workers and recreational users are complete and the sediment exposure pathways for on-installation site workers and recreational users are potentially complete.
- Off-post receptors could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-post receptors are potentially complete.
    - For the CAAF Hangar 7274 AOPI, surface water flow enters Dry Fork Creek which flows off post before flowing back on post. Also, historical dye tracer studies have indicated that groundwater beneath the AOPI may discharge at Quarles Spring. PFOS, PFOA, and PFBS were detected in the surface water sample collected at Quarles Spring. Quarles Spring has historically been used as a drinking water source but is reportedly used only for irrigation currently.
    - Runoff from the Old Clarksville Base FTA (SWMU 148) flows to Little West Fork Creek, which flows less than 5 miles before flowing off post.

Figure 7-9 shows the CSM for the CAAF Clamshell; Old Fire Training Area (SWMU 12/15); and CAAF Hangar 7166 AOPIs. AFFF was historically released to soil and paved surfaces during accidental releases from the hangar, during fire training exercises, or during nozzle testing or crash tank truck flushing.

- Soil was not sampled at these three AOPIs (concrete structures inhibited sampling around the hangar and clamshell, and the ground has been significantly reworked at the FTA). However, PFOS, PFOA, and/or PFBS were detected in groundwater samples collected in association with these AOPIs, indicating a potential source. Site workers (i.e., installation personnel) 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 potentially complete.
- Runoff from these CAAF AOPIs drains to Dry Fork Creek, which flows into Little West Fork Creek and eventually off post to the Red River. PFOS, PFOA, and PFBS were detected in surface water downgradient of the AOPIs in Little West Fork Creek, which may be accessed by site workers or recreational users. Impacts observed in the surface water bodies may be from multiple AOPIs. Additionally, based on observations from historical dye tracer studies, groundwater from beneath the AOPIs discharges at on-post springs which flow to Little West Fork Creek. Site workers and recreational users could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water exposure pathways for on-installation site workers

and recreational users are complete and the sediment exposure pathways for on-installation site workers and recreational users are potentially complete.

- On-post springs discharge groundwater from beneath the AOPIs and flow to Little West Fork Creek. The creek flows greater than 5 miles before flowing off post. Therefore, the surface water and sediment exposure pathways for off-installation receptors are incomplete.

Figure 7-10 shows the CSM for the CAAF Former Fire Training Area; AFFF Rinse-Out Building 6310; Training Area 03 Crash Site AOPIs. AFFF was historically released to soil and paved surfaces during fire training exercises, crash tank truck flushing, and fire response, respectively.

- Soil was sampled at all of these AOPIs, and PFOS, PFOA, and/or PFBS was detected in soil at all of these AOPIs. Site workers (i.e., installation personnel) 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.
- Runoff from these AOPIs drains to on-post surface water features, and/or groundwater from beneath these AOPIs discharges at spring features (according to historical dye tracer studies) that flow to Dry Fork Creek or Little West Fork Creek and eventually off post. PFOS, PFOA, and PFBS were detected downgradient of the AOPIs in Little West Fork Creek, which may be accessed by site workers or recreational users. Impacts observed in the surface water bodies may be from multiple AOPIs. Site workers and recreational users could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water exposure pathways for on-installation site workers and recreational users are complete and the sediment exposure pathways for on-installation site workers and recreational users are potentially complete.
- On-post springs discharge groundwater from beneath the AOPIs and flow to Little West Fork Creek. The creek flows greater than 5 miles before flowing off post. Therefore, the surface water and sediment exposure pathways for off-installation receptors are incomplete.

Figure 7-11 shows the CSM for the WWTP AOPI. AFFF-containing wastewater was historically received at the WWTP from accidental releases at the CAAF hangars, and foam was seen overtopping the WWTP infrastructure and floating down to Little West Fork Creek. The outfall for the treated wastewater from this facility is located along Little West Fork Creek.

- PFOS, PFOA, and/or PFBS was detected in soil at this AOPI. Site workers (i.e., installation personnel) could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust; therefore, the soil exposure pathways for on-installation site workers are complete.
- Runoff from this AOPI (and effluent from the WWTP) flows to Little West Fork Creek; PFOS, PFOA, and PFBS were detected downgradient of the AOPI in Little West Fork Creek, which may be accessed by site workers or recreational users. Impacts observed in the Little West Fork Creek may be from multiple upgradient AOPIs. Site workers and recreational users could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water exposure pathways for on-installation site workers and recreational users are complete and the sediment exposure pathways for on-installation site workers and recreational users are potentially complete.

- Runoff from the WWTP flows to Little West Fork Creek, which flows less than 5 miles before flowing off post. Off-post receptors could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-post receptors are potentially complete.

Figure 7-12 shows the CSM for the Former Fire Truck Maintenance Shop Building 5737. At the Former Fire Truck Maintenance Shop Building 5737, AFFF was accidentally released from a crash truck and flowed down stormwater drains which are directed to a sinkhole, which ponds water before recharging groundwater.

- PFOS, PFOA, and/or PFBS was detected in soil at this AOPI. Site workers (i.e., installation personnel) 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.
- Runoff from this AOPI is directed to a stormwater drains which lead to a sinkhole, and PFOS, PFOA, and PFBS were detected in a surface water sample from the sinkhole. Site workers could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water exposure pathways for on-installation site workers are complete and the sediment exposure pathways for on-installation site workers are potentially complete.
- Recreational users are not likely to access the sinkhole feature. Therefore, the surface water and sediment exposure pathways for on-installation recreational users are incomplete.
- Historical dye tracer studies have indicated that groundwater beneath the AOPI may flow off post to Millstone Spring. Off-post receptors could contact constituents in surface water and sediment via incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-post receptors are potentially complete.

Figure 7-13 shows the CSM for the Conex Containers 40 and 41 AFFF Storage area. The timeline and volume of AFFF storage at this location is not known. However, no spills or leaks were reported, and PFOS, PFOA, and PFBS were not detected in the soil sample associated with this AOPI. Therefore, the exposure pathways for this AOPI are incomplete for on- and off-post receptors.

Figure 7-14 shows the CSM for the Bradley Tank Fire AOPI, where AFFF was used to extinguish a fire in February 2021.

- PFOS was detected in soil at this AOPI. Site workers (i.e., installation personnel) 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.
- Runoff from this AOPI flows toward an on-post intermittent surface water feature, and/or groundwater from beneath the AOPI may discharge to surface water bodies that eventually flow off post. PFOS, PFOA, and PFBS were not detected in a stormwater sample that was collected downgradient of the AOPI. Therefore, the surface water and sediment exposure pathways are considered incomplete.

Following the SI sampling, 29 out of the 30 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 6-2**).

8 OFF-POST PRIVATE POTABLE WELL INVESTIGATION

Based on SI sampling results, off-post private potable wells were identified for potential sampling as part of the PA/SI investigation at FTC to determine whether there are off-post impacts to drinking water due to Army operations. These wells are downgradient of groundwater wells at CAAF (i.e., west of CAAF) and other cantonment area AOPIs (i.e., east of the installation) where PFOS and/or PFOA concentrations were detected at concentrations greater than the USEPA LHA. To identify potential potable wells that were downgradient of the installation boundaries to include in this sampling effort, an off--post well survey was completed using readily available information from the online database provided by the Kentucky Geological Survey and Tennessee Geological Survey. County records were also be reviewed to identify wells that may not be included in the Kentucky and Tennessee state databases, and relevant parcels were reviewed to compile a list of property owners. Available groundwater regional studies were reviewed to help identify off-post potable wells that may be downgradient of AOPIs. Attention was focused on historical dye tracer studies (including those reviewed for this study; **Appendix F**) rather than reports that rely on numerical simulations of groundwater flow because the latter are inappropriate for characterizing movement of groundwater in karst aquifers at the local scale.

After reviewing the available information, select off-post private potable wells were identified for possible sampling as part of this investigation based on the understanding of the relationship between on- and off-post hydrogeological conditions. If such wells are recommended for future sampling, community outreach and notification will be coordinated between the Army PA/SI team, FTC, Headquarters of the Department of the Army, and USAEC Divisions. If off-post private potable well sampling occurs, a letter report presenting a summary of the off-post private well investigation results and the associated laboratory reports will be included in a subsequent addendum.

9 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA/SI included two distinct efforts. The PA identified AOPIs at FTC based on the use, storage, and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (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.

The 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, or PFBS use, storage, and/or disposal at FTC. Following the evaluation, 30 AOPIs were identified.

Drinking water at FTC is supplied through a privatized entity (Jacobs Engineering Group, which began operating the system in 2003). Potable water supplied to the cantonment area is drawn from a spring, which has a pumphouse over the spring. SI sampling results for the spring are noted below.

All 30 AOPIs were sampled as part of the SI at FTC to identify presence or absence of PFOS, PFOA, or PFBS at each AOPI. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019a), the FTC QAPP Addendum (Arcadis 2019b), and the FCRs included in **Appendix L**.

PFOS, PFOA, and/or PFBS were detected in samples collected from 29 of the 30 AOPIs at FTC (i.e., excluding the Conex Containers 40 and 41 AFFF Storage AOPI). Exceedances of the OSD risk screening levels were observed in soil, groundwater, and/or surface water at 26 of the 30 AOPIs. The data are summarized below by media type.

Groundwater and spring surface water: For the purposes of this evaluation, the OSD risk screening levels used to compare groundwater and select surface water data are 40 ng/L for PFOS and PFOA and 600 ng/L for PFBS. The surface water data were only compared to the OSD risk screening levels if the feature sampled was an expression of groundwater (i.e., springs and a sinkhole). PFOS, PFOA, and/or PFBS were detected in 26 of the 29 primary groundwater samples collected, and exceedances of the OSD risk screening levels were observed in 16 of the samples (collected in association with 21 AOPIs, as some groundwater sampling locations evaluated multiple AOPIs). The maximum PFOS, PFOA, and PFBS concentrations observed in groundwater include 5,700 J ng/L PFOS (at monitoring well CAAF-9), 2,200 ng/L PFOA (at monitoring well CAAF-51), and 460 J ng/L PFBS (at monitoring well CAAF-51) downgradient of CAAF Hangar 7166. Additionally, five springs were sampled as they are expressions of groundwater, and one sinkhole was sampled as it is a recharge point to groundwater. PFOS, PFOA, and/or PFBS was present in all six of these surface water features, with exceedances of the PFOS OSD risk screening level observed at Quarles Spring (an off-post spring; 180 ng/L PFOS), Beaver Spring (130 ng/L PFOS), and at the sinkhole sampled near the Former Fire Truck Maintenance Shop Building 5737 (280 ng/L PFOS). PFOS, PFOA, and PFBS concentrations were less than the OSD risk screening levels at the other springs sampled (i.e., Boiling Spring, Dennis Spring, and SP126L).

Shallow Soil (0 to 2 feet): For the purposes of this evaluation, the OSD risk screening levels used to compare soil data are: 0.13 mg/kg for PFOS and PFOA and 1.9 mg/kg for PFBS (residential receptor

scenario). For the industrial/commercial receptor scenario, the OSD risk screening levels are: 1.6 mg/kg for PFOS and PFOA and 25 mg/kg for PFBS. PFOS, PFOA, and/or PFBS were detected in 55 of the 61 primary soil samples collected, and exceedances of the PFOS residential OSD risk screening level were observed in eight of the samples (associated with six AOPIs). The maximum PFOS, PFOA, and PFBS concentrations observed include 0.48 J mg/kg PFOS (at FTC-FS2-2 at Fire Station #2 Building 6634), 0.0089 mg/kg PFOA (at FTC-FFS-3 at the Former Fire Station #1 Building 2575), and 0.0013 mg/kg PFBS (at FTC-H7262-2 at CAAF Hangar 7262).

Following the SI sampling, 29 out of the 30 AOPIs with confirmed PFOS, PFOA, and/or PFBS presence were considered to have complete or potentially complete exposure pathways.

Complete Pathways:

- Soil exposure pathways for on-installation site workers for 29 of the 30 AOPIs (i.e., excluding the Conex Containers 40 and 41 AFFF Storage AOPI).

Potentially Complete Pathways:

- Groundwater exposure pathways for on-installation site workers and residents for 29 of the 30 AOPIs (i.e., excluding the Conex Containers 40 and 41 AFFF Storage AOPI).
- Groundwater exposure pathways for off-installation receptors for 29 of the 30 AOPIs (i.e., excluding the Conex Containers 40 and 41 AFFF Storage AOPI), due to a lack of land use controls off-installation and downgradient of FTC.
- Surface water and sediment exposure pathways for on-installation site workers for 28 of the 30 AOPIs (i.e., excluding the Conex Containers 40 and 41 AFFF Storage and Bradley Tank Fire AOPIs).
- Surface water and sediment exposure pathways for on-installation recreational users for 27 of the 30 AOPIs (i.e., excluding the Conex Containers 40 and 41 AFFF Storage, Former Fire Truck Maintenance Shop Building 5737, and Bradley Tank Fire AOPIs).
- Surface water and sediment exposure pathways for off-installation receptors for 22 of the 30 AOPIs.
- Twenty AOPIs are within the wellhead protection area for FTC's drinking water source and could potentially impact groundwater used to provide drinking water at FTC; therefore, the groundwater exposure pathways for on-post site workers and residents are potentially complete. Additionally, based on the detections of PFOS, PFOA, and/or PFBS in groundwater samples collected in association with a total of 25 AOPIs (i.e., including those within the wellhead protection area), the groundwater exposure pathway is potentially complete to account for the future potential uses of groundwater downgradient of any of the AOPIs for drinking water.

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 6-2**). **Table 9-1** below summarizes the AOPIs identified at FTC, PFOS, PFOA, and PFBS sampling and recommendations for each AOPI; further investigation is warranted at FTC. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

Table 9-1. Summary of AOPIs Identified during the Preliminary Assessment, PFOS, PFOA, and PFBS Sampling at FTC, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)			Recommendation
	GW	SO	SW/SP	
Current FTA Building 7237	Yes	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
Destiny Heliport Wash Rack Building 7243	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
Destiny Heliport Wash Rack Building 7251	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
Fire Station #4 Building 7241	Yes[1]	Yes	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7272	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7273	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7274	Yes[1]	NS	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7262	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7264	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7268	Yes[1]	No	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF FTA and Retention Pond	NS	Yes	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Hangar 7166	Yes[1]	NS	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Clamshell	Yes	NS	NA (Dry Fork Creek)	Future study in a remedial investigation
Fire Station #3 Building 7160	Yes[1]	Yes	Yes[1] (Quarles Spring)	Future study in a remedial investigation
CAAF Former FTA	Yes	No	NA (Dry Fork Creek)	Future study in a remedial investigation
Old FTAs, solid waste management units (SWMUs) 12/15	Yes	NS	NA (Dry Fork Creek)	Future study in a remedial investigation

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)			Recommendation
	GW	SO	SW/SP	
Fire Station #5 Building 4099	Yes	No	NS	Future study in a remedial investigation
Former Fire Truck Maintenance Shop Building 5737	No	No	Yes (sinkhole)	Future study in a remedial investigation
Former Fire Station #1 Building 2575	NS	Yes	NS	Future study in a remedial investigation
AFFF Rinse-Out Building 6310	Yes	No	NS	Future study in a remedial investigation
Old Clarksville Base FTA, SWMU 148	No	NS	NA (Little West Fork Creek)	No action at this time
Legacy Fire Truck Repair Shop Building 5124	Yes[1]	No	Yes[1] (Beaver Spring)	Future study in a remedial investigation
Conex Containers 40 and 41 AFFF Storage	NS	ND	NS	No action at this time
Building 5121 AFFF Storage	Yes[1]	No	Yes[1] (Beaver Spring)	Future study in a remedial investigation
Fire Station #1 Building 1747	No	Yes	Yes[1] (Beaver Spring)	Future study in a remedial investigation
Training Area 03 Crash Site	NS	Yes[2]	No (Dennis Spring)	Future study in a remedial investigation
Wastewater Treatment Plant	Yes	No	NA (Little West Fork Creek)	Future study in a remedial investigation
Sabre Airfield Hangar 6627	No	No	No (SP-126L)	No action at this time
Fire Station #2 Building 6634 and Wash Rack	No	Yes	No (SP-126L)	Future study in a remedial investigation
Bradley Tank Fire	No	No	NA (stormwater)	No action at this time

Notes and Acronyms:

1. Results from some groundwater and spring samples that were used to make recommendations for the AOPIs were collected at locations downgradient of multiple AOPIs (i.e., for groundwater) or from springs that may drain groundwater from beneath multiple AOPIs within that spring's basin. The source(s) of PFOS, PFOA, and PFBS in groundwater and/or surface water associated with the AOPI should be discerned during a future investigation.
2. Historical (March 2019) data

Light gray shading – detection greater than the OSD risk screening level

GW – groundwater
NA – not applicable (surface water and stormwater data collected in association with/downgradient of the AOPI were not compared to the OSD risk screening levels as the feature sampled was not an expression of groundwater [i.e., seeps/springs])
ND – not detected
NS – not sampled (for surface water, NS indicates that no relevant surface water features exist near the AOPI to sample)
SO – soil
SP – spring
SW – surface water
TBD – to be determined

Data collected during the PA (**Section 3** through **5**) and SI (**Section 6** through **8**) were sufficient to draw the conclusions and recommendations summarized above. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, and PFBS at FTC 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 methods, and documentation AFFF used during crash responses and fire training activities) due to lack of recordkeeping requirements. This is true 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. Additionally, while the operations at other facility types such as paint booths, automotive service shops, or car washes can sometimes involve use, storage, and/or disposal of PFAS-containing material (i.e., in paints, lubricants/oils, or car wash products), information obtained during the PA (i.e., personnel interviews and/or records) regarding the associated materials did not indicate that PFAS-containing materials were used, stored, or disposed at those facilities. These facilities were therefore not retained for further investigation at this time.

The timeline of completion and change-out procedures (i.e., flushing practices and/or AFFF and system component disposal) for updating fire suppression foam systems in Hangars 7262, 7264, and 7268 from AFFF to high-expansion foams is unknown. If improper change-out procedures were used, residual PFAS constituents may still be in the piping infrastructure of these hangars' fire suppression systems. It is unknown if Hangars 7227 or 7257 ever used AFFF in their fire suppression systems prior to high-expansion foams. Residual PFAS constituents may also be present in the fire trucks or foam trailer apparatus which previously contained AFFF.

Because the sewer system has received AFFF from hangars at CAAF and Sabre Heliport, and some components of the sewer system may be aged beyond useful service life and in need of rehabilitation, preferential PFOS, PFOA, and PFBS transport pathways may be observed along these utility corridors. Locations of potentially compromised infrastructure of the FTC sewer system have not been identified; leaks or cracks in piping may have led to secondary PFOS, PFOA, and PFBS releases along the utility corridor.

Other potential PFOS, PFOA, and PFBS sources may exist on post, such as hangars where AFFF was previously used in fire suppression systems but currently contain high-expansion foam, or at facilities

where it is unknown if PFAS-containing products were used. The potential secondary PFOS, PFOA, and PFBS source areas where it is unknown if PFAS-containing products were used, stored, or disposed (e.g., paint booths, automotive service or car wash shops, landfills) were not sampled as part of the SI at FTC. Additionally, PFOS, PFOA, and PFBS concentrations observed during the SI may be attributed to other or additional sources (e.g., at the Old Clarksville Base FTA where it is unknown if AFFF was used, the PFOS, PFOA, and PFBS concentrations observed in groundwater may be from other sources in the adjacent Landfill #8, FCPB-33). Potential off-post PFOS, PFOA, and PFBS sources (i.e., the Clarksville Regional Airport, fire departments, car wash and automobile maintenance facilities, or other community fire response locations) were not investigated as part of the PA/SI.

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 report (**Appendix E**; included in the final electronic deliverable only) and what was available online from state databases.

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.

Additionally, potable water sources were only sampled on post; while one spring location was sampled off post (Quarles Spring, used for irrigation purposes), other off-post locations (i.e., monitoring or potable water wells including potential residential wells) were not sampled during the SI but will be addressed in a separate scope of work (**Section 8**).

The available PFOS, PFOA, and PFBS analytical data are limited to the historical data presented in **Tables 4-1** and **4-2** (collected prior to this PA/SI) and the data presented in **Section 7** and **Appendix N** (collected during this SI). The available PFOS, PFOA, and PFBS data included in **Appendix N** were analyzed per the selected analytical method. The sampling scope of the SI focused on identifying presence or absence of PFOS, PFOA, and PFBS in certain media at the AOPIs. SI sampling at locations at or in close proximity of the AOPIs and the installation's potable water supply did not delineate the extent of PFOS, PFOA, and PFBS impacts or identify the primary migration pathways for the chemicals. It is possible that potential impacts from the AOPIs exist in groundwater at the AOPIs and were not discerned by the samples collected due to uncertainty in the architecture of conduit networks draining the bedrock and associated groundwater flow directions in this karst setting. However, the data collected are sufficient to identify presence or absence of PFOS, PFOA, and PFBS at each of the AOPIs.

Furthermore, the karst geology in the region presents complex groundwater transport pathways at FTC, and seasonal fluctuations of chemicals in the aquifer and at surface water discharge points are possible. The understanding of the complex groundwater and surface water interactions at FTC is limited to that reported in the historical dye tracer studies (ICF Consulting 2004, EA Engineering, Science, and Technology, Inc. 2013). Because of the karst hydrogeologic conditions with complex groundwater flow paths that exist at FTC, data collected at existing and temporary monitoring wells may not be representative of the associated AOPIs' source contribution of potential impacts to groundwater. Potential secondary PFOS, PFOA, and PFBS sources (i.e., at areas not retained for further investigation) were not sampled as there was no evidence of use, storage, or disposal of PFAS-containing materials at the time of the PA or SI.

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

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ACRONYMS

%	percent
µg/kg	micrograms per kilogram (or parts per billion)
µg/L	micrograms per liter
ADL	Arthur D. Little, Inc.
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
CAAF	Campbell Army Airfield
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
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
FB	field blank
FCR	Field Change Report
FTA	fire training area
FTC	Fort Campbell, Kentucky
GIS	geographic information system
GW	groundwater
HDPE	high-density polyethylene
HQAES	Headquarters Army Environmental System
IDW	investigation-derived waste
IMCOM	Installation Management Command

installation	United States Army or Reserve installation
IRP	Installation Restoration Program
ISA	International Systems of America, LLC
LHA	lifetime health advisory
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram (parts per million)
NA	not applicable
ND	not detected
NS	not sampled
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
PPOC	Pollution Prevention Operations Center
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
SP	spring

SSHP	Site Safety and Health Plan
SW	surface water
SWMU	solid waste management unit
TBD	to be determined
TGI	technical guidance instruction
TOC	total organic carbon
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

FIGURES

APPENDIX A

Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.

APPENDIX B

Preliminary Assessment/Site Inspection Quality Control Checklist

APPENDIX C

Antiterrorism/Operations Security Review Cover Sheet

APPENDIX E

Installation EDR Survey Reports

APPENDIX F

Research Log

APPENDIX G

Compiled Interview Logs

APPENDIX H

Site Reconnaissance Photo Log

APPENDIX I

Compiled Site Reconnaissance Logs

APPENDIX J

Site Inspection Field Notes

APPENDIX K

Site Inspection Field Forms

APPENDIX L

Field Change Reports

APPENDIX M

Data Usability Summary Report (Level IV analytical reports included in final electronic deliverable only)

APPENDIX N

Site Inspection Laboratory Analytical Results

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TABLES

Table 2-1 - 2015 USEPA Occurrence Data for Drinking Water at Fort Campbell
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Campbell, Kentucky

	Sample ID	Fort Campbell Water System (entry point to the distribution system from water treatment plant)			
	Sample Date	Feb-2015	May-2015	Aug-2015	Nov-2015
	Sample Type	N	N	N	N
Analyte (µg/L)	OSD Risk Screening Level for Tapwater (µg/L)				
Perfluorobutane Sulfonate (PFBS)	0.600	< 0.09	< 0.09	< 0.09	NA
Perfluoroheptanoic acid (PFHPA)	NA	< 0.01	< 0.01	< 0.01	NA
Perfluorohexane Sulfonate (PFHxS)	NA	< 0.03	< 0.03	< 0.03	NA
Perfluorononanoic acid (PFNA)	NA	< 0.02	< 0.02	< 0.02	NA
Perfluorooctanoic acid (PFOA)	0.040	< 0.02	< 0.02	< 0.02	< 0.02
Perfluorooctane Sulfonate (PFOS)	0.040	< 0.04	< 0.04	< 0.04	< 0.04

Notes:

1. Historical data are as provided in the USEPA Occurrence Data collected in response to the third Unregulated Contaminant Monitoring Rule, available online at: https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule.

2. Data are compared to the Office of the Secretary of Defense (OSD) risk screening level for the residential tapwater exposure scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.).

Acronyms:

< - analyte not detected at a concentration greater than the limit of detection; concentration is provided as less than the limit of detection
µg/L - micrograms per liter (parts per billion)
ID - identification
N - normal
NA - not applicable or not available
PFAS - per- and polyflluoroalkyl substances

Table 2-2 - Historical PFOS and PFOA Analytical Soil Data
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Campbell, Kentucky

		Sample ID	19084W01	19084W02	19084W03	19084W04	19084W05	19084W06
		Sample Date	3/25/2019	3/25/2019	3/25/2019	3/25/2019	3/25/2019	3/25/2019
		Sample Type	N	N	N	N	N	N
Analyte (µg/kg)	**Industrial/Commercial OSD Risk Screening Level (µg/kg)**	**Residential OSD Risk Screening Level (µg/kg)**						
Perfluorooctanoic acid (PFOA)	1,600	130	**99.0**	**36.7**	**19.0**	**59.2**	**11.3**	**0.397**
Perfluorooctane Sulfonate (PFOS)	1,600	130	**1980 E F2**	**1060**	**308**	**2150 E**	**378**	**5.83**

Notes:
1. Historical data and qualifiers are as provided by the installation in the laboratory report (Eurofins TestAmerica. 2019. Analytical Report for Fort Campbell, Kentucky. Laboratory Job ID: 490-170804-1. April 8.)
2. **Bolded** data indicate detections.
3. Gray shaded value indicates the detected concentration is greater than or equal to the Office of the Secretary of Defense (OSD) risk screening level for the residential exposure scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.). No exceedances were obsereved for the industrial/commercial receptor scenario.
4. Underlined data indicate concentrations greater than the risk screening levels for the industrial/commercial exposure scenario per the OSD guidance.

Acronyms:
µg/kg - micrograms per kilogram (parts per billion)
E - result exceeded calibration range
F2 - matrix spike/matrix spike duplicate relative percent difference exceeds control limits
ID - identification
N - normal
PFAS - per- and polyflluoroalkyl substances

Table 6-1 - Monitoring Well Construction Details
USAEC PFAS Prelminary Assessment/Site Inspection
Fort Campbell, Kentucky

Area of Potential Interest	Well Identification	Approximate Depth to Water[1] (ft btoc)	Screened Inteval (ft bgs)	Boring Depth (ft bgs)	Well Diameter (inches)	Screened Lithologic Unit
CAAF Hangar 7166	CAAF-9	50.75	48.5 - 63.5	63.5	2	Overburden
	CAAF-51	48.69	73 - 83	83	4	Limestone
	CAAF-55	71.74	UNK	78.9	UNK	Limestone
CAAF Clamshell	CAAF-32	25.65	40.5 - 50.5	50.5	4	Overburden
	CAAF-53	34.63	48 - 58	58	4	Limestone
	CAAF-52	49.40	57 - 67	85	4	Limestone
CAAF Former Fire Training Area	41MW004	44.78	38 - 48	48	2	Overburden
	41MW006	37.57	33 - 43	43	2	Overburden
Old Fire Training Area (SWMU 12/15)	12MW00100	58.94	75.5 - 85.5	85.5	4	Limestone
	12MW012	26.17	26 - 41	41	4	Overburden
	15MW00500	62.15	88 - 98	99.5	4	Limestone
Old Clarksville Base Fire Training Area (SWMU 148)[2]	FTC-008-MW-002	19.03	16.5 - 26.5	26.5	4	Overburden
	FTC-008-M03-E	21.17	32.8 - 42.8	43	4	Limestone
	FTC-008-M04-E	31.08	31.3 - 41.3	41.5	4	Limestone
Former Fire Truck Maintenance Shop Building 5737	FTC-144-M02-E	100.24	99 - 109	109	4	Limestone
Sabre Heliport Hangar 6627	FTC-147-M05-S	8.51	35 - 45	47	2	Overburden

Notes:

1. Approximate depth to water is as reported during the December 2019 site inspection field sampling event, except at FTC-144-M02-E and FTC-147-M05-S which were gauged during the March 2021 event.

2. Monitoring wells sampled as part of the site inspection for the area of potential interest are associated with the monitoring network for the nearby landfill (solid waste management unit [SWMU] 8).

Acronyms:

bgs - below ground surface
btoc - below top of casing
ft - feet
CAAF - Campbell Army Airfield
FTC - Fort Campbell
MW - monitoring well
UNK - unknown

Sources:

1. Arthur D. Little, Inc. 2002. Resource Convervation and Recovery Act Facility Investigation Report. January.
2. Fort Campbell. 2019. Monitoring Well Construction Details Request, email communication from L. Heffelman to L. Miller. September.
3. Untitled boring logs. Various years. Provided as appendices in historical administrative record documents.

Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Campbell, Kentucky

AOPI Grouping	AOPI(s)	Location	Sample/ Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
					OSD Tapwater	40		40		600	
					Sample Type	Result	Qual	Result	Qual	Result	Qual
CAAF AOPIs	CAAF Hangar 7166	FTC-CAAF-51	FTC-CAAF-51-121719	12/17/2019	N	**3,700**	J	**2,200**	J	**460**	J
		FTC-CAAF-55	FTC-CAAF-55-121719	12/17/2019	N	**1,100**	J-	**49**		**25**	
		FTC-CAAF-9	FTC-CAAF-9-121719	12/17/2019	N	**5,700**	J	**240**	J	**350**	J
	CAAF Clamshell and Fire Station #3 Building 7160	FTC-CAAF-32	FTC-CAAF-32-121719	12/17/2019	N	**3.3**		**1.6**	J	1.6	UJ
		FTC-CAAF-52	FTC-CAAF-52-121819	12/18/2019	N	**65**		**5.5**		**5.6**	
		FTC-CAAF-53	FTC-CAAF-53-121819	12/18/2019	N	**600**	J	**340**	J	**54**	
	Old Fire Training Area (SWMU 12/15)	FTC-12MW012	FTC-12MW012-121819	12/18/2019	N	**2,600**	J	**1,200**	J	**180**	J
		FTC-12MW00100	FTC-12MW00100-121819	12/18/2019	N	**5.8**		**3.6**		**1.1**	J
		FTC-15MW00500	FTC-15MW00500-121919	12/19/2019	N	**1,100**	J	**310**	J	**58**	
	CAAF Former Fire Training Area	FTC-41MW004	FTC-41MW004-121819	12/18/2019	N	1.7	U	1.7	U	**1.3**	J
		FTC-41MW006	FTC-41MW006-121819	12/18/2019	N	**160**	J	**7.6**		**4.9**	
	Destiny Heliport Washrack Buildings 7243 and 7251 and Fire Station #4 Building 7241	FTC-DHWRs-1	FTC-DHWRs-1-OBGW-032421	03/24/2021	N	**2,200**	J	**380**		**280**	
			FTC-FD-1-GW-032421	03/24/2021	FD	**2,200**	J	**360**		**250**	
	CAAF Hangars 7262, 7264, and 7268	FTC-H7260S-1	FTC-H7260S-1-OBGW-032421	03/24/2021	N	**47**		**4.9**		**5.4**	
	CAAF Hangars 7272, 7273, and 7274	FTC-H7270S-1	FTC-H7270S-1-OBGW-032321	03/23/2021	N	**1,400**	J	**45**		**76**	
	Current Fire Training Area Building 7237	FTC-FTA-7237-1	FTC-FTA-7237-1-OBGW-032621	03/26/2021	N	**98**	J-	**26**	J-	**56**	J-
	Fire Station #5 Building 4099	FTC-FS5-1	FTC-FS5-1-OBGW-032821	03/28/2021	N	**980**	J	**71**		**160**	
Mid-Cantonment AOPIs	AFFF Rinse-Out Building 6310	FTC-B6310-1	FTC-B6310-1-OBGW-033021	03/30/2021	N	**220**		**6.9**		**12**	
	Former Fire Truck Maintenance Shop Building 5737	FTC-144-M02-E	FTC-144-M02-E-032521	03/25/2021	N	3.9	U	3.9	U	3.9	U
South Canontment AOPIs	Old Clarksville Base Fire Training Area (SWMU 148)	FTC-008-M03-E	FTC-008-M03-E-121919	12/19/2019	N	1.8	U	1.8	U	1.8	U
		FTC-008-M04-E	FTC-008-M04-E-121919	12/19/2019	N	**1.8**		1.7	U	**0.91**	J
		FTC-008-MW-002	FTC-008-MW-002-121919	12/19/2019	N	**8.7**		**8.6**	J	**2.7**	
	Building 5121 AFFF Storage and Legacy Fire Truck Repair Shop Building 5124	FTC-PPOC-1	FTC-PPOC-1-OBGW-033021	03/30/2021	N	**670**		**12**		**13**	
	Fire Station #1 Building 1747	FTC-FS1-1	FTC-FS1-1-OBGW-032921	03/29/2021	N	**3.6**	J	**4.5**	J-	**5.2**	
	Wastewater Treatment Plant	FTC-WWTP-1	FTC-WWTP-1-OBGW-032921	03/29/2021	N	**410**		**330**		**54**	
Sabre Heliport	Sabre Heliport Hangar Building 6627	FTC-147-M05	FTC-147-M05-S-032521	03/25/2021	N	**11**		**5.0**		**3.6**	
		FTC-SHH-1	FTC-SHH-1-OBGW-033021	03/30/2021	N	3.9	U	3.9	U	3.9	U
Training Area 26 AOPI	Bradley Tank Fire	FTC-BTF-1	FTC-BTF-1-OBGW-010922	01/09/2022	N	**13**	J+	3.8	U	3.8	U
			FTC-BTF-1-OBGW-010922	01/09/2022	FD	**17**	J+	5.0	U	5.0	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Gray shaded value indicates the detected concentration is greater than or equal to the Office of the Secretary of Defense (OSD) risk screening level for the residential tapwater exposure scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.).

Acronyms/Abbreviations:
AFFF = aqueous film-forming foam
AOPI = area of potential interest
CAAF = Campbell Army Airfield
FD = field duplicate sample
FTC = Fort Campbell, Kentucky
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier
SWMU = solid waste management unit

Qualifier Descriptions:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.
UJ = The analyte was analyzed for but was not detected. The limit of quantitation is approximate and may be inaccurate or imprecise.

Table 7-2 - Surface Water and Stormwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Campbell, Kentucky

AOPI Grouping	AOPI(s)	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
					OSD Tapwater*	40		40		600	
					Sample Type	Result	Qual	Result	Qual	Result	Qual
CAAF AOPIs	CAAF Fire Training Area and Retention Pond	FTC-CFTA-4	FTC-CFTA-4-SW-121819	12/18/2019	N	**2.7**		**1.1**	J	1.8	U
	CAAF Hangar 7262	FTC-H7262-1	FTC-H7262-1-SW-032521	03/25/2021	N	**2.0**	J	3.6	U	3.6	U
	CAAF Hangar 7264	FTC-H7264-1	FTC-H7264-1-SW-032221	03/22/2021	N	3.6	U	3.6	U	3.6	U
	CAAF Hangar 7268	FTC-H7268-1	FTC-H7268-1-SW-032521	03/25/2021	N	**4.9**		3.4	U	3.4	U
	CAAF Hangar 7272	FTC-H7272-1	FTC-H7272-1-SW-032221	03/22/2021	N	**340**		**9.8**		**14**	
	CAAF Hangars 7273 and 7274	FTC-H7270S-1	FTC-H7270S-1-SW-032221	03/22/2021	N	**4.3**	J+	**2.0**	J	3.6	U
			FTC-FD-1-SW-032221	03/22/2021	FD	**4.7**		**2.3**	J	3.5	U
	General CAAF	FTC-DFC-1	FTC-DFC-1-SW-121919	12/19/2019	N	**45**		**6.1**		**5.7**	
		FTC-DFC-2	FTC-DFC-2-SW-121719	12/17/2019	N	**54**		**3.8**		**4.8**	
			FTC-FD-1-SW-121719	12/17/2019	FD	**50**		**4.0**		**4.3**	
		FTC-LWFC-1	FTC-LWFC-1-SW-121919	12/19/2019	N	**15**		**2.2**		**1.6**	J
		FTC-BOILINGSP*	FTC-BOILINGSP-1-GW-121619	12/16/2019	N	**13**		**2.3**	J	**2.1**	
			FTC-BOILINGSP-2-GW-121619	12/16/2019	N	**13**		**2.1**	J	**2.0**	
			FTC-FD-1-GW-121619	12/16/2019	FD	**13**		**2.1**	J	**2.1**	
		FTC-QUARLESSP*	FTC-QUARLESSP-SW-121719	12/17/2019	N	**180**		**9.8**		**9.2**	
	General - CAAF Hangars	FTC-160H-1	FTC-160H-1-SW-121919	12/19/2019	N	**9.8**		**2.1**		**2.1**	
Mid-Cantonment AOPIs	Former Fire Truck Maintenance Shop Building 5737	FTC-FTMS-1*	FTC-FTMS-1-SW-032321	03/23/2021	N	**280**		**3.9**		**7.4**	
South Cantonment AOPIs	Legacy Fire Truck Repair Shop Building 5124, Building 5121 AFFF Storage, and Fire Station #1 Building 1747	FTC-BEAVERSP*	FTC-BEAVERSP-SW-121619	12/16/2019	N	**130**		**8.5**		**8.4**	
	Training Area 03 Crash Site	FTC-DENNISSP*	FTC-DENNISSP-SW-121919	12/19/2019	N	**1.2**	J	1.9	U	1.9	U
	Wastewater Treatment Plant	FTC-LWFC-2	FTC-LWFC-2-SW-121919	12/19/2019	N	**15**		**2.7**		**1.8**	J
		FTC-LWFC-3	FTC-LWFC-3-SW-122019	12/20/2019	N	**17**		**2.3**		**1.8**	J
Sabre Heliport	Sabre Heliport Hangar Building 6627 and Fire Station #2 Building 6634 and Wash Rack	FTC-SHH-SP126L*	FTC-SHH-SP126L-SW-032521	03/25/2021	N	**11**		**2.0**	J	**5.1**	
Training Area 26	Bradley Tank Fire	FTC-BTF-1	FTC-BTF-1-SW-010922	01/09/2022	N	4.3	U	4.3	U	4.3	U
			FTC-FD-1-SW-010922	01/09/2022	FD	4.8	U	4.8	U	4.8	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Only surface water samples that are considered representative of groundwater (i.e., at springs which are surface expressions of groundwater or at sinkholes where surface water recharges groundwater, marked with a "*") are compared to the Office of the Secretary of Defense (OSD) risk screening level for the residential tapwater exposure scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.).
3. *Gray shaded value indicates the detected concentration is greater than or equal to the Office of the Secretary of Defense (OSD) risk screening level for the residential tapwater exposure scenario, where the comparison was applicable.

Acronyms/Abbreviations:
AFFF = aqueous film-forming foam
AOPI = area of potential interest
CAAF = Campbell Army Airfield
FD = field duplicate sample
FTC = Fort Campbell, Kentucky
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier

Qualifier Descriptions:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.

Table 7-3 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Campbell, Kentucky

AOPI Grouping	AOPI	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
					OSD Risk Screening Level	0.13 (R) 1.6 (IC)		0.13 (R) 1.6 (IC)		1.9 (R) 25 (IC)	
					Sample Type	Result	Qual	Result	Qual	Result	Qual
CAAF AOPIs	CAAF Hangars 7272 and 7273	FTC-160H-7272-1	FTC-16OH-7272-1-SO-121819	12/18/2019	N	**0.0050**		0.00069	U	0.0023	U
		FTC-160H-7273-1	FTC-16OH-7273-1-SO-121619	12/16/2019	N	**0.0077**		0.00068	U	0.0023	U
		FTC-160H-7273-2	FTC-16OH-7273-2-SO-121819	12/18/2019	N	**0.0057**		**0.0038**		0.0024	U
	CAAF Former Fire Training Area	FTC-FFTA-1	FTC-FFTA-1-SO-121819	12/18/2019	N	**0.0053**		0.00075	U	0.0025	U
		FTC-FFTA-2	FTC-FFTA-2-SO-121819	12/18/2019	N	**0.0039**		0.00058	U	0.0019	U
	Destiny Heliport Wash Rack Building 7251	FTC-DHWR-7251-1	FTC-DHWR-7251-1-SO-121819	12/18/2019	N	**0.0022**		**0.00055**	J	0.0024	U
		FTC-DHWR-7251-2	FTC-DHWR-7251-2-SO-121819	12/18/2019	N	**0.0037**		**0.0019**		0.0024	U
	Destiny Heliport Wash Rack Building 7243	FTC-DHWR-7243-1	FTC-DHWR-7243-1-SO-121819	12/18/2019	N	**0.0060**		0.00069	U	0.0023	U
		FTC-DHWR-7243-2	FTC-DHWR-7243-2-SO-121819	12/18/2019	N	**0.036**		**0.0020**		0.0024	U
	Fire Station #4 Building 7241	FTC-FS4-1	FTC-FS4-1-SO-032221	03/22/2021	N	**0.13**		**0.0017**	J+	0.0010	U
			FTC-FD-1-SO-032221	03/22/2021	FD	**0.10**		**0.0023**		0.0012	U
		FTC-FS4-2	FTC-FS4-2-SO-032221	03/22/2021	N	**0.070**		**0.00096**	J	0.0012	U
		FTC-FS4-3	FTC-FS4-3-SO-032221	03/22/2021	N	**0.051**		**0.0017**		0.0012	U
	Fire Station #3 Building 7160	FTC-FS3-1	FTC-FS3-1-SO-032221	03/22/2021	N	**0.42**	J	**0.0017**		0.0011	U
		FTC-FS3-2	FTC-FS3-2-SO-032221	03/22/2021	N	**0.063**		**0.0011**		0.0011	U
		FTC-FS3-3	FTC-FS3-3-SO-032221	03/22/2021	N	**0.13**		**0.0022**		0.0011	U
	CAAF Fire Training Area and Retention Pond	FTC-CFTA-1	FTC-CFTA-1-SO-121819	12/18/2019	N	**0.11**		0.00085	U	0.0028	U
			FTC-FD-1-121819	12/18/2019	FD	**0.11**		0.00072	U	0.0024	U
		FTC-CFTA-2	FTC-CFTA-2-SO-121819	12/18/2019	N	**0.17**	J	**0.00047**	J	0.0023	U
		FTC-CFTA-3	FTC-CFTA-3-SO-121819	12/18/2019	N	**0.080**		0.00077	U	0.0026	U
	Current Fire Training Area Building 7237	FTC-FTA-7237-1	FTC-FTA-7237-1-SO-121919	12/19/2019	N	**0.0028**		0.00068	U	0.0023	U
			FTC-FD-2-SO-121919	12/19/2019	FD	**0.0028**		0.00067	U	0.0022	U
		FTC-FTA-7237-2	FTC-FTA-7237-2-SO-121919	12/19/2019	N	**0.12**	J	**0.0022**		0.0025	U
		FTC-FTA-7237-3	FTC-FTA-7237-3-SO-121919	12/19/2019	N	**0.11**		**0.0011**		0.0023	U
	CAAF Hangar 7262	FTC-H7262-1	FTC-H7262-1-SO-081120	08/11/2020	N	0.0011	U	0.0011	U	0.0011	U
		FTC-H7262-2	FTC-H7262-2-SO-081120	08/11/2020	N	**0.019**		**0.0033**		**0.0013**	
		FTC-H7262-3	FTC-H7262-3-SO-081120	08/11/2020	N	**0.0073**		0.0013	U	0.0013	U
	CAAF Hangar 7264	FTC-H7264-1	FTC-H7264-1-SO-081120	08/11/2020	N	**0.0089**		0.0010	U	0.0010	U
		FTC-H7264-2	FTC-H7264-2-SO-081120	08/11/2020	N	**0.0066**		0.0020	U	0.0020	U
	CAAF Hangar 7268	FTC-H7268-1	FTC-H7268-1-SO-081120	08/11/2020	N	**0.029**		0.0010	U	0.0010	U
		FTC-H7268-2	FTC-H7268-2-SO-081120	08/11/2020	N	**0.0017**		0.0012	U	0.0012	U
		FTC-H7268-3	FTC-H7268-3-SO-081120	08/11/2020	N	**0.0067**		0.0013	U	0.0013	U
	Fire Station #5 Building 4099	FTC-FS5-1	FTC-FS5-1-SO-032221	03/22/2021	N	**0.041**		**0.0027**		0.0011	U
		FTC-FS5-2	FTC-FS5-2-SO-032221	03/22/2021	N	**0.091**		**0.00097**	J	0.0011	U
		FTC-FS5-3	FTC-FS5-3-SO-032221	03/22/2021	N	**0.0019**		**0.0010**	J	0.0012	U
Mid-Cantonment AOPIs	AFFF Rinse-Out Building 6310	FTC-B6310-1	FTC-B6310-1-SO-032221	03/22/2021	N	**0.082**		0.00094	U	0.00094	U
		FTC-B6310-2	FTC-B6310-2-SO-032221	03/22/2021	N	**0.012**		**0.00063**	J	0.0011	U
	Fire Station #1 Building 1747	FTC-FS1-1	FTC-FS1-1-SO-032321	03/23/2021	N	**0.0050**		0.0012	U	0.0012	U
		FTC-FS1-2	FTC-FS1-2-SO-032321	03/23/2021	N	**0.0041**		**0.00096**	J	0.0011	U
		FTC-FS1-3	FTC-FS1-3-SO-032321	03/23/2021	N	**0.30**	J	**0.0033**		0.0011	U
	Fire Truck Maintenance Shop Building 5737	FTC-FTMS-1	FTC-FTMS-1-SO-121919	12/19/2019	N	**0.0020**		0.00063	U	0.0021	U
		FTC-FTMS-2	FTC-FTMS-2-SO-121919	12/19/2019	N	0.00058	U	0.00058	U	0.0019	U
		FTC-FTMS-3	FTC-FTMS-3-SO-121919	12/19/2019	N	**0.0097**		0.00072	U	0.0024	U
	Former Fire Station #1 Building 2575	FTC-FFS-1	FTC-FFS-1-SO-121919	12/19/2019	N	**0.14**	J	**0.00082**		0.0023	U
		FTC-FFS-2	FTC-FFS-2-SO-121919	12/19/2019	N	**0.039**		**0.0019**		0.0025	U
		FTC-FFS-3	FTC-FFS-3-SO-121919	12/19/2019	N	**0.37**	J	**0.0089**		0.0026	U

Table 7-3 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Campbell, Kentucky

AOPI Grouping	AOPI	Location	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
					OSD Risk Screening Level	0.13 (R) 1.6 (IC)		0.13 (R) 1.6 (IC)		1.9 (R) 25 (IC)	
					Sample Type	Result	Qual	Result	Qual	Result	Qual
South Cantonment AOPIs	Legacy Fire Truck Repair Shop	FTC-LFTRS-2	FTC-LFTRS-2-SO-121919	12/19/2019	N	**0.034**		**0.0045**		0.0023	U
		FTC-LFTRS-3	FTC-LFTRS-3-SO-121919	12/19/2019	N	**0.012**		**0.00057**	J	0.0021	U
	Wastewater Treatment Plant	FTC-WWTP-1	FTC-WWTP-1-SO-121919	12/19/2019	N	**0.0086**		**0.00077**	J	0.0026	U
		FTC-WWTP-2	FTC-WWTP-2-SO-121919	12/19/2019	N	**0.10**		**0.0014**		0.0024	U
	Building 5121	FTC-B5121-1	FTC-B5121-1-SO-081120	08/11/2020	N	**0.085**		0.0010	U	0.0010	U
		FTC-B5121-2	FTC-B5121-2-SO-081120	08/11/2020	N	**0.011**		0.0010	U	0.0010	U
			FTC-FD-1-SO-081120	08/11/2020	FD	**0.013**		0.0010	U	0.0010	U
	Conex Containers 40 & 41	FTC-CONEX-1	FTC-CONEX-1-SO-081120	08/11/2020	N	0.0011	U	0.0011	U	0.0011	U
Sabre Heliport AOPI	Fire Station #2 Building 6634	FTC-FS2-1	FTC-FS2-1-SO-032421	03/23/2021	N	**0.0037**		0.0012	U	0.0012	U
		FTC-FS2-2	FTC-FS2-2-SO-032421	03/24/2021	N	**0.48**	J	**0.0023**		**0.00077**	J
		FTC-FS2-3	FTC-FS2-3-SO-032421	03/24/2021	N	**0.012**		0.0012	U	0.0012	U
	Sabre Heliport Hangar Building 6627	FTC-SHH-1	FTC-SHH-1-SO-122019	12/20/2019	N	**0.0021**		0.00071	U	0.0024	U
		FTC-SHH-2	FTC-SHH-2-SO-122019	12/20/2019	N	**0.0066**		**0.0074**		0.0023	U
		FTC-SHH-3	FTC-SHH-3-SO-122019	12/20/2019	N	**0.00049**	J	**0.00092**		0.0022	U
Training Area 26 AOPI	Bradley Tank Fire	FTC-BTF-1	FTC-BTF-1-SO-121321	12/13/2021	N	0.0011	U	0.0011	U	0.0011	U
			FTC-FD-1-SO-121321	12/13/2021	FD	0.0012	U	0.0012	U	0.0012	U
		FTC-BTF-2	FTC-BTF-2-SO-121321	12/13/2021	N	**0.00066**	J	0.0011	U	0.0011	U
		FTC-BTF-3	FTC-BTF-3-SO-121321	12/13/2021	N	**0.0015**		0.0013	U	0.0013	U
		FTC-BTF-4	FTC-BTF-4-SO-121321	12/13/2021	N	**0.0032**		0.00099	U	0.00099	U
		FTC-BTF-5	FTC-BTF-5-SO-121321	12/13/2021	N	0.0011	U	0.0011	U	0.0011	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Gray shaded value indicates the detected concentration is greater than or equal to the Office of the Secretary of Defense (OSD) risk screening level for the residential exposure scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.).

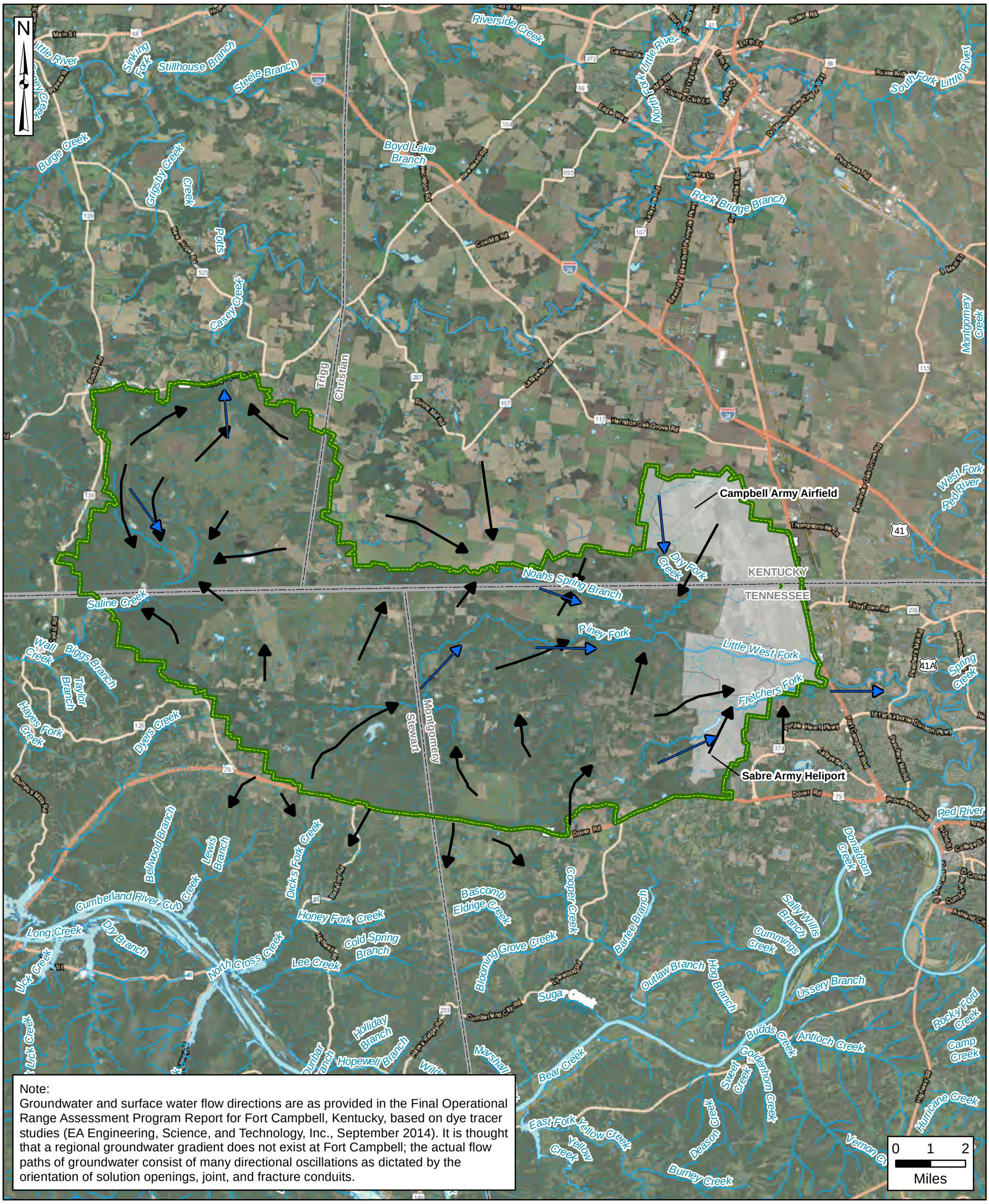
Acronyms/Abbreviations:
(R) = residential receptor scenario
(IC) = industrial/commercial receptor scenario
AFFF = aqueous film-forming foam
AOPI = area of potential interest
CAAF = Campbell Army Airfield
FD = field duplicate sample
FTC = Fort Campbell, Kentucky
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier

Qualifier Descriptions:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Campbell, KY

Figure 2-1
Installation Location



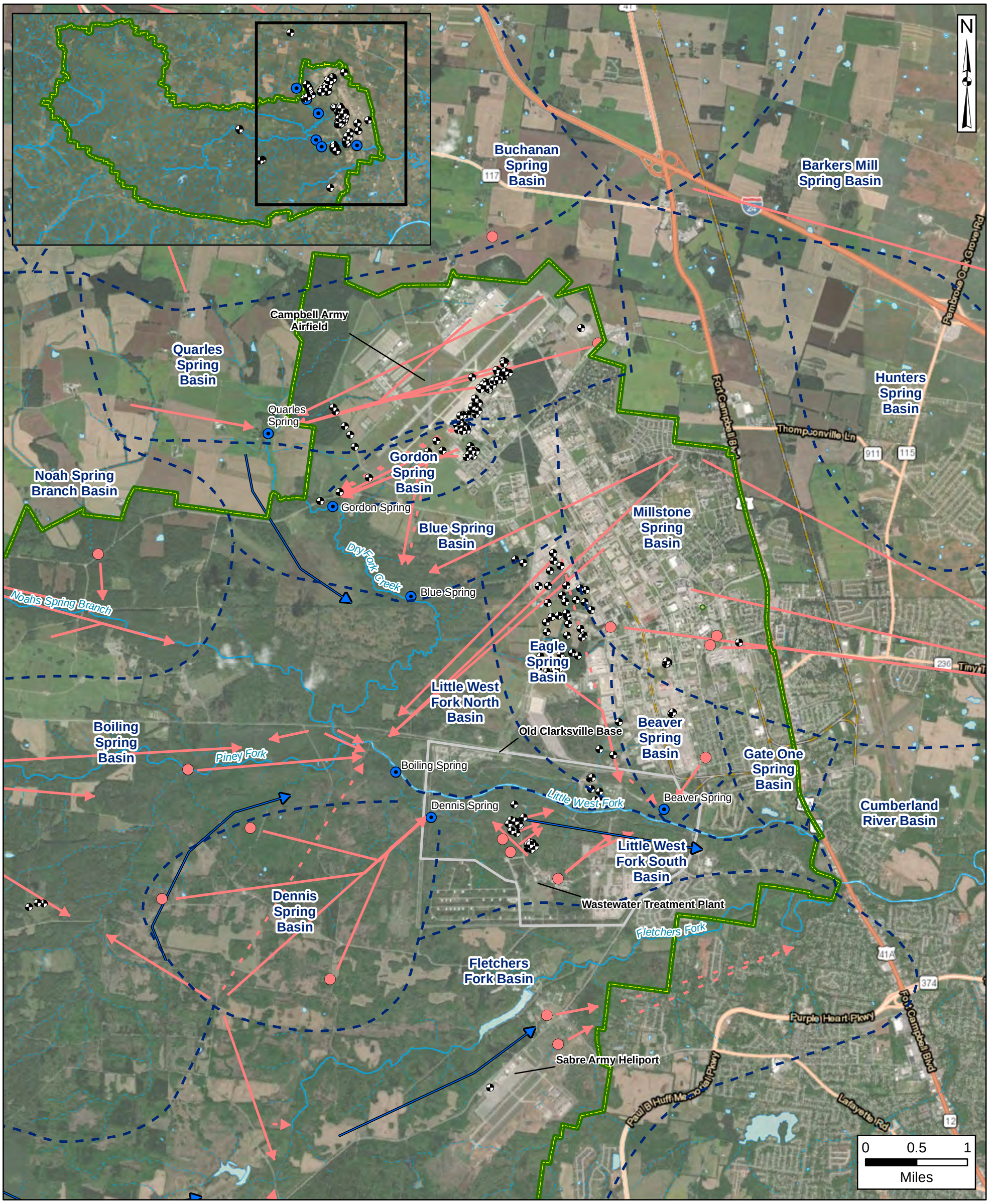
Installation Boundary
Cantonment Area
State Boundary
County Boundary
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Local Groundwater Flow Direction

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Campbell, KY

Figure 2-2a
Site Layout



- Installation Boundary
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Monitoring Well
- Spring
- Groundwater Basin Boundary
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)

Note: The status of each monitoring well shown may not be available; some may be plugged and abandoned.

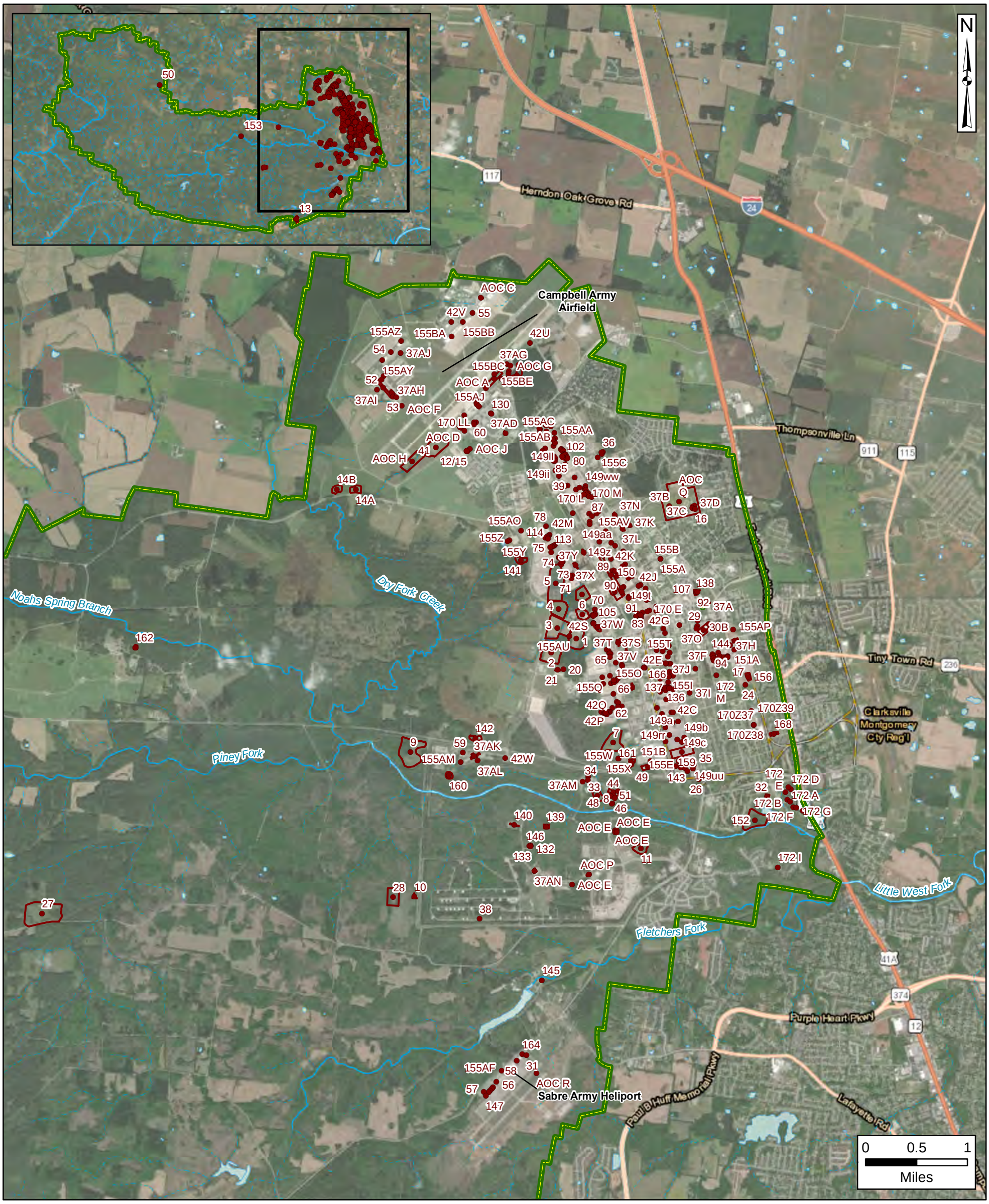
Dye Trace and Groundwater Basin Source: Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Campbell, KY

Figure 2-2b
Site Layout – Solid Waste Management Units



SWMU = solid waste management unit

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS
Preliminary Assessment /
Site Inspection
Fort Campbell, KY

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Figure 2-3a
Site Topography

Legend

- Installation Boundary
- Elevation Contour (feet)
- Water Body
- River/Stream (Perennial)
- Stream (Intermittent)

Contour Interval = 100 feet

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
USGS, Elevation Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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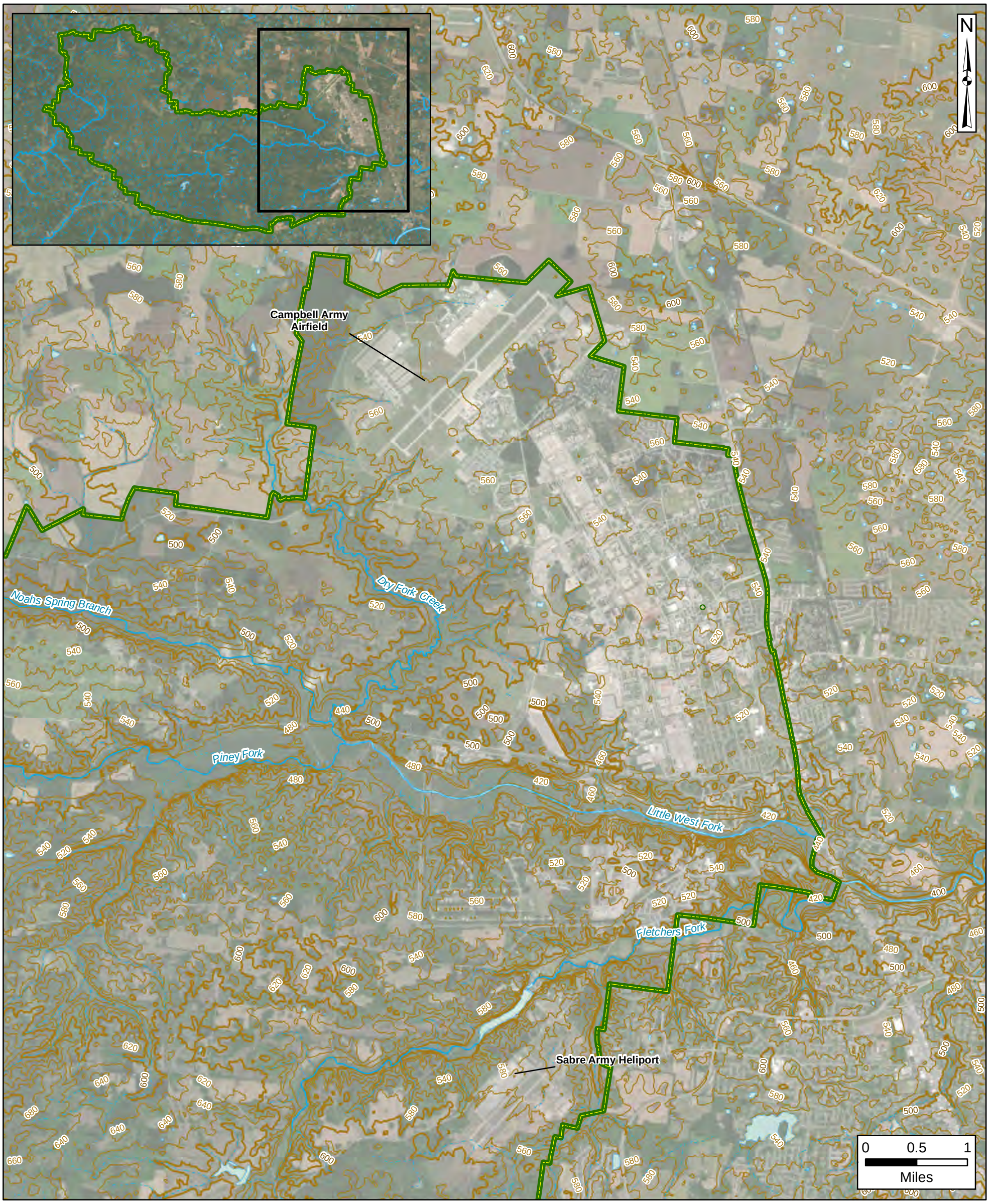
Fort Campbell, KY

Figure 2-3b
Site Topography - Cantonment Area



Installation Boundary
Elevation Contour (Index) (feet)
Elevation Contour (Intermediate) (feet)
Contour interval = 20 feet
River/Stream (Perennial)
Stream (Intermittent)
Water Body

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
USGS, Elevation Data, 2019
ESRI, ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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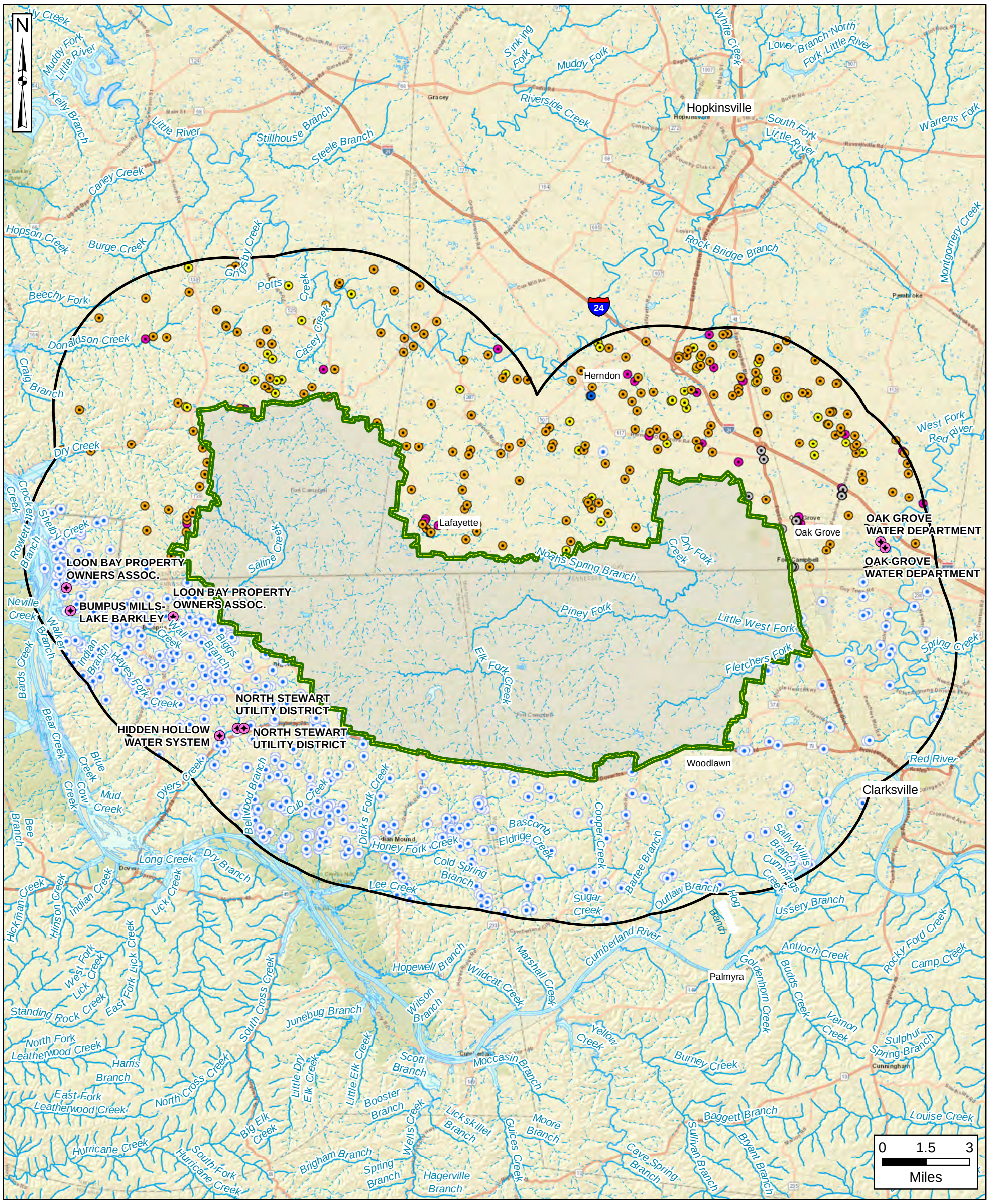
Fort Campbell, KY

Figure 2-4
Off-Post Potable Wells



Installation Boundary
5-Mile Radius
Public Water Supply System Well

Other Tennessee Well Locations
Well - Unspecified Use Type

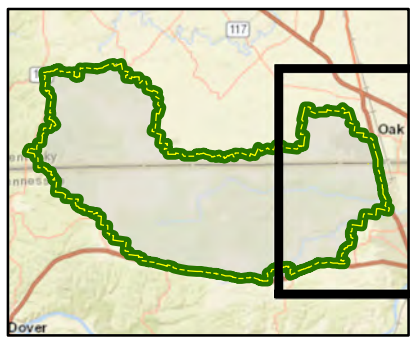
Other Kentucky Well Locations
Public Supply Well
Domestic Use Well
Agricultural/Irrigation Use Well
Recreational/Institutional
Industrial, Remedial, and Other
Well - Unspecified Use Type

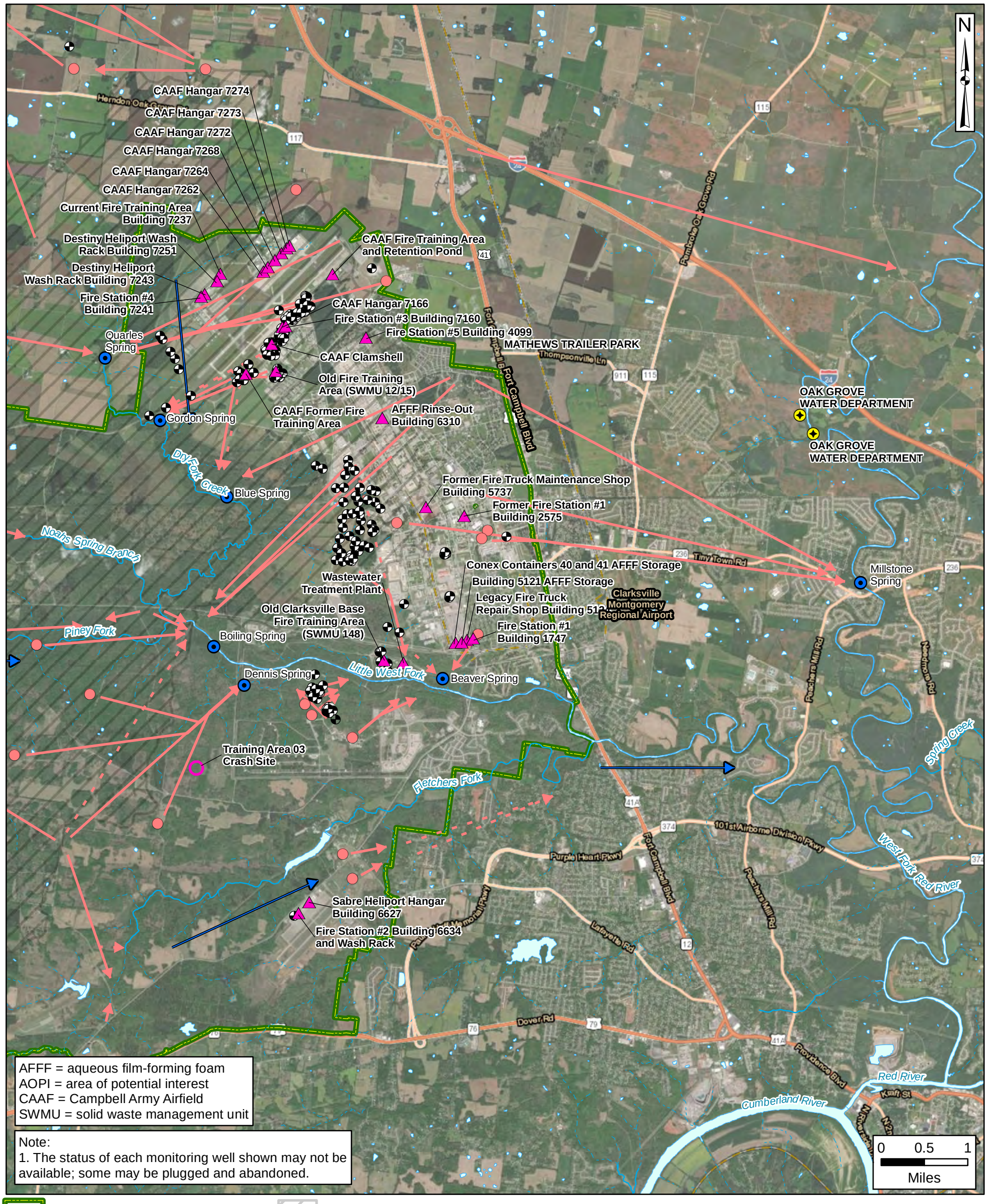
Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
EDR, Well Data, 2018
KGS, Well Data, 2020
TN DWR, Well Data, 2020
ESRI ArcGIS Online, World Street Map

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Campbell, KY

Figure 5-2a
Cantonment Area AOPI Locations





AFFF = aqueous film-forming foam
AOPI = area of potential interest
CAAF = Campbell Army Airfield
SWMU = solid waste management unit

Note:
1. The status of each monitoring well shown may not be available; some may be plugged and abandoned.

- Installation Boundary
- AOPI
- AOPI Area
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Wellhead Protection Area
- Monitoring Well
- Water Supply Well
- Spring
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)

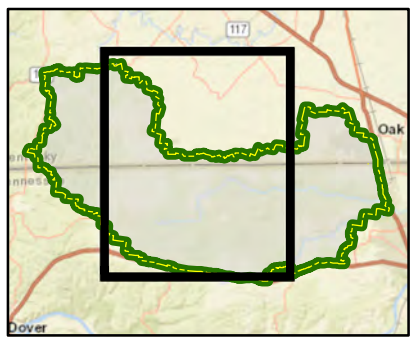
Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

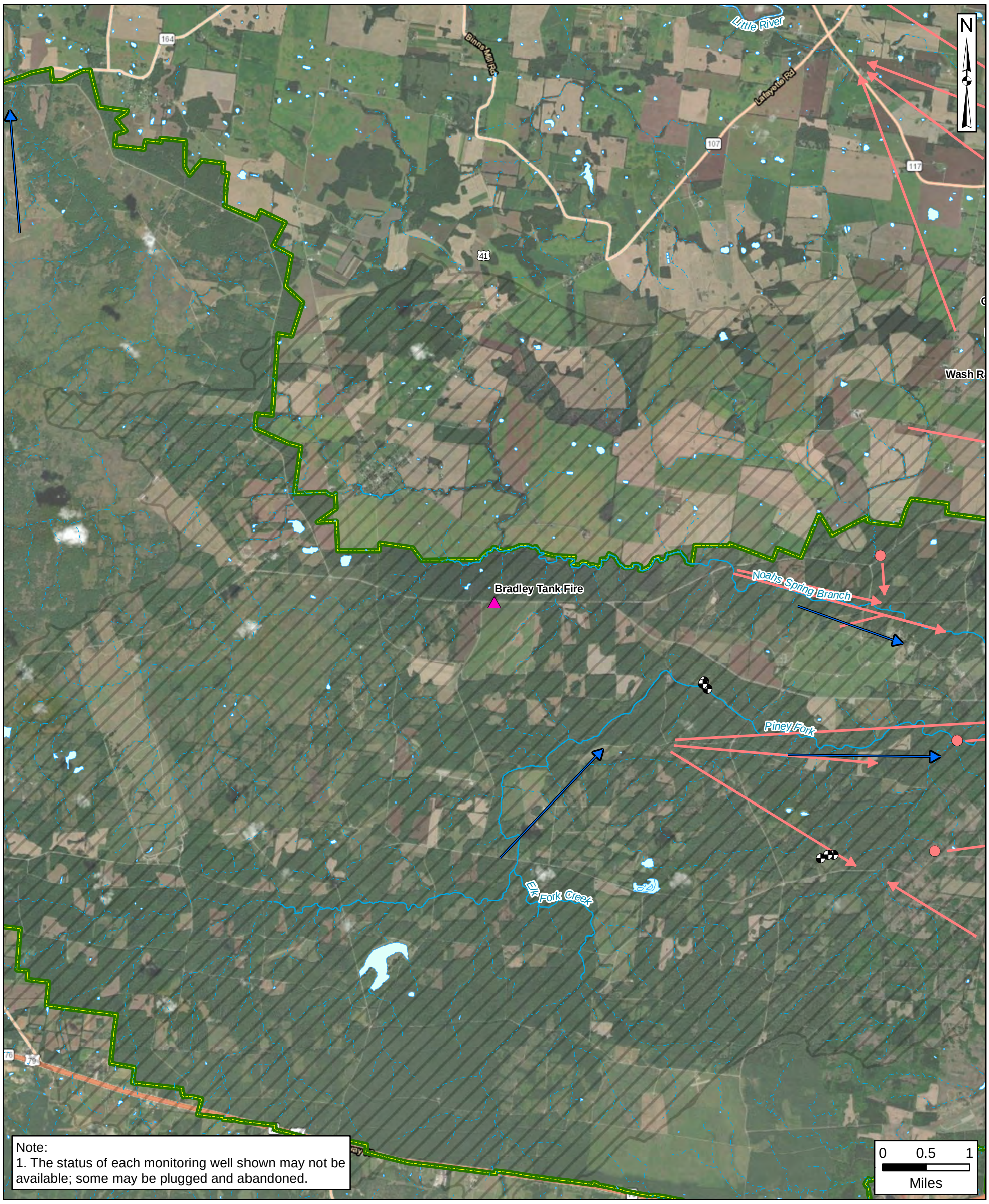
Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Campbell, KY

Figure 5-2b
Training Area AOPI Location





Installation Boundary
AOPI
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Wellhead Protection Area
Monitoring Well
Non-Well Dye Injection Location
Dye Trace Route (i.e., groundwater flow direction)

AOPI = area of potential interest

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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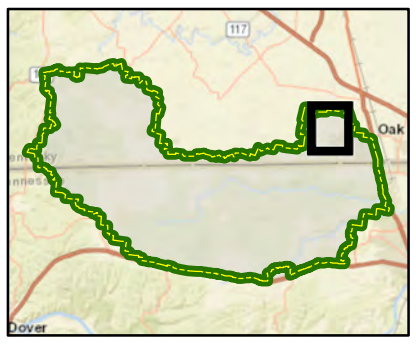
Fort Campbell, KY

Figure 5-3
Aerial Photo of CAAF AOPIs and Inferred AFFF Release Areas



- Installation Boundary
- AOPI
- Inferred AFFF Release Area
- SWMU Area
- Stormwater Utility Line
- Wastewater Utility Line
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Monitoring Well

AFFF = aqueous film-forming foam
AOPI = area of potential interest
CAAF = Campbell Army Airfield
SWMU = solid waste management unit

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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Figure 5-4
Aerial Photo of Mid-Cantonment AOPIs and Inferred AFFF Release Areas

Legend

- Installation Boundary
- AOPI
- Inferred AFFF Release Area
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
- Monitoring Well
- Spring
- Stormwater Utility Line
- Wastewater Utility Line

AFFF = aqueous film-forming foam
AOPI = area of potential interest

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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Figure 5-5
Aerial Photo of South Cantonment AOPIs and Inferred AFFF Release Areas

Legend

- Installation Boundary
- AOPI
- AOPI Area
- Inferred AFFF Release Area
- SWMU Area
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
- Monitoring Well
- Spring
- Stormwater Utility Line
- Wastewater Utility Line

AFFF = aqueous film-forming foam
AOPI = area of potential interest
SWMU = solid waste management unit

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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Fort Campbell, KY

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Figure 5-6
Aerial Photo of
Sabre Heliport Hangar 6627 and Inferred AFFF Release Areas

Legend

- Installation Boundary
- Inferred AFFF Release Area
- AOPI
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
- Monitoring Well

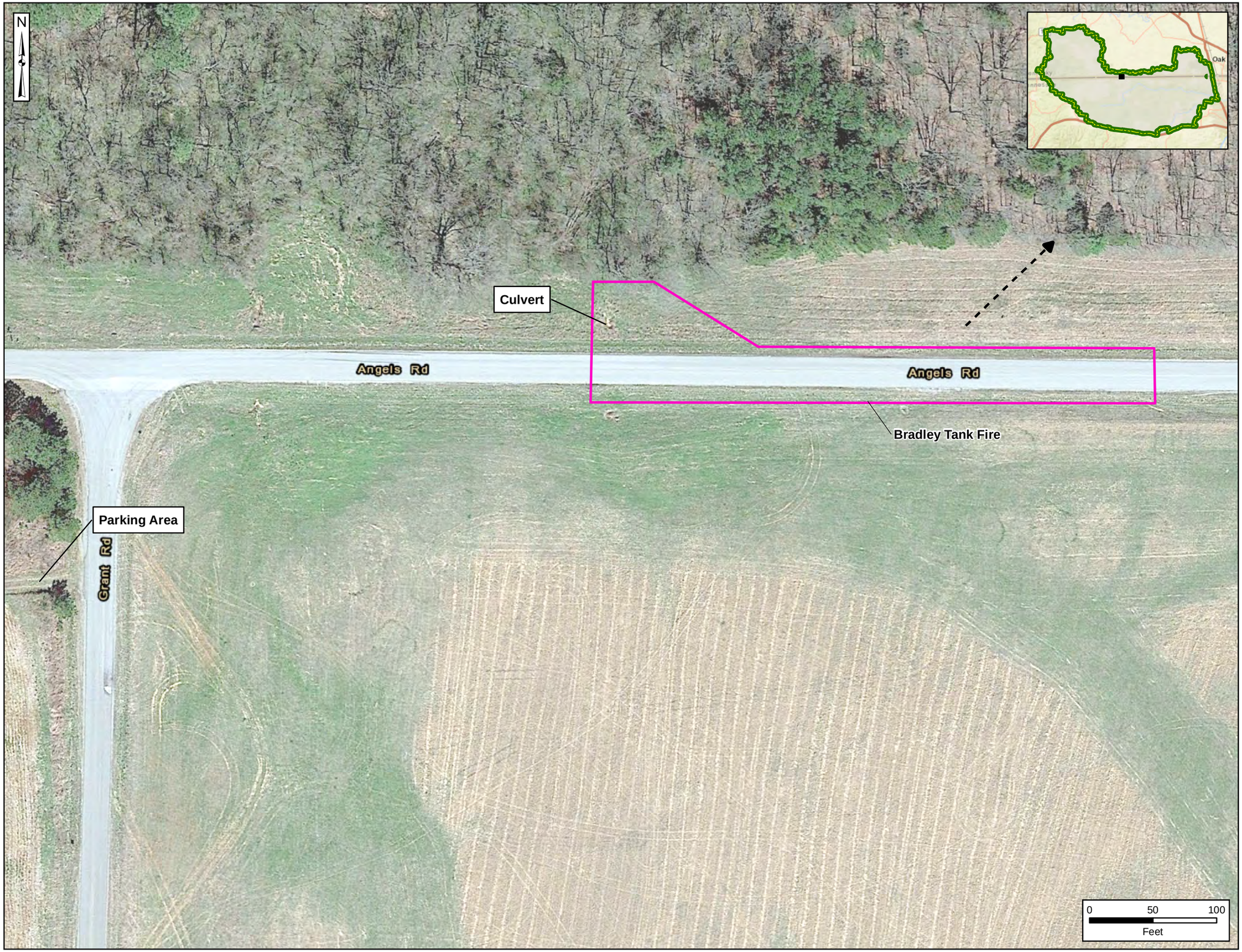
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Note:
1. Stormwater and wastewater utility lines were not provided in the geographic information system data for this area.

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North



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Fort Campbell, KY

Figure 5-7
Aerial Photo of
Bradley Tank Fire AOPI and
Inferred AFFF Release Area

Legend

- Installation Boundary
- AOPI
- Inferred Groundwater Flow Direction

AOPI = area of potential interest

Data Sources:
Fort Campbell, GIS Data, 2018
Google Earth, Aerial Imagery, 2019

Coordinate System:
WGS 1984, UTM Zone 16 North

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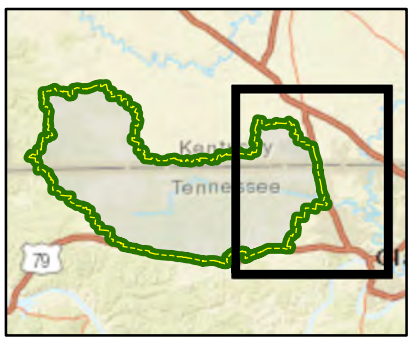
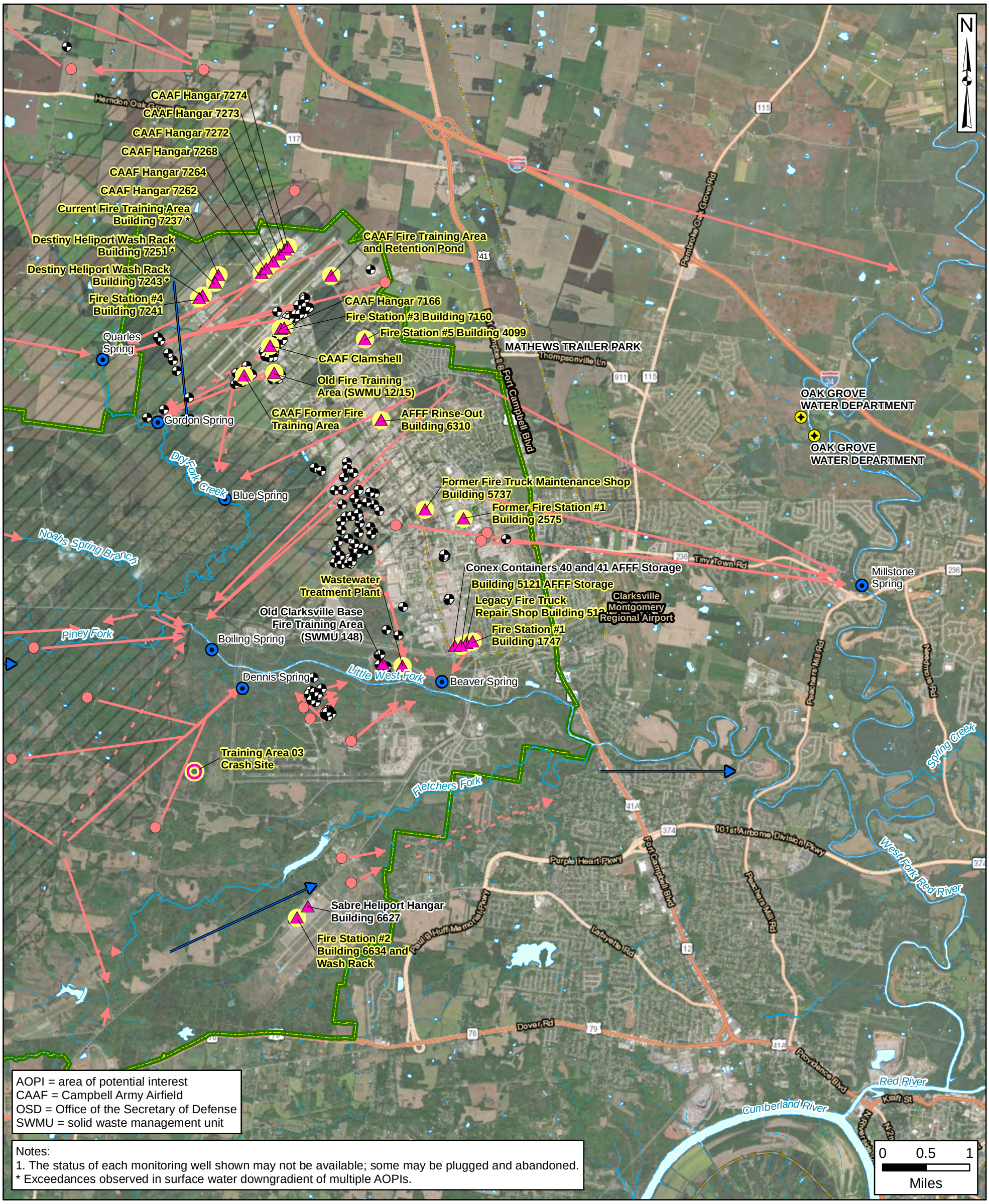
Fort Campbell, KY

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





AOPI = area of potential interest
CAAF = Campbell Army Airfield
OSD = Office of the Secretary of Defense
SWMU = solid waste management unit

Notes:
1. The status of each monitoring well shown may not be available; some may be plugged and abandoned.
* Exceedances observed in surface water downgradient of multiple AOPIs.

- Installation Boundary
- AOPI
- AOPI Area
- AOPI with OSD Risk Screening Level Exceedance
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Wellhead Protection Area
- Monitoring Well
- Water Supply Well
- Spring
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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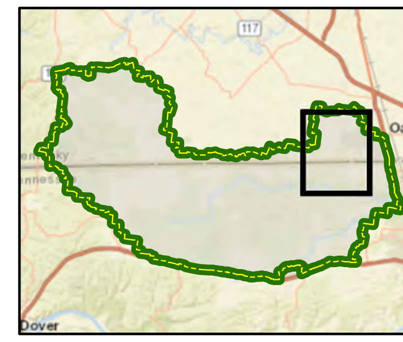
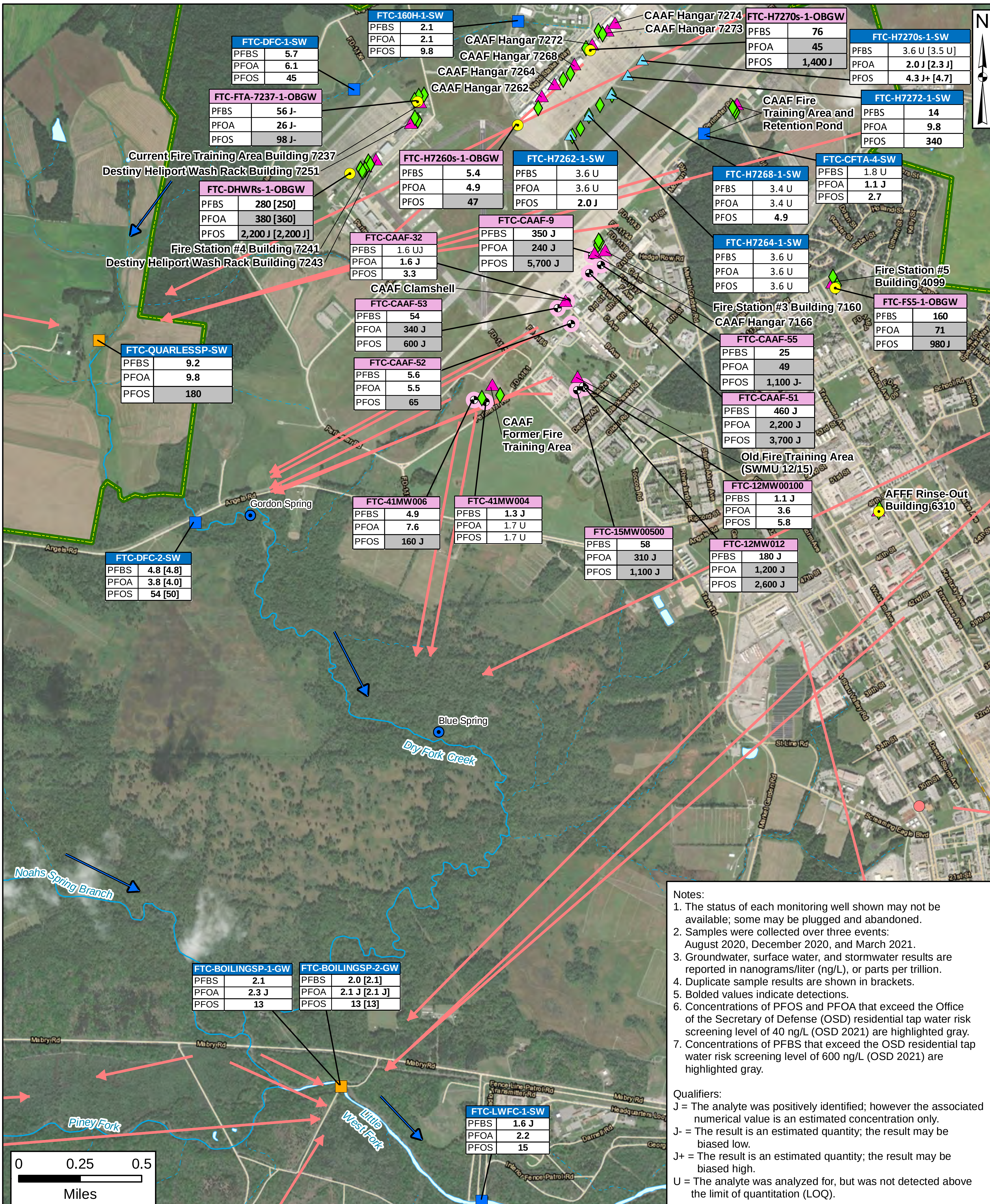
Fort Campbell, KY

Figure 7-2a
PFOS, PFOA, and PFBS Analytical Results for Groundwater, Surface Water, and Stormwater at Campbell Army Airfield AOPIs





Notes:
1. The status of each monitoring well shown may not be available; some may be plugged and abandoned.
2. Samples were collected over three events: August 2020, December 2020, and March 2021.
3. Groundwater, surface water, and stormwater results are reported in nanograms/liter (ng/L), or parts per trillion.
4. Duplicate sample results are shown in brackets.
5. Bolded values indicate detections.
6. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.
7. Concentrations of PFBS that exceed the OSD residential tap water risk screening level of 600 ng/L (OSD 2021) are highlighted gray.

Qualifiers:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
J- = The result is an estimated quantity; the result may be biased low.
J+ = The result is an estimated quantity; the result may be biased high.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Spring
Monitoring Well
Non-Well Dye Injection Location
Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
Groundwater Sampling Location (Existing Well)
Spring Sampling Location
Creek/Stream/Rentention Pond Sampling Location
Temporary Groundwater Sampling Location
Stormwater Sampling Location
Shallow Soil Sampling Location (0.5-2.0 feet below ground surface)

AFFF = aqueous film-forming foam
AOPI = area of potential interest
CAAF = Campbell Army Airfield
CFTA = CAAF Fire Training Area and Retention Pond
DFC = Dry Fork Creek
FTC = Fort Campbell
LWFC = Little West Fork Creek
OBGW = overburden groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
SW = surface water
SWMU = solid waste management unit

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

OSD 2021:
Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Campbell, KY

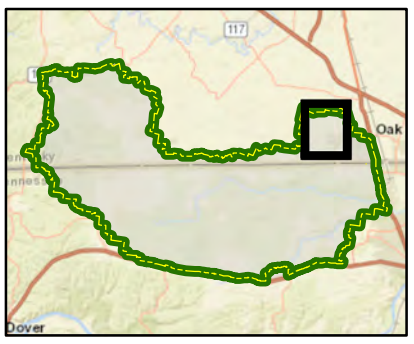


Figure 7-2b
PFOS, PFOA, and PFBS Analytical Results for Soil at Campbell Army Airfield AOPIs

FTC-H7268-1-SO	
PFBS	0.0010 U
PFOA	0.0010 U
PFOS	**0.029**

FTC-H7264-1-SO	
PFBS	0.0010 U
PFOA	0.0010 U
PFOS	**0.0089**

FTC-H7262-1-SO	
PFBS	0.0011 U
PFOA	0.0011 U
PFOS	0.0011 U

FTC-H7268-3-SO	
PFBS	0.0013 U
PFOA	0.0013 U
PFOS	**0.0067**

FTC-H7268-2-SO	
PFBS	0.0012 U
PFOA	0.0012 U
PFOS	**0.0017**

FTC-H7264-2-SO	
PFBS	0.0020 U
PFOA	0.0020 U
PFOS	**0.0066**

FTC-H7262-3-SO	
PFBS	0.0013 U
PFOA	0.0013 U
PFOS	**0.0073**

FTC-H7262-2-SO	
PFBS	**0.0013**
PFOA	**0.0033**
PFOS	**0.019**

FTC-160H-7273-1-SO	
PFBS	0.0023 U
PFOA	0.00068 U
PFOS	**0.0077**

FTC-160H-7272-1-SO	
PFBS	0.0023 U
PFOA	0.00069 U
PFOS	**0.0050**

FTC-160H-7273-2-SO	
PFBS	0.0024 U
PFOA	**0.0038**
PFOS	**0.0057**

FTC-FS3-3-SO	
PFBS	0.0011 U
PFOA	**0.0022**
PFOS	**0.13**

FTC-FS3-2-SO	
PFBS	0.0011 U
PFOA	**0.0011**
PFOS	**0.063**

FTC-FS3-1-SO	
PFBS	0.0011 U
PFOA	**0.0017**
PFOS	**0.42 J**

FTC-CFTA-3-SO	
PFBS	0.0026 U
PFOA	0.00077 U
PFOS	**0.080**

FTC-CFTA-2-SO	
PFBS	0.0023 U
PFOA	**0.00047 J**
PFOS	**0.170 J**

FTC-CFTA-1-SO	
PFBS	0.0028 U [0.0024 U]
PFOA	0.00085 U [0.00072 U]
PFOS	**0.110 [0.110]**

FTC-FTA-7237-2-SO	
PFBS	0.0025 U
PFOA	**0.0022**
PFOS	**0.120 J**

FTC-FTA-7237-3-SO	
PFBS	0.0023 U
PFOA	**0.0011**
PFOS	**0.110**

FTC-FTA-7237-1-SO	
PFBS	0.0023 U [0.0022 U]
PFOA	0.00068 U [0.00067 U]
PFOS	**0.0028 [0.0028]**

FTC-DHWR-7251-1-SO	
PFBS	0.0024 U
PFOA	**0.00055 J**
PFOS	**0.0022**

FTC-DHWR-7251-2-SO	
PFBS	0.0024 U
PFOA	**0.0019**
PFOS	**0.0037**

FTC-DHWR-7243-1-SO	
PFBS	0.0023 U
PFOA	0.00069 U
PFOS	**0.0060**

FTC-DHWR-7243-2-SO	
PFBS	0.0024 U
PFOA	**0.0020**
PFOS	**0.036**

FTC-FS4-1-SO	
PFBS	0.0010 U [0.0012 U]
PFOA	**0.0017 J+ [0.0023]**
PFOS	**0.13 [0.10]**

FTC-FS4-3-SO	
PFBS	0.0012 U
PFOA	**0.0017**
PFOS	**0.051**

FTC-FS4-2-SO	
PFBS	0.0012 U
PFOA	**0.00096 J**
PFOS	**0.070**

FTC-FS5-2-SO	
PFBS	0.0011 U
PFOA	**0.00097 J**
PFOS	**0.091**

FTC-FS5-3-SO	
PFBS	0.0012 U
PFOA	**0.0010 J**
PFOS	**0.0019**

FTC-FS5-1-SO	
PFBS	0.0011 U
PFOA	**0.0027**
PFOS	**0.041**

FTC-FFTA-1-SO	
PFBS	0.0025 U
PFOA	0.00075 U
PFOS	**0.0053**

FTC-FFTA-2-SO	
PFBS	0.0019 U
PFOA	0.00058 U
PFOS	**0.0039**

CAAF Hangar 7268
CAAF Hangar 7264
CAAF Hangar 7262
FTC-H7260s-1
CAAF Hangar 7274
CAAF Hangar 7273
CAAF Hangar 7272
FTC-H7270s-1
CAAF Hangar 7166
Fire Station #3 Building 7160
CAAF Fire Training Area and Retention Pond
Current Fire Training Area Building 7237
FTC-FTA-7237-1
Destiny Heliport Wash Rack Building 7251
Destiny Heliport Wash Rack Building 7243
Fire Station #4 Building 7241
FTC-DHWRs-1
FTC-CAAF-9
FTC-CAAF-55
FTC-CAAF-51
CAAF Clamshell
FTC-CAAF-32
FTC-CAAF-53
FTC-CAAF-52
Old Fire Training Area (SWMU 12/15)
FTC-12MW012
FTC-012MW00100
FTC-015MW00500
Fire Station #5 Building 4099
FTC-FS5-1
CAAF Former Fire Training Area
FTC-41MW006
FTC-41MW004

Station Spur
Night Stalker Way
Perimeter Rd
FD-1153
FD-1156
FD-1166
FD-1161
FD-1152
1st St
2nd St
Hedge Row Rd
Market Garden
Bell Rd
5th St
B Ave
G Ave
Glider Rd
Toccoa Rd
Dry Fork Creek

0 250 500 Feet
0 150 300 Feet
0 50100 Feet
0 0.1 0.2 Miles
0 100 200 Feet

N

Notes:
1. Samples were collected over three events: August 2020, December 2020, and March 2021.
2. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
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) residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.

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

Installation Boundary
AOPI
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Non-Well Dye Injection Location
Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
Monitoring Well
Groundwater Sampling Location (Existing Well)
Temporary Groundwater Sampling Location
Shallow Soil Sampling Location (0.5-2.0 feet below ground surface)

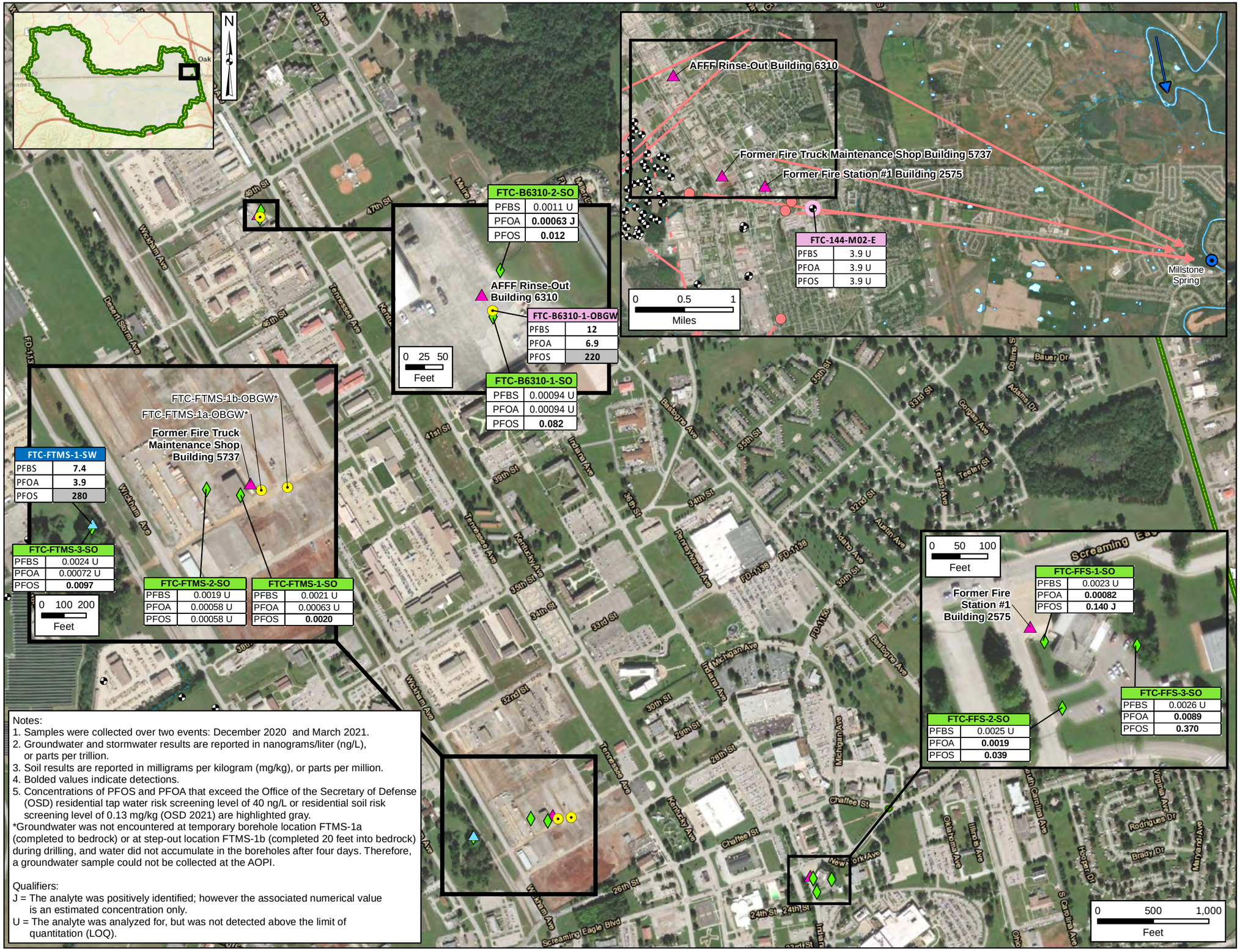
AOPI = area of potential interest
CAAF = Campbell Army Airfield
CFTA = CAAF Fire Training Area and Retention Pond
DHWR = Destiny Heliport wash rack
FFTA = former fire training area
FTC = Fort Campbell
MW = monitoring well
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
SO = soil
SW = surface water
SWMU = solid waste management unit

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

OSD 2021:
Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North



Notes:
1. Samples were collected over two events: December 2020 and March 2021.
2. Groundwater and stormwater results are reported in nanograms/liter (ng/L), or parts per trillion.
3. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
4. Bolded values indicate detections.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L or residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.

*Groundwater was not encountered at temporary borehole location FTMS-1a (completed to bedrock) or at step-out location FTMS-1b (completed 20 feet into bedrock) during drilling, and water did not accumulate in the boreholes after four days. Therefore, a groundwater sample could not be collected at the AOPI.

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).

USAEC PFAS Preliminary Assessment/Site Inspection Fort Campbell, KY

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Figure 7-3
PFOS, PFOA, and PFBS Analytical Results for Groundwater, Stormwater, and Soil at the Mid-Cantonment Area AOPIs

Legend

- Installation Boundary
- AOPI
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
- Spring
- Monitoring Well
- Groundwater Sampling Location (Existing Well)
- Temporary Groundwater Sampling Location
- Stormwater Sampling Location
- Shallow Soil Sampling Location (0.5-2.0 feet below ground surface)

AFFF = aqueous film-forming foam
AOPI = area of potential interest
FFS = Former Fire Station
FTC = Fort Campbell
FTMS = Former Fire Truck Maintenance Shop
OBGW = overburden groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
SO = soil
SW = surface water

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

OSD 2021:
Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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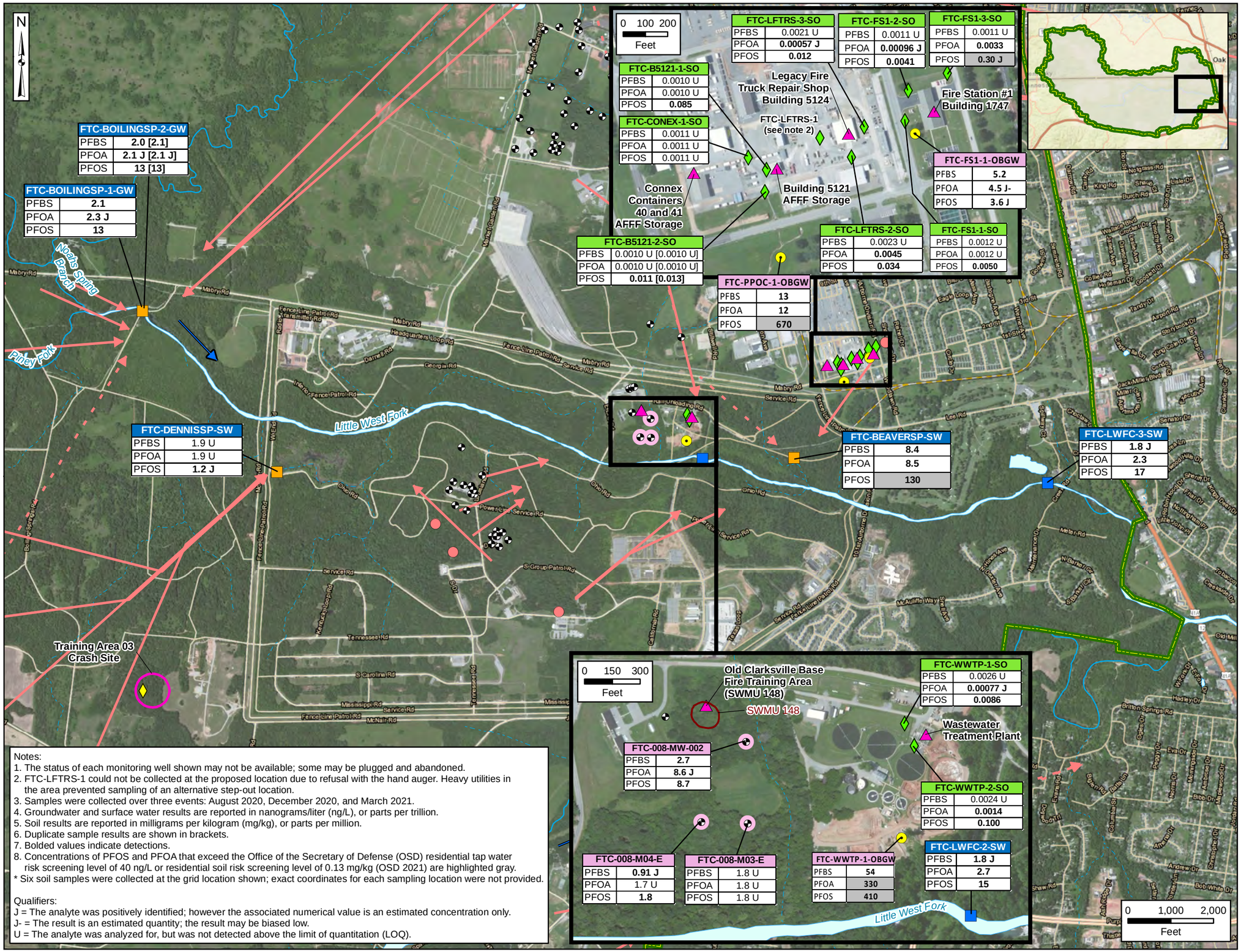
Figure 7-4
PFOS, PFOA, and PFBS Analytical Results for Groundwater, Surface Water and Soil at the South Cantonment Area AOPIs



Notes:
1. The status of each monitoring well shown may not be available; some may be plugged and abandoned.
2. FTC-LFTRS-1 could not be collected at the proposed location due to refusal with the hand auger. Heavy utilities in the area prevented sampling of an alternative step-out location.
3. Samples were collected over three events: August 2020, December 2020, and March 2021.
4. Groundwater and surface water results are reported in nanograms/liter (ng/L), or parts per trillion.
5. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
6. Duplicate sample results are shown in brackets.
7. Bolded values indicate detections.
8. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L or residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.

* Six soil samples were collected at the grid location shown; exact coordinates for each sampling location were not provided.

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

Legend

- Installation Boundary
- AOPI
- AOPI Area
- SWMU Area
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
- Monitoring Well
- Groundwater Sampling Location (Existing Well)
- Spring Sampling Location
- Creek/Stream Sampling Location
- Temporary Groundwater Sampling Location
- Shallow Soil Sampling Location (0.5-2.0 feet below ground surface)
- Approximate March 2019 Soil Sampling Area*

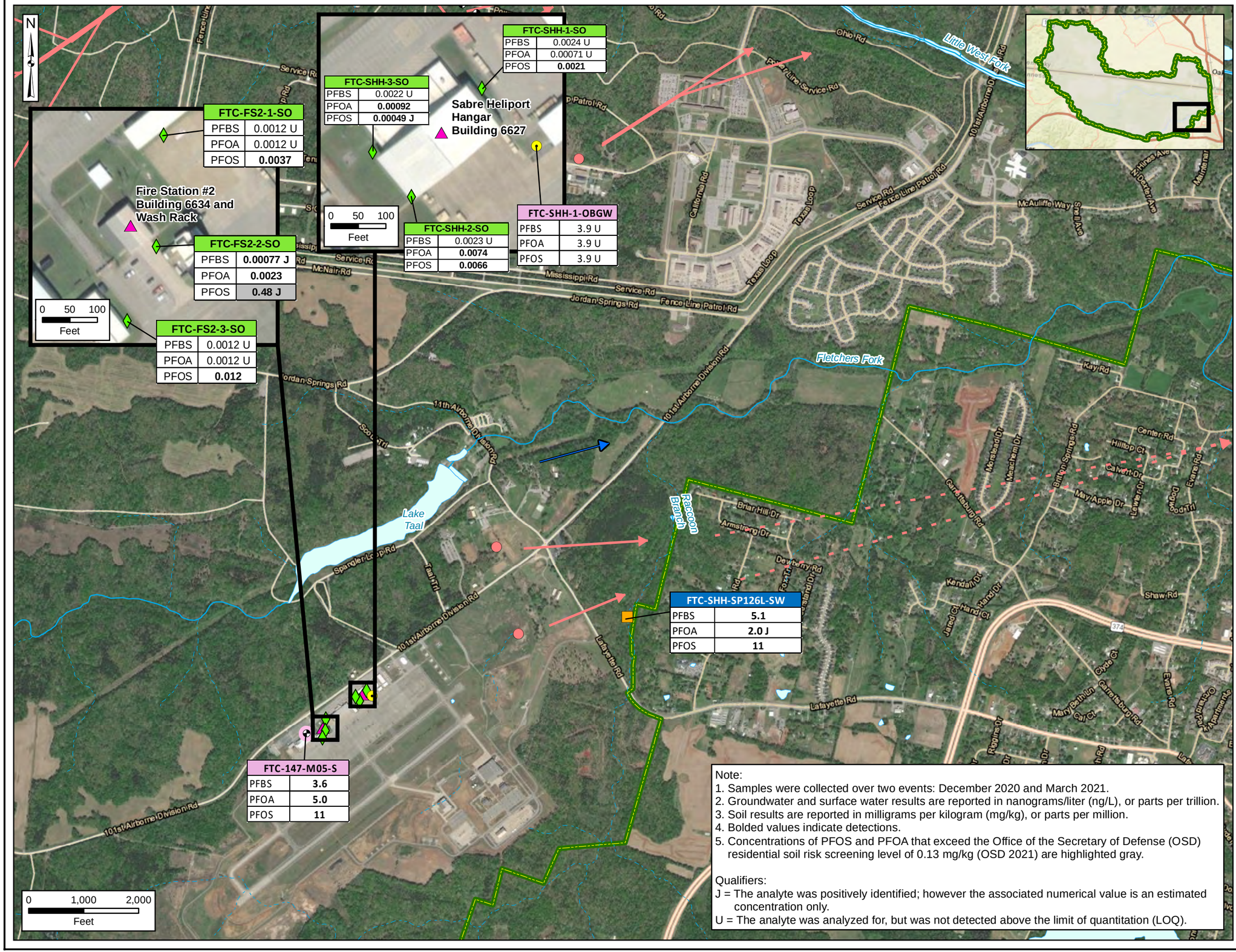
AOPI = area of potential interest
FTC = Fort Campbell
LFTRS = Legacy Fire Truck Repair Shop
LWFC = Little West Fork Creek
MW = monitoring well
OBGW = overburden groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
SO = soil
SP = spring
SW = surface water
SWMU = solid waste management unit
WWTP = Wastewater Treatment Plant

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

OSD 2021:
Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North



Note:
1. Samples were collected over two events: December 2020 and March 2021.
2. Groundwater and surface water results are reported in nanograms/liter (ng/L), or parts per trillion.
3. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
4. Bolded values indicate detections.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential soil risk screening level of 0.13 mg/kg (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).

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Figure 7-5
PFOS, PFOA, and PFBS Analytical Results for Groundwater, Surface Water, and Soil at Sabre Heliport AOPI

Legend

- Installation Boundary
- AOPI
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Non-Well Dye Injection Location
- Dye Trace Route (i.e., groundwater flow direction; dashed indicates unconfirmed result)
- Monitoring Well
- Groundwater Sampling Location (Existing Well)
- Spring Sampling Location
- Temporary Groundwater Sampling Location
- Shallow Soil Sampling Location (0.5-2.0 feet below ground surface)

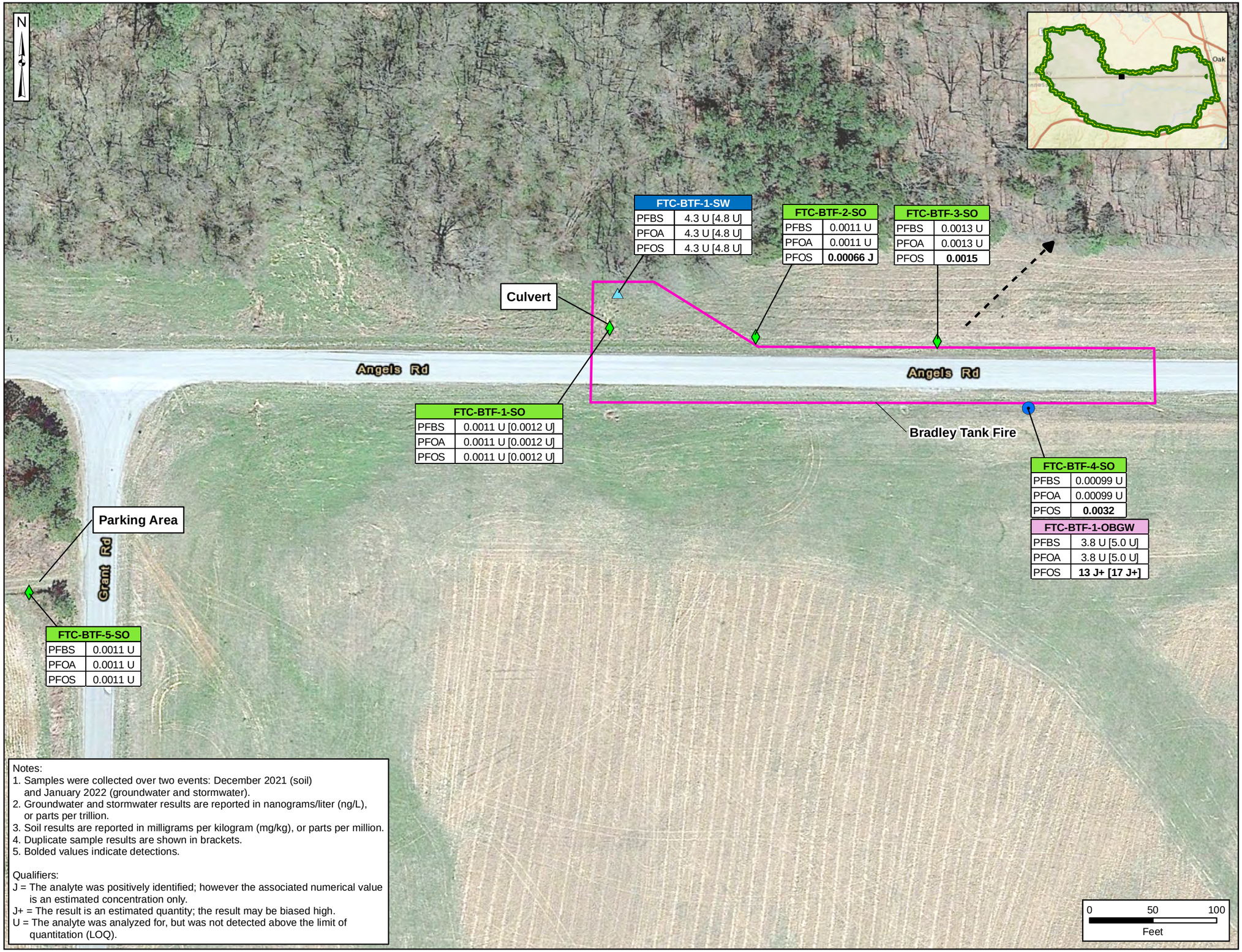
AOPI = area of potential interest
FTC = Fort Campbell
OBGW = overburden groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
SHH = Sabre Heliport Hangar
SO = soil
SW = surface water

Dye Trace Source:
Final 2002 Dye Trace Report, Fort Campbell, Kentucky, Prepared by: ICF Consulting, 23 January 2004, ICR Reference 032047.0.002.71

OSD 2021:
Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.

Data Sources:
Fort Campbell, GIS Data, 2018
NHD, Water Bodies, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North



Notes:
1. Samples were collected over two events: December 2021 (soil) and January 2022 (groundwater and stormwater).
2. Groundwater and stormwater results are reported in nanograms/liter (ng/L), or parts per trillion.
3. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
4. Duplicate sample results are shown in brackets.
5. Bolded values indicate detections.

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

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Figure 7-6
PFOS, PFOA, and PFBS Analytical Results for Groundwater, Stormwater, and Soil at Bradley Tank Fire AOPI

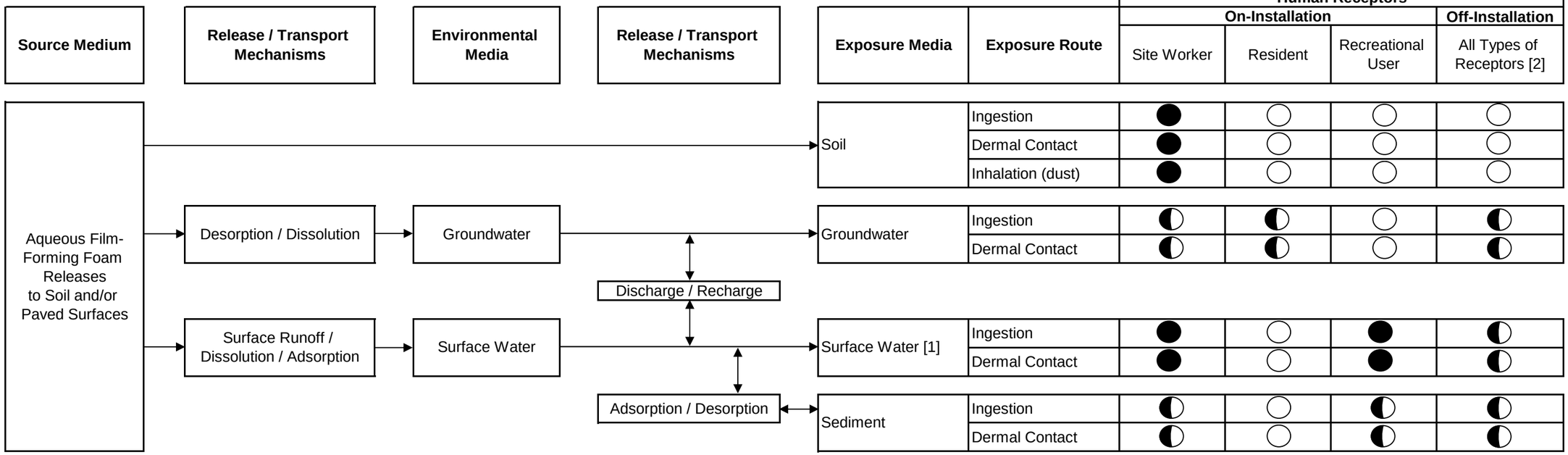
Legend

- Installation Boundary
- AOPI
- Inferred Groundwater Flow Direction
- Shallow Soil Sampling Location (0.5-2.0 feet below ground surface)
- Shallow Soil and Temporary Groundwater Sampling Location
- Stormwater Sampling Location

AOPI = area of potential interest
FTC = Fort Campbell
OBGW = overburden groundwater
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid
SO = soil
SW = stormwater

Data Sources:
Fort Campbell, GIS Data, 2018
Google Earth, Aerial Imagery, 2019

Coordinate System:
WGS 1984, UTM Zone 16 North



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
[3] The 18 areas of potential interest represented by this conceptual site model includes: Current Fire Training Area Building 7237; CAAF Fire Training Area and Retention Pond; Fire Station #3 Building 7160; Destiny Heliport Washrack Buildings 7243 and 7251; Fire Station #4 Building 7241; CAAF Hangars 7262, 7264, 7268, 7272, and 7273; Fire Station #5 Building 5099; Former Fire Station #1 Building 2575; Building 5121 AFFF Storage; Legacy Fire Truck Repair Shop Buiding 5124; Fire Station #1 Building 1747; Fire Station #2 Buildling 6634 and Wash Rack; and Sabre Heliport Hangar 6627.

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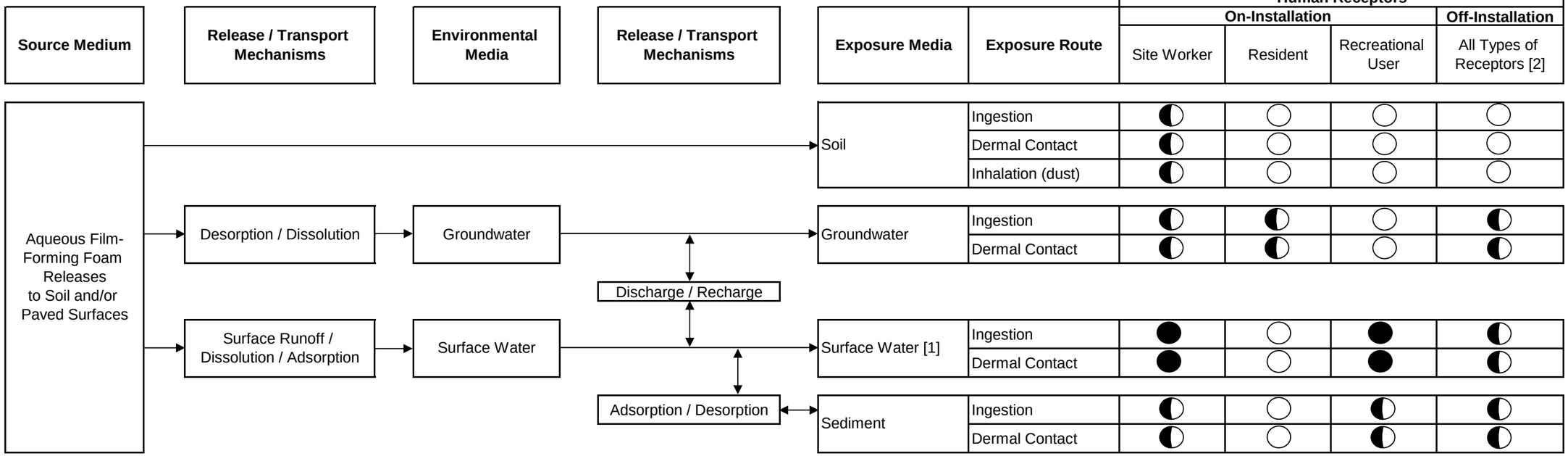
Conceptual Site Model - 18 Areas of Potential Interest Sampled for Soil
USAEC PFAS Preliminary Assessment / Site Inspection
Fort Campbell, Kentucky

Figure 7-7



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

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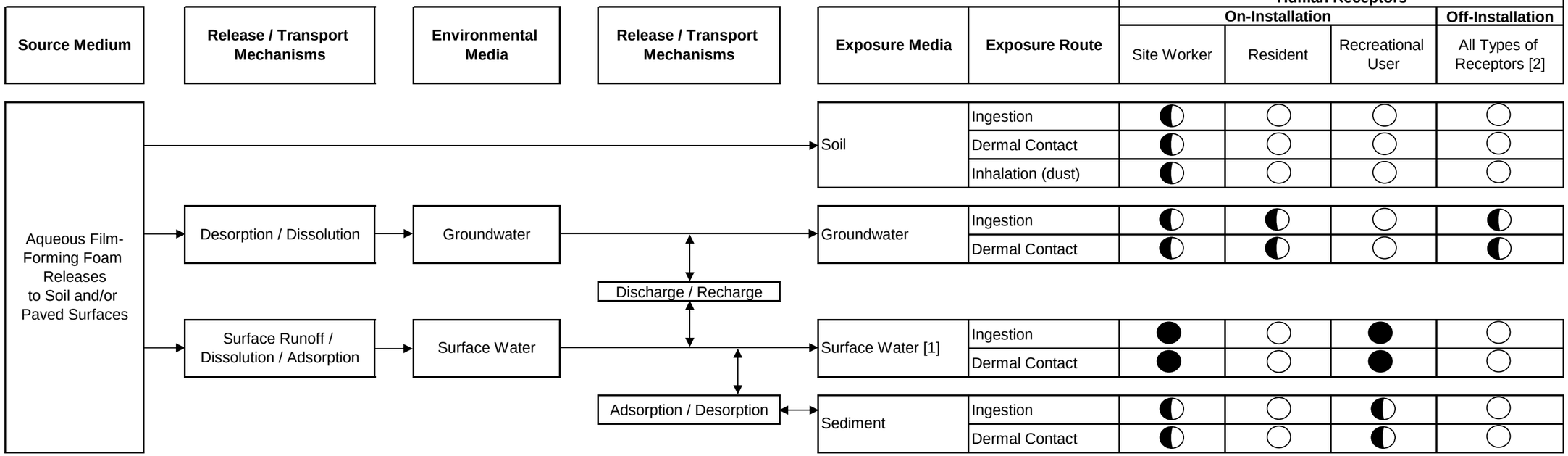
Conceptual Site Model - Campbell Army Airfield Hangar 7274 and Old Clarksville Base Fire Training Area (Solid Waste Management Unit 148)
USAEC PFAS Preliminary Assessment / Site Inspection

Figure 7-8



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

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Conceptual Site Model - Campbell Army Airfield Clamshell, Old Fire Training Area (Solid Waste Management Unit 12/15) and Campbell Army Airfield Hangar 7166
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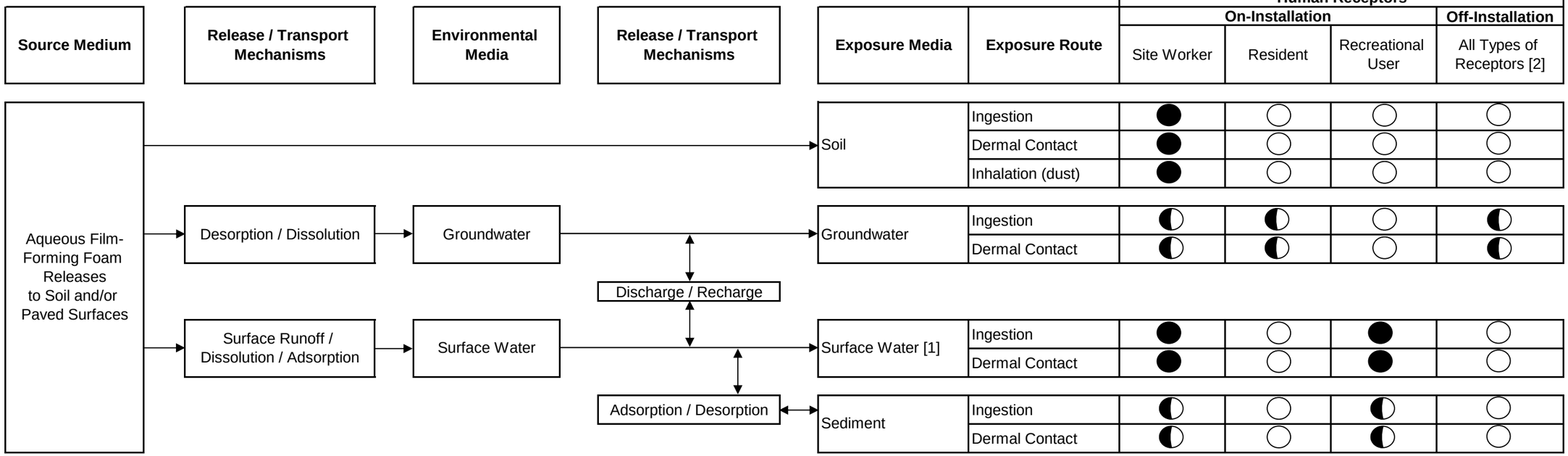
Figure 7-9



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

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Conceptual Site Model - Campbell Army Airfield Former Fire Training Area, Aqueous Film-Forming Foam Rinse-Out Building 6310, and Training Area 03 Crash Site
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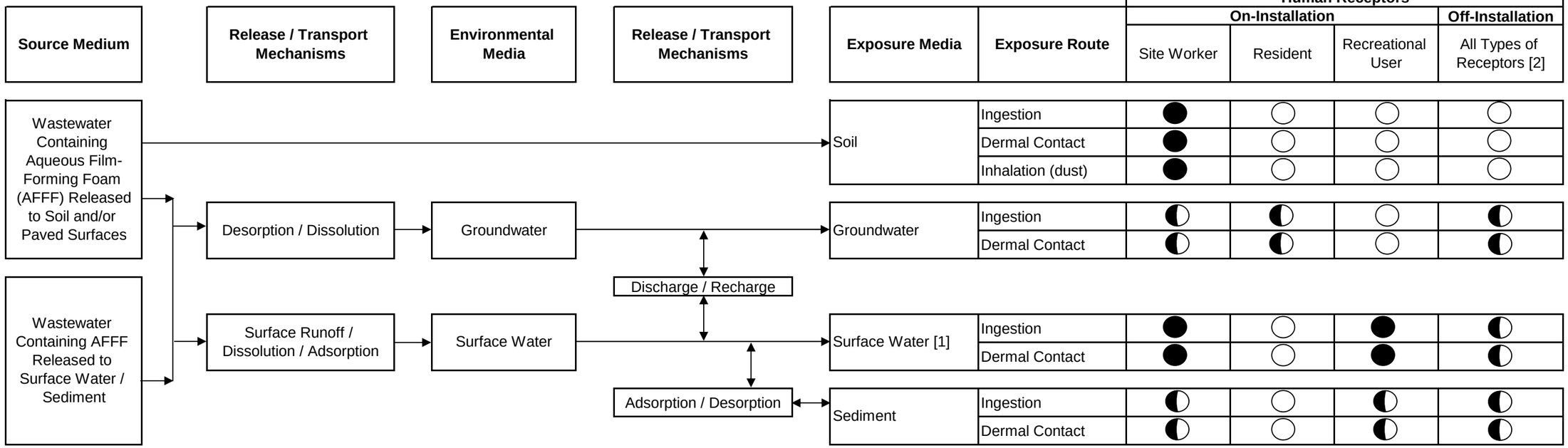
Fort Campbell, Kentucky

Figure 7-10



Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:

[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.

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

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Conceptual Site Model - Wastewater Treatment Plant
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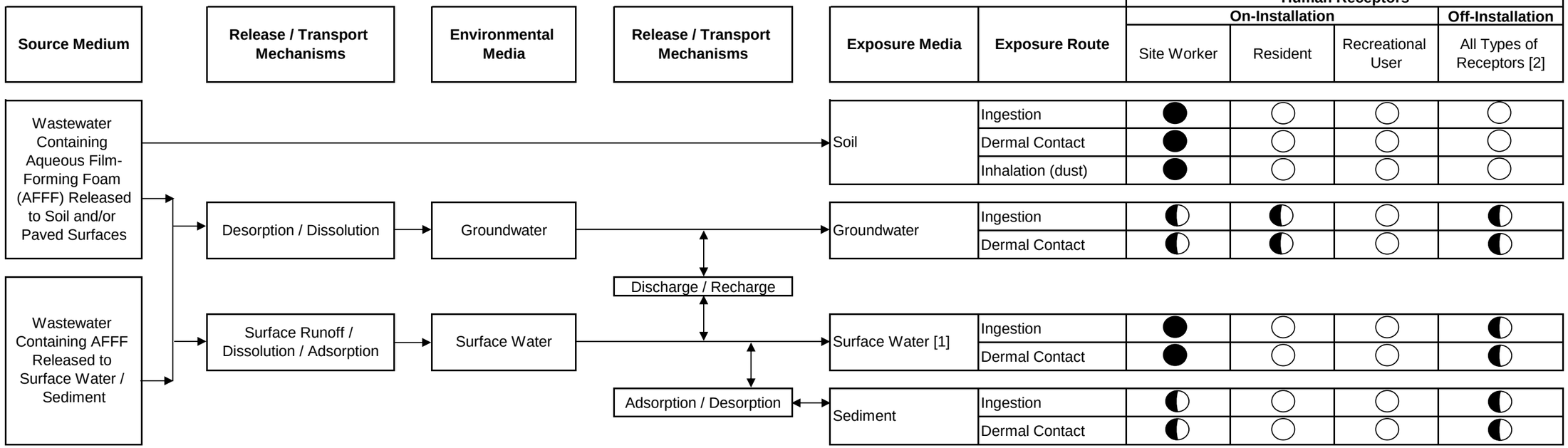
Fort Campbell, Kentucky

Figure 7-11



Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:

[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.

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

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Conceptual Site Model - Former Fire Truck Maintenance Shop Building 5737

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Fort Campbell, Kentucky

Figure 7-12

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 (AFFF) to Soil and/or Paved Surfaces				Soil	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
					Inhalation (dust)	◯	◯	◯	◯
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
			Discharge / Recharge						
	Surface Runoff / Dissolution / Adsorption	Surface Water		Surface Water [1]	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯
			Adsorption / Desorption	Sediment	Ingestion	◯	◯	◯	◯
					Dermal Contact	◯	◯	◯	◯

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

◯ = Incomplete Exposure Pathway

Notes:

[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.

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

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Conceptual Site Model - Conex Containers 40 and 41 AFFF Storage Area

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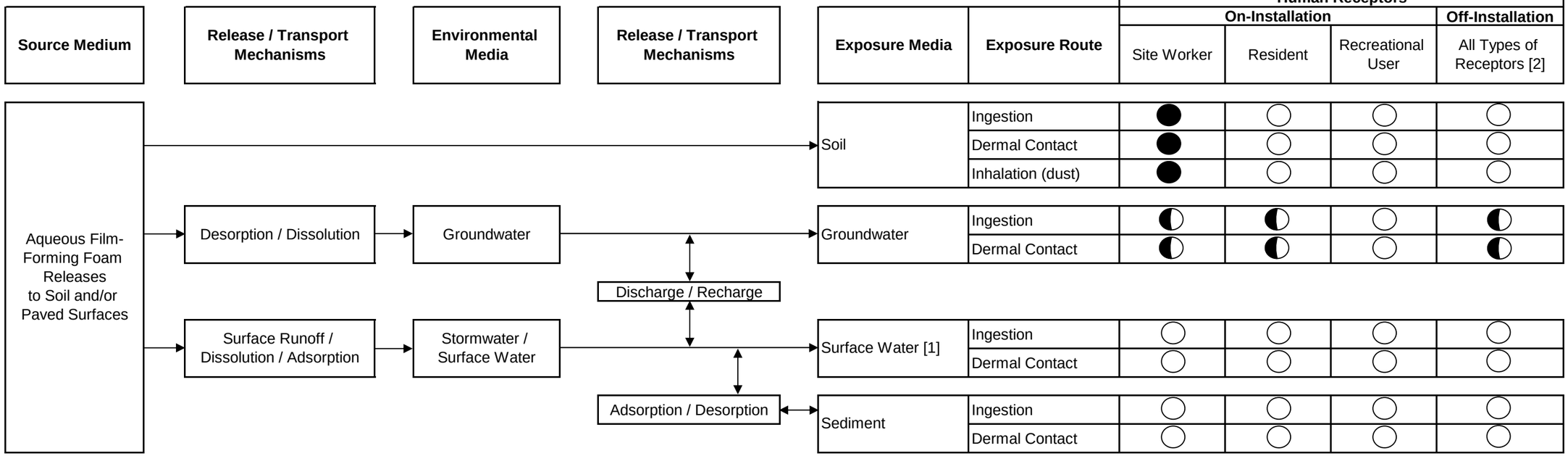
Figure 7-13



Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:

[1] Surface water exposure pathway for Site Workers describes incidental ingestion and dermal contact during an outdoor worker scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.

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

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Conceptual Site Model - Bradley Tank Fire

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Figure 7-14

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