FINAL
Site Inspection Report
Volunteer Training Site-Smyrna, Tennessee

Site Inspection for Perfluorooctanoic acid (PFOA), Perfluorooctanesulfonic acid (PFOS), Perfluorohexanesulfonic acid (PFHxS), Perfluorononanoic acid (PFNA), Hexafluoropropylene oxide dimer acid (HFPO-DA), and Perfluorobutanesulfonic acid (PFBS) at ARNG Installations, Nationwide

April 2023

Prepared for:

Army National Guard Bureau
111 S. George Mason Drive
Arlington, VA 22204

UNCLASSIFIED

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Acronyms and Abbreviations

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
AASF	Army Aviation Support Facility
AECOM	AECOM Technical Services, Inc.
AFB	Air Force Base
AFFF	aqueous film forming foam
AOI	Area of Interest
ARNG	Army National Guard
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	chain of custody
CSM	conceptual site model
DA	Department of the Army
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DUA	data usability assessment
DVR	data validation report
EDR™	Environmental Data Resources, Inc™
ELAP	Environmental Laboratory Accreditation Program
EM	Engineering Manual
FedEx	Federal Express
FTA	Fire Training Area
GPRS	Ground-Penetrating Radar Services, LLC
HDPE	high-density polyethylene
HFPO-DA	hexafluoropropylene oxide dimer acid
IDW	investigation-derived waste
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	liquid chromatography with tandem mass spectrometry
MIL-SPEC	military specification
MS	matrix spike
MSD	matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
ng/L	nanograms per liter
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid

134	PFOA	perfluorooctanoic acid
135	PFOS	perfluorooctanesulfonic acid
136	PID	photoionization detector
137	PQAPP	Programmatic UFP-QAPP
138	QA	quality assurance
139	QAPP	Quality Assurance Project Plan
140	QC	quality control
141	QSM	Quality Systems Manual
142	RI	Remedial Investigation
143	SI	Site Inspection
144	SL	screening level
145	SOP	standard operating procedure
146	TDEC	Tennessee Department of Environment and Conservation
147	TNARNG	Tennessee Army National Guard
148	TOC	total organic carbon
149	TPP	Technical Project Planning
150	UFP	Uniform Federal Policy
151	US	United States
152	USACE	United States Army Corps of Engineers
153	USCS	Unified Soil Classification System
154	USEPA	United States Environmental Protection Agency
155	USFWS	United States Fish and Wildlife Service
156	USGS	United State Geological Survey
157	VTS-S	Volunteer Training Site-Smyrna

Executive Summary

The Army National Guard (ARNG) G-9 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 the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense, 2022). The six compounds listed in the OSD memorandum include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS). These compounds are collectively referred to as "relevant compounds" throughout the document and the applicable screening levels (SLs) are provided in **Table ES-1**.

The PA identified one Area of Interest (AOI) where PFAS-containing materials may have been used, stored, disposed, or released historically (see **Table ES-2** for AOI locations). The objective of the SI is to identify whether there has been a release to the environment from the AOI identified in the PA and determine whether further evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted AOI 1. VTS-S Smyrna will also be referred to as the "facility" throughout this document.

VTS-S is in Smyrna, Tennessee, in Rutherford County, approximately 22 miles southeast of Nashville, and it comprises 868 acres of land. The facility is adjacent to the Smyrna/Rutherford County Regional Airport and is partially within the city limits of the Town of Smyrna, Tennessee (Tennessee ARNG, 2012). The facility includes aircraft hangars, a vehicle maintenance facility, fuel storage, surrounding parking areas, and offices.

The PA identified one AOI for investigation during the SI phase. SI sampling results from the AOI were compared to OSD SLs. **Table ES-2** summarizes the SI results for each AOI. Based on the results of this SI, further evaluation under CERCLA is warranted in a Remedial Investigation (RI) for AOI 1.

[1] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table ES-1: Screening Levels (Soil and Groundwater)

Analyte[b]	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	19	250	6
PFOS	13	160	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

b.) Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table ES-2: Summary of Site Inspection Findings and Recommendations

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary	Future Action
1	Concrete Hangar/Apron and Building 682S	◐	●	●	Proceed to RI

Legend:
N/A = not applicable
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

1. Introduction

1.1 Project Authorization

The Army National Guard (ARNG) G-9 is the lead agency in 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 the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense, 2022). The six compounds listed in the OSD memorandum will be referred to as "relevant compounds" throughout this document and include perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS) at ARNG facilities nationwide. The ARNG performed this SI at the at ARNG Volunteer Training Site (VTS)-Smyrna (VTS-S) in Smyrna, Tennessee. VTS-S is also referred to as the "facility" throughout this document.

The SI project elements were performed in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; United States [US] Environmental Protection Agency [USEPA], 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300; USEPA, 1994), and in compliance with US Department of the Army (DA) requirements and guidance for field investigations.

1.2 SI Purpose

A PA was performed at VTS-S (AECOM Technical Services, Inc. [AECOM], 2018a) that identified one Area of Interest (AOI) where PFAS-containing materials may have been used, stored, disposed, or released historically. The objective of the SI is to identify whether there has been a release to the environment from the AOI identified in the PA and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on screening levels (SLs) for the relevant compounds.

[1] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

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2. Facility Background

2.1 Facility Location and Description

VTS-S is near Smyrna, Tennessee, in Rutherford County, approximately 22 miles southeast of Nashville, and comprises 868 acres of land (**Figure 2-1**). The Smyrna/Rutherford County Regional Airport is situated to the west of the VTS-S. VTS-S is partially within the city limits of the Town of Smyrna, Tennessee (Tennessee ARNG [TNARNG], 2012).

After being established in 1941 as Smyrna Army-Air Base, construction of the facility began in 1942. During World War II, Smyrna Army-Air Base was used as a training facility for bomber pilots. In the years immediately following the war's end, base activities were reduced, and the base was deactivated in July 1947 (TNARNG, 2012). In August 1948, the base was reopened and then renamed Sewart Air Force Base (AFB) in 1950. When the Sewart AFB closed in July 1970, the US Army Corps of Engineers (USACE) retained a portion of the former installation, including the cantonment area; the National Airport Authority retained the airfield.

In 1970, the TNARNG obtained a license from the Nashville USACE to use 780.55 acres for troop education and various field training purposes on a continual basis. The airfield was transferred to the Metropolitan Nashville Airport Authority and has subsequently been transferred to the Smyrna/Rutherford County Airport Authority. Adjacent to airport property, on the western border of the training site, the Airport Authority and TNARNG have developed a joint use agreement for an approximately 11-acre parcel (TNARNG, 2012) that contains aircraft hangars, a vehicle maintenance facility, fuel storage, surrounding parking areas, and offices.

2.2 Facility Environmental Setting

VTS-S lies within the Central Basin physiographic region of the State. The Central Basin is characterized by gently rolling to nearly level lands; land surface elevations at VTS-S generally fall between 490 and 550 feet (TNARNG, 2012). Topography at the facility is generally flat to gently rolling and slopes from west to east toward Stewart Creek, a tributary of Stones River (**Figure 2-2**).

2.2.1 Geology

VTS-S is underlain mostly by the Ridley Limestone, which is Ordovician in age. Other Ordovician age units underlying VTS-S include the Carters, Lebanon, Pierce, and Murfreesboro Formations. Sinkholes and caves are characteristic features of limestone formations, and numerous sinkholes are present in the northeastern corner of VTS-S. The nature of such karst features allows significant interactions between surface water and groundwater as well as a variable depth to competent bedrock (e.g., at/near surface to tens of feet below ground surface [bgs]). VTS-S is also located on the outer portion of the New Madrid Seismic Zone, which is the most seismically active zone east of the Rocky Mountains (TNARNG, 2012).

Soil borings completed during the SI encountered clayey sands and lean clays as the dominant lithology of unconsolidated sediments below the facility. Lesser amounts of gravel were observed in most borings. Surface soil at VTS-02 was primarily composed of silt, which differs from the clayey sands observed at all other locations. The borings were completed at depths between 26 and 35 feet bgs. Fossiliferous limestone bedrock was observed at depths between 12.5 and 26.5 feet bgs across borings (see **Table 5-3**). The limestone was observed to be relatively competent, with moderately fractured zones in some locations. A sample for grain size analysis was collected at one location, AOI01-02 from 8 to 10 feet bgs and analyzed by American Society for Testing and Materials (ASTM) Method D-422. The results indicate that the soil sample was composed

primarily of silt (63.41 percent [%]) and clay (30.45%). These results and facility observations are consistent with the understood alluvial depositional environment of the unconsolidated surficial deposits overlying an Ordovician-aged carbonate unit, the Ridley Limestone (US Geological Survey [USGS], 2022a). Boring logs are presented in **Appendix E**, and grain size results are presented in **Appendix F**.

2.2.2 Hydrogeology

VTS-S lies above the Central Basin aquifer, which consists of generally flat-lying carbonate rocks of Ordovician to Devonian age and underlies the Central Basin physiographic province. Groundwater is stored in and moves through solution-enlarged vertical joints and horizontal bedding planes. Wells commonly yield 5 to 20 gallons per minute and are an important source of drinking water throughout much of the Central Basin (TNARNG, 2012).

Based on the surrounding topography, shallow groundwater is likely to flow primarily east toward Stewart Creek (**Figure 2-3**). Shallow groundwater and surface water are hydraulically connected in this region (USACE, 2018). Groundwater depth at VTS-S is anticipated to range from approximately 40 feet up to as shallow as 2 to 3 feet near Stewart Creek. Groundwater is recharged via the percolation of precipitation into the Central Basin aquifer. Some fractures and faults through the Central Basin aquifer may allow recharge to the underlying Knox aquifer, whose upper formation can also provide substantial quantities of water to wells in the Central Basin at depths of 1,000 feet or more (TNARNG, 2012).

A query of the Tennessee Department of Environment and Conservation's (TDEC) water well database identified six residential and one commercial water supply wells less than 1 mile southeast of VTS-S (TDEC, 2022). The identified water supply wells range in depth from 85 to 390 feet (Environmental Data Resources, Inc.™ [EDR™], 2018).

Depths to groundwater measured in March 2022 during the SI ranged from 14.57 to 25.22 feet bgs. Groundwater elevation contours from the SI are presented on **Figure 2-4** and indicate groundwater flow direction is generally to the northeast towards Stewart Creek.

2.2.3 Hydrology

VTS-S is located within the Stones River Upper Watershed (USGS Hydrologic Unit #05130203; USGS, 2022b), which includes approximately 589,440 acres (921 square miles) of land and water that ultimately drain into the Cumberland River. **Figure 2-5** shows perennial surface water features at VTS-S, including Stewart Creek and the J Percy Priest Reservoir. The J Percy Priest Reservoir is a 42-mile-long lake formed by a dam that is approximately 10 miles east of Nashville, on Stones River. VTS-S is located in an area of high flood risk, which is mitigated to some degree by USACE's control of water levels at the J Percy Priest Reservoir. A large portion of VTS-S falls at or below the "508-line", which is defined as portions under 508 feet above mean sea level and are subject to specific use restrictions (TNARNG, 2012).

Stormwater runoff at VTS-S flows north and east to two outfalls on Stewart Creek via open-flow ditches and limited storm drains; the two outfall locations are depicted on **Figure 2-4**. Stormwater is not treated before entering Stewart Creek. Flow into the facility's hangar floor drains is conveyed to two sump tanks, and wastewater from all wash racks passes through oil/water separators before discharging to the Town of Smyrna sanitary sewer system (TNARNG, 2012).

Potable water for VTS-S and surrounding areas is supplied by the Town of Smyrna from an intake on J Percy Priest Reservoir, approximately 6 miles downstream from VTS-S. The Town of Smyrna has capacity to provide up to 8 million gallons of water per day for the local community (TNARNG, 2012).

2.2.4 Climate

Data for Smyrna, Tennessee indicate that the mean annual temperature between 1981 and 2010 was 57.5 degrees Fahrenheit (ºF). The warmest months are July and August, with normal daily mean temperatures of 88.9 ºF and 90.0 ºF, respectively. January is the coldest month, with a mean temperature of 47.5 ºF. Average annual precipitation measured from 1981 to 2010 in Smyrna, Tennessee was 54.36 inches. Rainfall is heaviest during the month of May, averaging 5.75 inches; October and August are the driest months. Average monthly precipitation ranges from 3.44 inches in October to 5.75 inches in May (National Oceanic and Atmospheric Administration, 2022).

2.2.5 Current and Future Land Use

In April 2015, TNARNG's Army Aviation Support Facility (AASF) #1 transferred operations from VTS-S to Berry Field in Nashville, with some vehicle maintenance personnel and equipment remaining at VTS-S. VTS-S is the primary training facility for TNARNG units within 100 miles of the facility. In addition, a variety of non-ARNG organizations use the training site, including: the 100th Division and the 304th Military Police unit, both of which are Army Reserve units; 3-BCT 101st Airborne, a US Army unit; as well as local gun clubs, Reserve Officer Training Corps groups, and local law enforcement units. Approximately 60% of all training at VTS-S takes place either in classrooms or in virtual training facilities. Field training exercises at VTS-S account for 10 to 15% of overall usage at VTS-S and involve a wide variety of activities, such as: tracked and wheeled vehicle operations on all military-developed roads and major trails, mounted and dismounted maneuvers, field bivouacking, mine field detection, land navigation, aviation sling load training, and weapons firing.

The western boundary of VTS-S is adjacent to the Smyrna/Rutherford County Regional Airport. Smyrna Municipal Golf Course is located to the south. East and south of VTS-S are single family and high-density residential properties and industrial businesses. Anticipated future use is not expected to change from the current land usage.

2.2.6 Sensitive Habitat and Threatened/ Endangered Species

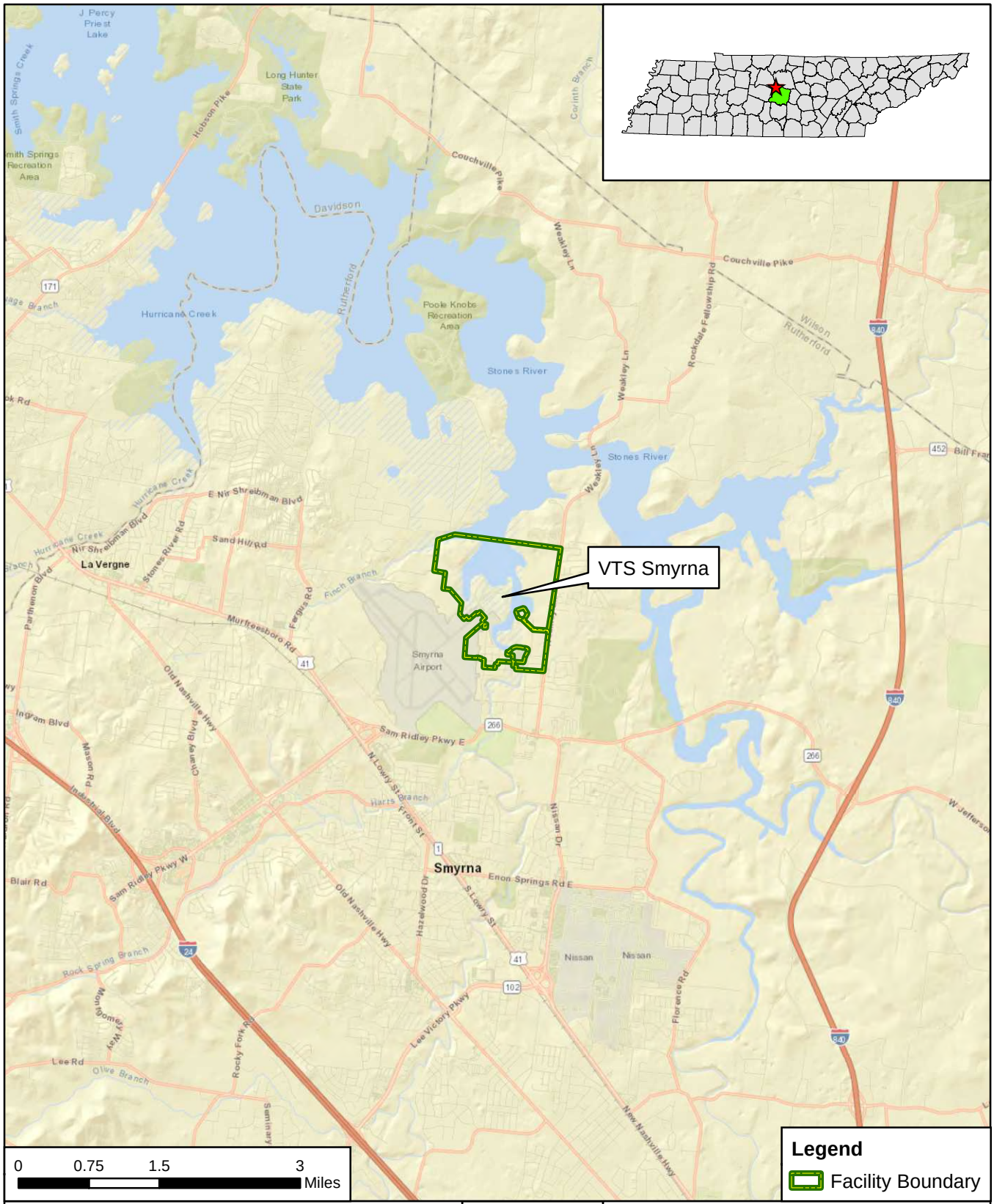
A wildlife survey has not occurred at the facility, and the facility does not have any significant areas of habitat. The following species have not been identified at the facility but may be present in the surrounding area.

The following birds, plants, mammals, and reptiles are federally endangered, threatened, proposed, and/ or are listed as candidate species in Rutherford County, Tennessee (US Fish and Wildlife Service [USFWS], 2022.

- **Insects:** Monarch butterfly, *Danaus plexippus* (candidate)
- **Mammals**: Gray Bat, *Myotis grisescens* (endangered); Indiana Bat, *Myotis sodalis* (endangered); Northern long-eared Bat, *Myotis septentrionalis* (threatened)
- **Flowering plants:** Bruan's Rock-cress, *Arabis perstellat*a (endangered); Guthrie's (pyne's) Ground-plum, *Astragalus bibullatus (*endangered); Leafy Prairie-clover, *Dalea foliosa* (endangered)
- **Crustaceans:** Nashville Crayfish, *Orconectes shoupi* (endangered)

2.3 History of PFAS Use

Two potential release areas were identified during the PA at VTS-S where AFFF was known to be used or released historically, including one fire training area (FTA) and one emergency response area (AECOM, 2018a). Fire training activities occurred for many years on the concrete apron on the front-west side of the facility hangars, using expiring AFFF extinguishers; the frequency, volume, and concentration of AFFF used at this location are unknown. Additionally, a fire occurred between the exterior walls of one hangar, Building 682S, in 2006. The hangar was equipped with a fire-suppression system, which engaged and filled the hangar; the volume of AFFF released during this incident is unknown. The Town of Smyrna Fire Department reportedly arrived after the AFFF was released and used only water on the fire. The potential release areas were grouped into one AOI based on proximity to one another and presumed groundwater flow direction. A description of AOI 1 is presented in **Section 3**.



CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
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SCALE	1:95,040	CHK BY	SS	8/1/2022
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan,		PM	CM	8/1/2022

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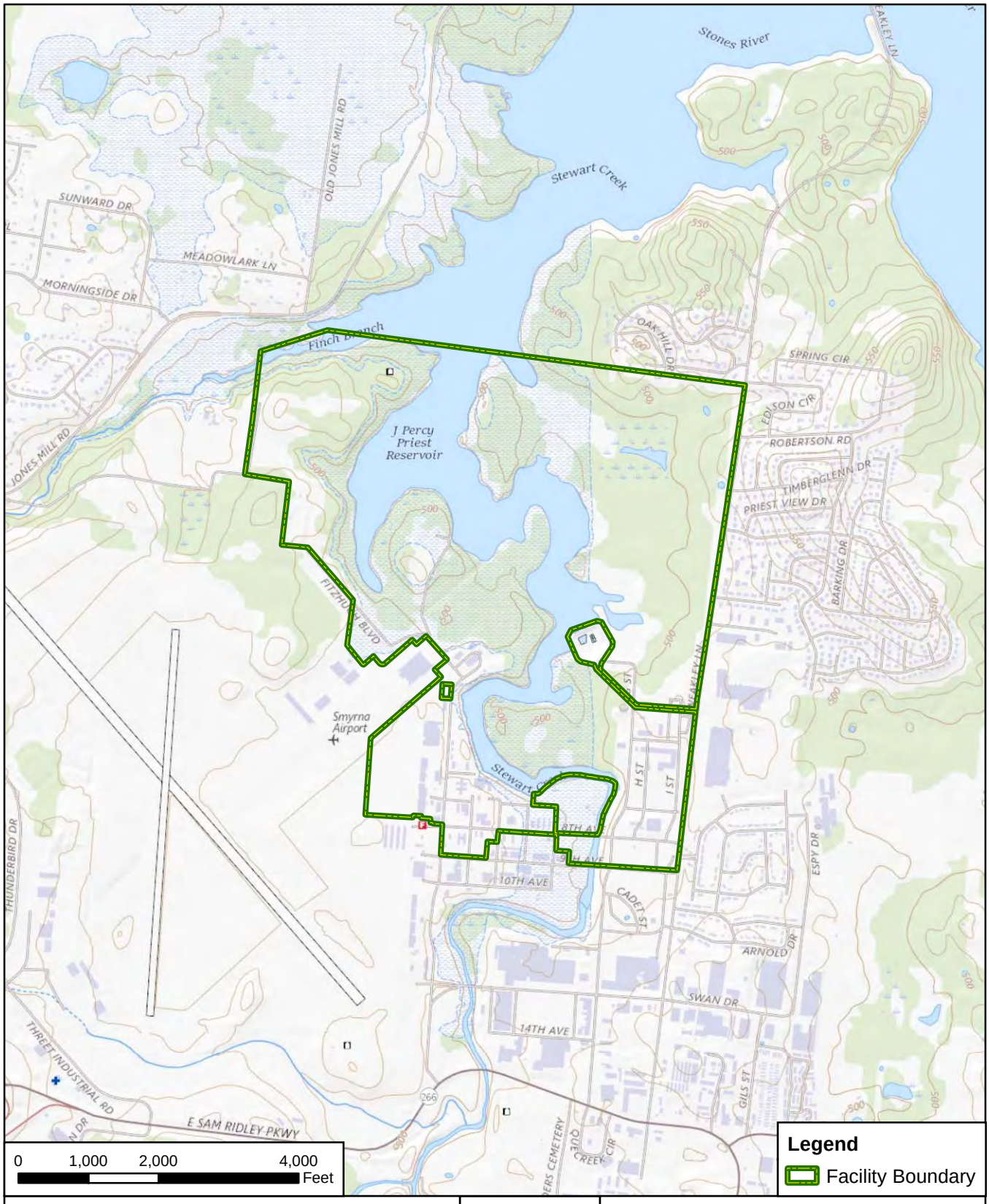
Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1



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PROJECT	Site Inspection at VTS Smyrna, TN			
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SCALE	1:24,000	CHK BY	SS	8/1/2022
Base Map: USGS The National Map: National Boundaries Dataset, 3DEP Elevation		PM	CM	8/1/2022

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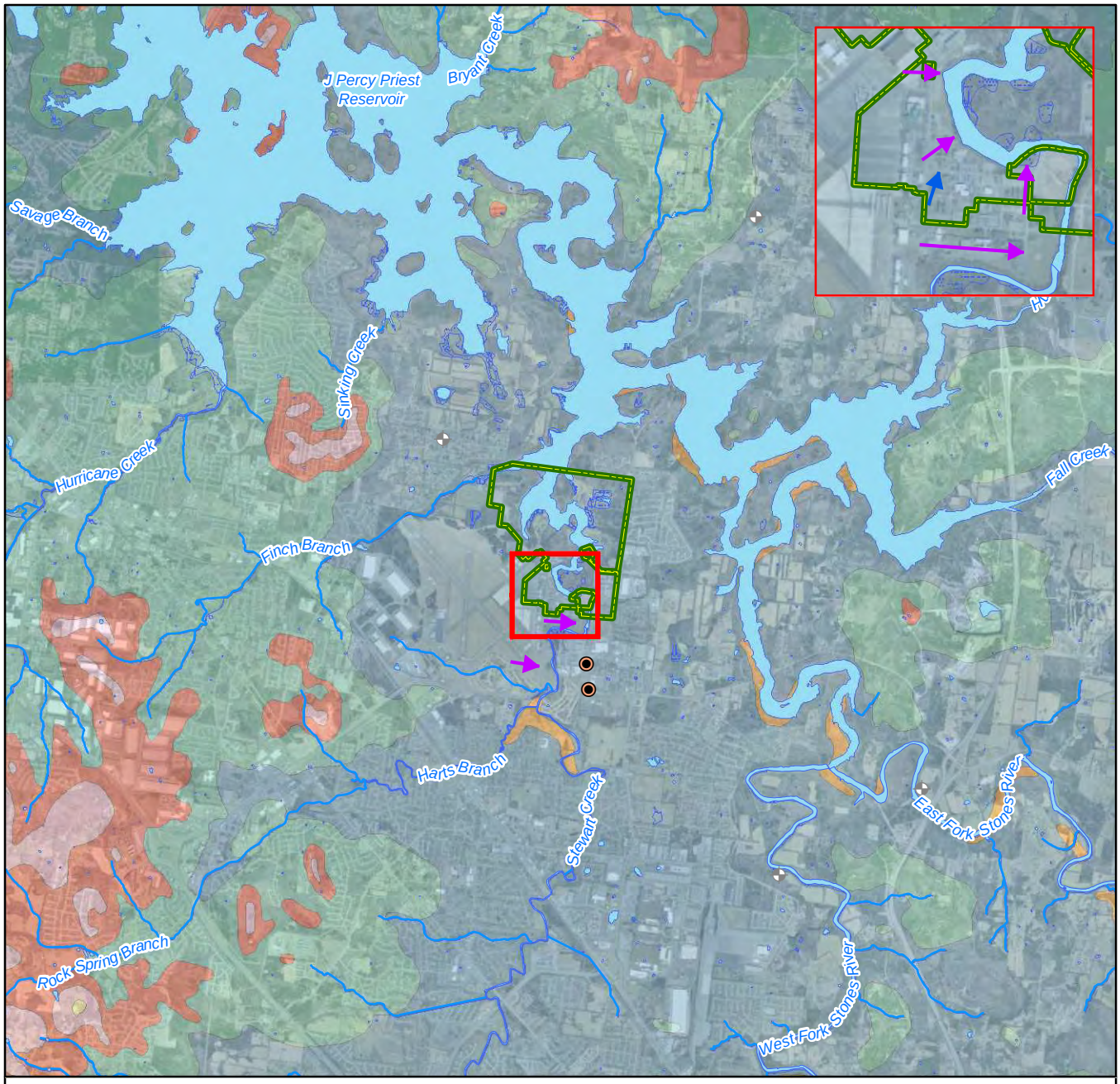
Facility Topography

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2



Facility Boundary
Water Body
Wetland
River/Stream
Groundwater Flow Direction
Inferred Groundwater Flow Direction

0 0.75 1.5 3 Miles

Geology

Richmond Group, Maysville Group, Eden Group, and Catheys Formations
Bigby-Cannon Limestone and Hermitage Formation
Carters Limestone
Lebanon Limestone
Ridley Limestone
Pierce and Murfreesboro Limestones

Wells

Domestic Well
Inactive USGS Monitoring Well

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	9/15/2022	GIS BY	MS	9/15/2022
SCALE	1:95,040	CHK BY	SS	9/15/2022
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/15/2022

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Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3

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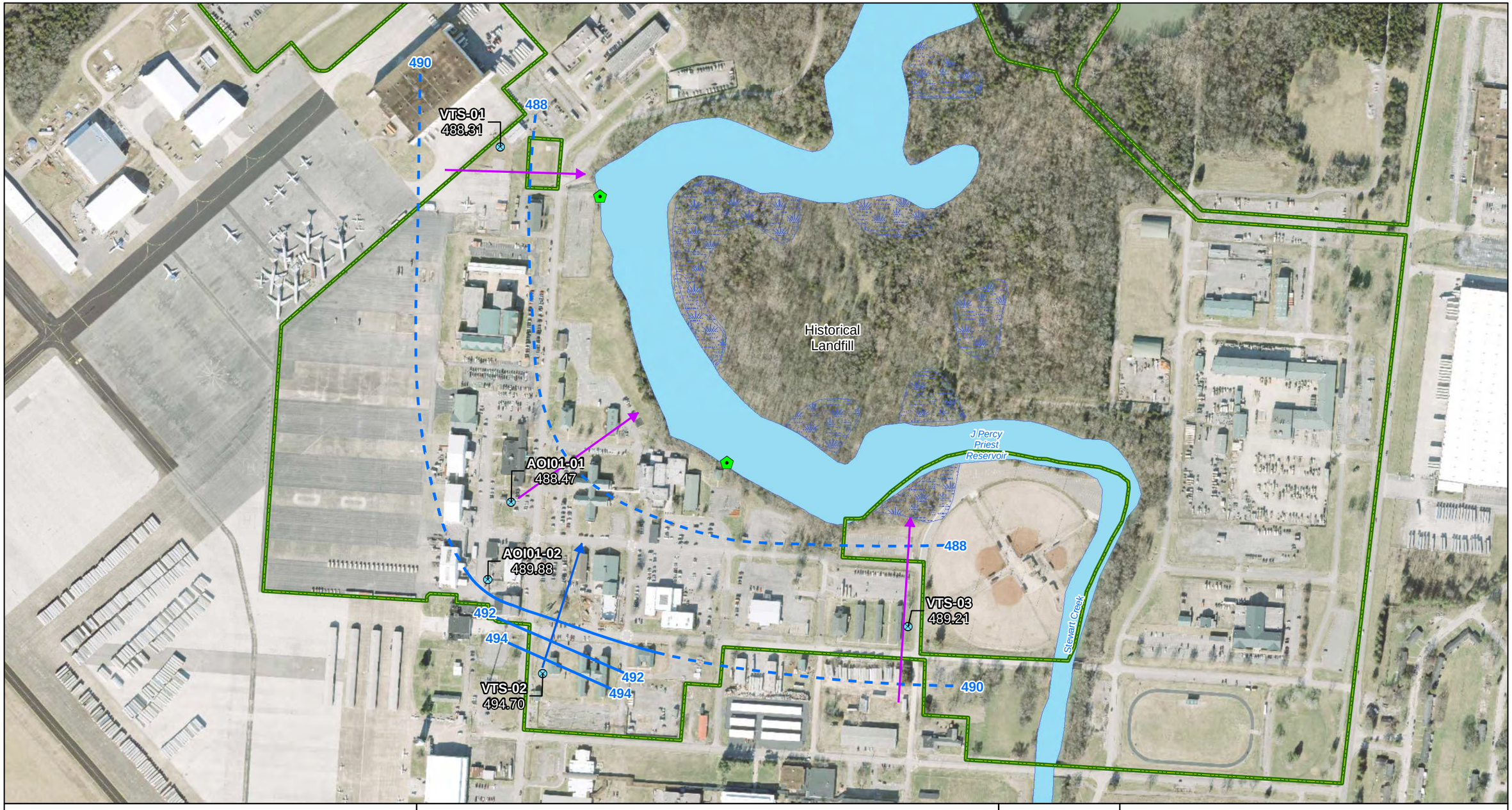

CLIENT	ARNG			
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SCALE	1:4,800	CHK BY	SS	10/20/2022
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	10/20/2022

Soil Boring and Monitoring Well
Approximate Storm Water Outfall
Facility Boundary
Water Body
Wetland
Groundwater elevations in ft NAVD88.

Groundwater Elevation Contour
Inferred Groundwater Elevation Contour
Groundwater Flow Direction
Inferred Groundwater Flow Direction

0 200 400 800 Feet

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Groundwater Elevations, March 2022

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-4

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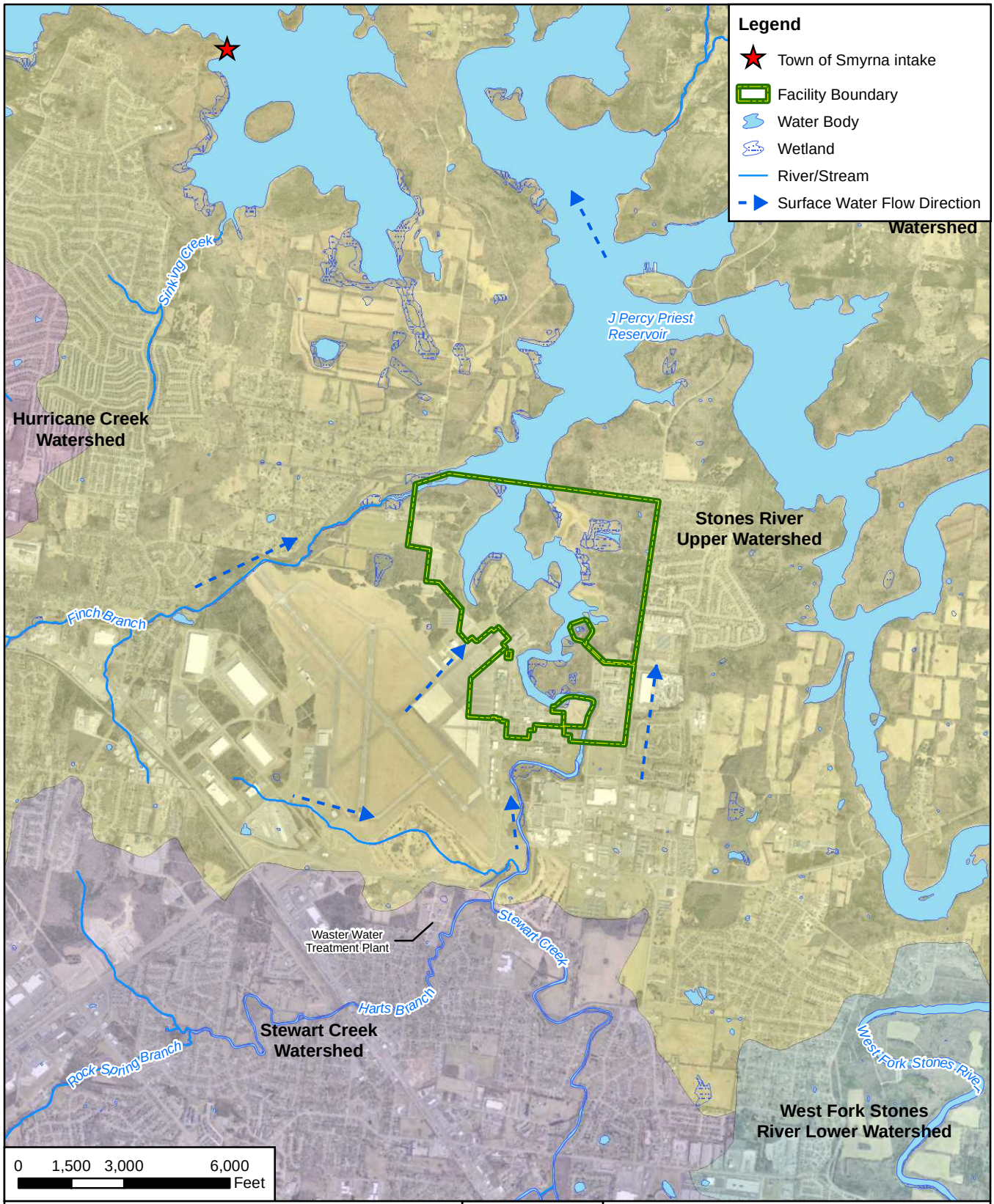

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
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SCALE	1:48,000	CHK BY	SS	9/7/2022
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/7/2022

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Surface Water Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-5

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3. Summary of Areas of Interest

The PA evaluated areas where PFAS-containing materials may have been used, stored, disposed, or released historically. Based on the PA findings, two potential release areas were identified at VTS-S and grouped into one AOI (AECOM, 2018a). The potential release areas are shown on **Figure 3-1**. Several potential adjacent off-facility sources (Smyrna/Rutherford County Regional Airport Fire Station, Buffalo Hangar, the 2017 Fuel Spill, and the 2016 Blue Angel Crash) are also shown on **Figure 3-1** for informational purposes, but are not evaluated as part of this SI.

3.1 AOI 1

AOI 1 consists of two potential release areas. The potential release areas are described below.

3.1.1 Hangar Building 682S

Based on the PA interview with TNARNG personnel, a fire occurred between exterior walls of Hangar Building 682S in 2006 due to welding operations. Staff reported the hangar's fire suppression system did not engage until the late stages of the incident. After the system engaged, AFFF was released and filled the hangar; the volume of AFFF used during this incident is unknown. The Town of Smyrna Fire Department reported using only water when they arrived on the scene, after the AFFF release. The Town of Smyrna Fire Department's incident report was included in PA report (AECOM, 2018a).

3.1.2 Concrete Ramp/Apron

According to VTS-S personnel, TNARNG used expired AFFF extinguishers for many years to conduct fire-training exercises on the concrete apron in the front-west of the hangars (Buildings 681, 682N, and 682S). AFFF runoff released from fire-training activities would have likely discharged to the nearest storm or sanitary sewer drain. Infiltration to subsurface soil may have occurred via pavement cracks or seams or leaks in underground piping. Such releases may have intercepted groundwater and migrated downgradient. The frequency, volume, and concentration of AFFF used at this location are unknown.

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CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	9/15/2022	GIS BY	MS	9/15/2022
SCALE	1:13,200	CHK BY	SS	9/15/2022
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/15/2022

- Approximate Storm Water Outfall
- Area of Interest
- Potential Release
- Facility Boundary
- Water Body
- Wetland
- River/Stream
- Surface Water Flow Direction
- Groundwater Flow Direction
- Inferred Groundwater Flow Direction
- Domestic Well

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Area of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

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4. Project Data Quality Objectives

As identified during the Data Quality Objective (DQO) process and outlined in the SI Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2022a), the objective of the SI is to identify whether there has been a release to the environment at the AOIs identified in the PA. For each AOI, ARNG determines if further investigation is warranted, a removal action is required to address immediate threats, or whether no further action is warranted. This SI evaluated groundwater and soil for presence or absence of relevant compounds at each of the sampled AOIs.

4.1 Problem Statement

ARNG will recommend an AOI for Remedial Investigation (RI) if related soil and groundwater samples have concentrations of the relevant compounds above the OSD risk-based SLs. The SLs are presented in **Section 6.1** of this report.

4.2 Information Inputs

Primary information inputs included:

- The PA for Volunteer Training Site-Smyrna (AECOM, 2018a);
- Analytical data from groundwater and soil samples collected as part of this SI in accordance with the site-specific Uniform Federal Policy (UFP)-QAPP Addendum (AECOM, 2022a); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.

4.3 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-2**). The vertical boundary of investigation was limited to the depth of first observed water in the unconsolidated soil or shallow bedrock (approximately 35 feet bgs). Off-facility sampling was not included in the scope of this SI. If future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights of entry will be obtained by ARNG with property owner(s). The temporal boundaries of the study were limited by field season conditions, specifically avoiding winter months.

4.4 Analytical Approach

Samples were analyzed by Pace Analytical Gulf Coast, accredited under the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP; Accreditation Number 74960) and the National Environmental Laboratory Accreditation Program (NELAP; Certificate Number 01955). Data were compared to applicable SLs within this document and decision rules as defined in the SI QAPP Addendum (AECOM, 2022a).

4.5 Data Usability Assessment

The Data Usability Assessment (DUA), which is provided in **Appendix A**, is an evaluation at the conclusion of data collection activities that uses the results of both data verification and validation in the context of the overall project decisions or objectives. Using both quantitative and qualitative methods, the assessment determines whether project execution and the resulting data have met installation-specific DQOs. Both sampling and analytical activities are considered to assess

whether the collected data are of the right type, quality, and quantity to support the decision-making (DoD, 2019a; DoD, 2019b; USEPA, 2017).

Based on the DUA, the environmental data collected during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUA and its associated data validation reports. These data are of sufficient quality to meet the objectives and requirements of the SI QAPP Addendum (AECOM, 2022a).

5. Site Inspection Activities

This section describes the environmental investigation and sampling activities that occurred as part of the SI. The SI sampling approach was based on the findings of the PA and implemented in accordance with the following approved documents:

- *Final Preliminary Assessment Report, Volunteer Training Site-Smyrna, Tennessee* dated October 2018 (AECOM, 2018a);
- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan* dated March 2018 (AECOM, 2018b);
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Volunteer Training Site-Smyrna, Tennessee* dated February 2022 (AECOM, 2022a);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018c); and
- *Final Site Safety and Health Plan, Volunteer Training Site-Smyrna, Tennessee* dated February 2022 (AECOM, 2022b).

The SI field activities were conducted from 28 February to 25 March 2022 and consisted of utility clearance, rotosonic boring, soil sample collection, permanent monitoring well installation, monitoring well development, groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2022a).

The following samples were collected during the SI and analyzed for a subset of 18 compounds by liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.3 Table B-15 to fulfill the project DQOs:

- Ten (10) soil samples from five sonic boring locations;
- Five groundwater samples from five newly installed permanent monitoring wells;
- Thirteen (13) quality assurance (QA)/quality control (QC) samples.

Figure 5-1 provides the sample locations for all media across the facility. **Table 5-1** presents the list of samples collected for each media. Field documentation is provided in **Appendix B**. A Log of Daily Notice of Field Activity was completed throughout the SI field activities, which is provided in **Appendix B1**. Sampling forms are provided in **Appendix B2**, monitoring well development forms are provided in **Appendix B3**, and land survey data are provided in **Appendix B4**. Additionally, a photographic log of field activities is provided in **Appendix C**.

5.1 Pre-Investigation Activities

In preparation for the SI field activities, project team members participated in Technical Project Planning (TPP) meetings, performed utility clearance, and sampled decontamination source water. Details for each of these activities are presented below.

5.1.1 Technical Project Planning

The USACE TPP Process, Engineer Manual (EM) 200-1-2 (USACE, 2016) defines four phases to project planning: 1.) defining the project phase; 2.) determining data needs; 3.) developing data collection strategies; and 4.) finalizing the data collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

A combined TPP Meeting 1 and 2 was held on 17 March 2021, prior to SI field activities. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2. The stakeholders for this SI included the ARNG, TNARNG, USACE, TDEC, and representatives familiar with the facility, the regulations, and the community. Stakeholders were provided the opportunity to make comments on the technical sampling approach and methods at the combined TPP Meeting 1 and 2. The outcome of the combined TPP Meeting 1 and 2 was memorialized in the SI QAPP Addendum (AECOM, 2022a).

A TPP Meeting 3 was held after the field event (date TBD) to discuss the results of the SI. Meeting minutes for TPP 3 are included in **Appendix D** of this report. Future TPP meetings will provide an opportunity to discuss the results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

AECOM's drilling subcontractor, Cascade Technical Services, LLC. placed a ticket with the "One Call" Tennessee utility clearance provider to notify them of intrusive work on 22 February 2022. However, because VTS-S is a private facility, the participating "One Call" locators did not clear utilities at the entire facility. Therefore, AECOM contracted Ground Penetrating Radar Services, LLC. (GPRS), a private utility location service, to perform utility clearance. GPRS performed utility clearance of the proposed boring locations on 28 February 2022 with input from the AECOM field team and VTS-S facility staff. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 feet of each boring were pre-cleared using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and Sampling Equipment Acceptability

The potable water source used for decontamination of drilling equipment was confirmed to be acceptable for use in a PFAS investigation prior to the start of field activities. A sample from a potable water source at VTS-S was collected on 21 January 2022, prior to mobilization, and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15. The results of the decontamination water sample are provided in **Appendix F**. A discussion of the results is presented in the DUA (**Appendix A**).

Materials that were used within the sampling zone were confirmed as acceptable for use in the sampling environment. The checklist of acceptable materials for use in the sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the SI QAPP Addendum (AECOM, 2022a). Prior to the start of field work each day, a Sampling Checklist was completed as an additional layer of control. The checklist served as a daily reminder to each field team member regarding the allowable materials within the sampling environment.

5.2 Soil Borings and Soil Sampling

Soil samples were collected via rotosonic (sonic) drilling technology, in accordance with the SI QAPP Addendum (AECOM, 2022a). A GeoProbe® 8140LC sonic drilling system was used to collect continuous soil cores to the target depth. A hand auger was used to collect soil from the top 5 feet of the boring, in accordance with AECOM utility clearance procedures. The soil boring locations are shown on **Figure 5-1**. Sampling intervals and soil boring depths are provided **Table 5-1** and **Table 5-2**, respectively.

Up to three discrete soil samples were collected from soil borings in the vadose zone for chemical analysis: one surface soil sample (0 to 2 feet bgs), one subsurface soil sample approximately 2 feet above the groundwater table, and one subsurface soil sample at the mid-point between the surface and the groundwater table. All three soil samples were collected only at one location,

VTS-01. In borings where groundwater was encountered in rock (AOI01-02, and VTS-03), the soil sample above the water table was not collected, in accordance with the QAPP Addendum (AECOM, 2022a). Additionally, two wells (VTS-02 and VTS-03) were installed to primarily evaluate potential migration of dissolved PFAS constituents in groundwater. For this reason and in accordance with the QAPP Addendum, surface soil was not sampled at those two boring locations (AECOM, 2022a), and as a result, only one midpoint soil sample was collected at VTS-03.

The soil cores were continuously logged for lithological descriptions by an AECOM field geologist using the Unified Soil Classification System (USCS). A photoionization detector (PID) was used to screen the breathing zone during boring activities as part of personal safety requirements. Observations and measurements were recorded on sampling forms (**Appendix B2**) and in a non-treated field logbook (i.e., composition notebook). Depth interval, recovery thickness, PID concentrations, moisture, relative density, color (using a Munsell soil color chart), and texture (using the USCS) were recorded. The boring logs are provided in **Appendix E**.

Soil borings completed during the SI found clayey sands and lean clays as the dominant lithology of unconsolidated sediments below the facility. Lesser amounts of gravel were observed in most borings. Surface soil at VTS-02 was primarily composed of silt, which differs from the clayey sands observed at all other locations. The borings were completed at depths between 26 and 35 feet bgs. Fossiliferous limestone bedrock was observed at depths between 12.5 and 26.5 feet bgs across borings (see **Table 5-3**). The limestone was observed to be relatively competent, with moderately fractured zones in some locations. A sample for grain size analysis was collected at one location, AOI01-02, from 8 to 10 feet bgs, and analyzed via ASTM Method D-422. The results are discussed in Section 6.2. Boring logs are presented in **Appendix E** and grain size results are presented in **Appendix F**.

Each soil sample was collected into laboratory-supplied PFAS-free high-density polyethylene (HDPE) bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via Federal Express (FedEx) under standard chain of custody (CoC) procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15, total organic carbon (TOC) (USEPA Method 9060A), pH (USEPA Method 9045D), and grain size (ASTM Method D-422) in accordance with the SI QAPP Addendum (AECOM, 2022a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. Matrix spike (MS)/MS duplicates (MSDs) were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, equipment rinsate blanks were collected at a rate of 5% and analyzed for the same parameters as the soil samples. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 degrees Celsius (°C) during shipment.

Sonic borings were converted to permanent monitoring wells, which were constructed in accordance with the SI QAPP Addendum (AECOM, 2022a) and applicable State requirements (TDEC, 2015). Wells were installed in grass areas to avoid disturbing concrete or asphalt surfaces.

5.3 Permanent Well Installation and Groundwater Sampling

During the SI, five permanent monitoring wells were installed within or downgradient of potential source areas. The locations of the wells are shown on **Figure 5-1**.

A GeoProbe® 8140LC rotosonic drill rig was used to install five 2-inch diameter monitoring wells. In accordance with State requirements (TDEC, 2015), the monitoring wells were constructed with Schedule 40 polyvinyl chloride, flush threaded 10-foot sections of riser, 0.010-inch slotted well

screen, and a threaded bottom cap. The general location and expected depth of the permanent wells were determined based on regional hydrogeologic data and historical facility information gathered in the PA. A filter pack of 20/40 silica sand was installed in the annulus around the well screen to a minimum of 2 feet above the well screen. A 2-foot-thick bentonite seal was placed above the filter sand and hydrated with the approved source water. Bentonite grout was placed in the well annulus from the top of the bentonite seal to ground surface. The bentonite grout was allowed to set for a minimum of 24 hours prior to well completion, in accordance with the SI QAPP Addendum (AECOM, 2022a). All monitoring wells were completed with flush mount well vaults. The screen interval of each of the groundwater monitoring wells is provided in **Table 5-3**.

Development and sampling of wells was completed in accordance with the SI QAPP Addendum (AECOM, 2022a). The newly installed monitoring wells were developed no sooner than 24 hours following installation by pumping and surging using a submersible pump. In wells with limited groundwater recharge, the wells were purged dry three times in succession using either a submersible pump or peristaltic pump. When used, the submersible pump was decontaminated thoroughly between each well. Samples were collected no sooner than 24 hours following development via low-flow sampling methods using a peristaltic pump with disposable, PFAS-free, HDPE tubing. New tubing was used at each well. The wells were purged at a rate determined in the field to reduce draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, oxidation-reduction potential, and turbidity) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**). Water levels were measured to the nearest 0.01 inch and recorded. Additionally, a subsample of each groundwater sample was collected in a separate container and a shaker test was completed to identify if there were any foaming. Slight foaming was observed in one sample taken from newly installed permanent monitoring well AOI01-01 and was noted on the CoC.

Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (AECOM, 2022a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. One field reagent blank was collected in accordance with the Programmatic UFP-QAPP (PQAPP) (AECOM, 2018b). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 °C during shipment.

5.4 Synoptic Water Level Measurements

A synoptic groundwater gauging event was performed on 20 March 2022. Groundwater elevation measurements were collected from the five new temporary monitoring wells. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-4**, and groundwater elevation data are provided in **Table 5-3**.

5.5 Surveying

The northern side of each well casing was surveyed by Tennessee-licensed land surveyors following guidelines documented in the SOPs included in the SI QAPP Addendum (AECOM, 2022a). Survey data from the newly installed wells on the facility were collected on 21 March 2022 in the applicable Universal Transverse Mercator zone projection with World Geodetic System 84 datum (horizontal) and North American Vertical Datum 1988 (vertical). The surveyed well data are provided in **Appendix B4**.

5.6 Investigation-Derived Waste

As of the date of this report, the disposal of investigation-derived waste (IDW) is not regulated federally. IDW generated during the SI is considered non-hazardous waste and was managed in accordance with the SI QAPP Addendum (AECOM, 2022a) and with the DA Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

Soil IDW (i.e., soil cuttings) generated during the SI activities were containerized in new, properly labelled 55-gallon drums and stored in a location designated by VTS-S staff and the TNARNG Environmental Department. Soil IDW from each borehole was containerized individually and not combined with IDW from other boreholes. The soil IDW was not sampled and assumes the PFAS characteristics of the associated soil samples collected from that source location.

Liquid IDW (i.e. purge water, development water, and decontamination fluids) generated during SI activities were containerized in new, properly-labelled 55-gallon drums and stored in a location designated by VTS-S staff and the TNARNG Environmental Department. Liquid IDW from each well was containerized individually and not combined with IDW from other wells. The liquid IDW was not sampled and assumes the PFAS characteristics of the associated groundwater samples collected from that source location. Final treatment and disposal of the liquid IDW was handled under a separate contract by another contractor.

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

5.7 Laboratory Analytical Methods

Samples were analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 at Pace Analytical Gulf Coast in Baton Rouge, Louisiana, a DoD ELAP and NELAP certified laboratory. Soil samples were also analyzed for TOC using USEPA Method 9060A, pH by USEPA Method 9045D, and grain size (ASTM D-422).

5.8 Deviations from SI QAPP Addendum

There were no deviations from the QAPP Addendum (AECOM, 2020a). No field changes or non-conformance reports were necessary.

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Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Volunteer Training Site-Smyrna, Tennessee

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
Soil Samples							
AOI01-01-SB-00-02	3/4/2022 7:40	0-2	x				
AOI01-01-SB-00-02-D	3/4/2022 7:40	0-2	x				Duplicate
AOI01-01-SB-00-02-MS	3/4/2022 7:40	0-2	x				MS
AOI01-01-SB-00-02-MSD	3/4/2022 7:40	0-2	x				MSD
AOI01-01-SB-12-14	3/4/2022 7:56	12-14	x				
AOI01-02-SB-00-02	3/3/2022 12:30	0-2	x	x	x		TOC/pH
AOI01-02-SB-08-10	3/3/2022 13:05	8-10	x			x	Grain Size
VTS-01-SB-00-02	2/28/2022 12:50	0-2	x				
VTS-01-SB-06-08	3/1/2022 9:45	6-8	x				
VTS-01-SB-06-08-D	3/1/2022 9:45	6-8	x				Duplicate
VTS-01-12-14	3/1/2022 10:00	12-14	x				
VTS-02-SB-11-13	3/3/2022 8:00	11-13	x				
VTS-02-SB-22-24	3/3/2022 8:15	22-24	x				
VTS-03-SB-10-12	3/2/2022 8:00	10-12	x				
Groundwater Samples							
AOI01-01-GW	3/25/2022 13:45	N/A	x				
AOI01-02-GW	3/25/2022 12:20	N/A	x				
AOI01-02-GW-D	3/25/2022 12:20	N/A	x				Duplicate
AOI01-02-GW-MS	3/25/2022 12:20	N/A	x				MS
AOI01-02-GW-MSD	3/25/2022 12:20	N/A	x				MSD
VTS-01-GW	3/20/2022 12:00	N/A	x				
VTS-02-GW	3/25/2022 14:55	N/A	x				
VTS-03-GW	3/20/2022 15:30	N/A	x				
Quality Control Samples							
VTS-ERB-01	3/1/2022 13:10	N/A	x				taken off of hand auger
VTS-ERB-02	3/2/2022 17:00	N/A	x				taken off of sonic rig cutting shoe
VTS-ERB-03	3/3/2022 9:50	N/A	x				taken off of soil spatula
VTS-ERB-04	3/4/2022 13:00	N/A	x				taken off of submersible pump
VTS-FRB-01	3/1/2022 11:35	N/A	x				FRB
VTS-S DECON	1/21/2022 10:30	N/A	x				DECON

Notes:
ASTM = American Society for Testing and Materials
bgs = below ground surface
ERB = equipment rinsate blank
FRB = field reagent blank
LC/MS/MS = Liquid Chromatography Mass Spectrometry
MS/MSD = matrix spike/ matrix spike duplicate
N/A = not applicable
QSM = Quality Systems Manual
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

Table 5-2
Soil Boring Depths
Site Inspection Report, Volunteer Training Site-Smyrna, Tennessee

Area of Interest	Boring Location	Soil Boring Depth (feet bgs)
1	AOI01-01	35
	AOI01-02	29.4
	VTS-01	27
	VTS-02	29.33
	VTS-03	26

Notes:

bgs = below ground surface
VTS = Volunteer Training Site

Table 5-3
Permanent Well Screen Intervals, Groundwater Elevations, and Bedrock Elevations
Site Inspection Report, Volunteer Training Site-Smyrna, Tennessee

Area of Interest	Boring Location	Permanent Well Screen Interval (feet bgs)	Top of Casing Elevation (feet NAVD88)	Ground Surface Elevation (feet NAVD88)	Depth to Water (feet btoc)	Depth to Water (feet bgs)	Groundwater Elevation (feet NAVD88)	Depth to Bedrock (feet bgs)	Bedrock Surface Elevation (feet NAVD 88)
1	AOI01-01	25.00 - 35.00	512.50	512.80	24.03	24.33	488.47	25.00	487.80
	AOI01-02	19.40 - 29.40	515.06	515.10	25.18	25.22	489.88	17.00	498.10
	VTS-01	15.15 - 25.15	507.74	508.20	19.43	19.89	488.31	26.50	481.70
	VTS-02	19.33 - 29.33	518.44	518.60	23.74	23.90	494.70	26.00	492.60
	VTS-03	14.78 - 24.78	503.40	503.78	14.19	14.57	489.21	12.50	491.28

Notes:

bgs = below ground surface
btoc = below top of casing
NAVD88 = North American Vertical Datum 1988
VTS = Volunteer Training Site

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CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	9/15/2022	GIS BY	MS	9/15/2022
SCALE	1:4,800	CHK BY	SS	9/15/2022
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/15/2022

Legend

- Soil Boring and Monitoring Well
- Approximate Storm Water Outfall
- Area of Interest
- Facility Boundary
- Water Body
- Wetland
- Surface Water Flow Direction
- Groundwater Flow Direction
- Inferred Groundwater Flow Direction
- Storm Sewer Line (Approx)
- New Sewer Line (Approx)

N

Site Inspection Sample Locations

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 5-1

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6. Site Inspection Results

This section presents the analytical results of the SI. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for AOI 1 is provided in **Section 6.3**. **Table 6-2** through **Table 6-5** present results in soil or groundwater for the relevant compounds. Tables that contain all results are provided in **Appendix F**, and the laboratory reports are provided in **Appendix G**.

6.1 Screening Levels

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the OSD dated 6 July 2022 (Assistant Secretary of Defense, 2022). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to the five compounds presented on **Table 6-1** below.

Table 6-1: Screening Levels (Soil and Groundwater)

Analyte[b]	Residential (Soil) (µg/kg)[a] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a]
PFOA	19	250	6
PFOS	13	160	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

b.) Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

The data in the subsequent sections are compared to the SLs presented in **Table 6-1**. The SLs for groundwater are based on direct ingestion. The SLs for soil are based on incidental ingestion and are applied to the depth intervals reasonably anticipated to be encountered by the receptors identified at the facility: the residential scenario is applied to surface soil results (0 to 2 feet bgs) and the industrial/commercial worker scenario is applied to shallow subsurface soil results (2 to 15 feet bgs). The SLs are not applied to deep subsurface soil results (>15 feet bgs) because 15 feet is the anticipated limit of construction activities.

6.2 Soil Physicochemical Analyses

To provide basic soil parameter information, soil samples were analyzed for TOC, pH, and grain size, which are important for evaluating transport through the soil medium. **Appendix F** contains the results of the TOC, pH, and grain size sampling. Results from the two samples collected had values ranging from 7.32 to 7.72 pH and 1400 to 1670 milligrams per kilogram TOC. A sample for grain size analysis was collected at one location, AOI01-02, from 8 to 10 feet bgs, and analyzed via ASTM Method D-422. The results indicate that the soil sample was comprised primarily of silt (63.41%) and clay (30.45%). These results and facility observations are consistent with the understood alluvial depositional environment of the unconsolidated surficial deposits overlying an Ordovician-aged carbonate unit, the Ridley Limestone (USGS, 2022a).

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport. According to the Interstate Technology Regulatory Council (ITRC), several important partitioning mechanisms include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions and are therefore relatively mobile in groundwater (Xiao et al., 2015), but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy, 2006; Guelfo and Higgins, 2013). When sufficient organic carbon is present, organic carbon normalized distribution coefficients (K_{oc} values) can help in evaluating transport potential, though other geochemical factors (for example, pH and presence of polyvalent cations) may also affect PFAS sorption to solid phases (ITRC, 2018).

6.3 AOI 1

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 1, which includes two potential release areas: Concrete Ramp/Apron and Building 682S. The soil and groundwater results are summarized on **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.3.1 AOI 1 Soil Analytical Results

Figure 6-1 through **Figure 6-5** present the ranges of detections in soil. **Table 6-2** through **Table 6-4** summarize the soil results.

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI01-01, AOI01-02, and VTS-01. Soil was also sampled from shallow subsurface soil (6 to 14 feet bgs) from all five boring locations (AOI01-01, AOI01-02, VTS-01, VTS-02, and VTS-03). A third subsurface soil sample was only taken at VTS-01 and VTS-02 due to the presence of bedrock above the water table at all other locations.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at concentrations below their respective SLs. At AOI1-01 and VTS-01, PFOA was detected at a maximum concentration of 0.363 J micrograms per kilogram (µg/kg); PFOS at a maximum concentration of 7.45 µg/kg; PFBS at a maximum concentration of 0.068 J µg/kg; and PFHxS at a maximum concentration of 0.102 J µg/kg. PFNA was detected in all three surface soil samples with a maximum concentration of 0.158 µg/kg.

PFOS, PFBS, PFHxS, and PFNA were each detected in at least one shallow subsurface soil at concentrations below their respective SLs at the following maximum concentrations: PFOS at 0.222 J µg/kg, PFBS at 0.024 J µg/kg; PFHxS at 0.208 J µg/kg; and PFNA at 0.029 J µg/kg. PFOA was not detected in shallow subsurface soil.

A single deep subsurface soil (22 to 24 feet bgs) was collected at the facility from boring location VTS-02. PFOS was detected at 0.075 J µg/kg. PFOA, PFHxS, PFNA, and PFBS were not detected.

6.3.2 AOI 1 Groundwater Analytical Results

Figure 6-6 and **Figure 6-7** present the ranges of detections in groundwater. **Table 6-5** summarizes the groundwater results.

Within AOI 1, groundwater was sampled from newly installed permanent monitoring wells AOI01-01 and AOI01-02. PFOA, PFBS, and PFNA were detected in at least one well at concentrations below the SLs. PFOS at AOI01-01 and AOI01-02 exceeded the SL of 4 nanograms per liter (ng/L) with concentrations of 7.00 ng/L and 58.8 ng/L, respectively.

Groundwater was also sampled at three other newly installed permanent monitoring wells, VTS-01 through VTS-03. These wells were installed outside of the AOI to evaluate presence or absence of PFAS in groundwater upgradient or side-gradient of the AOI. VTS-01 is located upgradient of AOI 1, just east and downgradient of the Buffalo Hangar, an adjacent off-facility potential source. VTS-02 is located side-gradient of AOI 1, and VTS-03 is side-gradient of AOI 1, near the eastern facility boundary. PFOA, PFBS, and PFHxS were detected below the SLs at all three locations at maximum concentrations of 2.82 ng/L, 3.08 ng/L, and 16.6 ng/L, respectively. PFOS was not detected at VTS-03. PFNA was not detected at VTS-01, VTS-02, or VTS-03. PFOS exceeded the SL of 4 ng/L at VTS-01 and VTS-02, with concentrations of 28.5 ng/L and 4.43 ng/L, respectively.

6.3.3 AOI 1 Conclusions

Based on the results of the SI, PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil below their respective SLs. PFOS was detected in groundwater at concentrations above the SL. Based on the exceedance of the PFOS SL in groundwater, further evaluation at AOI 1 is warranted.

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Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Volunteer Training Site-Smyrna

Area of Interest		AOI01							
Sample ID		AOI01-01-SB-00-02		AOI01-01-SB-00-02-D		AOI01-02-SB-00-02		VTS-01-SB-00-02	
Sample Date		03/04/2022		03/04/2022		03/03/2022		02/28/2022	
Depth		0-2 ft		0-2 ft		0-2 ft		0-2 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)									
PFBS	1900	0.068	J	0.037	J	ND	U	0.025	J
PFHxS	130	0.102	J	0.040	J	ND	U	0.084	J
PFNA	19	0.158	J	0.024	J	0.050	J	0.057	J
PFOA	19	0.363	J	ND	U	ND	U	0.156	J
PFOS	13	0.915	J-	0.163	J-	7.45		0.465	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

J- = Estimated concentration, biased low

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
VTS	Volunteer Training Site-Smyrna
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Volunteer Training Site-Smyrna

Area of Interest		AOI01													
Sample ID		AOI01-01-SB-12-14		AOI01-02-SB-08-10		VTS-01-SB-06-08		VTS-01-SB-06-08-D		VTS-01-SB-12-14		VTS-02-SB-11-13		VTS-03-SB-10-12	
Sample Date		03/04/2022		03/03/2022		03/01/2022		03/01/2022		03/01/2022		03/03/2022		03/02/2022	
Depth		12-14 ft		8-10 ft		6-8 ft		6-8 ft		12-14 ft		11-13 ft		10-12 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)															
PFBS	25000	ND	U	0.024	J	0.024	J	0.025	J	ND	U	ND	U	ND	U
PFHxS	1600	ND	U	0.208	J	0.045	J	0.038	J	0.045	J	ND	U	ND	U
PFNA	250	ND	U	ND	U	ND	U	ND	U	0.029	J	ND	U	ND	U
PFOA	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
PFOS	160	ND	U	0.189	J	0.110	J	0.135	J	0.222	J	0.077	J	0.105	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
VTS	Volunteer Training Site-Smyrna
µg/kg	micrograms per kilogram

Table 6-4
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Deep Subsurface Soil
Site Inspection Report, Volunteer Training Site-Smyrna

Area of Interest	AOI01	
Sample ID	VTS-02-SB-22-24	
Sample Date	03/03/2022	
Depth	22-24 ft	
Analyte	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)		
PFBS	ND	U
PFHxS	ND	U
PFNA	ND	U
PFOA	ND	U
PFOS	0.075	J

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AOI	Area of Interest
DL	detection limit
ft	feet
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
VTS	Volunteer Training Site-Smyrna
µg/kg	micrograms per kilogram

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Volunteer Training Site-Smyrna

Area of Interest		AOI01											
Sample ID		AOI01-01-GW		AOI01-02-GW		AOI01-02-GW-D		VTS-01-GW		VTS-02-GW		VTS-03-GW	
Sample Date		03/25/2022		03/25/2022		03/25/2022		03/20/2022		03/25/2022		03/20/2022	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)													
PFBS	601	1.28	J+	2.51	J+	2.88	J+	2.83	J+	0.939	J+	3.08	J
PFHxS	39	1.44	J	20.7	J+	24.7	J+	16.6		2.14	J	4.25	
PFNA	6	2.15	J	ND	U	ND	U	ND	U	ND	U	ND	U
PFOA	6	4.68		3.41	J	4.14		2.82	J	1.47	J	2.26	J
PFOS	4	7.00		49.8	J+	58.8	J+	28.5		4.43		ND	U

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

J+ = Estimated concentration, biased high

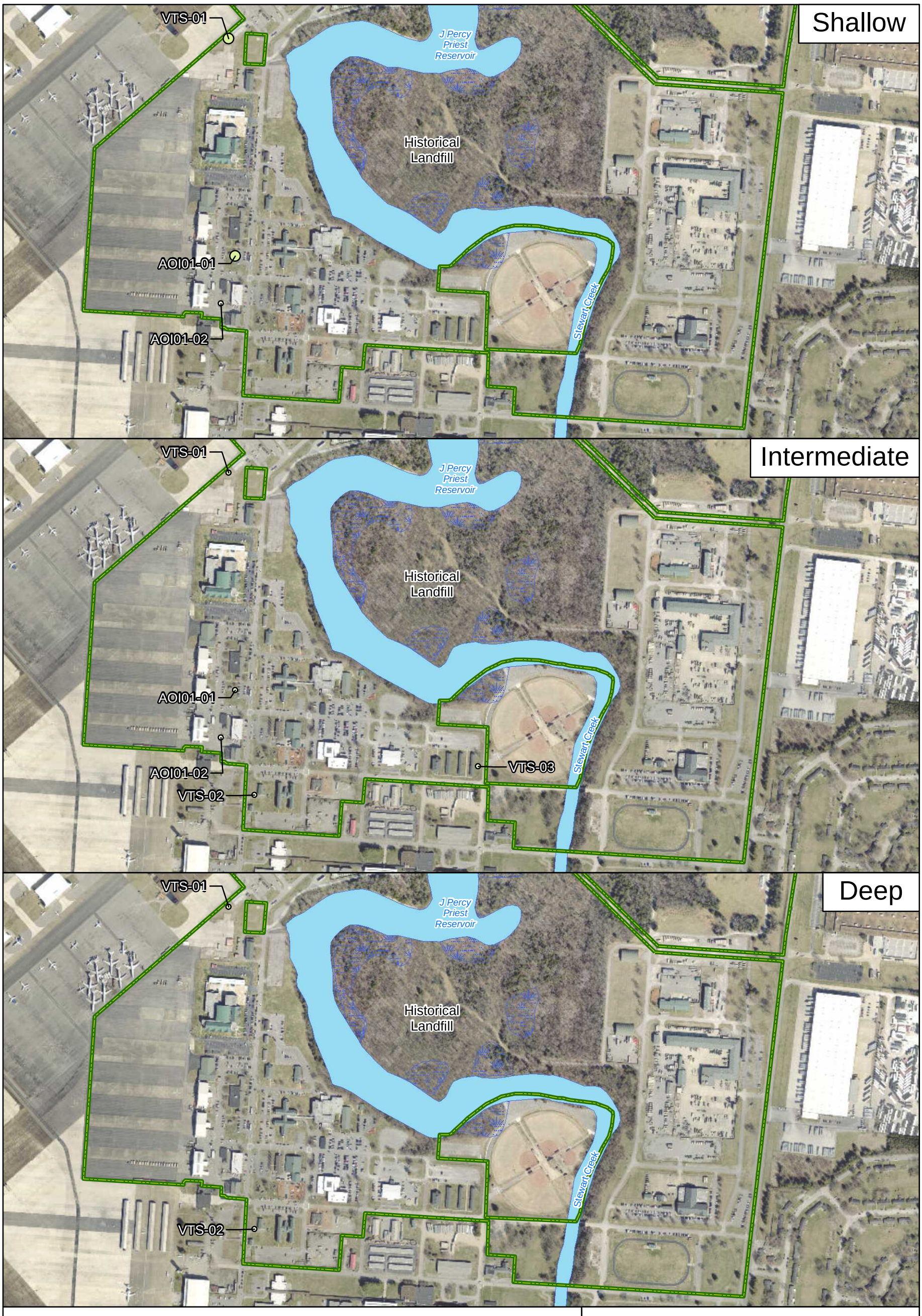
U = The analyte was not detected at a level greater than or equal to the adjusted DL

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
VTS	Volunteer Training Site-Smyrna
ng/l	nanogram per liter



Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFOA Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	8/9/2022	GIS BY	MS	8/9/2022
SCALE	1:7,800	CHK BY	SS	8/9/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/9/2022

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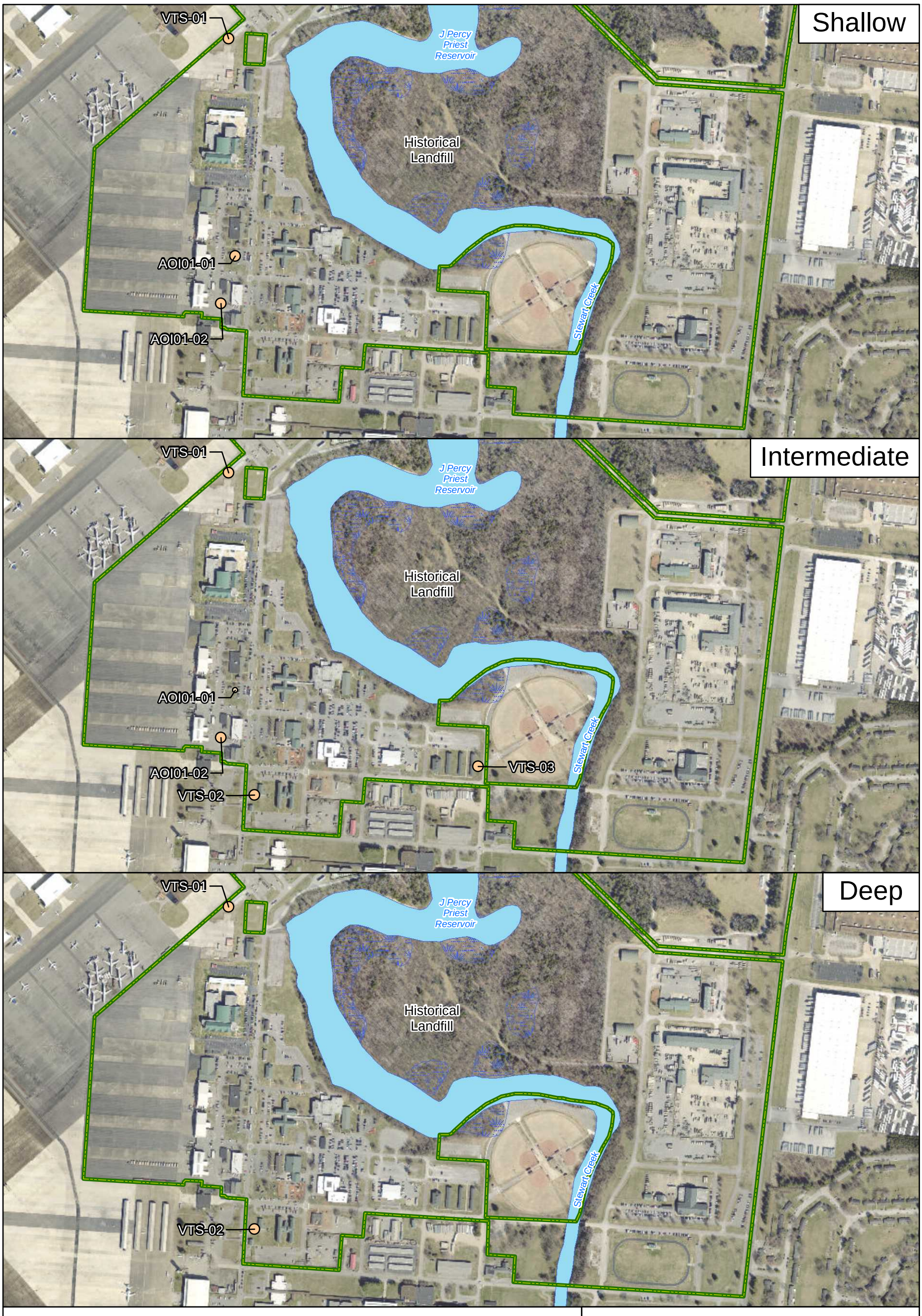
Figure 6-1



Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFOS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	8/9/2022	GIS BY	MS	8/9/2022
SCALE	1:7,800	CHK BY	SS	8/9/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/9/2022

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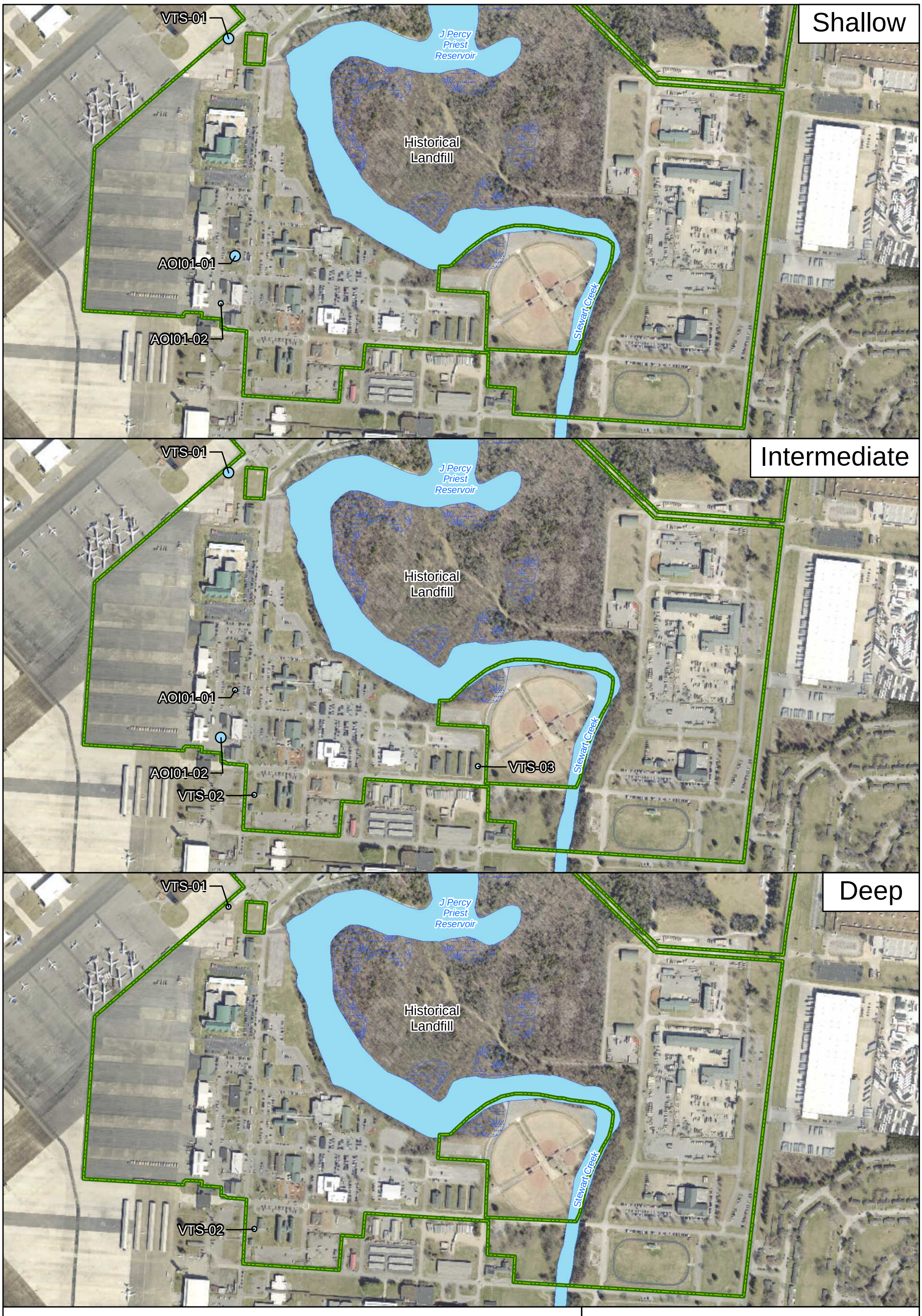
Figure 6-2



Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFBS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	8/9/2022	GIS BY	MS	8/9/2022
SCALE	1:7,800	CHK BY	SS	8/9/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/9/2022

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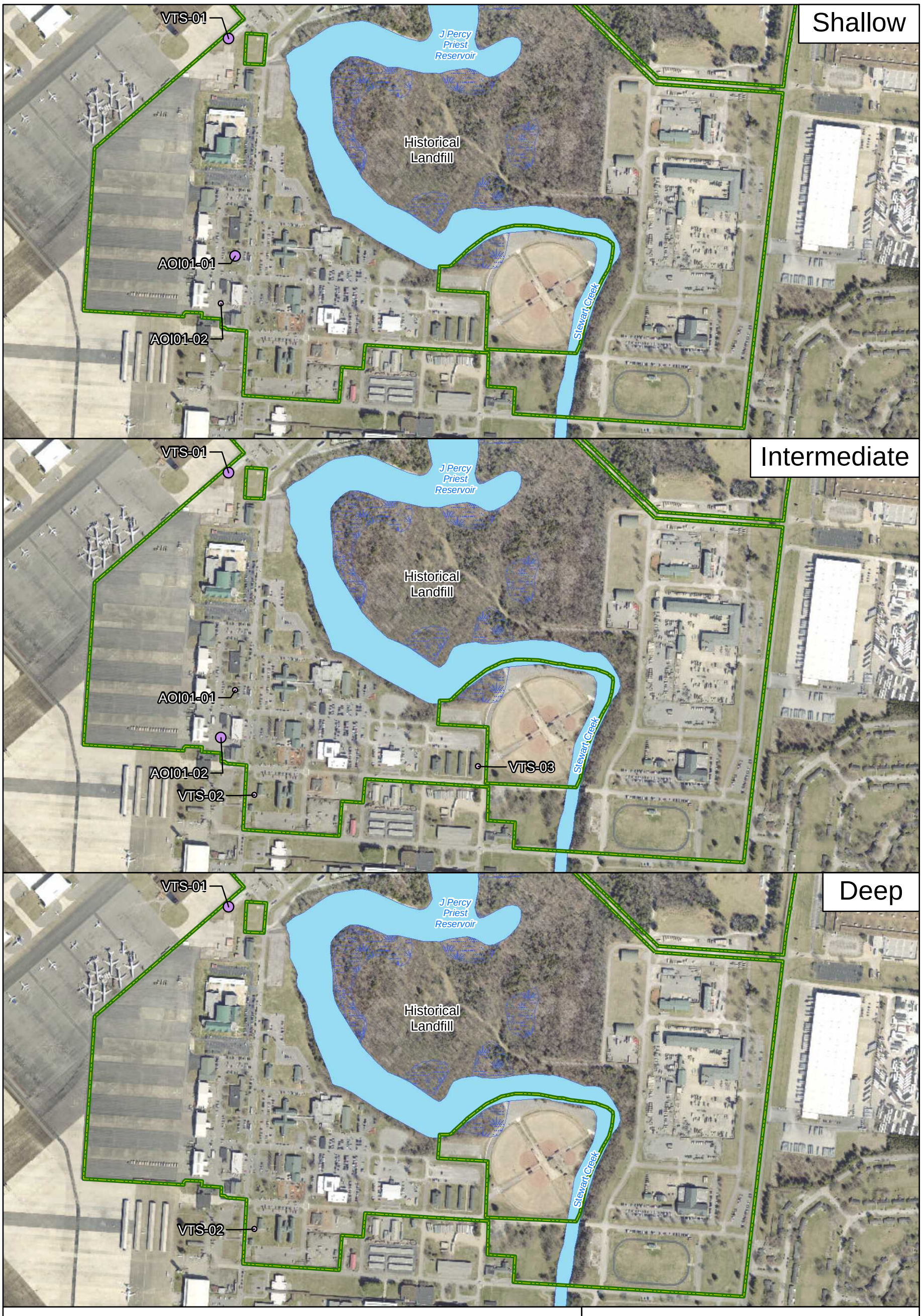
Figure 6-3



Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFHxS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	8/9/2022	GIS BY	MS	8/9/2022
SCALE	1:7,800	CHK BY	SS	8/9/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	8/9/2022

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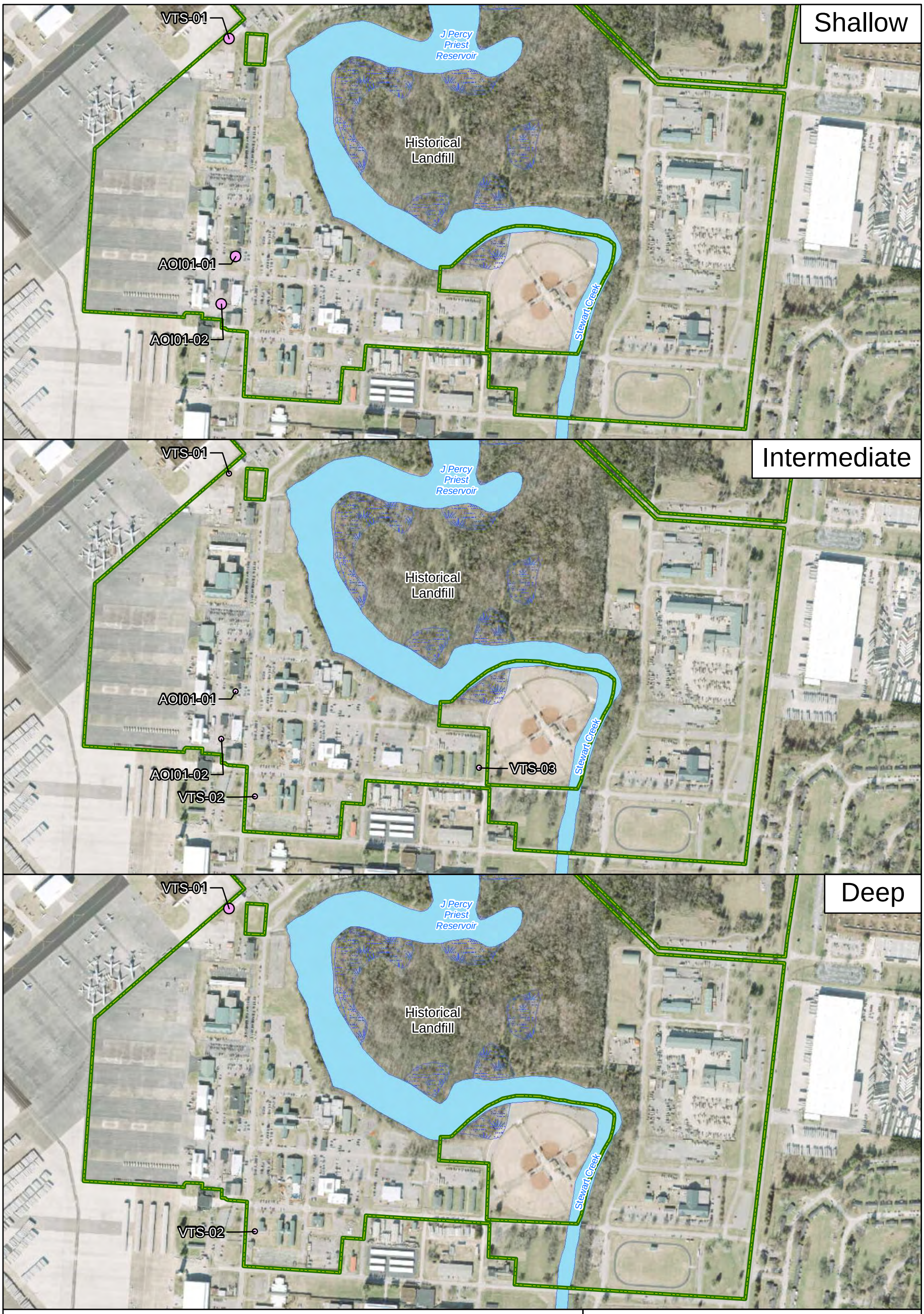
Figure 6-4



Facility Boundary
Water Body
Wetland

PFNA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

N

0 325 650 1,300 Feet

Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFNA Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	9/22/2022	GIS BY	MS	9/22/2022
SCALE	1:7,800	CHK BY	SS	9/22/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/22/2022

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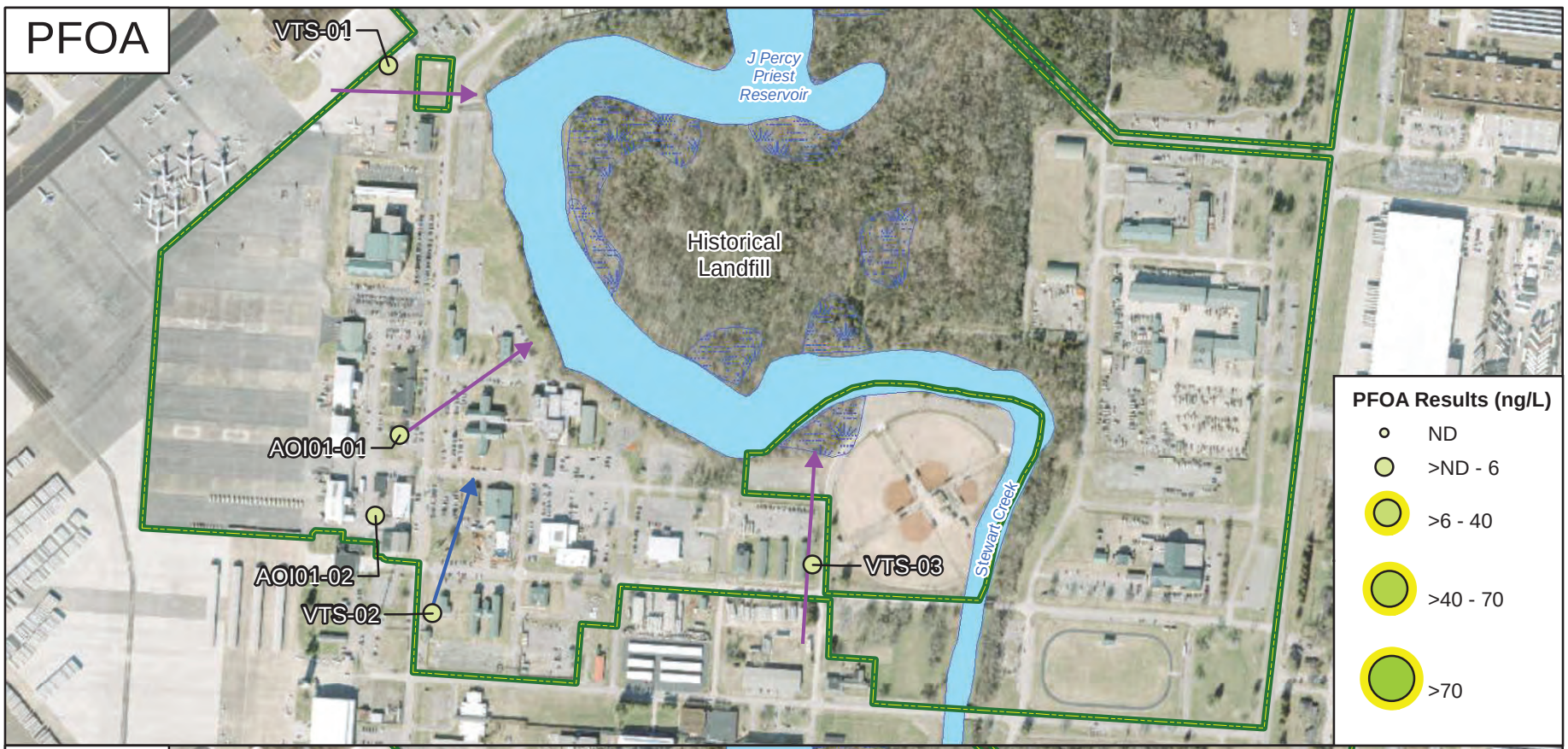
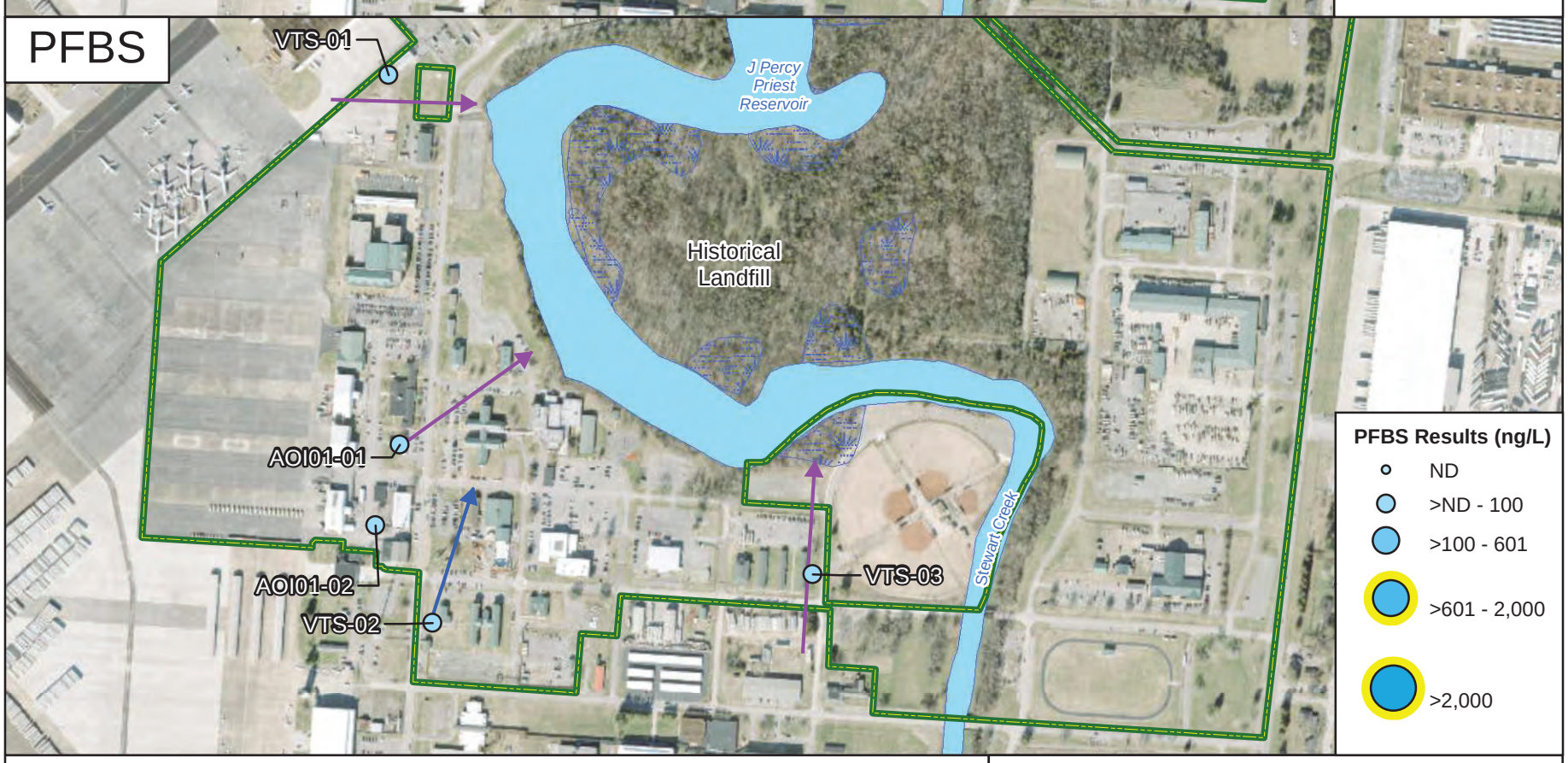
Figure 6-5

PFOA



PFOS

PFBS



Legend

- Facility Boundary
- Water Body
- Wetland
- Groundwater Flow Direction
- Inferred Groundwater Flow Direction

N

0 325 650 1,300 Feet

Exceedances of the OSD SL are depicted with a yellow halo.

PFOA, PFOS, and PFBS Detections in Groundwater

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	10/5/2022	GIS BY	MS	10/5/2022
SCALE	1:7,800	CHK BY	SS	10/5/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	10/5/2022

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Figure 6-6

PFHxS

VTS-01

J Percy Priest Reservoir

Historical Landfill

AOI01-01

AOI01-02

VTS-02

VTS-03

Stewart Creek

Stewart Creek

PFHxS Results (ng/L)

- ND
- >ND - 39
- >39 - 100
- >100 - 1,000
- >1,000

PFNA

VTS-01

J Percy Priest Reservoir

Historical Landfill

AOI01-01

AOI01-02

VTS-02

VTS-03

Stewart Creek

Stewart Creek

PFNA Results (ng/L)

- ND
- >ND - 6
- >6 - 100
- >100 - 1,000
- >1,000

Legend

- Facility Boundary
- Water Body
- Wetland
- Groundwater Flow Direction
- Inferred Groundwater Flow Direction

N

0 325 650 1,300 Feet

Exceedances of the OSD SL are depicted with a yellow halo.

PFHxS and PFNA Detections in Groundwater

CLIENT	ARNG			
PROJECT	Site Inspection at VTS Smyrna, TN			
REVISED	9/15/2022	GIS BY	MS	9/15/2022
SCALE	1:7,800	CHK BY	SS	9/15/2022
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	9/15/2022

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Figure 6-7

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7. Exposure Pathways

The CSM for AOI 1, revised based on the SI findings, is presented on **Figure 7-1**. Please note that while the CSM discussion assists in determining if a receptor may be impacted, the decision to move from SI to RI or interim action is determined based upon exceedances of the SLs for the relevant compounds and whether the release is more than likely attributable to the DoD. A CSM presents the current understanding of the site conditions with respect to known and suspected sources, potential transport mechanisms and migration pathways, and potentially exposed human receptors. A human exposure pathway is considered potentially complete when the following conditions are present:

1. Contaminant source;
2. Environmental fate and transport;
3. Exposure point;
4. Exposure route; and
5. Potentially exposed populations.

If any of these elements are missing, the pathway is incomplete. The CSM figure uses an empty circle symbol to represent an incomplete exposure pathway. Areas with an incomplete pathway generally warrant no further action. However, the pathway is considered potentially complete if the relevant compounds are detected, in which case the CSM figure uses a half-filled circle symbol to represent a potentially complete exposure pathway. Additionally, a completely filled circle symbol is used to indicate when a potentially complete exposure pathway has detections of relevant compounds above the SLs. Areas with an identified potentially complete pathway that have detections of the relevant compounds above the SLs may warrant further investigation. Although the CSMs indicate whether potentially complete exposure pathways may exist, the recommendation for future study in an RI or no action at this time is based on the comparison of the SI analytical results for the relevant compounds to the SLs.

In general, the potential routes of exposure to the relevant compounds are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of toxicological study. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA, 2001). Receptors at the facility include site workers (e.g., facility staff and visiting soldiers), construction workers, trespassers, residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

The SI results in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at AOI 1 based on the aforementioned criteria.

7.1.1 AOI 1

AFFF was historically released at AOI 1 during fire training activities at the Concrete Ramp outside of the three facility hangars. Additionally, AFFF was released by the fire suppression system during a fire in hangar Building 682S. PFOA, PFOS, PFBS, PFHxS, and PFNA were detected in soil at AOI 1 and side-gradient of the AOI.

Based on the results of the SI in AOI 1 and the surrounding facility, ground-disturbing activities could potentially result in site worker, current or future construction worker, or trespasser (although unlikely due to restricted access) exposure to PFOA, PFOS, PFBS, PFHxS, and PFNA via inhalation of dust. Off-facility recreational users of the nearby J Percy Priest Reservoir or Volunteer Park ball fields may potentially be exposed to PFOA, PFOS, PFBS, PFHxS, and PFNA via inhalation of dust caused by on-facility ground disturbing activities. Additionally, nearby residents may potentially be exposed to these contaminants via inhalation of dust. Ground-disturbing activities could also potentially result in site worker, construction worker, or trespasser exposure via ingestion of surface soil.

Ground-disturbing activities could also potentially result in construction worker exposure to PFOS, PFBS, PFHxS, and PFNA in subsurface soil via ingestion. Construction activities were observed in the vicinity of AOI 1, at the northwest corner of 8th Avenue and B Street during the SI. The CSM for AOI 1 is presented on **Figure 7-1**.

7.2 Groundwater Exposure Pathway

The SI results in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors based on the aforementioned criteria.

7.2.1 AOI 1

PFOS exceeded the SLs in four of the five newly installed permanent monitoring wells at the facility. PFOS was not detected at VTS-03. PFOA, PFBS, and PFHxS, were detected in groundwater from all five newly installed permanent monitoring wells within or outside of AOI 1 but did not exceed SLs. PFNA was detected only in well AOI01-01 but did not exceed the SL. There are no potable water supply wells downgradient of AOI 1. However, less than 0.25 miles downgradient of the release area is Stewart Creek, an upriver tributary of J Percy Priest Reservoir, which is the source of drinking water for the Town of Smyrna and the facility. Due to PFOS SL exceedances the ingestion exposure pathway for site workers, trespassers (although unlikely due to restricted access), off-facility residents, and recreational users is considered potentially complete. Depths to water measured in March 2022 during the SI ranged from 14.57 to 25.22 feet bgs. Therefore, groundwater may be encountered during construction activities and the ingestion exposure pathway for construction workers is considered potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.3 Surface Water and Sediment Exposure Pathway

Surface water and sediment were not sampled as a part of this SI. The SI results in soil and groundwater, in combination with knowledge of the fate and transport properties of PFAS, were used to determine whether a potentially complete pathway exists between the source and potential receptors.

7.3.1 AOI 1

PFAS are water soluble and can migrate readily from soil to surface water via leaching and run-off. Groundwater and surface water at AOI 1 are connected (USACE, 2018). Because PFOA, PFBS, PFHxS, and PFNA were detected in soil and groundwater at AOI 1 and PFOS was detected in soil and exceeded the SL in groundwater, it is possible that those compounds may have migrated from soil and groundwater to Stewart Creek via groundwater discharge or the stormwater system outfalls along Stewart Creek (see **Figure 2-4**). Stewart Creek discharges north into J Percy Priest Reservoir. Since the reservoir provides potable water to the facility, the surface

water and sediment ingestion exposure pathway for site workers, construction workers, or trespassers (although unlikely due to restricted access) is considered potentially complete.

J Percy Priest Reservoir is also used for recreational fishing activities and provides drinking water to the Town of Smyrna. Therefore, the surface water and sediment ingestion exposure pathway for off-facility residents and recreational users is also considered potentially complete due to PFOS SL exceedances and groundwater and surface water near the facility being connected.

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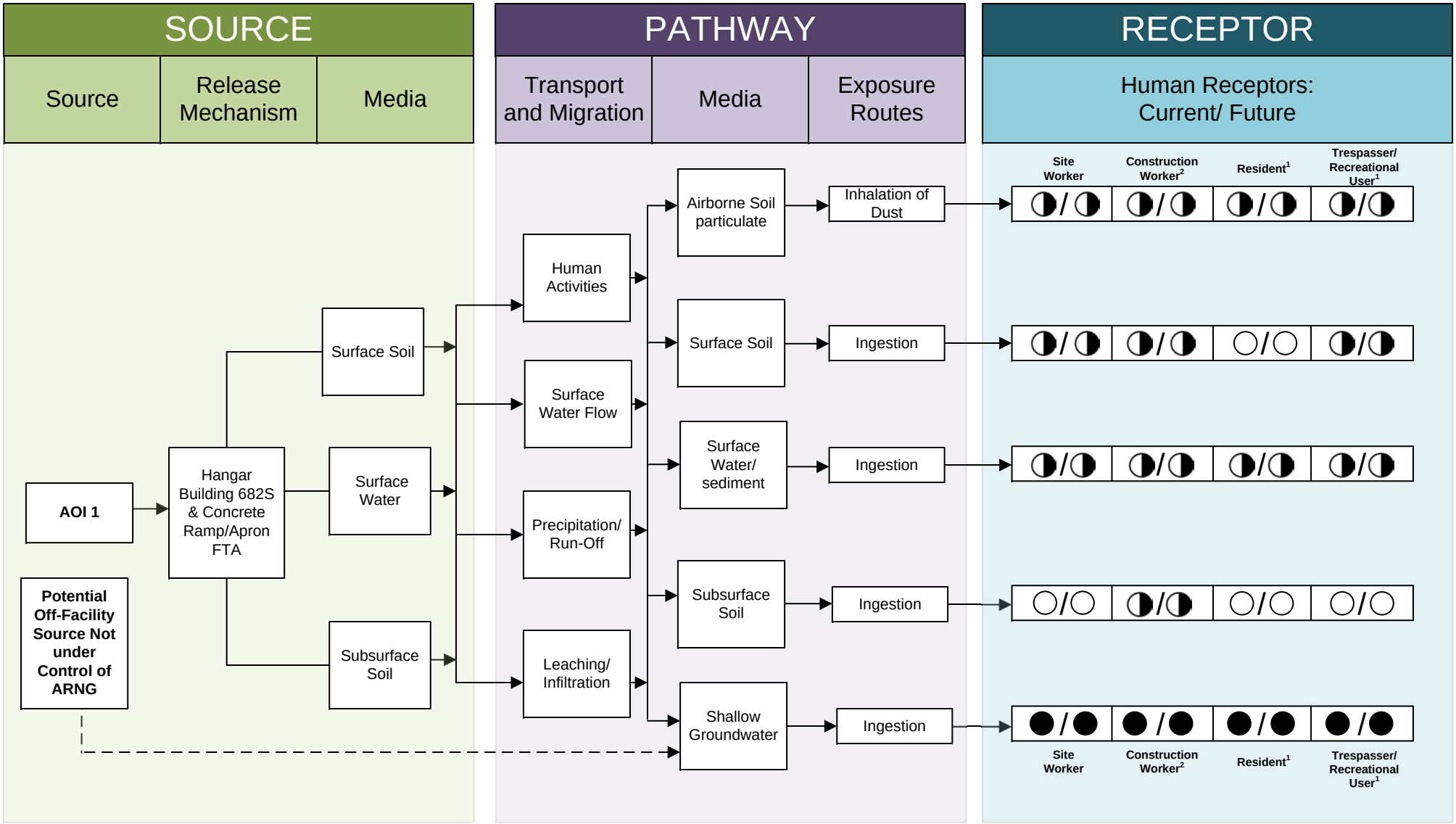

LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Potentially Complete Pathway with Exceedance of SL

NOTES

1. The resident and recreational users refer to off-facility receptors.

2. Active construction was occurring outside of AOI 1 as of the date of SI field work.

Figure 7-1
Conceptual Site Model, AOI 1
Volunteer Training Site-Smyrna, Tennessee

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8. Summary and Outcome

This section summarizes SI activities and findings. The most significant findings are summarized in this section and are reproduced directly or abstracted from information contained in this report. The outcome provides general and comparative interpretations of the findings relative to the SLs.

8.1 SI Activities

The SI field activities were conducted between 28 February and 25 March 2022 and consisted of utility clearance, sonic boring, soil sample collection, permanent monitoring well installation, monitoring well development, groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2022a).

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2022a), samples were collected and analyzed for a subset of 18 compounds by LC/MS/MS compliant with QSM 5.3 Table B-15 as follows.

- Ten (10) soil samples from five sonic boring locations;
- Five grab groundwater samples from five newly installed permanent monitoring wells;
- Thirteen (13) QA/QC samples.

An SI is conducted when the PA determines an AOI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at the AOI 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. Additionally, the CSM was refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure at the AOI, which is described in **Section 7**.

8.2 Outcome

Based on the results of this SI, further evaluation under CERCLA is warranted in an RI for AOI 1 (see **Table 8-1**). Based on the CSM developed and revised in light of the SI findings, there is potential for exposure to receptors from AOI 1 from sources on the facility resulting from historical DoD activities. Sample analytical concentrations collected during the SI were compared against the project SLs in soil and groundwater, as described in **Table 6-1**. A summary of the results of the SI data relative to the SLs is as follows:

- At AOI 1:
    - The detected concentrations of PFOA, PFOS, PFHxS, PFNA, and PFBS in soil at AOI 1 were below their respective SLs.
    - PFOS in groundwater exceeded its SL of 4 ng/L with a maximum concentration of 58.8 ng/L at location AOI01-02. Based on the results of the SI, further evaluation of AOI 1 is warranted in the RI.

Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of MIL-SPEC AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a

920 component of other products the military used. In addition, it is unlikely that GenX would be an
921 individual chemical of concern in the absence of other PFAS.

922 **Table 8-1** summarizes the SI results for soil and groundwater used to determine if an AOI should
923 be considered for further investigation under CERCLA and undergo an RI.

924 **Table 8-1: Summary of Site Inspection Findings and Recommendations**

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary	Future Action
1	Concrete Ramp/Apron FTA & Hangar Building 682S	◐	●	●	Proceed to RI

925
926 Legend:
927 ● = detected; exceedance of the screening levels
928 ◐ = detected; no exceedance of the screening levels
929 ○ = not detected
930

9. References

AECOM. 2018a. *Final Preliminary Assessment Report, Volunteer Training Site-Smyrna, Tennessee*. October.

AECOM. 2018b. *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/ W912DR17F0192*. 9 March.

AECOM. 2018c. *Final Programmatic Accident Prevention Plan, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/W912DR17F0192.* July.

AECOM. 2022a. *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Volunteer Training Site-Smyrna, Tennessee, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide.* February.

AECOM. 2022b. *Final Site Safety and Health Plan, Volunteer Training Site-Smyrna, Tennessee, Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide*. February.

Assistant Secretary of Defense. 2022. *Investigation Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program*. United States Department of Defense. 15 September.

DA. 2018. *Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances.* 4 September.

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

DoD. 2019b. *General Data Validation Guidelines. Environmental Data Quality Workgroup*. 4 November.

EDR™. 2018. EDR Radius Map Report with GeoCheck, VTS Smyrna, TN. 29 June.

Guelfo, J.L. and Higgins, C.P. 2013. *Subsurface Transport Potential of Perfluoroalkyl Acids at Aqueous Film-Forming Foam (AFFF)-Impacted Sites*. Environmental Science and Technology 47(9): 4164-71.

Higgins, C.P., and Luthy, R.G. 2006. *Sorption of Perfluorinated Surfactants on Sediments*. Environmental Science and Technology 40 (23): 7251-7256.

ITRC. 2018. *Environmental Fate ant Transport for Per- and Polyfluoroalkyl Substances*. March.

NOAA, 2022. 1981-2010 Climate Normals for Smyrna Airport, TN US. Accessed 25 April 2022 at http://www.ncdc.noaa.gov/cdo-web/datatools/normals.April.

TDEC. 2015. *Rules of TDEC Water Resources Division Chapter 0400-45-09 Water Well Licensing Regulations and Well Construction Standards*, September 2015. *https://publications.tnsosfiles.com/rules/0400/0400-45/0400-45-09.20150917.pdf.* Accessed November 2018.

TDEC. 2022. *Tennessee Water Well Desktop Application*. TDEC Division of Water Resources / Drinking Water Unit. Accessed 21 April 2022 at https://tdeconline.tn.gov/tdecwaterwells/.

TNARNG. 2012. *Integrated Natural Resources Management Plan*, *Volunteer Training Site, Smyrna, Rutherford County, Tennessee.* March.

USACE. 2016. *Technical Project Planning Process*, EM-200-1-2. 26 February.

USACE. 2018. *J. Percy Priest Reservoir, Draft Water Supply Storage Reallocation Report and Integrated Environmental Assessment*. USACE Nashville District. Accessed 25 April 2022 at https://usace.contentdm.oclc.org/digital/api/collection/p16021coll7/id/6929/download. April.

USEPA. 1980. *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*.

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

USEPA. 2001. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments)*. December.

USEPA. 2017. *National Functional Guidelines for Organic Superfund Data Review*. OLEM 9355.0-136, EPA-540-R-2017-002. Office of Superfund Remediation and Technology Innovation. January.

USFWS. 2022. *Species by County Report, County: Rutherford, Tennessee.* Environmental Conservation Online System. Accessed 18 April 2022 at https://ipac.ecosphere.fws.gov/location/M2VOZG22PZGYVCTCGZ3EAL3OF4/resources.

USGS. 2022a. *Geologic units in Rutherford County, Tennessee*. Mineral Resources Online Spatial Data by State. Accessed 21 April 2022 at https://mrdata.usgs.gov/geology/state/fips-unit.php?code=f47149.

USGS. 2022b. *National Water Information System: Mapper*. Accessed 21 April 2022 at https://maps.waterdata.usgs.gov/mapper/index.html.

Xiao, F., Simcik, M. F., Halbach, T. R., and Gulliver, J. S. 2015, *Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoate (PFOA) in Soils and Groundwater of a U.S. Metropolitan Area: Migration and Implications for Human Exposure.* Water Research 72: 64-74.