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

Fort Detrick, Maryland

Prepared For:
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October 2022

Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

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Prepared for:

U.S. Army Corps of Engineers

Contract No.: W912DR-18-D-0004

Delivery Order No.: W912DR1818F0685

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October 2022

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

Fort Detrick is located in Frederick County, Maryland within the City of Frederick, approximately 47 miles west of Baltimore, Maryland and 45 miles northwest of Washington, D.C. Fort Detrick is comprised of four noncontiguous parcels designated as Area A, Area B, Area C Water Treatment Plant (WTP), and Area C Wastewater Treatment Plant (WWTP), which in total cover approximately 1,212 acres. All identified AOPIs at Fort Detrick are located within Area A and Area B.

The Fort Detrick PA identified four AOPIs for investigation during the SI phase. SI sampling results from the four AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, and PFBS. PFOS, PFOA, and/or PFBS were detected in soil and/or groundwater at all four AOPIs; however, only one of the four AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The Fort Detrick PA/SI identified the need for further study in a CERCLA 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 Fort Detrick, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No)			Recommendation
	GW	SO	SW	
Area B AFFF Equipment Testing Area 1	Yes[1]	No	No	Further study in a remedial investigation
Area B AFFF Equipment Testing Area 2	No	No	No	No action at this time

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No)			Recommendation
	GW	SO	SW	
Area A Building 1419 – Current Fort Detrick Fire Station	No	No	No	No action at this time
Area A Building 1504 – Former Fort Detrick Fire Station	No	No	No	No action at this time

Notes:

1. Two rounds of groundwater sampling were conducted, in September and December of 2020. The highest PFOS, PFOA, and PFBS concentrations in groundwater from all sampled monitoring wells during both events were used to determine whether there was an OSD residential tap water risk screening levels exceedance.

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

GW – groundwater

SO – soil

SW – surface water

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12580 and is conducting the PA/SI consistent with its authority under CERCLA, 42 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 Detrick 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 Fort Detrick and was completed in accordance with CERCLA and The National Oil and Hazardous Substances Pollution Contingency Plan.

1.1 Project Background

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

In 2016, the United States Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016). On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water 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 (OSD 2021). 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 (industrial/commercial). These screening criteria are discussed further in **Section 6.5**.

1.2 PA/SI Objectives

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

1.2.1 PA Objectives

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

1.2.2 SI Objectives

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

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

1.3 PA/SI Process Description

For Fort Detrick, PA/SI development followed a similar process as described in **Sections 1.3.1** through **1.3.5** below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for Fort Detrick. The PA and SI processes are documented in the PA/SI Quality Control Checklist included as **Appendix B**.

While PA and SI activities were conducted concurrently, the results for Fort Detrick's sub-installation, Forest Glen Annex, will be reported in a separate document, per United States Army Environmental Command (USAEC) request.

1.3.1 Pre-Site Visit

First, an installation kickoff teleconference was held between applicable points of contact (POCs) from USAEC, United States Army Corps of Engineers (USACE), Fort Detrick, and Arcadis U.S., Inc. (Arcadis). The kickoff call was conducted on 11 July 2018, approximately 4 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 Fort Detrick.

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

- The Installation Management Command (IMCOM) operation order
- The Army PA OPSEC 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, and additional document review.

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 07 to 08 August 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.

Personnel interviews were conducted with individuals having significant historical knowledge at Fort Detrick. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, and corroborating other interviewees' information. Site reconnaissance was not performed during the site visit, since all preliminary locations identified during the records review process, the installation in-brief meeting, and during the installation personnel interviews were classified as areas not retained for further investigation.

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 08 August 2018 with the installation 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. 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. Map document files and associated geographic information system (GIS) data are provided as **Appendix D**. GIS data layers created for the project are included in a Spatial Data Standards for Facilities, Infrastructure, and Environment-compliant geodatabase.

1.3.4 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFOS, PFOA, and PFBS presence or absence at each AOPI and determine whether further investigation is warranted. First, an SI kickoff teleconference was held between the Army PA team and Fort Detrick on 24 October 2019.

The objectives of the SI kickoff teleconference were to:

- discuss the AOPIs selected for sampling
- gauge regulatory involvement (USEPA and the Maryland Department of the Environment [MDE]) requirements or preferences
- confirm the plan for investigation derived waste (IDW) handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- discuss general SI deliverable and field work schedule information and logistics.

Following development of the SI sampling technical approach, an SI scoping teleconference was held on 12 November 2019 to obtain concurrence on the SI sampling plan from USAEC, USACE, and the installation. An additional SI scoping call including regulators was held on 03 December 2019 to obtain concurrence on the SI sampling plan from USEPA and MDE. Additional discussion topics during these teleconferences included:

- discuss the proposed sampling plan for each AOPI
- provide an updated SI deliverable and field work schedule.

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 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 Fort Detrick in **Sections 6.1** through **6.1.3**.

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 (DoD 2018). 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 Fort Detrick, 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

Fort Detrick is located in Frederick County, Maryland within the City of Frederick, approximately 47 miles west of Baltimore and 45 miles northwest of Washington, D.C. (**Figure 2-1**). Fort Detrick is comprised of four noncontiguous parcels designated as Area A, Area B, Area C Water Treatment Plant (WTP), and Area C Wastewater Treatment Plant (WWTP), which in total cover approximately 1,212 acres (Arcadis 2013), as shown on **Figure 2-2**. Area A, the largest parcel, is approximately 799 acres and houses most of the installation's activities; consequently, Area A is significantly developed and serves as the main post (PIKA-Arcadis 2018). Area B is located 0.5 mile from Area A and covers approximately 399 acres. Area C is a 12-acre parcel containing the WTP and WWTP for Fort Detrick.

2.2 Mission and Brief Site History

Military use of Fort Detrick began in 1930, when Frederick County leased 90 acres of land (now part of Area A) used as a municipal airport to the Maryland National Guard for use as a summer training camp for the 104th Observation Squadron. In 1941, President Roosevelt ordered the establishment of the U.S. Biological Warfare program, and in 1943, Camp Detrick was assigned to the Army Chemical Warfare Service for the development of a Biological Warfare Research Center. Camp Detrick was established as an installation for the research and development of offensive and defensive biological warfare techniques and agents.

Shortly after the end of World War II, Camp Detrick was designated as a permanent installation. From 1943 through 1969, Fort Detrick served as the nation's center for biological warfare research. Early research (prior to 1945) was conducted in temporary buildings and facilities. These temporary buildings were gradually replaced, and by 1945 approximately 245 permanent structures had been built, most of which have subsequently been demolished (PIKA-Arcadis 2018).

Seven-acre and 5-acre tracts were acquired in 1944 for development and use as water and wastewater treatment plants, respectively. Collectively, these two tracts are now referred to as Area C. In 1946, 399 acres, now designated as Area B, were acquired to provide an outdoor test area, commonly called the "grid test area." An additional 153 acres adjoining Area A were acquired during 1946 and 1947. The Army acquired an additional 503 acres of land adjacent to the Post in 1952 primarily for plant science research in Area A.

After the discontinuance of biological warfare activities on 01 April 1972, control of Fort Detrick was transferred from the U.S. Army Materiel Command to the Office of the Surgeon General, Department of the Army, and was further assigned as a subordinate installation of the U.S. Army Medical Department. In 1973, Fort Detrick was reassigned from the U.S. Army Surgeon General to the newly created U.S. Army

Health Services Command. In 1995, U.S. Army Health Services Command was reorganized into the U.S. Army Medical Command. (Fort Detrick 2007).

As a direct result of the terrorist events in 2001, a concept was developed that Fort Detrick Area A would become the home to a consortium of new laboratories that would be co-located on a campus that would come to be known as the National Interagency Biodefense Campus (Fort Detrick 2018).

In 1946, Area B was acquired to provide an outdoor test area, commonly referred to as the "grid test area," a large circular grid designed to provide an outdoor biological simulant testing area. The Army tested many types of munitions in the Area B-Grid (Arcadis 2019b). In addition to serving as a proving ground, Area B was used as the primary location for Fort Detrick's waste management activities. Eight sites in Area B have been identified as former disposal sites, containing wastes generated at the installation, including chemical, biological, and radiological materials (Arcadis 2019b).

2.3 Current and Projected Land Use

Fort Detrick is currently an IMCOM installation supporting a multi-governmental community that conducts biomedical research and development, medical material management, worldwide communications, and the study of foreign plant pathogens. Each branch of the U.S. military is represented among approximately 7,800 military, federal, and contractor employees assigned to this installation (Fort Detrick 2007).

2.4 Climate

The climate of Frederick County is moderately humid and temperate. The mean temperature is 53 degrees Fahrenheit; the annual mean precipitation is 43 inches and is relatively evenly distributed throughout the year. Additionally, Fort Detrick typically receives an average of 35 inches of snowfall annually; on average, 32 days of the year have at least one inch of snow on the ground. The prevailing wind is from the south. Average windspeed is highest, 11 miles per hour, in March (Arcadis 2019b).

2.5 Topography

Frederick, Maryland is located within the Piedmont Physiographic province, and as such, is marked with gently rolling hills. Fort Detrick itself is positioned in the Frederick Valley, a north-south trending valley approximately 26 miles long and 6 miles wide at its greatest. Elevations at Fort Detrick Area A and Area B range from 300 feet to 400 feet above mean sea level. Catoctin Mountain, which lies west of the installation, belongs to the Appalachian province, and its peak is approximately 1,700 feet above mean sea level (Arcadis 2019b). A topographic map of Fort Detrick is provided on **Figure 2-3.**

2.6 Geology

Much of the Frederick Valley is underlain by the Frederick and Grove Limestones. Dissolution of the limestone has resulted in surface features and drainage systems common to karst topography. The dissolution of the limestone creates cavities within the rocks that become enlarged, progressively integrating subsurface voids. An extensive underground drainage system of voids develops and results in a poorly developed surface network of streams.

Bedrock within the vicinity of Area A is generally hard gray limestone with some tentatively identified shaley units of the Cambrian-aged limestone of the Frederick Formation occurring at depths greater than 50 feet below ground surface (bgs). The limestone has been shown to contain sporadic solution features as indicated during several well installations in Area A, and sinkhole structures have also been observed in the area (IT Corporation 2000). Area B is underlain by two distinct bedrock units: Cambrian-aged limestone of the Frederick Formation underlies the southern part of Area B and Triassic-aged conglomerate of the New Oxford Formation underlies the northern part of Area B (Arcadis 2019b).

2.7 Hydrogeology

Areas A, B and C of Fort Detrick consist of rock that is susceptible to karst weathering, the process by which soluble rock such as limestone is preferentially weathered by circulating groundwater. In karst aquifers, groundwater gradually enlarges the most favorable groundwater pathways, and alters the way in which groundwater moves through the aquifer. Groundwater beneath Area A is confined almost entirely to the limestone bedrock aquifer. Downhole geophysical logs suggest that groundwater flows through secondary fracture or solution porosity. In addition, solution features have also been shown to act as conduits for groundwater movement in the area. Groundwater flow in southwest corner of Area A (near the AOPIs) has been shown to be generally to the southwest (IT Corporation 2000). Throughout most of Area B, the water table occurs in the unconsolidated materials above rock. The saturated thickness of the overburden is generally not more than 15 feet and is described as reddish-brown heterogeneous mixture of silt or clay with sand and gravel. In the northern and far western parts of Area B, the overburden is frequently unsaturated. The transmissivity of the overburden is inferred to be low, a function of the low permeability and limited saturated thickness. Overburden water levels are typically similar to those measured in deeper bedrock, suggesting that the unconsolidated aquifer is hydraulically integrated with bedrock. The overburden aquifer functions primarily for storage and vertical transmission of groundwater, while most lateral transport occurs in the underlying karst system. The majority of groundwater flow that occurs beneath Area B is interpreted to move through a complex network of karst conduits east-by-southeast towards Carroll Creek (Arcadis 2019b).

The primary discharge zones for Area A and Area B groundwater are streams feeding into, and springs located along Carroll Creek. Springs are points of focused groundwater discharge where, in karst aquifers, the groundwater transported in conduit networks discharges to surface water. Area B contains several small springs or seeps feeding Streams 3 and 4 in the southwestern portion of Fort Detrick. Numerous larger springs are located along Carroll Creek where it crosses inside Area B's eastern boundary, extending downstream to and beyond the confluence with Stream 2 (Arcadis 2019b). Spearmint Spring and Robinson Box Spring have been identified as important discharge points for groundwater flow beneath Areas A and B. Many streams originating within or transecting Area B feed into Carroll Creek, which eventually flows into the Monocacy River approximately 4.5 miles downstream of Fort Detrick. The Monocacy River is used for drinking water; however, no intakes have been identified within 5 miles downstream of the Fort Detrick boundary. There are no streams present within the vicinity of the identified Area A AOPIs.

2.8 Surface Water Hydrology

The Monacacy River is the major drainage feature of Frederick County and flows through the Frederick Valley to the Potomac River (Fort Detrick 2018). The Monacacy River is located east of Fort Detrick and the City of Frederick. Carroll Creek is a tributary of the Monacacy River and courses between Areas A and B of Fort Detrick.

As in most karst systems, there is a close relationship between surface water and groundwater. The Carroll Creek drainage basin receives a large portion of its recharge from the Catoctin Mountains, west of Area B, where bedrock is generally low-transmissivity, fractured metamorphic rock. The majority of streams in the basin emerge near the foot of this upland. Where streams pass from the upland onto the karst-influenced, high-transmissivity carbonates in the valley, the streams begin to lose flow and may go dry seasonally. In some instances, streams disappear entirely, where they are captured by sinkholes (e.g., Stream 1 on the western side of Area B). Intense recharge near the Bull Run Mountain Fault (due to the losing streams) drives localized downward gradients and promotes deeper circulation than farther downgradient where recharge is diminished. Note that there is no evidence that the fault itself is a significant preferential flow zone. To the contrary, water-levels in wells nearest the fault show an eastward gradient (away from the fault), indicating that the fault is not a hydraulic sink. As the surface streams descend in elevation eastward, they transition back from losing to gaining, receiving groundwater discharge from springs and seeps. As groundwater moves eastward across Area B, flow paths converge upward and discharge at several springs located along Carroll Creek (Arcadis 2019b).

The Monocacy River, Carroll Creek, and other associated tributaries and streams located within and around Fort Detrick are classified as potable under the MDE classification; however, no drinking water intakes were identified 5-miles downstream of Fort Detrick.

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 Fort Detrick.

2.9.1 Stormwater Management System Description

Stormwater from the central and western portions of Area A drains west into Carroll Creek, whereas stormwater from the eastern portion of Area A drains east into Detrick Branch and Two-Mile Run. There are eight separate surface water outfalls in Area A. The majority of storm water in Area A is diverted through a system of surface ditches, culverts, inlets, and storm sewer lines. There are two principal outfalls in Area B that discharge storm water to Carroll Creek and three outfalls in Area C that discharge storm water to the Monocacy River (Fort Detrick 2018). All discharged water from these areas ultimately flows to the Monocacy River. Fort Detrick has three separate general permits for storm water discharge and one for wastewater discharge (Army 2018).

The large number of new projects and laboratories at Area A following 11 September 2001, prompted Fort Detrick to pursue a regional, watershed-based approach to storm water management rather than a

project-by-project approach. The MDE has approved several Storm Water Institutional Management Plans for Area A.

2.9.2 Sewer System Description

Sanitary wastewater generated from Fort Detrick is conveyed to the Area C WWTP located along the Monocacy River. The treatment process at the WWTP consists of the following: primary clarifiers, trickling filters, secondary clarifiers, chlorinators, flow measurement devices, and sulfur dioxide injectors (sulfonators) for dechlorination. The effluent from the WWTP is discharged to the Monocacy River (USACE 1999).

2.10 Potable Water Supply and Drinking Water Receptors

Fort Detrick maintains its own potable water-supply system, which is sourced from the Monocacy River and treated at the Area C Water Treatment Plant. Fort Detrick also uses groundwater for non-potable, research purposes. Groundwater is provided by two supply wells located in Area A, designated PW-569 and PW-577, which are located adjacent to Building 568 (Arcadis 2019b). No on-post potable water wells are present at Fort Detrick.

Off-post private and municipal well locations within a 2-mile radius of the installation were provided by Fort Detrick personnel from past private well sampling investigations (PIKA 2015), as well as private well and water provision data provided by the Frederick County Division of Planning and Permitting and the Division of Utilities and Solid Waste Management. Much of the property surrounding Area A and property to the south and east of Area B are connected to public water. Future connection to public water is planned for areas to the north and southwest of Area B and to the north of Area A. Private wells and municipal wells were identified in residential areas immediately west of Area B and immediately north of Area A in a residential neighborhood; however, no active water wells were identified south and east of the installations in the interpreted directions of groundwater flow, based on the 2019 Remedial Investigation Report (Arcadis 2019b). **Figure 2-4** shows the locations of the identified off-post private wells and the interpreted directions of groundwater flow in Area A and Area B.

An Environmental Data Resources, Inc. (EDR) report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. An EDR report was generated for Fort Detrick, which 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 providing well search results provided as **Appendix E.**

2.11 Ecological Receptors

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

A variety of wildlife is present at Fort Detrick. White-tailed deer, mice, raccoons, red foxes, and groundhogs are among the animal species that have been observed on the installation. Similarly, many different species of birds have been observed in the area. Carroll Creek is known to support a variety of

fish, including rosyside dace, carp, blacknose dace, longnose dace, bluntnose minnow, creek chub, pearl dace, white sucker, yellow bullhead, redbreast sunfish, bluegill, largemouth bass, fantail darter, Potomac sculpin, and rainbow trout (IT Corporation 2001).

In addition, an unnamed trout hatchery located between Areas A and B was identified as a possible ecological receptor. This trout hatchery resides within Hospital Spring, one of many naturally occurring springs produced from discharging Area A and B groundwater.

Bluegrasses, tall fescue, perennial rye, and other common grasses and forbs exist in Area B (US Army Engineer Waterways Experiment Station 1997). Stream 2, to the south of Area B, is a riparian area dominated by cottonwoods. This riparian area may be classified as an upland wetland (IT Corporation 2001).

2.12 Previous PFAS Investigations

Previous (i.e., pre-PA) PFAS investigations relative to Fort Detrick, including both those conducted and not conducted by the Army, are summarized to provide full context of available PFAS data for Fort Detrick. However, only data collected by the Army will be used to make recommendations for further investigation. In 2016, under the directive of IMCOM, Fort Detrick analyzed water samples collected from the Area C Water Treatment Plant, which supplies water to Fort Detrick, at the point of entry into the distribution system for PFOS and PFOA. Based on discussions with Fort Detrick, low levels of PFOS and PFOA were detected above the PFOS and PFOA detection limit of 2.00 ng/L:

- 2.87 ng/L PFOS
- 2.77 ng/L PFOA

Sampling data from the Third Unregulated Contaminant Monitoring Rule were also reviewed. PFOS and PFOA sampling results from the City of Frederick Entry Point to the Distribution System and six WTP entry points (Lester L. Dingle Filter Plant, Monocacy Filter Plant, Linganore Creek Filter Plant, New Design WTP, and Woodspring WTP), believed to be within a 5-mile radius of Fort Detrick, were reviewed. All these entry points are upgradient of Fort Detrick. Analyses of these samples indicated that PFOS and PFOA were not detected. Detection limits were 40 and 20 ng/L for PFOS and PFOA, respectively.

In October 2019, groundwater samples were collected from wells in and around a capped disposal area located in the southwestern portion of Area B as part of a pump and treat system pilot test. Eighteen groundwater samples from 18 monitoring wells were collected and analyzed for PFAS. The maximum reported concentrations of PFOS, PFOA, and PFBS from this sampling event were 7.7 ng/L for PFOS in BMW-102, 9.0 ng/L for PFOA in BMW-57D and 6.7 ng/L for PFBS in BMW-58D. The locations of the three sampled wells with maximum PFOS, PFOA, and PFBS concentrations and their analytical results are presented on **Figure 2-5**.

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 Fort Detrick, data were collected from two principal sources of information:

1. Records review
2. Personnel interviews

These sources of data, along with their relative application to this PA, are discussed below. The specific findings of records review and personnel interviews relevant to PFAS-containing materials at Fort Detrick are described in **Section 4**.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program (IRP) administrative record documents, compliance 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 Fort Detrick is provided in **Appendix F**.

3.2 Personnel Interviews

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

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

- Acting Fire Chief
- Environmental Manager
- Onsite IRP Manager
- Environmental Chief
- Water Quality Program Manager
- Cultural and Natural Resources Manager
- Pest Controller
- Architect Master Planner
- Master Planner
- Fire Captain

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

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were not conducted at Fort Detrick. Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were evaluated in the PA (during records review and personnel interviews) and were categorized as AOPIs or as areas not retained for further investigation at this time. All preliminary locations identified during the records review process, the installation in-brief meeting, and/or during the installation personnel interviews were classified as areas not retained for further investigation following interviews and analysis of received information from Fort Detrick personnel.

Following the site visit, programmatic guidance detailing AOPI classification was updated to include all fire stations and aqueous film-forming foam (AFFF) storage locations. Based on this guidance, two fire stations were reclassified as AOPIs. Additionally, the Fort Detrick Fire Captain who was not available for comment during the site visit was interviewed via telephone in August, November, and December 2018 and provided information detailing historical AFFF releases as part of fire equipment training exercises in Area B (**Sections 5.2.1 and 5.2.2**). Based on this provided information, two additional areas were added as AOPIs following the site-visit.

A summary of the observations made, and data collected through records reviews (**Appendix F**) and installation personnel interviews (**Appendix G**) during the PA process for Fort Detrick 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**.

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

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

4.1 AFFF Use, Storage, and Disposal Areas

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

Historically, fire-related equipment and materials, including AFFF, were stored in Building 1504, the Former Fort Detrick Fire Department building. Currently, AFFF is stored in the Current Fort Detrick Fire Department building, Building 1419. Review of a Fire and Emergency Services inventory document provided by USAEC noted that 40 gallons of AFFF are stored in Building 1419, and that an additional 90 gallons of AFFF are actively stored on Fort Detrick Fire Department fire engines. Prior to the site-visit, a rotary-wing landing area was identified as a potential storage area for AFFF. Interviews with installation personnel and further review of installation documents confirmed that the landing pad operated between 1929 and 1942, approximately 25 years before the invention and wide-spread use of AFFF.

One area (Building 393) was identified during document research as a possible waste disposal area for empty AFFF totes. Per an interviewed Fort Detrick fire captain, all AFFF on-post was classified and disposed of as hazardous waste and would not have been stored at Building 393. AFFF was likely stored in Building 1520 prior to off-site disposal.

Following personnel interviews and document research, it was concluded that AFFF had been used to assist with Fort Detrick Fire Department training operations. An interviewed Fort Detrick fire captain stated that AFFF was released to ground surface on two occasions as part of an AFFF certification procedure sometime between 2005 and 2008. These two areas, called Area B AFFF Equipment Testing Area 1 and Area B AFFF Equipment Testing Area 2, are located in the northern portion of Area B. The procedures included the release of 0.5 gallon of National Universal Gold 1-3% AFFF. A former burn pit and fire training area operated between 1955 and 1969 was also identified in Area A during records review. An

interviewed Fort Detrick fire chief stated that Fort Detrick would not have had inventory of AFFF during that timeframe.

One confirmed release of AFFF as part of fire response was confirmed at Fort Detrick between 2008 and 2011. An interviewed Fort Detrick fire captain stated that approximately 1 gallon of 3% Universal Gold AFFF was used in response to a dumpster fire located along the wall of Building 376. All released AFFF was reportedly contained within the dumpster, and exposure to the environment did not occur. Another fire response was confirmed to have occurred at Building 527 in 1974. An interviewed Fort Detrick fire chief stated that AFFF use in response to this fire was highly unlikely.

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

Following document research and personnel interviews at Fort Detrick, pesticide and herbicide use areas, WWTP, sludge drying beds, sewer systems, landfills, and waste pits and, were all identified as preliminary locations for use, storage, and/or disposal PFAS-containing materials. A summary of information gathered in 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**.

Pesticide and Herbicide Use and Storage Areas

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 at and/or stored at Army installations and did not identify Fort Detrick as an installation having used or stored PFAS-containing pesticides/insecticides. Additionally, the PA team reviewed available pesticide, herbicide, and insecticide use inventory documentation provided by the installation and did not identify PFAS-containing pesticide, herbicide, or insecticide use, storage, or disposal.

WWTPs, Sludge Drying Beds, and Sewer Systems

As described in **Section 2.9.2**, one WWTP was identified in Area C of Fort Detrick where PFAS-containing materials were potentially disposed of via the Fort Detrick sanitary sewer system and from leachate collected from the Area B Active Landfill between 1991 and 1998. A series of sludge drying beds used to dry biosolid sludge generated at the WWTP between 1982 and 1988 were also identified adjacent to the Area C WWTP.

The Contaminated Sewer System for Biological Agents was also identified in Area A during records review. Operation of this restricted-use sewer system included the piping of biological test waste into a series of holding tanks which were then treated with steam and heat before being released into the primary sanitary sewer system connected to the Area C WWTP. This system was identified due to the potential use of PFAS-containing pesticides and herbicides. The system was retired in 2017.

Landfills/Waste Pits

Three historical landfills, one active landfill and one waste pit were identified in Area B of Fort Detrick where PFAS-containing materials were potentially disposed. Review of historical environmental investigations indicated that sanitary, herbicide and pesticide, medical, decontaminated drum, and metal

waste were disposed at these areas. The active landfill (Active Area B Landfill) also received biosolid waste generated at the Area C WWTP between 1991 and 1998.

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 Fort Detrick) 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.

Interviews with Fort Detrick Fire Department personnel identified a fire-training area located in and operated by Frederick County (approximately 4.5 miles downgradient of Fort Detrick). AFFF response training is conducted at this location. Estimated amounts and frequency of release were not documented. As part of a mutual aid agreement with Frederick County, the Fort Detrick Fire Department has also occasionally used AFFF when responding to vehicle fires on nearby Interstate 70.

Community fire stations within a 5-mile radius of Fort Detrick include; the Frederick County Volunteer Fire and Rescue Department – Headquarters, Independent Hose Company Station 1, Junior Fire Company Station 2, Citizen Truck Company Station 4, United Steam Fire Company Station 3, Braddock Heights Volunteer Fire Company Station, United - Westview Fire Station 23, Frederick County Volunteer Fire and Rescue Department, Spring Ridge Fire Station 33, Walkersville Volunteer Fire Company Station 11, and Middletown Volunteer Fire Company Station 7. These facilities could potentially be off-post PFAS sources if they use AFFF.

5 SUMMARY AND DISCUSSION OF PA RESULTS

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

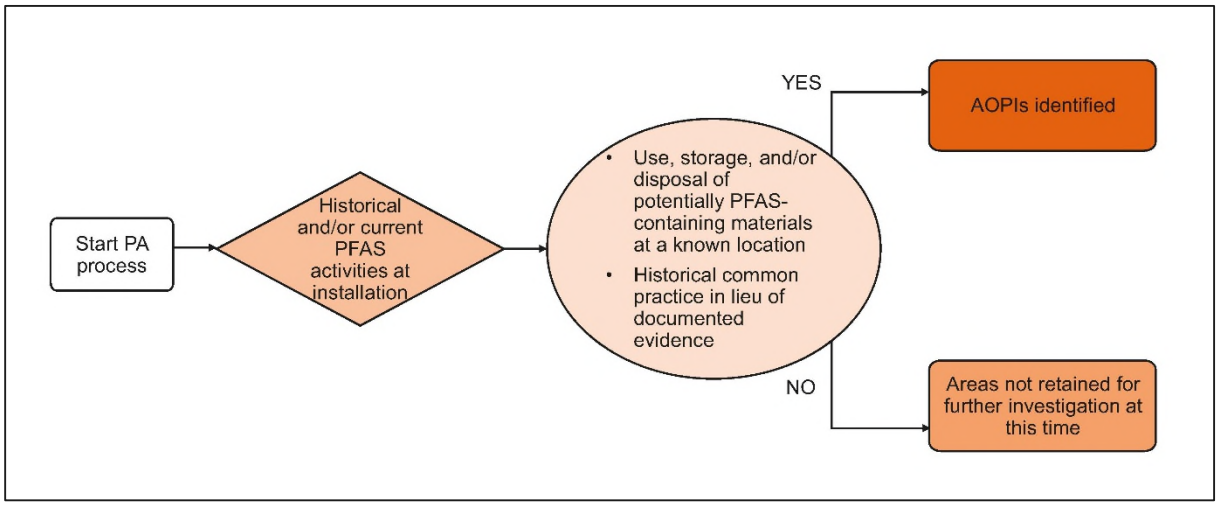

Figure 5-1: AOPI Decision Flowchart

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 Fort Detrick are presented in **Section 8**.

5.1 Areas Not Retained for Further Investigation

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

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

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

Area Description	Dates of Operation	Relevant Site History	Rationale
Burn Pit / Old Fire Training Area (FTD-11)	1955 to 1969	Burn Pit shared the same location as a 1955 Fort Detrick Fire Department training site. The Fort Detrick Fire Department controlled	The dates of use for the Burn Pit predate the period of use for AFFF. No evidence of PFOS, PFOA, or PFBS containing materials used,

Area Description	Dates of Operation	Relevant Site History	Rationale
		access to this burning pit from 1957 until operations ceased in 1969.	stored and/or disposed at this location.
Building 376 – Dumpster Fire Location	2008 to 2011	AFFF used in response to a dumpster fire in the mid- to late 2000s. An interviewed the Fort Detrick Fire Captain stated that approximately 1 gallon of 3% Universal Gold AFFF was used in response to the fire, with all AFFF contained within the dumpster, and exposure to the environment did not occur.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location..
Facility 1501 – Rotary-Wing Landing Area	1929 to 1942	Rarely used landing pad for emergency purposes. No historical evidence of crash response. Only ABC fire extinguishers confirmed as fire suppressants here. Predates usage of AFFF.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Building 527 – Old One-Million Liter Test Sphere	1974	Site of building fire. Surrounding enclosure was razed to ground during fire. Based on an interview with a Fort Detrick Fire Chief, AFFF use at this location is considered highly unlikely. No confirmed knowledge of AFFF use in fire response.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Building 393 – Recycling Center	To Present	The west portion of Building 393 operates as the installation's recycling center. Identified as a possible waste disposal area for AFFF totes prior to the PA site visit. AFFF was disposed of as hazardous waste per an interviewed the Fort Detrick Fire Captain. AFFF cannisters would not have been sent to this recycling center.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Pesticide and Herbicide Testing Fields A, C, D, E, and F	1944 to 1974	Fields A, C, D, E, and F were herbicide and pesticide test fields located within Area A. The Crops Division conducted preliminary tests of various chemicals in the laboratories and greenhouses, and outdoor field experiments with the most promising chemicals followed on a very limited scale at these "garden plots" (e.g., 6- by 18-foot field of a single crop).	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
Ditto Ave Garden Plots	1959 to 1974	Similar to the Herbicide Test Fields A, C, D, E, and F, multiple herbicides were tested at the Ditto Avenue Garden Plots.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Small Crop/Tree Research Plots	Early 1960s to 1974	Similar to the Herbicide Test Fields A, C, D, E, and F, multiple herbicides were tested at the Small Crop/Tree Research Plots.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Building 1315 – Greenhouse Test Area (FTD 67)	1968 to Present	Building 1315 is a greenhouse that was operated by the Vegetation Control Division (part of the Crops Division) from 1968 to 1974 and the U.S. Department of Agriculture (USDA) from 1974 to present. Hundreds of herbicides were tested by both the Crops Division and USDA in and around this greenhouse, with herbicide waste draining into a French drain system.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Building 391 – Spray Facility	Continuous	Located in the western portion of Area A. Building contained three hood compartments used for spray application of test chemicals on plants. An exhaust system had particulate filters certified to remove 99.97% of particles 0.3 micron or larger and deep-bed charcoal filter to remove chemical vapors. No information available detailing the test chemicals used at this location. If any PFOS/PFOA/PFBS releases occurred, they would have been small scale.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Contaminated Sewer System for Biological Agents (FTD-03)/ Area A Sewer System	1946 to 2017	The “Restricted Area” of Fort Detrick contains a “contaminated sewer line” where effluent contaminated by biological agents was piped from drains in the floors of test areas into holding tanks. The effluent was treated with heat and steam to kill biological agents before being released into the non-contaminated sanitary sewer system. Portions of this system were taken out of operations (sealed and decontaminated with hypochlorite) over time and the last of this system was taken out of operation in 2017. This system is no longer in operation.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Building 1520 – Hazardous Waste Storage	~1955 to Present	Building 1520 is the 90-day accumulation point for hazardous wastes that were produced by tenants of the installation.	No evidence of PFOS, PFOA, or PFBS containing pesticides or herbicides used, stored

Area Description	Dates of Operation	Relevant Site History	Rationale
		Room 3 of building is storage for pesticides and herbicides. AFFF canisters stored here prior to off-site disposal.	and/or disposed at this location. No evidence of PFOS, PFOA, or PFBS release from building to environment detailed during interviews.
Building 122 – Pesticide and Herbicide Storage Building	Unknown	There are various herbicides and pesticides stored in this building with the largest container having a capacity of approximately 5 gallons. Potential spills occurring in this building would be contained within the curbed area.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Active Area B Landfill	1990 to Present	Fort Detrick's landfill is in operation approximately twice a week and receives incinerated municipal and medical waste. Since 1990, landfill leachate has been collected and transported to the Area C WWTP for processing. The landfill received WWTP sludge until 1998, and from 2005 to 2014. As there were no identified PFAS-containing material releases into the sanitary sewer system at Fort Detrick, WWTP sludge is not considered a source of PFAS impacts.	No evidence of PFOS, PFOA, or PFBS -containing wastes being disposed of in this landfill.
Area B-3: Landfill (West) (FTD-51)	1970s to 1990	2.8-acre landfill bordering current Fort Detrick landfill located in northwest corner of Area B. Operated as Fort Detrick's sanitary landfill from the 1970s through 1990 and received various types of waste, including biosolids from the Area C WWTP, from 1982 to 1990.	No evidence of PFOS, PFOA, or PFBS -containing wastes being disposed of in this landfill.
Area B-3: Landfill (East) (FTD-51)	1950s to 1960s	0.4-acre landfill located in northwest corner of Area B. Wastes reportedly included herbicide and insecticide waste, decontaminated drums, metal and general debris, and decontaminated (sterilized) materials from Area A laboratories. Fort Detrick not identified as an installation having used or stored PFAS-containing pesticides/insecticides.	No evidence of PFOS, PFOA, or PFBS -containing wastes being disposed of in this landfill.
Area B-11 Chemical Disposal Area (FTD-49)	1969 to 1972	These pits received wastes from Fort Detrick, the U.S. Bureau of Standards, and Walter Reed Army Medical Center. Wastes disposed here include laboratory chemicals, pesticides/herbicides, and medical wastes.	No evidence of PFOS, PFOA, or PFBS -containing wastes being disposed of in this landfill.

Area Description	Dates of Operation	Relevant Site History	Rationale
		Sandia decontamination foam used during 2001 to 2004 excavation. Foam determined to be not PFAS-containing. Fort Detrick not identified as an installation having used or stored PFAS-containing pesticides / insecticides.	
Herbicide Testing Field B	1947 to 1974	Field B was an herbicide test field located in the northeastern quadrant of Area B. The Crops Division conducted preliminary tests of various chemicals in the Area A laboratories and greenhouses, and outdoor field experiments with the most promising chemicals would have been conducted in this test parcel.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.
Area C: Wastewater Treatment Plant (FTD-63) Effluent Outfall	1991 to Present	The Area C WWTP began receiving leachate from the Area B Active Landfill in 1991. The WWTP outfall is downstream of the Water Treatment Plant intake in the Monocacy River. WWTP sludge was applied to the Area B Active Landfill until 1998. Between 1998 and 2004, Fort Detrick sent the dried sludge to a radioactive waste facility in Utah. Starting in 2005, sludge was again applied to the Area B Active Landfill. Fort Detrick started contracting off-site disposal of WWTP sludge in 2013 to 2014.	No disposal of PFAS-containing materials were identified to have been introduced to the Area C WWTP; therefore, the WWTP and generated sludge is not considered a source of PFAS-contamination. WWTP sewage treatment process outfall is an active location covered by MDE National Pollutant Discharge Elimination System permits and is not covered by the Installation Restoration Program or CERCLA. Sewage sludge generation and off-site disposal is an ongoing process that is not covered by the Installation Restoration Program or CERCLA.
Sludge Drying Beds	1982 to 1988	Between 1982 and 1988, sludge was stockpiled next to the WWTP and then moved to the Area B-3 Landfill. Approximately 100 tons of dry sludge per year were placed directly on the ground, uncovered. Active Area B landfill leachate was introduced into the WWTP starting	No evidence of PFOS, PFOA, or PFBS containing materials used, stored and/or disposed at this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
		1990, and these sludge beds predate that time frame.	

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. Two of the AOPIs overlap with Fort Detrick IRP sites and/or Headquarters Army Environmental System (HQAES) sites (**Figure 5-2**). The AOPI, overlapping IRP site identifier, HQAES number, and current site status are discussed within each AOPI subsection presented below. At the time of this PA, one of the Fort Detrick IRP sites (Fort Detrick Area B Groundwater, FTD 72/24225.1043) has historically been investigated for the possible presence of PFAS in a limited area, as described in **Section 2.12**.

The AOPI locations are shown on **Figure 5-2**. Aerial photographs of each AOPI are presented on **Figures 5-3** through **5-6** and include active monitoring wells in the vicinity of each AOPI.

5.2.1 Area B AFFF Equipment Testing Area 1 (FTD 72/24225.1043)

The Area B AFFF Equipment Testing Area 1 (**Figure 5-3)** is identified as an AOPI following records research and personnel interviews due to the use, storage, and/or disposal of PFAS-containing materials. Historically National Gold 1-3% AFFF was used as part of a unit certification exercise conducted at this location sometime between 2008 and 2015. Less than 1-gallon total of diluted (0.1%) AFFF was reportedly sprayed. The Area B AFFF Equipment Testing Area 1 resides atop a grassy open area adjacent to a dirt road surrounding the active Area B Landfill. The area is relatively level. Groundwater and surface water within the vicinity of this AOPI flow off-post and discharge into multiple springs located along the eastern boundary of Area B. These springs feed into Carroll Creek with eventual discharge into the Monocacy River. Both river bodies are classified as potable by the MDE.

The Area B AFFF Equipment Testing Area 1 AOPI resides within the boundaries of one existing IRP site: Area B Groundwater (FTD 72/24225.1043). All groundwater in Area B was included under the Fort Detrick IRP program in 2004. The site is currently being investigated for a trichloroethene (TCE)/ tetrachloroethene (PCE) plume that extends from the southwestern portion of Area B in an easterly direction beyond the eastern Area B boundary. The exact dimensions of the plume are unknown due, in part, to the Karst geology. The site is currently undergoing interim remedial action.

5.2.2 Area B AFFF Equipment Testing Area 2 (FTD 72/24225.1043; FTD 43/24225.1015)

The Area B AFFF Equipment Testing Area 2 (**Figure 5-4)** is identified as an AOPI following records research and personnel interviews due to the use, storage, and/or disposal of PFAS-containing materials. Historically National Gold 1-3% AFFF was used as part of a unit certification exercise conducted at this location sometime between 2008 and 2015. Less than 1-gallon total of diluted (0.1%) AFFF was reportedly sprayed. The Area B AFFF Equipment Testing Area 2 resides atop a gravel lot surrounded by grass. Multiple storage containers surround the site as well as one small building located towards the

northeast. Groundwater and surface water within the vicinity of this AOPI flow off-post and discharge into multiple springs located along the eastern boundary of Area B. These springs feed into Carroll Creek with eventual discharge into the Monocacy River. Both river bodies are classified as potable by the MDE.

The Area B AFFF Equipment Testing Area 2 AOPI resides within the boundaries of two existing IRP sites: Area B Groundwater (FTD 72/24225.1043) and the Pit 20 Detonation Area (FTD 43/24225.1015). All groundwater in Area B was included under the Fort Detrick IRP program as site FTD 72 in 2004. The site is currently being investigated for a TCE/PCE plume that extends from the southwestern portion of Area B in an easterly direction beyond the eastern Area B boundary. The exact dimensions of the plume are unknown due, in part, to the Karst geology. The site is currently undergoing interim remedial action.

The Pit 20 Detonation Area IRP site (FTD 43/ 24225.1015) consists of two former explosives burn pits. One pit in the north (B20 N) overlaps with the boundaries of the Area B AFFF Equipment Testing Area 2. B20 N was historically investigated for explosives and metals. A remedial investigation was conducted at the site in 2007, and a No Further Action Decision Document was signed in February 2008.

5.2.3 Area A Building 1419 – Current Fort Detrick Fire Station

The Area A – Building 1419 – Current Fort Detrick Fire Station (**Figure 5-5)** is identified as an AOPI following records research and personnel interviews due to the use, storage, and/or disposal of PFAS-containing materials. Historical and current storage of firetrucks and containers containing AFFF is documented at this location. The AOPI resides within the developed administrative Area A of Fort Detrick. The fire station is bounded to the east and west by two cement driveways, with grass lawns bordering the edges of the driveways. Based on review of aerial photography and topographic maps, surface runoff is suspected to flow radially along the driveways and across topography into storm water channels.

5.2.4 Area A Building 1504 – Former Fort Detrick Fire Station

The Area A – Building 1504 – Former Fort Detrick Fire Station (**Figure 5-6)** is identified as an AOPI following records research and personnel interviews due to the use, storage, and/or disposal of PFAS-containing materials. Historical storage of firetrucks and containers containing AFFF is documented at this location. Additionally, there is a lack of operational history of AFFF use at the fire station from before the mid-to late-2000s. The AOPI was in use until 2011 and resides within the developed administrative Area A of Fort Detrick. The fire station is bounded to the northwest and southeast by two cement driveways. Grass lawns border portions of the southwestern and southeastern boundaries of the fire station building. Based on review of aerial photography and topographic maps, surface runoff is suspected to flow northeast along topography into storm water channels located along the main fire station access road.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at Fort Detrick, an SI for PFOS, PFOA, and PFBS was conducted in accordance with CERCLA. SI sampling was completed at Fort Detrick at all four 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 2020b) 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 2012b). 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 sediment pathways as potentially complete, which guided the SI sampling. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI sampling began in September 2020 with the collection of field data and analytical samples. Four Area B monitoring wells were resampled in December 2020.

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 2020b) 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 Fort Detrick. Non-conformances 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 2020b), the objective of the SI is to identify whether there has been a release to the environment at the AOPIs identified in the PA and to determine if further investigation is warranted. This SI evaluated groundwater, soil, and surface water for PFOS, PFOA, and PFBS presence or absence at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

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

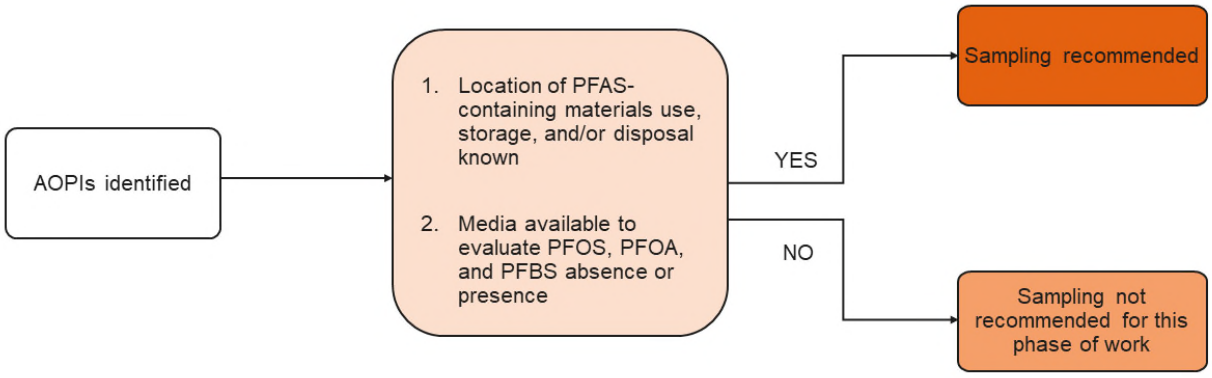

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at Fort Detrick is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2020b) for the September 2020 sampling event.

Surface water and groundwater were sampled to identify PFAS presence, type (of the selected constituents as listed in Worksheet #15 of the QAPP Addendum [Arcadis 2020b]), and concentrations. Soil was sampled to identify PFAS presence, type (of the 19 selected constituents as listed in Worksheet #18 of the PQAPP [Arcadis 2019a]), and concentrations, as wells as for total organic carbon (TOC), pH, and grain size in one sample collected per AOPI (i.e., not every soil sample collected). These data were collected as they may be useful in future fate and transport studies. The targeted sampling areas are believed to have the greatest potential for PFOS, PFOA, and PFBS detections associated with known releases of AFFF.

The sampling depths at existing monitoring wells were at approximately the center of the saturated screened interval. **Table 6-1** includes the monitoring well construction details for the wells sampled during the SI.

6.2.1 Area A

At Fort Detrick Area A, three soil samples were collected from each of the two AOPIs (Building 1419 and Building 1504). Two existing pumping wells (PW-569 and PW-577) downgradient of potential release areas were sampled to evaluate whether PFOS, PFOA, and/or PFBS has impacted groundwater at/near the AOPIs. Surface water was collected from Spearmint Spring, which is a known groundwater discharge point for Area A.

6.2.2 Area B

At Fort Detrick Area B in September 2020, six soil samples and six groundwater samples collected from existing monitoring wells were analyzed to inform the presence or absence of PFOS, PFOA, and PFBS at the AFFF Equipment Testing Area 1 and AFFF Equipment Testing Area 2 Area B AOPIs. In December 2020, four of the Fort Detrick Area B monitoring wells were resampled to confirm September 2020 results. (Note: to be conservative, the highest PFOS, PFOA and PFBS concentrations in groundwater from all sampled monitoring wells during both events was used to determine whether there was an OSD

residential tap water risk screening level exceedance). In September 2020, a surface water sample was also collected from Robinson Box Spring, which is a known groundwater discharge point for Area B.

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 2020b), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2020a). The sampling methods described in the SOPs and TGIs establish equipment requirements, procedures for preparing equipment and containers before sampling, sampling procedures under various conditions, and procedures for storing samples to ensure that sample contamination does not occur during collection and transport. In general, sampling techniques used in the SI were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2019a) and QAPP Addendum (Arcadis 2020b). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes (i.e., daily logs) and field forms (i.e., groundwater purging logs and sample collection logs) documenting the SI sampling activities are included in **Appendix H** and **Appendix I**, respectively.

6.3.1 Field Methods

6.3.1.1 Area A

At Area A, groundwater samples were collected from existing, active pumping wells. Groundwater from the active pumping wells was collected as grab samples from existing, in-line sample ports prior to treatment. Soil samples were collected via hand auger from 0 to 2 feet bgs. Grab surface water samples were collected using PFAS-free bailers from Spearmint Spring. Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 6.3.4**

6.3.1.2 Area B

At Area B, groundwater samples were collected using Fort Detrick-specific modified low-flow purging methods from approximately the center of the saturated screened interval at existing monitoring wells. Based on depth to water measurements, either a peristaltic pump or portable bladder pump with PFAS-free disposable high-density polyethylene tubing was used to collect groundwater samples. Soil samples were collected via hand auger from 0 to 2 feet bgs. Grab surface water samples were collected using PFAS-free bailers from Robinson Box Spring. Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 6.3.4.**

6.3.2 Quality Assurance/Quality Control

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

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2020b), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, and PFBS. EBs were collected for media sampled for PFOS, PFOA, and PFBS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2020b). The decontaminated reusable equipment from which equipment blanks were collected include pump/tubing, hand augers, and water-level meters, as applicable to the sampled media. Analytical results for blank 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) were encountered during the Fort Detrick SI work.

In some cases, clarifications to the established scope of work were needed but do not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum. A minor modification to the scope of work detailed in the QAPP Addendum and PQAPP and that did not affect DQOs is summarized below:

- Based on a call with the Army on 10 November 2020, the decision was made to resample the wells near Area B AFFF Equipment Testing Area 1. These field activities were conducted on 10 December 2020 and 28 December 2020. Minutes from this call are included as **Appendix J.**

6.3.4 Decontamination

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

6.3.5 Investigation-Derived Waste

IDW soils from the investigation were spread on the Area B landfill. Groundwater purged during sampling and water from decontamination were containerized in Department of Transportation-approved 55-gallon drums, labeled as non-hazardous, and analyzed for waste characterization. The water IDW was then disposed through a carbon drum into the Area B sanitary sewer. Equipment IDW was collected in bags and disposed in municipal waste receptacles. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, and high-density polyethylene and silicon tubing) that may come in contact with sampling media. Analytical results for IDW samples collected during the SI are discussed in **Section 7.5**.

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, an ELAP-accredited laboratory for PFAS analysis including PFOS, PFOA, and PFBS by liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 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 (DoD 2017), 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 2020b) 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% confidence” (DoD 2017). The lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias is known as the limit of quantitation ([LOQ]; DoD 2017). Concentrations detected between the LOD and LOQ, therefore, are considered estimates and are qualified as such on laboratory analytical reports. Instrument-specific detection limits (e.g., the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence; DoD 2017), as provided for each analyte by the laboratory, are reported along with the LODs and LOQs in the laboratory analytical reports included in the Data Usability Summary Report (DUSR) (**Appendix K**)**.**

6.4.2 Data Validation

All analytical data generated during the SI, except grain size and data generated from IDW profiling, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019a). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.1 (DoD 2017). 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 K**. The Level IV analytical reports are included within **Appendix L** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

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

Based on the final data usability assessment, the environmental data collected at Fort Detrick during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix K**), and as indicated in the full analytical tables (**Appendix L**) provided for the SI results. These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019a) and Fort Detrick and Forest Glen QAPP Addendum (Arcadis 2020b). Data qualifiers applied to laboratory analytical results for samples collected during the SI at Fort Detrick are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-2**.

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]	Soil (mg/kg or ppm) [1,2]	Soil (mg/kg or ppm) [1,2]
PFOS	40	0.13	1.6
PFOA	40	0.13	1.6
PFBS	600	1.9	25

Notes:

1. Risk screening levels for tap water and soil provided by the OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15 (**Appendix A**).
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet bgs), regardless of the current and projected land use of the AOPI.

mg/kg = milligram per kilogram
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 and surface water data for this Army PFAS PA/SI. The surface water from the springs is an expression of groundwater. While the current and most likely future land uses of the AOPIs at Fort Detrick are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, and PFBS will be used to evaluate detected soil concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, or PFBS are detected greater than the applicable OSD risk screening levels, further study in a remedial investigation is recommended in **Section 8.**

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at Fort Detrick (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 2020b). The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

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

Field parameters measured for groundwater during low-flow purging and sample collection and for surface water during sample collection are provided on the field forms in **Appendix I**. Soil lithological descriptions are provided on the field forms in **Appendix I**. The results of the SI are grouped by AOPI and discussed for each medium as applicable. Groundwater was generally first encountered at depths of approximately 23.5 to 25 feet bgs downgradient of Area B AFFF Equipment Testing Area 1 and 20 to 35 feet bgs in the vicinity of the Area B AFFF Equipment Testing Area 2.

Table 7-4 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Y/N)
Area B AFFF Equipment Testing Area 1	Y[1]
Area B AFFF Equipment Testing Area 2	N
Area A Building 1419 – Current Fort Detrick Fire Station	N
Area A Building 1504 – Former Fort Detrick Fire Station	N

Notes:

1. Two rounds of groundwater sampling were conducted in September and December of 2020. The highest PFOS, PFOA and PFBS concentrations in groundwater from all sampled monitoring wells during both events was used to determine whether there was an OSD residential tap water risk screening levels exceedance.

7.1 Area A Building 1419 – Current Fort Detrick Fire Station

The subsections below summarize the soil PFOS, PFOA, and PFBS analytical results associated with the Building 1419 – Current Fort Detrick Fire Station. The Building 1419 – Current Fort Detrick Fire Station is located in the south-central portion of Area A along Ditto Avenue. The majority of groundwater flow that occurs beneath Area A is interpreted to move through a complex network of karst conduits east-by-southwest (IT Corporation 2000).

7.1.1 Downgradient Area A Groundwater and Surface Water

The primary discharge zones for groundwater originating from beneath Area A are streams feeding into Carroll Creek and springs located to the west of Area A along Carroll Creek. Springs are points of focused groundwater discharge where, in karst aquifers, the groundwater transported in conduit networks discharges to surface water. The subsections below summarize the groundwater and surface water PFOS, PFOA, and PFBS analytical results associated with groundwater and surface water samples collected from existing non-potable supply wells and springs located downgradient of the Building 1419 – Current Fort Detrick Fire Station and the Building 1504 – Former Fort Detrick Fire Station AOPIs.

7.1.1.1 Groundwater

Groundwater sampling was conducted at two existing non-potable supply wells (FTD-PW577 and FTD-PW569) located hydraulically downgradient of the Building 1419 – Current Fort Detrick Fire Station and the Building 1504 – Former Fort Detrick Fire Station AOPIs. **Figure 7-2** and **Table 7-1** show the analytical results for these downgradient groundwater sampling locations.

PFOS was detected at concentrations of 3.4 ng/L in FTD-PW577, 4 M ng/L in FTD-PW569, and 3.6 M ng/L in a duplicate sample collected from FTD-PW577. The reported concentrations of PFOS in all collected samples did not exceed OSD risk screening levels.

PFOA was detected at concentrations of 3.3 M ng/L in FTD-PW577, 3.6 M ng/L in FTD-PW569, and 3.5 M ng/L in a duplicate sample collected from FTD-PW577. The reported concentrations of PFOA in all collected samples did not exceed OSD risk screening levels.

PFBS was detected at concentrations of 2 ng/L in FTD-PW577, 2.1 M ng/L in FTD-PW569, and 2.2 M ng/L in a duplicate sample collected from FTD-PW577. The reported concentrations of PFBS in all collected samples did not exceed OSD risk screening levels

7.1.1.2 Surface Water

One surface water sample and corresponding duplicate sample was collected from Spearmint Spring, one of the primary discharge points for groundwater transported in conduit networks via surface water from Area A. **Figure 7-2** and **Table 7-3** show the analytical results for the collected surface water sample.

PFOS was detected in the normal and duplicate sample at concentrations of 7.5 M ng/L and 7.4 ng/L, respectively. PFOA was detected in the normal and duplicate sample at concentrations of 4.3 M ng/L and 4.4 M ng/L, respectively. PFBS was detected in the normal and duplicate sample at concentrations of 4.3

M ng/L and 4.4 M ng/L, respectively. The reported concentrations of PFOS, PFOA, and PFBS in both the normal and duplicate samples did not exceed the OSD risk screening levels for tap water.

7.1.2 Soil

Soil sampling was conducted at Building 1419 – Current Fort Detrick Fire Station at three borings located alongside the main fire station driveway. Composite soil samples were collected from 0 to 2 feet bgs using a hand auger. **Figure 7-2** and **Table 7-2** show the analytical results for soil sampling locations at the Building 1419 – Current Fort Detrick Fire Station AOPI.

PFOS was detected at concentrations of 0.00023 JM mg/kg at FTD-B1419-1-SO, 0.00023 JM mg/kg at FTD-B1419-3-SO, and in normal and duplicate samples at FTD-B1419-2-SO at concentrations of 0.00025 JM mg/kg and 0.00023 mg/kg JM, respectively. The reported concentrations of PFOS in all collected samples did not exceed OSD risk screening levels.

PFOA was detected at concentrations of 0.00026 JM mg/kg at FTD-B1419-1-SO, 0.00033 JM mg/kg at FTD-B1419-3-SO, and a in normal and duplicate samples at FTD-B1419-2-SO at concentrations of 0.00066 JM mg/kg and 0.00026 JM mg/kg, respectively. The reported concentrations of PFOS in all collected samples did not exceed OSD risk screening levels.

PFBS was not detected in any of the soil samples.

7.2 Area A Building 1504 – Former Fort Detrick Fire Station

The subsections below summarize the soil PFOS, PFOA, and PFBS analytical results associated with the Building 1504 – Former Fort Detrick Fire Station AOPI. The Building 1504 – Former Fort Detrick Fire Station AOPI is located in the southern portion of Area A along Porter Street and against the southern installation boundary. The majority of groundwater flow that occurs beneath Area A is interpreted to move through a complex network of karst conduits east-by-southwest (IT Corporation 2000).

7.2.1 Downgradient Area A Groundwater and Surface Water

Downgradient Area A groundwater and surface water are described in **Section 7.3.1**.

7.2.2 Soil

Composite soil samples were collected via hand auger from a depth of 0 to 2 feet at three distinct points located along the main Building 1504 – Former Fort Detrick Fire Station AOPI driveway. **Figure 7-2** and **Table 7-2** show the analytical results for soil sampling locations at the Building 1419 – Current Fort Detrick Fire Station AOPI.

PFOS was detected at a concentration of 0.0016 mg/kg in sample FTD-B1504-3-SO, and at estimated concentrations of 0.00087 M mg/kg in sample FTD-B1504-1-SO and 0.00056 JM mg/kg in sample FTD-B1504-2-SO. The reported concentrations of PFOS in all collected samples did not exceed OSD risk screening levels.

PFOA was detected at a concentration of 0.00094 M mg/kg in sample FTD-B1504-3-SO, and at an estimated concentration of 0.00038 JM mg/kg in sample FTD-B1504-2-SO. PFOA was not detected in

sample FTD-B1504-1-SO. The reported concentrations of PFOA in samples FTD-B1504-2-SO and FTD-B1504-3-SO did not exceed OSD risk screening levels.

PFBS was detected at an estimated concentration of 0.00045 J mg/kg in sample FTD-B1504-3-SO. PFBS was not detected in samples FTD-B1504-1-SO and FTD-B1504-2-SO. The reported concentration of PFBS in sample FTD-B1504-3-SO did not exceed OSD risk screening levels.

7.3 Area B AFFF Equipment Testing Area 1

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results associated with the Area B AFFF Equipment Testing Area 1. The Area B AFFF Equipment Testing Area 1 is located in the northwestern corner of Area B and directly north of the Active Area B Landfill (FTD-48). During SI sampling, depth to groundwater was observed to be between 23.5 feet bgs and 25 feet bgs in monitoring wells BMW-3, BMW-77 and BMW-5 located down-gradient of the Area B AFFF Equipment Testing Area 1. The majority of groundwater flow that occurs beneath Area B is interpreted to move through a complex network of karst conduits east-by-southeast towards Carroll Creek (Arcadis 2019b).

7.3.1 Groundwater

Two rounds of groundwater sampling were conducted in September and December of 2020. Groundwater samples were collected from three existing monitoring wells located downgradient of the Area B AFFF Equipment Testing Area 1 AOPI. **Figure 7-3** and **Table 7-1** show the analytical results for these sampling events. PFOS, PFOA and PFBS were detected in groundwater at all sampled monitoring wells during both events.

PFOS was detected in groundwater at a concentration (43 M [manually integrated compound] ng/L) exceeding the OSD risk screening level for tap water at BMW-77 in September 2020. Subsequent sampling in December 2020 detected PFOS in groundwater at a concentration (11 ng/L) below the OSD risk screening level for tap water. PFOS was detected in groundwater samples collected from BMW-3 and BMW-5 in September and December 2020, but all at concentrations below the OSD risk screening level for tap water. PFOS concentrations at BMW-3 ranged between a high of 26 M ng/L in September 2020 to a low of 10 ng/L in December 2020. PFOS was detected at BMW-5 at a concentration of 11 M ng/L and 11 ng/L in September and December 2020, respectively.

PFOA was detected in groundwater at a concentration (41 M ng/L) exceeding the OSD risk screening level for tap water (40 ng/L) at BMW-77 in September 2020. Subsequent resampling in December 2020 detected PFOA in groundwater at a concentration (24 M ng/L) below the OSD risk screening level for tap water. PFOA was also detected in groundwater samples collected from BMW-3 and BMW-5 in both September and December 2020, but all at concentrations were below the OSD risk screening level for tap water (40 ng/L). PFOA concentrations in samples collected from BMW-3 ranged from a high of 11 M ng/L in the normal sample collected in September 2020, to a low of 4.9 M ng/L in a duplicate sample collected in December 2020. PFOA concentrations in samples collected from BMW-5 ranged from a high of 7.8 M ng/L in the normal sample collected in September 2020, to a low of 6.5 ng/L in the normal sample collected in December 2020.

PFBS was detected in groundwater at concentrations below the OSD risk screening levels for drinking water in all samples collected from BMW-3, BMW-5, and BMW-77 in September and December 2020.

PFBS concentrations ranged between a low of 1.6 J (estimated quantity) ng/L in the September sample collected at BMW-5, to a high of 5.3 ng/L in the September sample collected at BMW-77

7.3.2 Soil

Soil sampling was conducted at the Area B AFFF Equipment Testing Area 1 at three borings located within the potential source area. Composite soil samples were collected from 0 to 2 feet bgs using a hand auger. **Figure 7-3** and **Table 7-2** show the analytical results for soil sampling locations at the Area B AFFF Equipment Testing Area 1 AOPI. PFOS was detected at two of the soil sampling location and PFOA was detected at one of the soil sampling locations., PFBS was not detected in any of the soil sampling locations. The concentrations of PFOS and PFOA did not exceed their respective OSD risk screening levels.

PFOS was detected at estimated concentrations of 0.00038 J mg/kg in sample FTD-AFFF1-2-SO, and 0.00042 JM mg/kg in sample FTD-AFFF1-3-SO. PFOS was not detected in either normal or duplicate samples collected at FTD-AFFF1-1-SO.

PFOA was detected at an estimated concentration of 0.00034 JM mg/kg in sample FTD-AFFF1-3-SO. PFOA was not detected at AFFF-1-2-SO or in normal or duplicate samples collected at FTD-AFFF1-1-SO.

PFBS was not detected in any of the normal or duplicate samples collected.

7.4 Area B AFFF Equipment Testing Area 2

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results associated with the Area B AFFF Equipment Testing Area 2. The Area B AFFF Equipment Testing Area 2 is located in the north-central portion of Area B and due east of the Active Area B Landfill (FTD-48). During SI sampling, depth to groundwater was observed to be between 20.37 feet bgs and 34.76 feet bgs in monitoring wells BMW-29A, BMW-11 and BMW-11D. The majority of groundwater flow that occurs beneath Area B is interpreted to move through a complex network of karst conduits east-by-southeast towards Carroll Creek (Arcadis 2019b).

7.4.1 Groundwater

Groundwater sampling was conducted at the Area B AFFF Equipment Testing Area 2 in September 2020 at one existing monitoring well located within the footprint of the potential source area (BMW-29A), and two downgradient existing monitoring wells (BMW-11 and BMW-11D). In December 2020, groundwater from BMW-29A was resampled and analyzed for PFOS, PFOA, and PFBS; BMW-11 and BMW-11D were not resampled in December 2020. **Figure 7-3** and **Table 7-1** show the analytical results for groundwater sampling locations at the Area B AFFF Equipment Testing Area 2. The depth to groundwater ranged from approximately 20 feet bgs to 34.76 feet bgs at the time samples were collected in both September and December.

PFOS, PFOA and PFBS were not detected in groundwater at well BMW-11.

PFOS, PFOA, and PFBS were detected in the September 2020 groundwater sample collected from BMW-11D at concentrations of 4.3 M ng/L, 2.5 M ng/L, and 0.91 J ng/L, respectively. All three compounds were detected at concentrations below the OSD tap water risk screening levels.

PFOS, PFOA, and PFBS were detected in the September 2020 groundwater sample collected from BMW-29A at concentrations of 2.7 M ng/L, 19 M ng/L, and 2.8 J- (estimated quantity; may be biased low) ng/L, respectively. All three compounds were detected at concentrations below the OSD risk screening levels for groundwater. One additional groundwater sample was collected from BMW-29A in December 2020 and analyzed for PFAS. PFOS, PFOA, and PFBS from this sample were detected below the OSD tap water risk screening levels at respective concentrations of 3.5 M ng/L, 16 M ng/L, and 0.97 JM ng/L.

7.4.2 Soil

Soil sampling was conducted at the Area B AFFF Equipment Testing Area 2 at three borings located within the potential source area. Composite soil samples were collected from 0 to 2 feet bgs using a hand auger. **Figure 7-3** and **Table 7-2** show the analytical results for soil sampling locations at the Area B AFFF Equipment Testing Area 2 AOPI.

PFOS was detected at a concentration of 0.0094 M mg/kg at sample point FTD-AFFF2-1-SO, and at an estimated concentration of 0.00028 JM mg/kg at sample point FTD-AFFF2-2-SO. The concentrations of PFOS did not exceed OSD risk screening levels.

PFOA and PFBS were not detected.

7.4.3 Downgradient Area B Surface Water

The primary discharge zones for groundwater originating from beneath Area B are streams feeding into Carroll Creek and springs located to the east of Area B along Carroll Creek. Springs are points of focused groundwater discharge where, in karst aquifers, the groundwater transported in conduit networks discharges to surface water. This subsection summarizes the surface water PFOS, PFOA, and PFBS analytical results associated with the surface water sample collected at Robinson Box Spring, one of the primary discharge points for groundwater transported in conduit networks via surface water from Area B. **Figure 7-3** and **Table 7-3** show the analytical results for this surface water sample.

PFOS, PFOA, and PFBS were detected at respective concentrations of 2.4 I ng/L, 1.7 M ng/L, and 2.9 ng/L. The reported concentrations of all three compounds did not exceed their respective OSD tap water risk screening levels.

7.5 Investigation Derived Waste

Specific IDW samples were not collected as part of this project, rather analytical results were averaged from the samples collected at each well. None of the analytical samples exceeded 70 ng/L for PFOS, PFOA, and/or PFBS. The IDW water was run through granular activated carbon, as agreed upon by the installation. The IDW disposal plan was coordinated with Fort Detrick. The full analytical results (i.e., for all constituents analyzed) collected during the SI are included in **Appendix L**.

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 25,000 to 4,200 mg/kg, with an average on 13,625 mg/kg. The TOC at this installation was within range of values typically observed in topsoil (5,000 to 30,000 mg/kg). The combined percentage of fines (i.e., silt and clay) in soils at Fort Detrick ranged from 48.4 to 67.3% with an average of 60.06%. In general, 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 at Fort Detrick ranged from 13% to 24.9% with an average of 17.23% and was typical for clay. The pH of the soil was slightly alkaline (7 to 9 standard units). Based on these geochemical and physical soil characteristics (i.e., high percentage of fines and TOC) observed underlying the installation during the SI, PFAS constituents are expected to be relatively less mobile at Fort Detrick than in soils with lower percentages of fines and TOC.

7.7 Blank Samples

Detections of PFOS, PFOA, and PFBS are summarized below for QA/QC samples. Other than what is noted below, concentrations of PFOS, PFOA, and PFBS in all other QA/QC samples were not detected.

PFOA was detected in the equipment blank sample FTD-EB-2(090820) at a concentration of 1.7 J ng/L. The equipment blank was collected to determine PFOS, PFOA, and PFBS presence in the stainless-steel scoop used to place soil from the ground into the soil sample container. The PFOA detection in the equipment blank was three orders of magnitude lower than the residential OSD risk screening level for soil and therefore could not contribute to a false positive conclusion. Additionally, no soil samples demonstrated PFOA concentrations greater than 1% of the residential OSD risk screening level, so cross contamination is not an issue. The full analytical results for blank samples collected during the SI are included in **Appendix L**.

7.8 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2020b) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSM presented on **Figure 7-4** and in this section therefore represent the current understanding of the potential for human exposure. For all 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, PFBS releases at Army installations are soil, groundwater, surface water, and sediment. Once released to the environment, a primary factor that inhibits the movement of PFAS constituents is the presence of organic matter and organic co-constituents in soils and sediments. Generally, PFAS constituents are mobile in the potentially affected media, and they are not known to be fully broken down by natural processes.

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

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

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

Figure 7-4 shows the CSM for all four AOPIs identified at Fort Detrick. AFFF was historically released to soil at both Area B AFFF Equipment Testing Areas 1 and 2. AFFF was confirmed to be stored at both Building 1419 – Current Fort Detrick Fire Station and Building 1504 – Former Fort Detrick Fire Station. Releases of AFFF to soil and pavement could migrate to groundwater via desorption and dissolution, and to surface water and sediment of Carroll Creek via shallow groundwater discharge from Robinson Box Spring.

- PFOS, PFOA, and/or PFBS were detected in soil at all identified AOPIs, and site workers could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete. The AOPIs are not likely to be regularly accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at the Area B AOPIs (AFFF Equipment Testing Area 1 and AFFF Equipment Testing Area 2), as well as downgradient of the two identified Area A AOPIs (Building 1419 – Current Fort Detrick Fire Station and Building 1504 – Former Fort Detrick Fire Station). The four AOPIs are downgradient of the Area C Water Treatment Plant and are therefore not likely to affect potable water supply at Fort Detrick. Therefore, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are incomplete. Recreational users are not likely to contact groundwater in the subsurface on-post; therefore, the groundwater exposure pathway for on-installation recreational users is incomplete. Recreational users and/or residents may contact

groundwater at the off-post discharge points of Robinson Box or Spearmint Spring; therefore, the groundwater exposure pathway for off-installation recreational users is potentially complete.

- PFOS, PFOA, and/or PFBS were detected in groundwater and groundwater originating at these AOPIs flows off-post towards Carroll Creek through Area A's western boundary, and Area B's eastern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Surface water bodies on-post are not used for drinking water. On-installation site workers and residents are not likely to contact surface water and sediment; therefore, these exposure pathways are incomplete. Recreational users could contact constituents in Carroll Creek through incidental ingestion and dermal contact; as such, the surface water and sediment exposure pathways for on-installation recreational users are potentially complete.
- Surface water bodies flow off-post through Carroll Creek before discharging to the Monocacy River. Although both Carroll Creek and the Monocacy River are not currently used for drinking water within 5 miles downstream of the Fort Detrick boundary, there is the potential that these surface water bodies could be used for drinking water in the future. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is complete. Additionally, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are complete.

Following the SI sampling, all four AOPIs had confirmed PFOS, PFOA, and/or PFBS presence and were considered to have complete or potentially complete exposure pathways. Although the CSM indicates 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 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA/SI included two distinct efforts. The PA identified AOPIs at Fort Detrick 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.

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

Fort Detrick maintains its own potable water-supply system, which is sourced from the Monocacy River and treated at the Area C Water Treatment Plant. In 2016, under the directive of IMCOM, Fort Detrick analyzed water samples collected from the Area C Water Treatment Plant at the point of entry into the distribution system for PFOS and PFOA. Low levels of PFOS (2.87 ng/L) and PFOA (2.77 ng/L) were detected above their respective minimum reporting level of 2.00 ng/L. All reported detections of PFOS and PFOA were below their respective OSD risk screening levels for water.

In 2019, PFOS and PFOA were sampled in the groundwater of the southern portion of Area B. Maximum concentrations of PFOS and PFOA were 7.7 ng/L in BMW-102 and 9.0 ng/L in BMW-57D, respectively.

All AOPIs were sampled during the SI at Fort Detrick to identify presence or absence of PFOS, PFOA, and PFBS at each AOPI. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the Fort Detrick QAPP Addendum (Arcadis 2020). All four AOPIs had detections of PFOS, PFOA, and/or PFBS in groundwater, soil, and surface water, and one AOPI exceeded OSD risk screening levels. PFOS, PFOA, and PFBS detections and maximum concentrations in each sampled medium are summarized below:

- All 15 groundwater samples collected had PFOS, PFOA, and/or PFBS detections. The maximum PFOS, PFOA, and PFBS concentrations in groundwater were observed at the Area B AFFF Equipment Testing Area 1 AOPI from existing monitoring well BMW-77 on 8 September 2020. PFOS (43 M ng/L) and PFOA (41 M ng/L) were detected at concentrations above the OSD risk screening level, and PFBS (5.3 ng/L) was detected at a concentration below the OSD risk screening level. When resampled on 10 December 2020, the PFOS and PFOA concentrations were 11 ng/L and 24 ng/L, respectively.
- Ten out of 12 soil samples collected had PFOS, PFOA, and/or PFBS detections, but none of the detections exceeded their respective OSD risk screening levels. The maximum concentration of PFOS in soil (0.0094 M mg/kg) was observed at the Area B AFFF Equipment Testing Area 2 AOPI. The maximum concentration of PFOA (0.00094 M mg/kg) and PFBS (0.00045 J mg/kg) in soil were observed at the Area A Building 1504 – Former Fort Detrick Fire Station AOPI.
- PFOS, PFOA, and PFBS were detected in surface water samples collected from both the Area A and the Area B groundwater discharge points at concentrations below their respective OSD risk

screening levels. The maximum surface water detections for PFOS, PFOA, and PFBS were observed in the surface water samples collected for Area A at Spearmint Spring, with concentrations of 7.5 ng/L, 4.4 ng/L, and 4.4 ng/L, respectively.

Following the SI sampling, all identified AOPIs had confirmed PFOS, PFOA, and/or PFBS presence and were considered to have complete or potentially complete exposure pathways. Soil exposure pathways for on-installation site workers are potentially complete at all four AOPIs. PFOS, PFOA and/or PFBS were detected in groundwater at or downgradient of all AOPIs.. Due to a lack of land use controls off-installation and downgradient of Fort Detrick, the groundwater exposure pathways for off-installation receptors are also potentially complete for all four AOPIs. Surface water is not used for drinking water at Fort Detrick, however recreational users and off-installation receptors could contact constituents in surface water and sediment via incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways are potentially complete for both on-installation recreational users and off-installation receptors**.**

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 8-1** below summarizes the AOPIs identified at Fort Detrick, PFOS, PFOA, and PFBS sampling and recommendations for each AOPI; further investigation is warranted at Fort Detrick. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

Table 8-1 Summary of AOPIs Identified during the PA, PFOS, PFOA, and PFBS Sampling at Fort Detrick and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No)			Recommendation
	GW	SO	SW	
Area B AFFF Equipment Testing Area 1	Yes[1]	No	No	Further study in a remedial investigation
Area B AFFF Equipment Testing Area 2	No	No	No	No action at this time
Area A Building 1419 – Current Fort Detrick Fire Station	No	No	No	No action at this time
Area A Building 1504 – Former Fort Detrick Fire Station	No	No	No	No action at this time

Notes:

1. Two rounds of groundwater sampling were conducted in September and December of 2020. The highest PFOS, PFOA and PFBS concentrations in groundwater from all sampled monitoring wells during both events was used to determine whether there was an OSD residential tap water risk screening levels exceedance.

Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
SO – soil

SW – surface water

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

Discrepancies in AFFF inventory totals were noted during the PA stage. AFFF inventory amounts provided by Fort Detrick Fire Department personnel during the site-visit differed from the AFFF inventory totals reported to and compiled by IMCOM in 2016.

Documents detailing the brands of pesticides used for testing purposes by the USDA at Fort Detrick Building 1315 – Greenhouse Test Area between the years of 1980 to 2008, 2013, and 2015 to 2017 were provided by Fort Detrick personnel following the site visit. The extensive pesticide data was not reviewed for potential PFAS constituents before the Building 1315 – Greenhouse Test Area was excluded as an AOPI because it was determined that pesticide testing practices at this location were unlikely to contain PFAS-containing materials.

The Pesticide and Herbicide Testing Fields A, B, C, D, E and F, the Ditto Avenue Garden Plots, and the Small Crop/Tree Research Plots at Fort Detrick were used for herbicide testing purposes between 1944 to 1974. Documents detailing the herbicides tested at these locations between 1944 to 1962 were reviewed and found not to contain PFAS-containing materials (USACE 2012a). The herbicide testing data for the years 1963 to 1974 was not available for review, and thus the application of PFAS-containing herbicides at these test locations during this timeframe could not be confirmed.

Chemical inventories detailing the pesticides and herbicides tested at the Building 391 – Spray Facility, and the Building 122 – Pesticide and Herbicide Storage Building were not available for review. As such, PFOS, PFOA, and/or PFBS usage could not be confirmed.

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

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

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

Finally, the available PFOS, PFOA, and PFBS analytical data is limited to results from existing monitoring wells, surface water samples collected from known groundwater discharge springs, and shallow soil samples from the four AOPIs. No residential wells or private wells were included in this SI. Available data, including PFOS, PFOA, and PFBS, are listed in **Appendix L**, which were analyzed per the selected analytical method.

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

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ACRONYMS

%	percent
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
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
GIS	geographic information system
GW	groundwater
IDW	investigation-derived waste
IMCOM	Installation Management Command
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
J	estimated quantity
J-	estimated quantity; may be biased low
LOD	limit of detection
LOQ	limit of quantitation
M	manually integrated compound
MDE	Maryland Department of the Environment
mg/kg	milligrams per kilogram (parts per million)
N	no
ng/L	nanograms per liter (parts per trillion)
OSD	Office of the Secretary of Defense

PA	preliminary assessment
PCE	tetrachloroethene
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SW	surface water
TCE	trichloroethene
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
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
WTP	water treatment plant
WWTP	wastewater treatment plant
Y	yes

TABLES

Table 6-1 - Monitoring Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Detrick, Maryland

ARCADIS

Area of Potential Interest	Sampling Location ID[1]	Total Well Depth (ft bgs)	Measuring Point Elevation (ft amsl)	Measuring Point	Depth to Groundwater from MP (ft)	Groundwater Elevation (ft amsl)	Screened Interval (ft bgs)	Casing Diameter (inches)
FTD – Area B AFFF Equipment Testing Area 2	FTD-BMW11	NM	357.2	TOC	22.7	334.5	25-35	2
	FTD-BMW11D	NM	357.3	TOC	22.5	334.8	153.8-163.8	2
	FTD-BMW29A	60	371.03	TOC	37.6	333.5	48-58	2
	FTD-BMW3	NM	367.5	TOC	29.9	337.6	25-35	2
FTD – Area B AFFF Equipment Testing Area 1	FTD-BMW5	NM	360.1	TOC	26.6	333.5	25-35	2
	FTD-BMW77	73.5	366.26	TOC	28.8	337.5	56-71	2

Notes:
1. All sampled monitoring wells were already existing monitoring wells.

Acronyms/Abreviations:

AFFF - aqueous film-forming foam
amsl - above mean sea level
bgs - below ground surface
ft - feet
FTD - Fort Detrick
ID - identification
MP - measuring point
NM - not measured (not surveyed)
TOC - top of casing
UNK- unknown

Sources:
Fort Detrick Site Inspection Field Forms
Arcadis. 2019b. Draft Final Remedial Investigation Report – Area B Groundwater. December.

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

					Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
					OSD Tapwater RiskScreening Level	40		40		600	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
FTD – Area A (Buildings 1409 and 1504)	Monitoring Well	FTD-PW569	FTD-PW569(090920)	09/09/2020	N	**4.0**	M	**3.6**	M	**2.1**	
FTD – Area A (Buildings 1409 and 1504)	Monitoring Well	FTD-PW577	DUP-02-SW(090920) / FTD-PW577(090920)	09/09/2020	FD	**3.6**	M	**3.5**	M	**2.2**	
			FTD-PW577(090920)	09/09/2020	N	**3.4**	J-	**3.3**	MJ-	**2.0**	J-
FTD – Area B AFFF Equipment Testing Area 2	Monitoring Well	FTD-BMW-11	FTD-BMW11(090920)	09/09/2020	N	1.8	U	1.8	U	1.8	U
FTD – Area B AFFF Equipment Testing Area 2	Monitoring Well	FTD-BMW-11D	FTD-BMW11D(090920)	09/09/2020	N	**4.3**	M	**2.5**	M	**0.91**	J
FTD – Area B AFFF Equipment Testing Area 2	Monitoring Well	FTD-BMW-29A	FTD-BMW29A(090820)	09/08/2020	N	**2.7**	M	**19**	M	**2.8**	J-
			FTD-BMW29A(122820)	12/28/2020	N	**3.5**	M	**16**	M	**0.97**	JM
FTD – Area B AFFF Equipment Testing Area 1	Monitoring Well	FTD-BMW-3	DUP-01-GW(090920) / FTD-BMW3(090920)	09/09/2020	FD	**23**	M	**9.7**	M	**3.8**	
			FTD-BMW3(090920)	09/09/2020	N	**26**	M	**11**	M	**4.1**	
			FTD-DUP01-GW-121020 / FTD-BMW3-121020	12/10/2020	FD	**10**		**4.9**	M	**2.2**	BJ+
			FTD-BMW3-121020	12/10/2020	N	**10**		**5.1**	M	**2.1**	
FTD – Area B AFFF Equipment Testing Area 1	Monitoring Well	FTD-BMW-5	FTD-BMW5(090820)	09/08/2020	N	**11**	M	**7.8**	M	**2.0**	
			FTD-BMW5-121020	12/10/2020	N	**11**		**6.5**		**1.6**	J
FTD – Area B AFFF Equipment Testing Area 1	Monitoring Well	FTD-BMW-77	FTD-BMW77(090820)	09/08/2020	N	**43**	M	**41**	M	**5.3**	
			FTD-BMW77-121020	12/10/2020	N	**11**		**24**	M	**4.8**	

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

Acronyms/Abbreviations:
AFFF = aqueous film-forming foam
AOPI = area of potential interest
FTD = Fort Detrick
ID = identification
N = primary sample
ng/L = nanogram per liter
OSD = Office of the Secretary of Defense
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
Qual = qualifier

Qualifier
BJ+ = Detected sample results greater than the limit of quantification (LOQ) and less than the blank action level (BAL)
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.
M = Manually integrated compound
U = The analyte was anlyzed for but the result was not detected above the limit of quantitation (LOQ).

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Detrick, Maryland

			Analyte			PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
			OSD Industrial/Commercial Risk Screening Level			1.6		1.6		25	
			OSD Residential RiskScreening Levels			0.13		0.13		1.9	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
FTD – Area A Building 1419 – Current Fort Detrick Fire Station	Soil	FTD-B1419-1	FTD-B1419-1-SO(090920)	09/09/2020	N	**0.00023**	JM	**0.00026**	JM	0.0022	U
FTD – Area A Building 1419 – Current Fort Detrick Fire Station	Soil	FTD-B1419-2	DUP-02-SO(090920) / FTD-B1419-2-SO(090920)	09/09/2020	FD	**0.00023**	JM	**0.00026**	JM	0.0022	U
			FTD-B1419-2-SO(090920)	09/09/2020	N	**0.00025**	JM	0.00066	U	0.0022	U
FTD – Area A Building 1419 – Current Fort Detrick Fire Station	Soil	FTD-B1419-3	FTD-B1419-3-SO(090920)	09/09/2020	N	**0.00023**	JM	**0.00033**	JM	0.0021	U
FTD – Area A Building 1504 – Former Fort Detrick Fire Station	Soil	FTD-B1504-1	FTD-B1504-1-SO(090920)	09/09/2020	N	**0.00087**	M	0.00075	U	0.0025	U
FTD – Area A Building 1504 – Former Fort Detrick Fire Station	Soil	FTD-B1504-2	FTD-B1504-2-SO(090920)	09/09/2020	N	**0.00056**	JM	**0.00038**	JM	0.0023	U
FTD – Area A Building 1504 – Former Fort Detrick Fire Station	Soil	FTD-B1504-3	FTD-B1504-3-SO(090920)	09/09/2020	N	**0.0016**		**0.00094**	M	**0.00045**	J
FTD – Area B AFFF Equipment Testing Area 1	Soil	FTD-AFFF1-1	DUP-01-SO(090820) / FTD-AFFF1-1-SO(090820)	09/08/2020	FD	0.0007	U	0.0007	U	0.0023	U
			FTD-AFFF1-1-SO(090820)	09/08/2020	N	0.00073	U	0.00073	U	0.0024	U
FTD – Area B AFFF Equipment Testing Area 1	Soil	FTD-AFFF1-2	FTD-AFFF1-2-SO(090820)	09/08/2020	N	**0.00038**	J	0.00072	U	0.0024	U
FTD – Area B AFFF Equipment Testing Area 1	Soil	FTD-AFFF1-3	FTD-AFFF1-3-SO(090820)	09/08/2020	N	**0.00042**	JM	**0.00034**	JM	0.0023	U
FTD – Area B AFFF Equipment Testing Area 2	Soil	FTD-AFFF2-1	FTD-AFFF2-1-SO(090820)	09/08/2020	N	**0.0094**	M	0.00073	U	0.0024	U
FTD – Area B AFFF Equipment Testing Area 2	Soil	FTD-AFFF2-2	FTD-AFFF2-2-SO(090820)	09/08/2020	N	**0.00028**	JM	0.00069	U	0.0023	U
FTD – Area B AFFF Equipment Testing Area 2	Soil	FTD-AFFF2-3	FTD-AFFF2-3-SO(090820)	09/08/2020	N	0.00065	U	0.00065	U	0.0022	U

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Detrick, Maryland

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

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

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

Table 7-3 - Surface Water PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Fort Detrick, Maryland

						PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
			Analyte								
			OSD Tapwater RiskScreening Level			40		40		600	
Associated AOPI	Location Type	Location	Sample ID / Parent Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
FTD – Area A (Buildings 1409 and 1504)	Surface Water/Seep	FTD-AREAA-1	DUP-01-SW(090920) / FTD-AREAA1(090920)	09/09/2020	FD	**7.4**		**4.4**	M	**4.4**	
			FTD-AREAA1(090920)	09/09/2020	N	**7.5**	MJ-	**4.3**	MJ-	**4.3**	J-
FTD – Area B (AFFF Release Areas 1 and 2)	Surface Water/Seep	FTD-AREAB-1	FTD-AREAB1(090920)	09/09/2020	N	**2.4**	J	**1.7**	M	**2.9**	

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

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

Qualifier
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.
M = Manually intergrated compound

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 2-1
Site Location

NOTE: SOME MAP FEATURES REMOVED TO COMPLY WITH OPERATIONAL SECURITY REQUIREMENTS

Area A

Area B

Area C

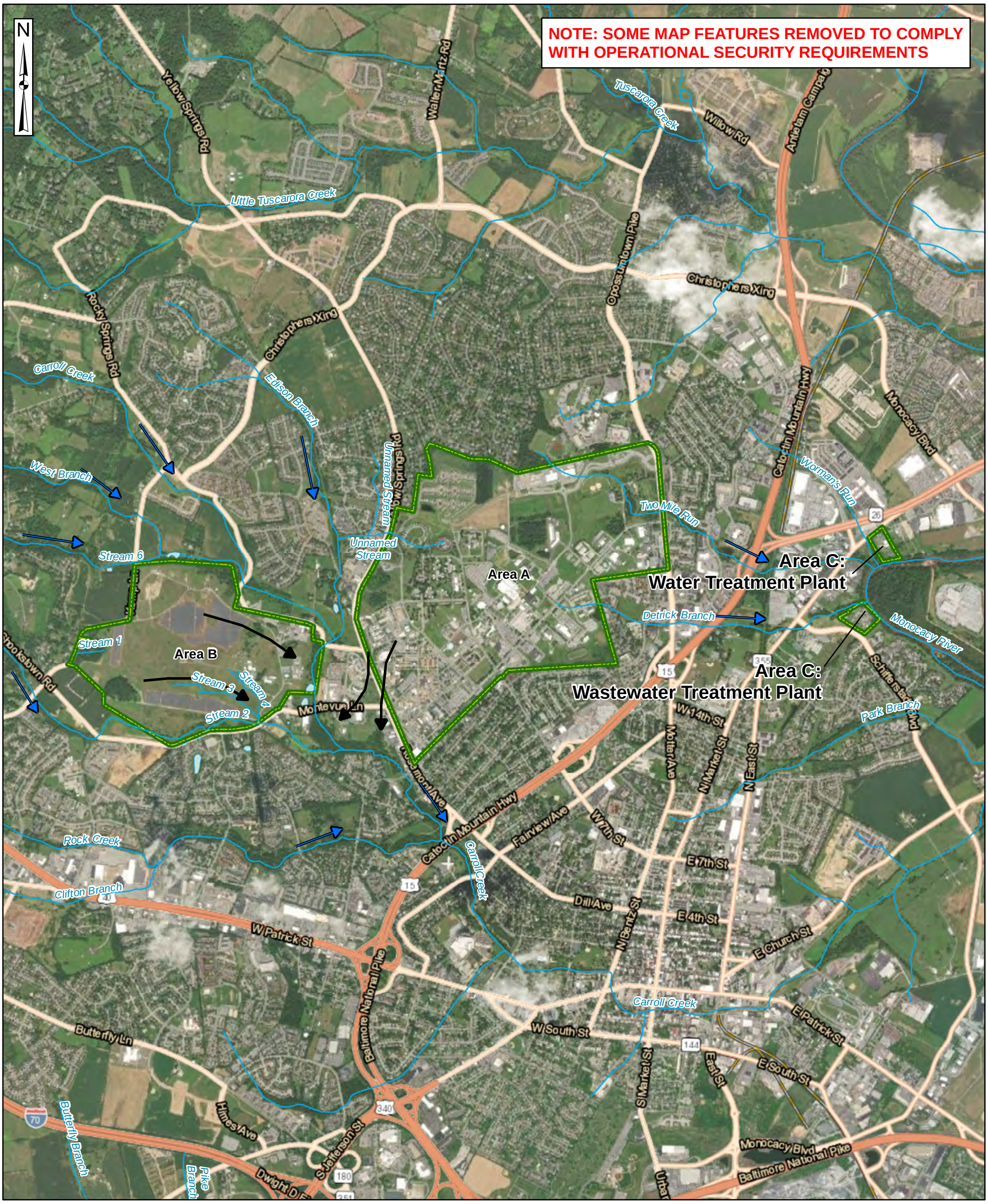
Installation Boundary

Data Sources:
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 2-2
Site Layout

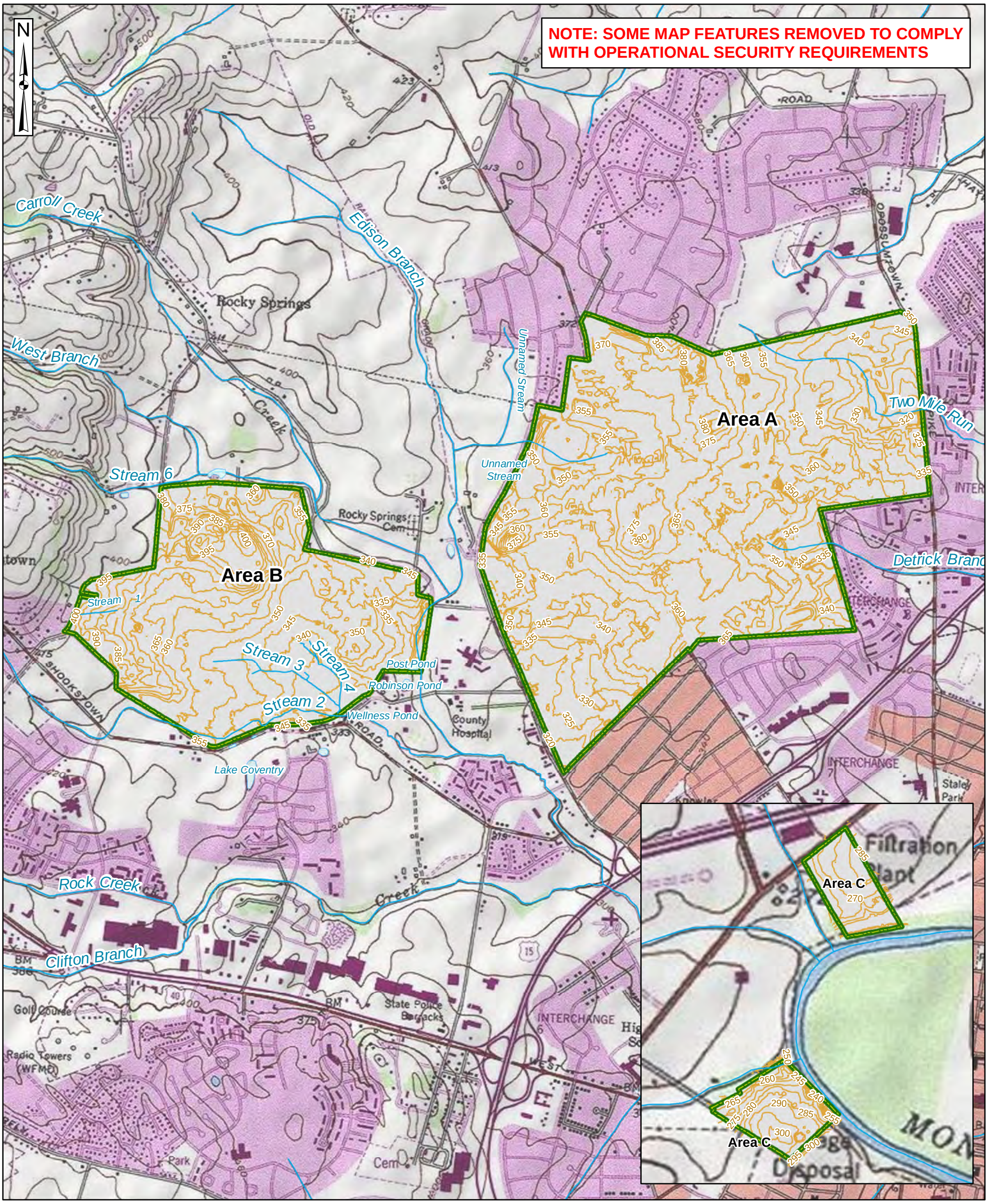


Data Sources:
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 2-3
Topographic Map

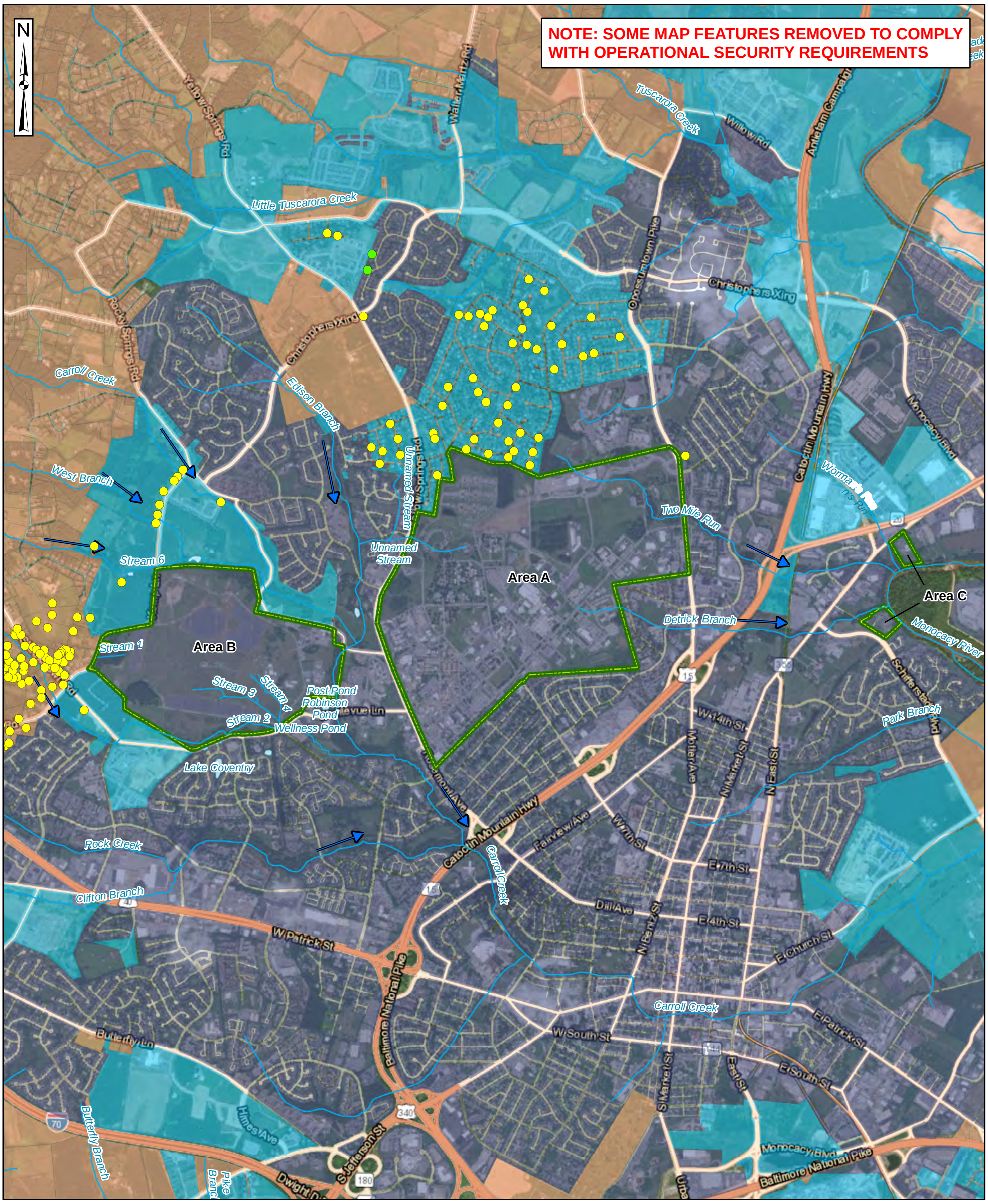


Data Sources:
ESRI ArcGIS Online, Topo Map

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 2-4
Off-Post Potable Wells



- Installation Boundary
- River/Stream
- Water Body
- Private Well
- Municipal Well

Frederick County Planned Connection to Public Water Service

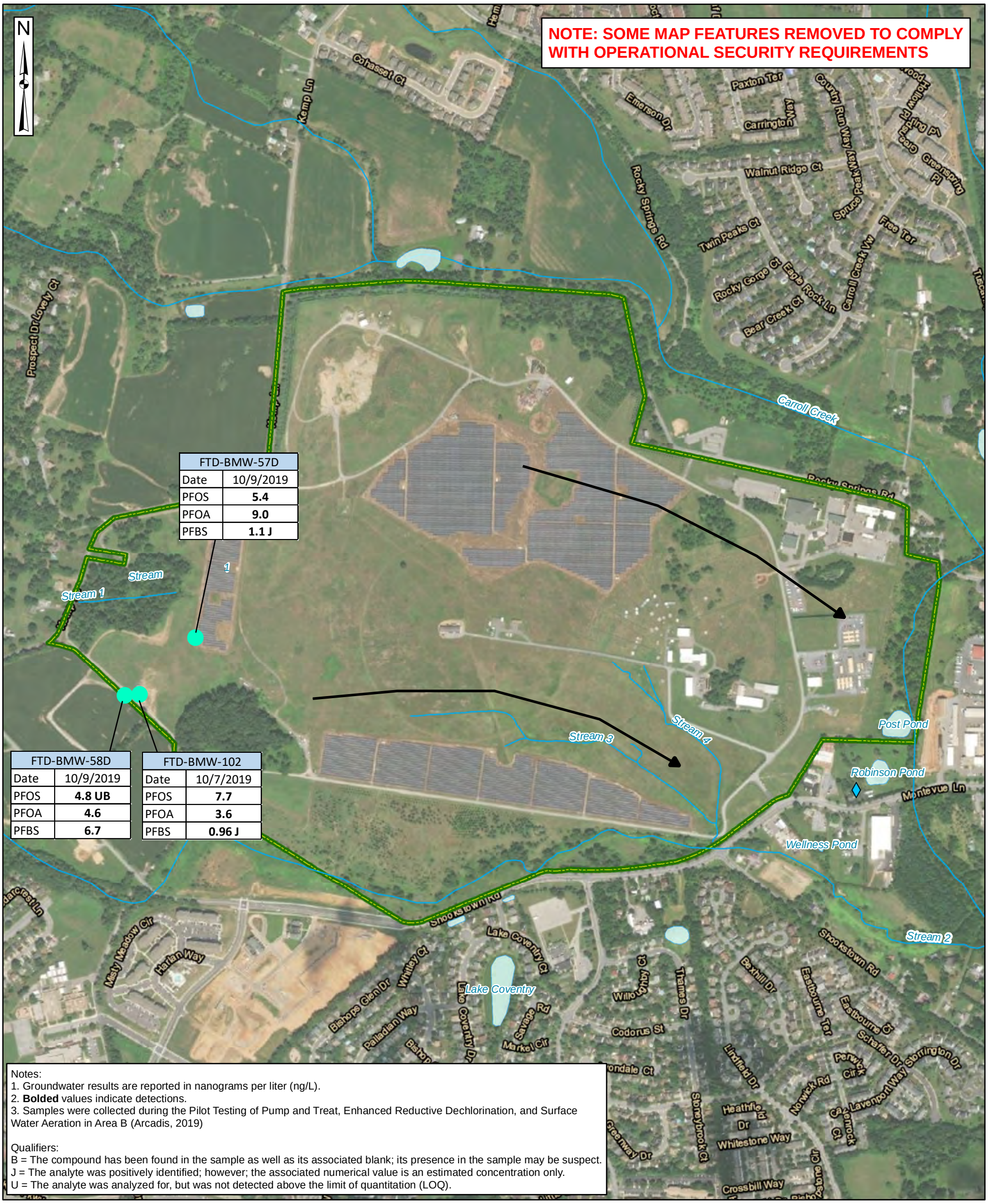
- Connected
- Future Connection Planned
- No Planned Service

Data Sources:
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 2-5
Area B Historical Maximum
PFOS, PFOA, and PFBS Analytical Results



Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. **Bolded** values indicate detections.
3. Samples were collected during the Pilot Testing of Pump and Treat, Enhanced Reductive Dechlorination, and Surface Water Aeration in Area B (Arcadis, 2019)

Qualifiers:
B = The compound has been found in the sample as well as its associated blank; its presence in the sample may be suspect.
J = The analyte was positively identified; however; the associated numerical value is an estimated concentration only.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- Seep/Spring Location
- River/Stream
- Water Body
- Groundwater Flow Direction
- Monitoring Point with Historical PFOA, PFOA, and PFBS Analytical Results

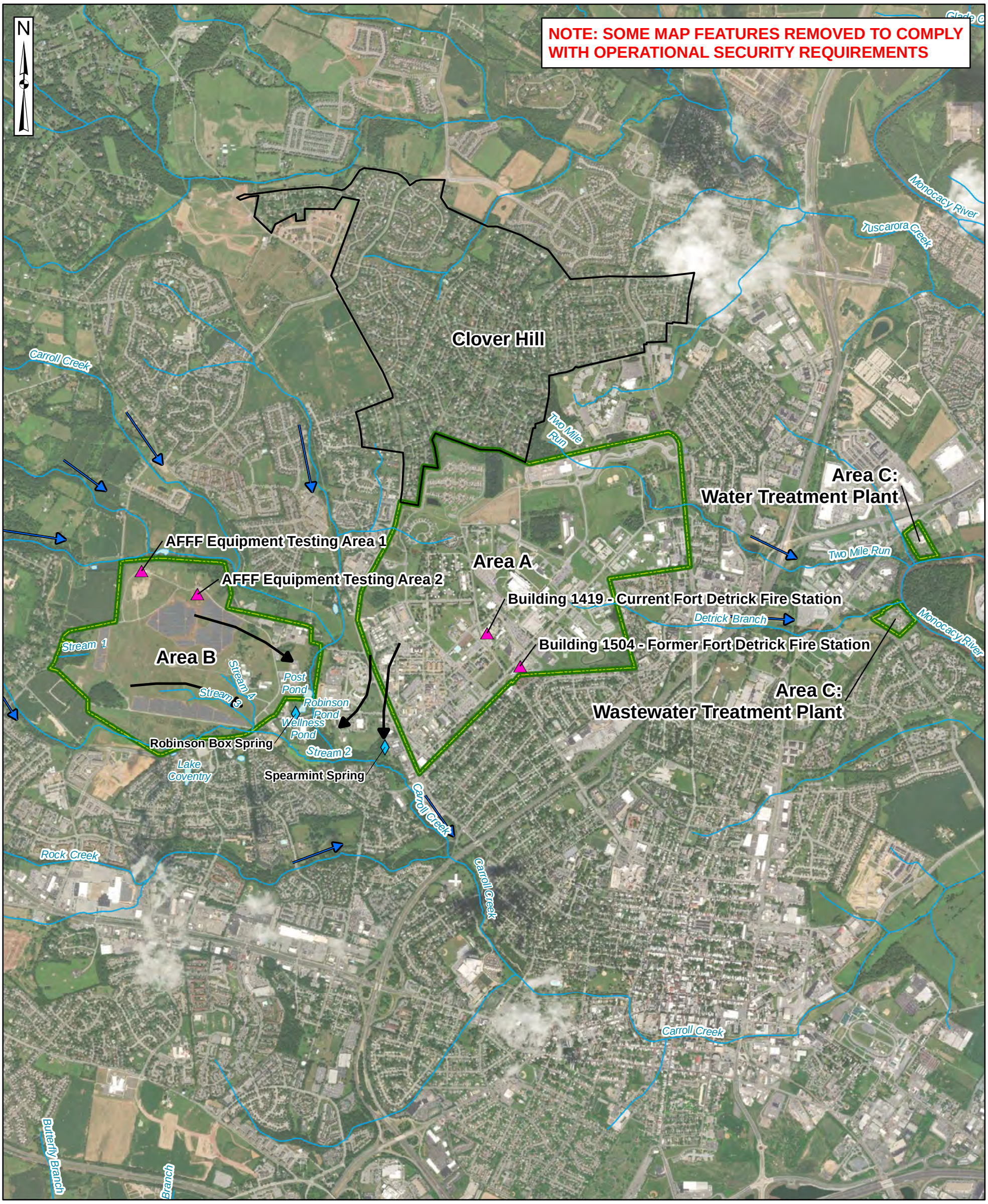
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Arcadis, *Area B Pilot Study*, 2019;
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 5-2
AOPI Locations



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

Data Sources:
Arcadis, *Draft Final Remedial Investigation Report - Area B Groundwater*, Groundwater Flow Direction, December 2019;
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 5-3
Aerial Photo of Area B
AFFF Equipment Testing Area 1 AOPI

NOTE: SOME MAP FEATURES REMOVED TO COMPLY WITH OPERATIONAL SECURITY REQUIREMENTS

N

AFFF Equipment Testing Area 1

- Installation Boundary
- AOPI
- River/Stream
- Water Body
- Surface Runoff Flow Direction
- Groundwater Flow Direction

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

Data Sources:
Arcadis, *Draft Final Remedial Investigation Report - Area B Groundwater*, Groundwater Flow Direction, December 2019;
Google Earth, Aerial Imagery, 2019

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 5-4
Aerial Photo of Area B
AFFF Equipment Testing Area 2 AOPI

N

NOTE: SOME MAP FEATURES REMOVED TO COMPLY WITH OPERATIONAL SECURITY REQUIREMENTS

AFFF Equipment Testing Area 2

Pit 20 Detonation Area North (FTD-43)

Installation Boundary
AOPI
Environmental Site
River/Stream
Surface Runoff Flow Direction
Groundwater Flow Direction

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

Data Sources:
Arcadis, *Draft Final Remedial Investigation Report - Area B Groundwater*, Groundwater Flow Direction, December 2019;
Google Earth, Aerial Imagery, 2019

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 5-5
Aerial Photo of Area A Building 1419 – Current Fort Detrick Fire Station AOPI

NOTE: SOME MAP FEATURES REMOVED TO COMPLY WITH OPERATIONAL SECURITY REQUIREMENTS

Building 1419 -
Current Fort Detrick Fire Station

Installation Boundary
AOPI
River/Stream
Groundwater Flow Direction
Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
Google Earth, Aerial Imagery, 2019

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 5-6
Aerial Photo of Area A Building 1504 – Current Fort Detrick Fire Station AOPI

NOTE: SOME MAP FEATURES REMOVED TO COMPLY WITH OPERATIONAL SECURITY REQUIREMENTS

N

Building 1504 - Former Fort Detrick Fire Station

Installation Boundary
AOPI
River/Stream
Surface Runoff Flow Direction
Groundwater Flow Direction

AOPI = area of potential interest

Data Sources:
Google Earth, Aerial Imagery, 2019

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

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

- Installation Boundary
- AOPI Location
- AOPI with OSD Risk Screening Level Exceedance
- Clover Hill Neighborhood
- Seep/Spring Location
- River/Stream
- Water Body
- Surface Water Flow Direction
- Groundwater Flow Direction

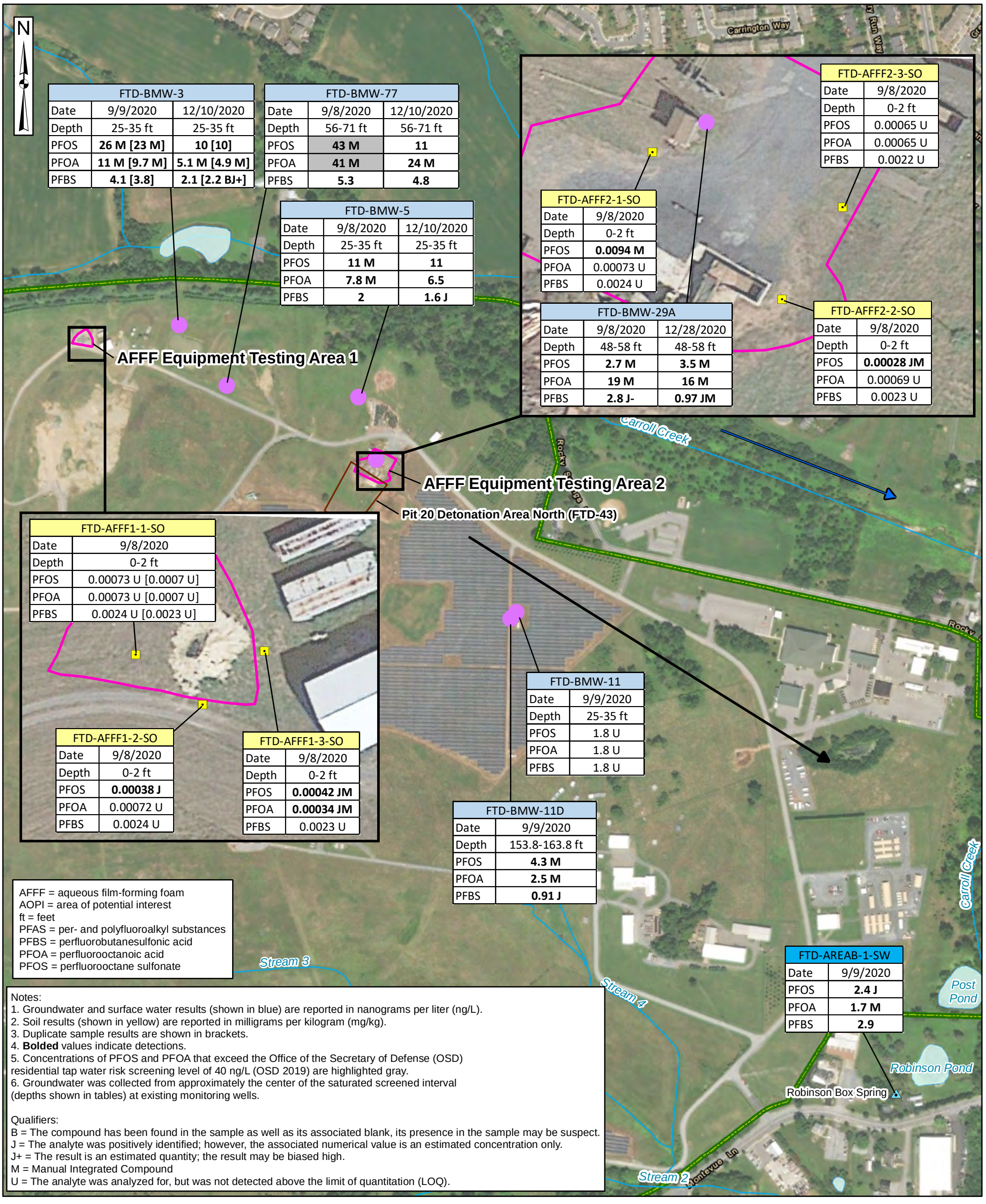
AFFF = aqueous film-forming foam
AOPI = area of potential interest
OSD = Office of the Secretary of Defense

Data Sources:
Arcadis, *Draft Final Remedial Investigation Report - Area B Groundwater*, Groundwater Flow Direction, December 2019;
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 7-2
Area B AFFF Equipment Testing Area 1 and Area B AFFF Equipment Testing Area 2 PFOS, PFOA, and PFBS Analytical Results



FTD-BMW-3		
Date	9/9/2020	12/10/2020
Depth	25-35 ft	25-35 ft
PFOS	**26 M [23 M]**	**10 [10]**
PFOA	**11 M [9.7 M]**	**5.1 M [4.9 M]**
PFBS	**4.1 [3.8]**	**2.1 [2.2 BJ+]**

FTD-BMW-77		
Date	9/8/2020	12/10/2020
Depth	56-71 ft	56-71 ft
PFOS	**43 M**	**11**
PFOA	**41 M**	**24 M**
PFBS	**5.3**	**4.8**

FTD-BMW-5		
Date	9/8/2020	12/10/2020
Depth	25-35 ft	25-35 ft
PFOS	**11 M**	**11**
PFOA	**7.8 M**	**6.5**
PFBS	**2**	**1.6 J**

FTD-AFFF2-3-SO	
Date	9/8/2020
Depth	0-2 ft
PFOS	0.00065 U
PFOA	0.00065 U
PFBS	0.0022 U

FTD-AFFF2-1-SO	
Date	9/8/2020
Depth	0-2 ft
PFOS	**0.0094 M**
PFOA	0.00073 U
PFBS	0.0024 U

FTD-BMW-29A		
Date	9/8/2020	12/28/2020
Depth	48-58 ft	48-58 ft
PFOS	**2.7 M**	**3.5 M**
PFOA	**19 M**	**16 M**
PFBS	**2.8 J-**	**0.97 JM**

FTD-AFFF2-2-SO	
Date	9/8/2020
Depth	0-2 ft
PFOS	**0.00028 JM**
PFOA	0.00069 U
PFBS	0.0023 U

FTD-AFFF1-1-SO	
Date	9/8/2020
Depth	0-2 ft
PFOS	0.00073 U [0.0007 U]
PFOA	0.00073 U [0.0007 U]
PFBS	0.0024 U [0.0023 U]

FTD-AFFF1-2-SO	
Date	9/8/2020
Depth	0-2 ft
PFOS	**0.00038 J**
PFOA	0.00072 U
PFBS	0.0024 U

FTD-AFFF1-3-SO	
Date	9/8/2020
Depth	0-2 ft
PFOS	**0.00042 JM**
PFOA	**0.00034 JM**
PFBS	0.0023 U

FTD-BMW-11	
Date	9/9/2020
Depth	25-35 ft
PFOS	1.8 U
PFOA	1.8 U
PFBS	1.8 U

FTD-BMW-11D	
Date	9/9/2020
Depth	153.8-163.8 ft
PFOS	**4.3 M**
PFOA	**2.5 M**
PFBS	**0.91 J**

FTD-AREAB-1-SW	
Date	9/9/2020
PFOS	**2.4 J**
PFOA	**1.7 M**
PFBS	**2.9**

AFFF = aqueous film-forming foam
AOPI = area of potential interest
ft = feet
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Notes:
1. Groundwater and surface water results (shown in blue) are reported in nanograms per liter (ng/L).
2. Soil results (shown in yellow) are reported in milligrams per kilogram (mg/kg).
3. Duplicate sample results are shown in brackets.
4. **Bolded** values indicate detections.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2019) are highlighted gray.
6. Groundwater was collected from approximately the center of the saturated screened interval (depths shown in tables) at existing monitoring wells.

Qualifiers:
B = The compound has been found in the sample as well as its associated blank, its presence in the sample may be suspect.
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.
M = Manual Integrated Compound
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
Environmental Site
River/Stream
Water Body
Groundwater Flow Direction
Surface Water Flow Direction
Soil Sampling Location
Surface Water Sampling Location
Groundwater Sampling Location

Data Sources:
Arcadis, *Draft Final Remedial Investigation Report - Area B Groundwater*, Groundwater Flow Direction, December 2019;
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Fort Detrick (FTD), MD

Figure 7-3
Area A Building 1419 – Current Fort Detrick Fire Station and Area A Building 1504 – Former Fort Detrick Fire Station PFOS, PFOA, and PFBS Analytical Results

NOTE: SOME MAP FEATURES REMOVED TO COMPLY WITH OPERATIONAL SECURITY REQUIREMENTS

FTD-B1419-1-SO	
Date	9/9/2020
Depth	0-2 ft
PFOS	**0.00023 JM**
PFOA	**0.00026 JM**
PFBS	0.0022 U

FTD-B1419-3-SO	
Date	9/9/2020
Depth	0-2 ft
PFOS	**0.00023 JM**
PFOA	**0.00033 JM**
PFBS	0.0021 U

Building 1419 - Current Fort Detrick Fire Station

FTD-B1419-2-SO	
Date	9/9/2020
Depth	0-2 ft
PFOS	**0.00025 JM [0.00023 JM]**
PFOA	0.00066 U **[0.00026 JM]**
PFBS	0.0022 U [0.0022 U]

FTD-B1504-3-SO	
Date	9/9/2020
Depth	0-2 ft
PFOS	**0.0016**
PFOA	**0.00094 M**
PFBS	**0.00045 J**

FTD-PW577	
Date	9/9/2020
PFOS	**3.4 J- [3.6 M]**
PFOA	**3.3 MJ- [3.5 M]**
PFBS	**2 J- [2.2]**

Building 1504 - Former Fort Detrick Fire Station

FTD-B1504-1-SO	
Date	9/9/2020
Depth	0-2 ft
PFOS	**0.00087 M**
PFOA	0.00075 U
PFBS	0.0025 U

FTD-PW569	
Date	9/9/2020
PFOS	**4 M**
PFOA	**3.6 M**
PFBS	**2.1**

FTD-B1504-2-SO	
Date	9/9/2020
Depth	0-2 ft
PFOS	**0.00056 JM**
PFOA	**0.00038 JM**
PFBS	0.0023 U

FTD-AREAA1-SW	
Date	9/9/2020
PFOS	**7.5 MJ- [7.4]**
PFOA	**4.3 MJ- [4.4 M]**
PFBS	**4.3 J- [4.4]**

Spearmint Spring

Notes:
1. Groundwater and surface water results (shown in blue) are reported in nanograms per liter (ng/L).
2. Soil results (shown in yellow) are reported in milligrams per kilogram (mg/kg).
3. Duplicate sample results are shown in brackets.
4. **Bolded** values indicate detections.

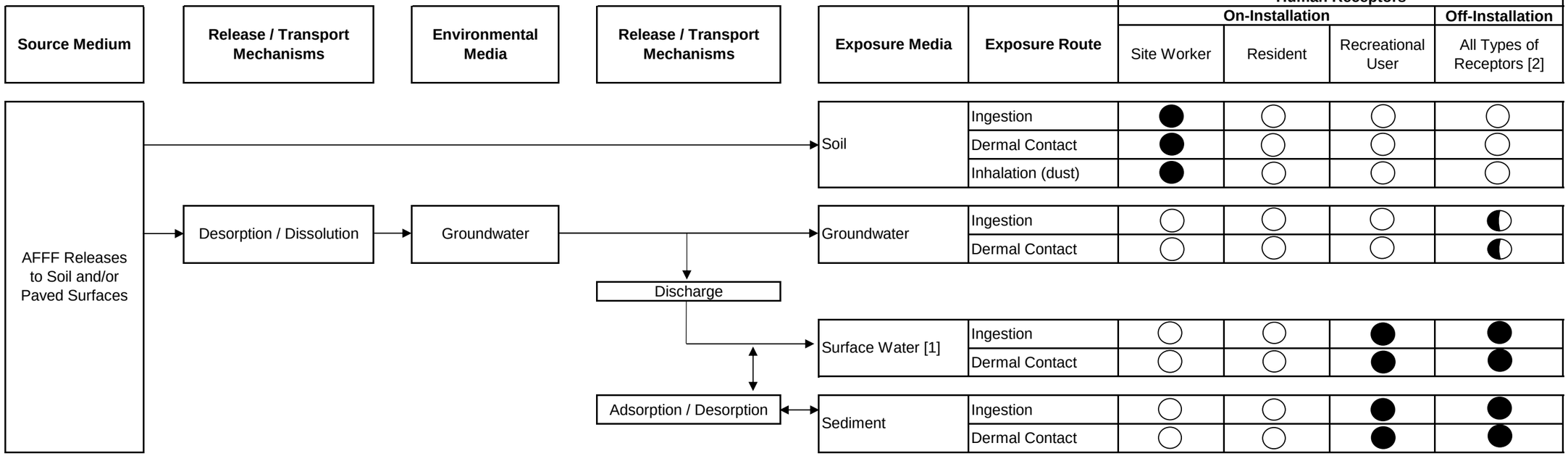
Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
M = Manual Integrated Compound
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

- Installation Boundary
- AOPI
- River/Stream
- Groundwater Flow Direction
- Surface Water Flow Direction
- Soil Sampling Location
- Surface Water Sampling Location
- Groundwater Sampling Location

Data Sources:
Arcadis, *Draft Final Remedial Investigation Report - Area B Groundwater*, Groundwater Flow Direction, December 2019;
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water 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.

ARCADIS

Conceptual Site Model for Fort Detrick AOPIs
USAEC PFAS Preliminary Assessment / Site Inspection

Figure 7-4