United States Army Corps of Engineers
New England District

# Final

# Supplemental Site Inspection Report for Per- and Polyfluoroalkyl Substances (PFAS)

## Former Sudbury Training Annex,
## Areas of Contamination A9 and P13
## Former Fort Devens Army Installation
## Sudbury, Massachusetts

Contract No. W912WJ-19-D-0014

Contract Delivery Order No. W912WJ-20-F-0105

July 2023

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# Supplemental Site Inspection Report for Per- and Polyfluoroalkyl Substances (PFAS)

**Former Sudbury Training Annex, Areas of Contamination A9 and P13**
**Former Fort Devens Army Installation**
**Sudbury, Massachusetts**

July 2023

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**CERTIFICATION**

**I hereby certify that the enclosed Report, shown and marked in this submittal, is that proposed to be incorporated with Contract Number W912WJ-19-D-0014. This document was prepared in accordance with the U.S. Army Corps of Engineers (USACE) Scope of Work and is hereby submitted for Government approval.**

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# Acronyms and Abbreviations

| | |
|---|---|
| AFFF | aqueous film-forming foam |
| AOC | area of contamination |
| AMSL | above mean sea level |
| ARNWR | Assabet River National Wildlife Refuge |
| AST | above-ground storage tank |
| ATEC | Army Test and Evaluation Command |
| BCT | Base Closure Team |
| bgs | below ground surface |
| BRAC | Base Realignment and Closure |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Register |
| cfs | cubic feet per second |
| CMR | Code of Massachusetts Regulation |
| CVOC | Chlorinated Volatile Organic Compound |
| DoD | Department of Defense |
| DoDM | Department of Defense Environmental Restoration Program Manual |
| DoD 2022 Memo | July 2022 Memorandum re: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July |
| DPT | direct push technology |
| DUP | duplicate |
| E&E | Environment & Ecology |
| EB | equipment blank |
| EIS | extracted internal standard |
| FB | field blank |
| FD | field duplicate |
| FEMA | Federal Emergency Management Agency |
| FFA | Federal Facilities Agreement |
| FS | feasibility study |
| GIS | Geographic Information System |
| gpm | gallons per minute |
| HDPE | high-density polyethylene |
| HFPO-DA | hexafluoropropylene oxide dimer acid |
| HQ | hazard quotient |
| IRP | Installation Restoration Program |
| KGS | KOMAN Government Solutions |
| LCS | laboratory control spike |
| LHA | Lifetime Health Advisory |
| LUCs | land use controls |
| MassDEP | Massachusetts Department of Environmental Protection |
| MCP | Massachusetts Contingency Plan |

| | |
|---|---|
| MEP | Master Environmental Plan |
| MERS | Mobile Emergency Response Support |
| MFA | Massachusetts Firefighting Academy |
| ml | milliliter |
| MMCL | Massachusetts maximum contaminant level |
| MS/MSD | matrix spike/matrix spike duplicate |
| NAD 83 | North American Datum 1983 |
| Natick Labs | U.S. Army Natick Research Development and Engineering Center Laboratory |
| ng/g | nanograms per gram |
| ng/L | nanograms per liter |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NFG | National Functional Guideline |
| NPL | National Priority List |
| NSSC | Natick Soldiers System Command |
| OHM | OHM Remediation Services Corp. |
| ORP | oxidation reduction potential |
| ORSG | Office of Research and Standards Guideline |
| OSHA | Occupational Safety and Health Administration |
| OU | operable unit |
| PA | preliminary assessment |
| PFAS | per- and polyfluoroalkyl substances |
| PFAS6 | PFOS, PFOA, PFHxS, PFNA, PFHpA, PFDA |
| PFBS | perfluorobutanesulfonic acid |
| PFDA | perfluorodecanoic acid |
| PFHpA | perfluoroheptanoic acid |
| PFHxS | perfluorohexanesulfonic acid |
| PFNA | perfluorononanoic acid |
| PFOA | perfluorooctanoic acid |
| PFOS | perfluorooctanesulfonic acid |
| POL | Petroleum, Oil, Lubricant |
| QA | quality assurance |
| QAPP Addendum | Addendum for Supplemental Site Inspection to the Uniform Federal Policy for Quality Assurance Project Plan – Site Inspection for Per- and Polyfluoroalkyl Substances (PFAS), Former Sudbury Training Annex |
| QC | quality control |
| QSM | Quality Systems Manual |
| ROD | Record of Decision |
| RSL | Regional Screening Level |
| S-A JV | SERES-Arcadis 8(a) |
| SA | Study Area |
| SI | site inspection |
| SSI | supplemental site inspection |

| | |
|---|---|
| SSI Work Plan | Final Supplemental Site Inspection Work Plan for Per- and Polyfluoroalkyl Substances, Former Sudbury Training Annex |
| SSSL | site-specific screening level |
| SOP | standard operating procedure |
| Sudbury Annex | Former Fort Devens Sudbury Training Annex |
| THQ | target hazard quotient |
| TOC | total organic carbon |
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| U.S. | United States |
| USACE | United States Army Corps of Engineers |
| USAF | United States Air Force |
| U.S.C. | United States Code |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UST | underground storage tank |
| VOC | volatile organic compound |
| Weston | Roy F. Weston, Inc. |

# 1 Introduction

The United States (U.S.) Army Base Realignment and Closure Office (BRAC) is responsible for addressing potential contamination at former active Army installations that is the direct result of historic Army activities. Site identification, investigations, and any potential environmental remedies are in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, 42 United States Code [U.S.C.] §§9601 et. seq.), the Defense Environmental Restoration Program (10 U.S.C. §2701 et. seq.), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 Code of Federal Regulation [CFR] Part 300). The process of identifying and investigating a site, for either pollutants and contaminants or hazardous substances, begins with a Preliminary Assessment and then a Site Investigation (40 CFR 300.420). The SERES-Arcadis 8(a) Joint Venture (JV), Limited Liability Company (LLC)[1] (hereafter referred to as the S-A JV) has prepared this Supplemental Site Inspection (SSI) report on behalf of the U.S. Army Corps of Engineers, New England District (USACE) under Contract W912WJ-19-D-0014, for areas of contamination (AOCs) A9 – Petroleum, Oil, and Lubricants (POL) Burn Area and P13 – Former Massachusetts Firefighting Academy (MFA) at the Former Fort Devens Army Installation (Devens) Sudbury Training Annex (Sudbury Annex) located in Stow, Massachusetts.

## 1.1 Objectives

The SSI at AOCs A9 and P13 (**Figure 1-1**) was conducted to further evaluate impacts of per- and polyfluoroalkyl substances (PFAS) at the two sites. The objectives of the SSI were to further delineate the extent of PFAS contamination in soil and groundwater observed during the Site Inspection (SI) for PFAS conducted in 2018 (KGS 2020) and confirm/refine the conceptual site model (CSM) related to the risk/exposure pathways at the AOCs.

Historical sources of PFAS at AOCs A9 and P13 were determined to likely be the use of fire-fighting foams (KGS 2017). Aqueous film-forming foam (AFFF) was developed in the mid-1960s (Place et al. 2013) with synthetic surfactants containing perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) to extinguish Class B fires, (i.e., flammable liquid fires [Occupational Safety and Health Administration (OSHA) 1910.155(c) (9)]) and was used by both military and civilian firefighters. These substances are not hazardous substances under either CERCLA or the Resource Conservation and Recovery Act.

## 1.2 Regulatory Requirements

Activities completed as a part of the SSI were subject to, and consistent with, the NCP, the Department of Defense (DoD) Environmental Restoration Program Manual (DoDM 4715.20*),* USEPA guidance including, *Federal Facilities Remedial Site Inspection Summary Guide* (United States Environmental Protection Agency [USEPA] 2005), and is consistent with the USEPA *Guidance for Performing Site Inspections Under CERCLA* (USEPA 1992). In addition, the SSI was conducted with regulatory coordination from the Massachusetts Department of Environmental Protection (MassDEP) and the USEPA Region 1. Field activities for the SSI were completed in accordance with the *Final Supplemental Site Inspection Work Plan for Per- and Polyfluoroalkyl Substances, Former Sudbury Training Annex* (SSI Work Plan; KOMAN Government Solutions [KGS] 2021) and the *Addendum for Supplemental Site Inspection to the Uniform*

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[1] The SERES-Arcadis JV is composed of protégé firm SERES Engineering & Services, LLC (SERES) and its mentor, Arcadis U.S., Inc. (Arcadis).

*Federal Policy for Quality Assurance Project Plan – Site Inspection for Per- and Polyfluoroalkyl Substances (PFAS), Former Sudbury Training Annex*, (QAPP Addendum; S-A JV 2021).

Regulatory guidance specific to PFAS investigation at Devens includes the following:

- In May 2016, USEPA issued the final Drinking Water Lifetime Health Advisory (LHA) of 70 nanograms per liter (ng/L) for the combined or individual concentrations of PFOA and PFOS (USEPA 2016).
- In February 2018, USEPA Region 1 developed Fort Devens (including Sudbury Annex) site-specific screening levels (SSSLs) for PFOS, PFOA, and perfluorobutanesulfonic acid (PFBS) via groundwater (ingestion), soil (dermal and ingestion), surface water (ingestion), sediment (dermal and ingestion), and fish consumption exposure pathways (USEPA Region 1 2018).
- Establishment of PFAS standards in Massachusetts began in 2018:
  - In June 2018, MassDEP issued an Office of Research and Standards Guideline (ORSG), which recommended contaminant levels in drinking water be protective against adverse health effects for all people consuming the water over a lifetime. An ORSG of 70 ng/L was set for the combined or individual concentrations of five PFAS (PFOA, PFOS, perfluorononanoic acid [PFNA], perfluorohexanesulfonic acid [PFHxS], and perfluoroheptanoic acid [PFHpA]).
  - In April 2019, MassDEP proposed draft amendments to the Massachusetts Contingency Plan (MCP) that included groundwater and soil cleanup standards for six PFAS compounds. In December 2019, Massachusetts finalized (under the MCP) formal PFAS cleanup standards for groundwater and specific PFAS limits for soil (MassDEP 2020). The groundwater standard is 20 ng/L for combined or individual concentrations of six PFAS (PFAS6: PFOS, PFOA, PFHxS, PFNA, PFHpA, and perfluorodecanoic acid [PFDA]). The criteria that determine the applicability of the standards are described in regulation 310 Code of Massachusetts Regulations (CMR) 40.0932 and presented in the MCP Numerical Standards (MassDEP 2017). Specifically, the MCP categories of standards applicable at Devens are:
    - Category GW-1: Concentrations based on the use of groundwater as drinking water, either currently or in the foreseeable future.
    - Category GW-2: Concentrations based on the potential for volatile material to migrate into indoor air from shallow groundwater.
    - Category GW-3: Concentrations based on the potential environmental effects resulting from contaminated groundwater discharging to surface water.
  - In December 2019, MassDEP proposed draft PFAS maximum contaminant levels for public water supplies under the Massachusetts Drinking Water Regulations, 310 CMR 22.00 that were the same as the groundwater standards.
  - In January 2020, the ORSG was revised to be consistent with the proposed PFAS maximum contaminant levels for public drinking water supplies.
  - On October 2, 2020, the MassDEP promulgated final regulations in 310 CMR 22.00 establishing a Massachusetts maximum contaminant level (MMCL) for PFAS6 concentrations in drinking water (MCP groundwater category GW-1).
  - On June 16, 2022, the MassDEP issued an update to the Interim Guidance on Sampling and Analysis of PFAS at Disposal Sites Regulated under the MCP to incorporate the USEPA final Drinking Water LHAs for hexafluoropropylene oxide dimer acid (HFPO-DA; also referred to as GenX) and PFBS and Interim LHAs for PFOA and PFOS (MassDEP 2022).

- In October 2019, the DoD's Office of the Secretary of Defense issued guidance on the investigation of PFOS, PFOA, and PFBS at DoD locations in a memorandum titled *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program* (DoD 2019). The memorandum provided risk-based screening levels for PFOS, PFOA, and PFBS in groundwater (tapwater) or soil, calculated using the USEPA's regional screening level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. The memorandum indicated that, in the presence of only one PFAS, the screening level based on a target non-cancer hazard quotient (HQ) = 1.0 is used; in the presence of multiple PFAS, the more conservative screening level based on an HQ = 0.1 is used (DoD 2019). The memorandum was updated in September 2021 with new PFBS screening levels (DoD 2021).

- On May 18, 2022, the USEPA issued RSLs based on new toxicity values for PFOS, PFOA, PFNA, PFHxS, and HFPO-DA (also referred to as GenX; USEPA 2022a).

- Subsequently in June 2022, USEPA Region 1 updated the Devens SSSLs for PFOS, PFOA, PFBS, and included SSSLs for PFNA, PFHxS, and HFPO-DA for groundwater (ingestion plus dermal for PFBS), soil (ingestion and dermal), surface water (ingestion and dermal), sediment (ingestion and dermal), and fish tissue (consumption) (USEPA Region 1 2022). The SSSLs for Devens are calculated using the USEPA RSL Calculator (USEPA 2022c).

- On June 15, 2022, USEPA issued revised Drinking Water LHAs for the combined or individual concentrations of PFOA and PFOS and new Drinking Water LHAs for PFBS and HFPO-DA and its ammonium salt (together referred to as "Gen X chemicals"). PFBS was developed as a replacement for PFOS; HFPO-DA was developed as a replacement for PFOA (USEPA 2022b).

- On July 6, 2022, the DoD's Office of the Secretary of Defense issued a revised memorandum (DoD 2022 Memo) that provided technical guidance related to the May 2022 updated USEPA RSLs for PFOS, PFOA, PFNA, PFHxS, and HFPO-DA, with PFBS remaining unchanged since the previous update (DoD 2022). The memorandum notes that, "HFPO-DA has primarily been used as a replacement for PFOA in the manufacture of fluoropolymers, so it is not likely to have been released at the vast majority of DoD properties." This memorandum became effective immediately and superseded and canceled the Assistant Secretary of Defense for Sustainment memorandum, "Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program," dated September 15, 2021 (DoD 2021).

In accordance with the DoD 2022 Memo, PFAS detections in groundwater, soil, surface water, and sediment at the Sudbury Annex are compared to the June 2022 Devens SSSLs. Analytical results are also screened against MassDEP MMCL for groundwater for informational purposes.

## 1.3 Report Organization

The remainder of the report is organized as follows:

- Site Background
- Site Physical Characteristics
- SSI Field Activities
- Summary of Results and Data Analysis
- Quality Assurance/Quality Control
- Migration/Exposure Pathways and Targets
- Conclusions and Recommendations

This report synthesizes the previous investigations to date and includes the recent field activities as well as providing a path forward for the site.

# 2 Site Background

## 2.1 Sudbury Annex

### 2.1.1 Site History

In 1942, the U.S. Army purchased property from numerous landowners in and around Stow, Massachusetts to establish the Maynard Ammunition Depot. During World War II, the installation was used as a holding area for ammunition awaiting shipment overseas. After the war, the installation was renamed the Sudbury Annex. The facility was generally used for troop training, product and equipment testing, munitions/explosives testing and disposal, disposal of various wastes from the U.S. Army Natick Research Development and Engineering Center Laboratory (Natick Labs), and for research and development. In 1982, the Sudbury Annex became a part of Fort Devens, later established as the Devens Reserve Forces Training Area in 1996.

In 1995 the Sudbury Annex was placed on the BRAC list under BRAC95. The plans were for the Sudbury Annex to be transferred in three parts to (1) the U.S. Fish and Wildlife Service (USFWS) (2,205.2 acres), (2) the U.S. Air Force (4.15 acres) and, (3) the Federal Emergency Management Agency (FEMA) (71.5 acres).

With the acquired land transferred on September 28, 2000, the USFWS established the Assabet River National Wildlife Refuge (ARNWR). The refuge encompasses a large wetland complex, several smaller wetlands and vernal pools, and large forested areas. These areas serve as important feeding and breeding areas for migratory birds and other wildlife. The refuge is open to the public for uses such as wildlife observation, environmental education, hunting, and fishing.

In 2003, the USFWS removed military buildings and non-military buildings on the remaining USFWS property. Barbed wire and other safety hazards were also removed. In 2005, the refuge opened a series of designated walking trails. A visitor center opened on October 17, 2010, which is open weekly from Thursday-Sunday. Numerous educational programs are conducted in the refuge, including tours of the former Army bunkers, which the USFWS left in place (USACE 2011).

In 2003, approximately 72 acres of the Sudbury Annex were transferred to FEMA, though FEMA formerly had a permit to occupy a parcel of the Annex since 1980. The transferred land included five non-contiguous small parcels. FEMA currently uses the land for its operations and training missions, including use of a Mobile Emergency Response Support (MERS) center.

### 2.1.2 Sudbury Annex Regulatory Background

The Sudbury Annex was assessed for environmental contamination under the DoD Installation Restoration Program (IRP) starting in 1980. A Site Discovery was completed in 1981, a Preliminary Assessment (PA) in 1983, and a Site Investigation in 1987. In February 1990, the site was officially listed on the National Priority List (NPL). A Federal Facility Agreement (FFA) between USEPA and the Army, signed on November 15, 1991, states that the Army, as the lead agency, is responsible for carrying out all work required in accordance with the requirements of CERCLA and the NCP, under USEPA oversight. Further, the FFA states all work completed at the site pursuant to the agreement and the 1992 Master Environmental Plan (MEP) (OHM Remediation Services Corp. [OHM] 1992) shall be funded by the Army.

The Army agreed to undertake, fully implement, and report on the following tasks listed in the MEP:

- A PA and SI of the Site and all AOCs identified in the MEP
- Remedial Investigations of all AOCs
- Feasibility Studies (FS) of all AOCs
- Proposed Plans and Record of Decisions (RODs) for all AOCs
- Remedial Actions, Removal and Remedial Designs for all AOCs
- Operation and Maintenance of Remedial Actions at the AOCs

A total of 73 AOCs were identified in the Sudbury Annex, including eight that were grouped into five Operable Units (OUs), as shown below in **Exhibit 2-1**.

***Exhibit 2-1 Operable Units at Sudbury Annex***

| Operable Unit (OU) | Site Description |
|---|---|
| **OU1** | AOC A7 – Old Gravel Pit Landfill |
| **OU2** | AOC A9 – Petroleum, oil, lubricants (POL) Burn Area |
| **OU3** | AOC A4 – Waste Dump |
| **OU4** | AOC P11 – Building T405 Dump Area<br>AOC P13 – Former Massachusetts Firefighting Academy (MFA) |
| **OU5** | AOC A12 – Abandoned UST at Site A9<br>AOC P36 – Former Raytheon Building Tl04<br>AOC P37 – Building Tl06 UST |

Between 1980 and 2001, the Army conducted investigations at the Sudbury Annex to address potentially contaminated areas. The investigations were followed up with removal of contaminated soil and underground storage tanks (USTs) within the Annex. To prevent trespassers from physical harm or contact with contaminated areas, the Army fenced off several sites and buildings.

Sixty-five AOCs, not associated with any of the five CERCLA OUs, were closed out with No Further Action Decision Documents signed by the Base Closure Team (BCT) and were listed in the 2001 Five-Year Review (Roy F. Weston, Inc. [Weston] 2001). The Army and USEPA signed a Source Control ROD for OUs 1 and 2 (AOC A7 and AOC A9) in 1995 (OHM 1995b), with the Massachusetts Department of Environmental Protection (MassDEP) concurrence. The Army and USEPA signed a Management of Migration ROD for OUs 1 and 3 (AOCs A4, A7, and A9) with MassDEP concurrence in 1997. The Army and USEPA signed a ROD for OU4, which included Area P11 and P13, in September 1996 with MassDEP concurrence.

Sudbury Annex was removed from the NPL on November 30, 2001, through USEPA publication in the Federal Register of a deletion notice of the Sudbury Annex from the NPL (USACE 2011). The action became effective January 29, 2002.

## 2.2 AOC A9 and AOC P13

AOCs A9 and P13 were identified for investigation as suspected PFOS/PFOA source areas in the 2017 PA (KGS 2017). An SI was completed in 2018 to determine the presence or absence of PFOS and PFOA at the potential source areas (KGS 2020). An overview of historical property use is summarized below in **Exhibit 2-2**.

***Exhibit 2-2 Historical Property Use at AOC A9 and AOC P13***

**AOC A9 – POL Burn Area**
**(Former Massachusetts Firefighting Academy [MFA] Training Area)**

| Time Frame | Property Information/Use |
|---|---|
| Pre - 1950s | Farm with agricultural use |
| 1956 - 1986 | Flame Retardant Clothing Test Site |
| 1970 - 1984 | MFA Training Area |
| Mid-1970s to 1991 | State Police burned confiscated fireworks |
| 2000 | Land transferred to USFWS |
| 2005 | ARNWR established |

**AOC P13 – Former Massachusetts Firefighting Academy (MFA)**

| Time Frame | Property Information |
|---|---|
| Early 1940s | Farm with house, garage, cowshed, and barn |
| 1952 – 1963 | Buildings T405, T406, T407. T408, T409, T462 and T466 were erected under Army operations |
| 1973 – 1978 | Massachusetts Air National Guard use of Buildings T406, T407, T408, T409, and T403, and the surrounding acreage |
| 1985-1987 | MFA granted use of property for classroom and training of firefighters |
| 2005 | ARNWR established |

### 2.2.1 AOC A9 – POL Burn Area (Former Massachusetts Firefighting Academy Training Area)

AOC A9 comprises approximately 8 acres located in the northern portion of the Sudbury Annex between Patrol Road and the Assabet River. The area is topographically level and nearly square. An unnamed stream west of the area flows towards the Assabet River. The entrance to AOC A9 is located near the North Gate to Sudbury Annex. AOC A9 is located in an area geologically mapped as kame terrace. The area is surrounded by a chain-link fence and a constructed berm. Large sections of the open area are covered by long grass and shrubbery. In addition, a maintenance building was constructed on the site in 2020 by the USFWS. The perimeter of AOC A9 is surrounded by forest and the western side of the area is heavily vegetated. The Assabet River bounds the northern side of the POL Burn Area, which was operated by the MFA from 1970 through 1984 as a firefighting training area.

The earliest documented use of AOC A9 was for agricultural purposes (OHM 1995a). A 1939 aerial photograph of the area shows remnants of a formerly extensive orchard. Sometime during the late 1950s the area was cleared of all vegetation, levelled, surrounded by an earthen berm, and enclosed by a fence. In 1958, the Sudbury Annex property was transferred to the Quartermaster Research and Engineering Center at Natick.

The two primary activities at AOC A9 contributing to PFAS contamination at the site were flame retardant clothing testing by the Natick Labs and firefighting training exercises by the MFA. Both activities are discussed in greater detail below.

#### 2.2.1.1 Flame Retardant Clothing Test Site

A portion of AOC A9 was used as a testing facility for fire-retardant clothing by Natick Labs from 1959 through 1986 (ABB-Environmental Services, Inc. [ABB-ES] 1997b). Site development for these activities included the erection of buildings; installation of USTs, pumping facilities with associated underground piping; and construction of a fire-retardant cloth testing facility (**Figure 2-1**). Three structures were erected in this area as part of the test site. Building T401 was located at the area entrance gate. Building T402 was located in the southeastern corner of the area and was used to store mannequins for the flame-retardant cloth testing by Natick Labs. The fireproof clothing test area was located near the center of the cleared portion of the area (**Figure 2-1**). This area was lined with cinder block walls and had an asphalt base, and was bounded on the north by a large, freestanding, concrete wall with metal doors. A metal shed stood to the east of the cloth test pit in Study Area (SA) P12. The shed sat on a concrete slab and was surrounded on four sides and top by a chain-link fence to protect a pump apparatus for an UST. The fire-proof clothing testing area was used approximately one week per year and flames and smoke were controlled by the MFA as a training exercise.

The flame-retardant cloth testing procedure involved dressing a mannequin in the cloth material to be evaluated, placing the mannequin in a litter-shaped basket attached to an overhead pulley system, and then passing the mannequin over a flaming pit. The pit was fueled with oil that was stored in a UST and pumped through forced air nozzles installed in the base of the pit to maximize combustion efficiency and minimize pollutions. The shed in SA P12 (**Figure 2-1**) housed the pumping unit, and the oil flowed through underground fuel lines.

The shed and fence were removed by OHM to assist in the UST removal performed by the Army Test and Evaluation Command (ATEC).

Further details concerning the Flame Retardant Clothing Testing Site are included in Appendix C.1 of the SI (KGS 2020).

#### 2.2.1.2 Massachusetts Firefighting Academy Training Area (POL Burn Area)

The MFA, through agreement with Natick Labs, used the southwest quadrant of AOC A9 from 1970 through the end of 1984 for firefighting training exercises (OHM 1995a).

MFA activities included the construction and use of two fire pits and several trenches (referred to as the “Fire Pit Area” or POL Burn area for firefighting training (**Figure 2-1**). Supporting facilities included at least one above-ground storage tank (AST) and storage drums. One fire pit was approximately 20 feet long by 20 feet wide and no more than 2 feet deep, with a 1- to 1.5-foot-high berm composed of soil and cinder blocks that surrounded it. The bottom of the pit was unlined. During firefighting training exercises, this pit was filled with approximately six inches of water topped off with virgin fuel oil and ignited (OHM 1995a). When fuel oil costs began to rise, MFA utilized watered-down JP-4 jet fuel with MassDEP permission. The second pit used for training consisted of two 10- to 15--foot long trenches in the shape of a "T". These trenches were 18 to 24-inches wide, approximately 24-inches deep, unlined, and were used for fire suppression/flashback training. Later, the "T" was backfilled and replaced with a "Z" configuration in the same area. The usual practice was for the flammable fluid provider to deliver material one to two days ahead of the training exercise. Fuel was placed in a tank and into the waterfilled pits. The water was obtained from a hydrant near AOC A9 (OHM 1995a).

In November 1975 and between 2000 and 2012, PFAS-containing ultrafoam concentrate demonstrations were conducted by the MFA at the MFA Stow Campus and Sudbury Annex.

Further details concerning use of burn pits at AOC A9 are included in Appendix C.2 of the SI (KGS 2020).

AOC A9 was also used by the Massachusetts State Police in the early to mid-1970s to burn confiscated fireworks (OHM 1994). No records were found regarding what specific methods were used, the volume of material incinerated, or where on the site this activity occurred.

POL-contaminated soils were excavated and removed from the area of the former firefighting training pits between September 1987 and July 1988. Approximately 1,100 cubic yards of soil were transported and disposed at the AOC A7 landfill. The depth of the excavation in one location was 26 feet. The excavations were backfilled with soils from an unknown location on the Sudbury Annex. The material was staged in the POL area until it was used as backfill. This material was not certified as clean.

The Army and USEPA signed a Source Control ROD for OUs 1 and 2 (AOC A7 and AOC A9) in 1995 (OHM 1995b), with the MassDEP concurrence. The Army and USEPA signed a Management of Migration ROD for OUs 1 and 3 (AOCs A4, A7, and A9) with MassDEP concurrence in 1997 (ABB-ES 1997b). The planned future use for the AOCs was changed in the ROD from residential development to wildlife refuge (ABB-ES 1997).

## 2.2.2 AOC P13 – Former Massachusetts Firefighting Academy

AOC P13 is located south of the North Gate to Sudbury Annex at the junction of White Pond Road and Cross Road. The surficial geology of this area has been classified as outwash plain. The ground surface slopes north to south and is gently rolling. A small pond is located across Cross Road and streams flow toward Honey Brook along the northeastern and southern edges of the area. The area is surrounded by a chain-link fence and consists of locations of former buildings, with some foundation remnants, and grass-covered fields. A parking lot is located by White Pond Road.

The area was used as a farm prior to the Army's acquisition in the early 1940s (OHM 1994). Farm structures including a farmhouse (Building T401), a garage (T410), a cowshed (T403), and a barn (T404) were converted to military use.

### 2.2.2.1 Army Operations at AOC P13

In 1952, Buildings T405 (barricade building), T406 (heat plant and shops), T407 (miscellaneous and operations), T408 (surveillance building), and T409 (assembly and packaging building) were erected (**Figure 2-2**). It is possible that these structures were used to conduct munitions Quality Control (QC) inspection and testing (OHM 1994). Between 1952 and 1963 Building T462 was constructed as a fire station and Building T466 as a general storehouse. From January 1973 to January 1978 the Massachusetts Air National Guard used Buildings T403, T406, T407, T408, and T409, as well as the surrounding acres for training exercises and storage of tactical weather station equipment (OHM 1994).

Building T404 was leased to the United States Air Force (USAF) in 1981 for use as office space for scientists working on meteorological research projects. Building T462 may have also been used by the USAF Geophysics Laboratory as an equipment machine shop from July 1985 to 1990. None of the buildings remain at the site (OHM 1994).

Further details concerning use of AOC P13 site are included in Appendix C.4 of the SI (KGS 2020).

#### 2.2.2.2 MFA Operations at AOC P13

The most recent use of the AOC P13 area has been by the MFA. Beginning in 1982, the MFA used the area on a limited basis, after their off-site facility burned down in an arson fire (OHM 1994).

Use by the MFA was formalized when a 26-month license from September 1985 to November 1987 was granted by the Army to the MFA for use and occupancy of Buildings T406 and T409, and adjacent land for the training of firefighters. Use of the property was limited to the training for MFA and MFA was responsible for the maintenance, protection, repair and restoration of the premises at its own cost and expense (KGS 2020). The MFA used Building T406 for a classroom and Buildings T461 and T462 for storage of equipment.

AOC P13 reportedly was not used by MFA for chemical fire training or storage (OHM 1994). Car fire and flammable liquid fire training were conducted in the parking area (Former Burn Pad) at the entrance of AOC P13 (**Figure 2-2**).

- Car fire training was conducted approximately five times per year using a vehicle with the fuel tanks removed and straw as the combustible material (OHM 1994).
- Flammable liquid fire training was conducted approximately twelve times per year using a burning pan assembly extinguished with fire extinguishers. The pan assembly had a plywood cover to prevent rainwater from overfilling the pan. A second pan below the burn pan was used to contain spills.

In the mid-1980s, the MFA transferred classroom and training activities outside of the Sudbury Annex property to their new facility at 1 State Street in Stow, Massachusetts.

## 2.3 Previous Site Investigations for PFAS

### 2.3.1 Preliminary Assessment

The Army completed the PA for Sudbury Annex in October 2017, documenting the base-wide evaluation of PFOS and PFOA due to its emerging contaminant status and potential historical use at the Sudbury Annex. In accordance with 40 CFR 300.420(b)(1) and (2), the PA concluded that potential PFOS and PFOA impacts should be further investigated at the following locations under an SI, pursuant to CERCLA and 40 CFR 300.420(c):

- AOC A9 – POL Burn Area (Former Massachusetts Firefighting Academy Training Area)
- AOC P13 – Former Massachusetts Firefighting Academy

USEPA and MassDEP concurred with the PA and its recommendations.

### 2.3.2 Site Inspection

In June 2018, an SI was conducted in accordance with the *Final Site Inspection Work Plan for Per- and Polyfluoroalkyl Substances (PFAS) for AOC A9 and AOC P13* (KGS 2018) to determine the presence or absence of PFOS and PFOA at the potential source areas at AOCs A9 and P13 and presented in the SI report (KGS 2020).

The field investigations were conducted in June and July 2018 and included collection of two soil samples collected by composited two soil boring cores from 0 to 5 feet below ground surface (bgs) and collection of groundwater samples from varying depths from eight temporary drive points at each AOC. PFAS were detected in groundwater at AOCs A9 and P13, as well as in soil at AOC A9.

Soil samples collected at AOCs A9 and P13 during the SI were analyzed for the following 14 PFAS compounds:

- PFBS
- PFDA
- PFHpA
- PFHxS
- PFNA
- PFOS
- PFOA
- N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)
- N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)
- Perfluorododecanoic acid (PFDoA)
- Perfluorohexanoic acid (PFDoA)
- Perfluorotetradecanoic acid (PFTeA)
- Perfluorotridecanoic acid (PFTriA)
- Perfluoroundecanoic acid (PFUnA)

The maximum detected concentrations for PFOS, PFOA, and PFBS in soil and groundwater at both AOCs were compared to the 2016 USEPA LHA and 2018 Devens PFAS SSSLs to evaluate potential human health risks. Ecological receptors were not evaluated during the SI because toxicological information of PFOS/PFOA for exposed fish and wildlife were not sufficient at the time for evaluation of these receptors.

A summary of the results and comparison to 2018 SSSLs are presented below.

- PFAS were not detected in soil at AOC P13. PFAS were detected in soil at AOC A9. The highest concentrations of PFOS and PFOA in soil were an estimated 250 nanograms per gram (ng/g) and estimated 7.1 ng/g, respectively).
- PFAS were detected in all groundwater samples collected from both AOCs A9 and P13.
    - At AOC A9, PFOS and PFOA concentrations in groundwater exceeded the 2018 Devens SSSLs at six of the seven locations downgradient of the former MFA firefighting training area. The concentrations of PFOS and PFOA in groundwater did not exceed the Devens SSSLs in the AOC A9 xylene plume area (A9-18-08). PFBS concentrations in groundwater at AOC A9 did not exceed the Devens SSSLs. The highest concentrations of PFOS and PFOA in groundwater were in samples collected immediately downgradient of the soil removal area associated with the MFA firefighting training. The sum of PFOS and PFOA at temporary wells A9-18-01 and A9-18-02 were 11,590 nanograms per liter (ng/L) and 13,500 ng/L, respectively. The concentrations of PFOS were generally an order of magnitude higher than PFOA suggesting that the source of the contamination was likely AFFF used during historic fire training activities performed by MFA in this area.
    - At AOC P13, PFOS and PFOA concentrations in groundwater exceeded the 2018 Devens SSSLs at two of the eight locations sampled. The sum of PFOS and PFOA at temporary

wells P13-18-03 and P13-18-06 were 166 ng/L (PFOS 130 ng/L and PFOA 36 ng/L) and 100 ng/L (PFOS not detected and PFOA 100 ng/L), respectively.

## 2.4 Future Land Use for the Site

AOCs A9 and P13 are located within the ARNWR. The current land use includes a USFWS maintenance building at AOC A9.

In April 2016, the USFWS installed a bedrock water supply well at AOC A9 permitted by the Nashoba Associated Boards of Health on September 28, 2015 (Permit No. 6381) to support the on-site maintenance facility at the ARNWR (USFWS, personal communication, May 3, 2022).

In July 2022, the Army informed the USFWS that given the presence of PFAS in the overburden aquifer at the site, the Army did not support or recommend use of the USFWS well because, based on hydraulic conditions at the site, there is a potential for migration of groundwater from the overburden to the bedrock during pumping. The Army acknowledged they had no authority to prevent the USFWS from using the well for domestic water supply use but, if USFWS use of the well facilitates migration of PFAS compounds into a currently uncontaminated aquifer, the USFWS will be responsible for remediation (Army 2022). The USFWS has indicated that the pump is not in the well and the well is not in use.

There is no anticipated change to the future land use for the sites.

# 3 Site Physical Characteristics

The physical setting at AOCs A9 and P13 were detailed in the SI (KGS 2020) and is not repeated here. This section presents a brief summary of the physical setting with any updates to the initial physical characteristics based on observation during the SSI field activities.

## 3.1 Sudbury Annex Physical Setting

Topography at the Sudbury Annex is level to slightly undulating in the lowlands with oval-shaped hills composed of glacial till (drumlins). Elevations range from 170 to 321 feet above mean sea level (AMSL) within the boundaries of the Annex.

Surface soil over much of the Sudbury Annex consists mainly of fine to medium sands and gravels with some white marble hardpack chips below the surface.

The north side of the Sudbury Annex is bounded by the Assabet River which flows from southwest to northeast, at an average daily discharge rate of 198 cubic feet per second (cfs) with a depth range of 1 to 7 feet (USGS 2022).

## 3.2 Site Geology

In the 28 shallow (0 to 3 feet bgs) locations sampled at AOC A9, soils consisted of fine to medium sands and clays. There was also trace gravel and construction hard pack marble chips depending on the location. Surface soil permeability is expected to be generally medium-to-high. In the 12 deeper (0 to 15 feet bgs) locations, the soil was similarly described as fine to medium sand and clay interbedded with thicker layers of massive sand bedding. Aquifer overburden materials were not fully observed because soil borings were not advanced to the water table. However, from what was observed, soil permeability is expected to be medium with vertical flow impeded, but not halted, by clay interbedding.

## 3.3 Site Hydrogeology

As noted in the SI (KGS 2020), at AOC A9, the overburden water-bearing unit has been characterized as an unconfined water-bearing zone consisting of a glacial kame terrace overlying glacial till. Glacial deposits consist of silty sand, sand, and gravel overlying sandy silt. Groundwater flow direction and discharge from the overburden aquifer at AOC A9 is primarily northwest to the Assabet River (Dames & Moore 1986 and ABB-ES 1997a). During the SSI investigation depth to water in AOC A9 ranged from 0.98 to 37.30 feet bgs.

AOC P13 is located on a gently sloping terrace of glacial outwash sand and gravel between two hills composed primarily of glacial till. The highly permeable soils over much of the AOC P13 area allow for high recharge rates. Known groundwater discharge areas are a spring and wetland approximately 400 feet northwest of AOC P13 and Honey Brook located approximately 400 feet south of AOC P13 (Environment & Ecology [E&E] 1995). During the SSI investigation depth to water in AOC P13 ranged from 0.56 to 16.30 feet bgs.

The SI identified that groundwater flow from under AOC P13 flows north and eventually to the Assabet River. A spring and wetland north of White Pond Road are the source of a perennial stream which discharges north to the Assabet River.

# 4 SSI Field Activities

The SI recommended that additional groundwater samples be collected at AOCs A9 and P13 and additional soil samples be collected at AOC A9 to further delineate the extent of PFAS contamination in soil and groundwater observed during the SI. In addition, the USEPA and MassDEP requested that surface water and sediment samples be collected at AOCs A9 and P13. Therefore, a work plan was developed to collect soil samples from 42 locations, groundwater samples from nine groundwater profile locations, and surface water and sediment samples from four co-located locations at AOC A9, and groundwater samples from 10 groundwater profile locations and surface water and sediment samples from five co-located locations at AOC P13. Soil samples collected at AOC P13 during the SI had no detections of PFAS, therefore no additional soil samples were proposed for collection at AOC P13 during the SSI. This section presents a summary of the field investigations conducted in accordance with the SSI Work Plan (KGS 2021) and QAPP Addendum (S-A JV 2021).

## 4.1 Utility Clearance

On October 28, 2021 and November 1, 2021, subsurface clearance was performed by Geophysical Applications at the proposed boring locations at AOCs A9 and P13. Subsurface clearance was also performed through DigSafe® clearance by participating utility companies at the proposed boring locations on November 5, 2021 (**Figures 4-1** and **4-2**).

## 4.2 Sample Collection

Between November 8, 2021 and January 12, 2022 soil, groundwater, surface water, and sediment samples were collected at AOCs A9 and P13. Except as noted below and in **Section 4.4**, samples were collected at the locations identified in the SSI Work Plan (KGS 2021) in accordance with the QAPP Addendum for PFAS (S-A JV 2021). The sampling locations were surveyed during the SSI using survey-grade Global Positioning System equipment. Data were referenced to the Massachusetts State Plane Coordinate System North American Datum 1983 (NAD 83). Sample collection logs are included in **Appendix A**.

### 4.2.1 Soil Samples

A total of 106 soil samples and 11 duplicate soil samples were collected at 40 locations across AOC A9. Shallow near surface samples were obtained at 28 locations from 0 to 1 foot and 1 to 3 feet bgs to characterize the extent and magnitude of PFAS in vadose zone at potential historic source areas. Soil samples at 12 locations were collected from 0 to 1 foot, 1 to 3 feet, 3 to 7 feet, and 7 to 15 feet bgs to identify the horizontal extent of PFAS at the perimeter of AOC A9. Final soil sample locations at AOC A9 are summarized in **Table 4-1** and presented on **Figure 4-1**. **Exhibit 4-1** provides the rationale for the soil sample locations at AOC A9 and summarizes the samples collected.

***Exhibit 4-1 Summary of Soil Sample Locations at AOC A9***

| Location Description | Number of Locations | Locations | Number of Samples | Sample Intervals |
|---|---|---|---|---|
| Throughout AOC A9 and at perimeter | 12 | A9-21-01 through A9-21-12 | 48 + 7 DUP | 0 to 1 foot, 1 to 3 feet, 3 to 7 feet, and 7 to 15 feet bgs |
| Outside the former firefighting training area | 17 | A9-21-13, A9-21-14, A9-21-17 through A9-21-21, A9-21-26, A9-21-27, A9-21-33 through A9-21-40 | 36 + 2 DUP | 0 to 1 feet bgs and 1 to 3 feet bgs |
| Inside the former firefighting training area | 11 | A9-21-15, A9-21-16, A9-21-22 through A9-21-25, A9-21-28 through A9-21-32 | 22 + 2 DUP | 0 to 1 feet bgs and 1 to 3 feet bgs |

Soil samples were collected using a Geoprobe® Macro-Core® core barrel fitted with a cutting shoe and acetate liner. The core barrel was advanced into the subsurface using a Geoprobe® 7822DT direct push technology (DPT) drilling rig. Soil lithologies were logged and sample material from the sleeve liner was transferred to a fresh high-density polyethylene (HDPE) plastic sheet. Soil samples from the appropriate intervals were then placed in laboratory-supplied HDPE containers with unlined lids. Samples were stored on ice after collection and were picked up onsite by courier and transported to Eurofins TestAmerica Edison where they were kept in cold storage and subsequently transported by courier to Eurofins Lancaster Laboratories Env, LLC for PFAS analysis by Modified Method 537 in compliance with DoD Quality Systems Manual (QSM) Version 5.3, Table B-15 (DoD 2019).

At the six soil borings with a co-located groundwater sample, borings were abandoned by backfilling with a cement-bentonite slurry after the groundwater samples were collected. Groundwater sampling is described in **Section 4.2.2**.

Due to the potential for cross contamination, extensive measures were taken to decontaminate in between samples and boring locations. A new acetate liner and HDPE sheet were used for each sample collected. Additionally, the core barrels and stainless-steel trowel were decontaminated with the following procedure. First the tool was washed well in PFAS free water mixed with Alconox to remove any residual sediment. After the initial wash, the tool was rinsed in PFAS free water to remove any residual wash. Finally, fresh PFAS-free, laboratory-grade, deionized water was used for a final rinse before the tools were re-attached or wrapped in non-treated foil. After soil sample collection, an equipment blank was collected from the decontaminated stainless-steel trowel and core barrel by pouring PFAS-free, laboratory-grade, deionized water over the tool and collecting the runoff directly into 250-milliliter(ml) HDPE bottles. In addition, field reagent blanks were collected each week throughout the field activities by pouring PFAS-free, laboratory-grade, deionized water directly into 250-ml HDPE bottles. Collection of quality assurance/quality control (QA/QC) samples is also discussed in **Section 6**. Excess soil was returned to the area of collection.

### 4.2.2 Groundwater Samples

Groundwater samples were collected from the 19 temporary wells and two permanent wells summarized in **Table 4-2** and presented on **Figures 4-1** and **4-2** to further assess the extent of PFOS/PFOA at AOCs A9 and P13. Depth to water for each well is included in **Table 4-2**. Temporary well logs are included in **Appendix A**. **Exhibit 4-2** below summarizes the two groundwater sample locations and the 19 vertical profile temporary well locations, with the number of samples collected at each location (parent + duplicate [DUP]), and the depth ranges for the samples collected. In addition, field reagent blanks were collected for

QA/QC in accordance with the SSI Work Plan (KGS 2021). Collection of QA/QC samples is discussed in **Section 6**.

***Exhibit 4-2 Summary of Groundwater Monitoring Well and Vertical Profile Sample Locations at AOC A9 and AOC P13***

| Site | Sample Locations | Location ID | Number of Samples Collected | Sampled Depth Range (feet bgs) | Depth to Water (feet bgs) | Description |
|---|---|---|---|---|---|---|
| AOC A9 | 6 | A9-21-01 | 6 | 16-59 | 15.75 | • Five temporary well points in the historical firefighting area, as well as the modern storage building and yard.<br>• One temporary well at the center of the site.<br>At each location, a 15-foot vertical soil profile was recorded and soil samples were collected, from four depth intervals: 0 to 1 foot, 1 to 3 feet, 3 to 7 feet, and 7 to 15 feet bgs. |
| | | A9-21-02 | 5 + 1 DUP | 16-60 | 17.78 | |
| | | A9-21-03 | 5 + 1 DUP | 14-58 | 14.30 | |
| | | A9-21-04 | 3 | 31-55 | 20.79 | |
| | | A9-21-05 | 4 + 1 DUP | 41-75 | 37.30 | |
| | | A9-21-06 | 4 | 31-65 | 24.20 | |
| AOC A9 | 3 | A9-21-07 | 6 | 6-59 | 3.25 | • Three temporary well points along the boundary of the site with the Assabet River. |
| | | A9-21-08 | 6 | 6-57 | 1.38 | |
| | | A9-21-09 | 4 + 1 DUP | 6-40 | 0.98 | |
| AOC A9 | 2 | OHM-A9-53 | 1 + 1 DUP | NA | 32.35 | • Two permanent monitoring wells between AOC A9 and the Assabet River. |
| | | OHM-A9-58 | 1 | NA | 32.11 | |
| AOC P13 | 10 | P13-21-01 | 4 + 1 DUP | 16-50 | 3.92 | • One temporary well point directly outside the approximate location of the former burn pile.<br>• Nine temporary well points surrounding the site both up- and down-gradient. |
| | | P13-21-02 | 5 | 16-59 | 15.47 | |
| | | P13-21-03 | 7 + DUP | 16-73 | 16.30 | |
| | | P13-21-04 | 6 | 11-67 | 9.50 | |
| | | P13-21-05 | 3 + DUP | 9-30 | 9.00 | |
| | | P13-21-06 | 4 + DUP | 6-29.5 | 6.08 | |
| | | P13-21-07 | 3 | 6-30 | 0.56 | |
| | | P13-21-08 | 5 | 6-50 | 5.50 | |
| | | P13-21-09 | 2 | 30-44 | 5.42 | |
| | | P13-21-10 | 7 | 8-70 | 8.71 | |
| **TOTAL SAMPLES COLLECTED** | | | **100 (91 + 9 DUP)** | | | |

Temporary vertical profile groundwater sampling locations were installed using the Geoprobe® SP22. The SP22 consists of 2.25-inch outer casing equipped with an expendable drive point that is advanced into the subsurface using a Geoprobe® 7822DT DPT drilling rig. Once the outer casing is advanced to the total depth, a 48-inch stainless steel screen, attached to 1.25-inch segmented inner rods, is lowered into the outer casing to the total depth. The outer casing is then retracted expelling the expendable drive point and exposing the inner screen.

Groundwater samples were collected from screened intervals every 10 feet from the water table to the depth of refusal. The 10-foot sample interval was designed to maximize the range of information collected while maintaining a pattern appropriate for the scale. Deviations from the target sampling intervals are discussed in **Section 4.4**.

A peristaltic pump was used to collect the groundwater samples. Each sample was collected after the groundwater levels stabilized and two volumes of the inner casing were purged from the temporary well. At five locations, the depth to groundwater was greater than 27 feet bgs and an inertial pump was utilized to collect the groundwater sample since a peristaltic pump does not function effectively at that depth. The inertial pump was fitted with HDPE tubing and a stainless-steel foot valve. The sampling procedure at these locations remained the same.

Field parameters were measured for each sample and included temperature, specific conductance, pH, dissolved oxygen, oxidation-reduction potential (ORP), and turbidity after the removal of twice the inner rod volume. In accordance with the SSI Work Plan (KGS 2021) and QAPP Addendum for PFAS (S-A JV 2021), groundwater samples were collected in laboratory-supplied HDPE containers with unlined lids using disposable HDPE tubing for each sample interval and at each location. Samples were stored on ice after collection and were picked up onsite by courier and transported to Eurofins TestAmerica Edison where they were kept in cold storage and subsequently transported by courier to Eurofins Lancaster Laboratories Env, LLC for laboratory analysis. Samples were submitted for PFAS analysis in accordance with USEPA PFAS by Modified Method 537 in compliance with DoD QSM Version 5.3, Table B-15 (DoD 2019). At the six AOC A9 sample locations surrounding the modern storage building and historic firefighting area, 15-foot vertical soil profiles were collected in conjunction with the groundwater sampling.

The foot valve and Geoprobe® tooling were decontaminated with the same procedure used for the soil sampling equipment, described above. After collecting the groundwater samples, each borehole was abandoned by pouring cement-bentonite grout down the borehole until filled to the ground surface. Purged water from sampling was returned to the ground near the associated temporary well location.

The two permanent monitoring wells were sampled in accordance with the PFAS Sampling Procedures and Low-Flow Groundwater Purging for Monitoring Wells Standard Operating Procedure (SOP) dated June 2018, included in the QAPP Addendum (S-A JV 2021).

### 4.2.3 Surface Water and Sediment Samples

Surface water and sediment samples were collected at AOCs A9 and P13 to assess whether PFAS are present in surface water and sediment in the Assabet River downgradient of AOC A9 and in wetlands downgradient of AOC P13. Co-located surface water and sediment samples were collected from four locations at AOC A9 and five locations at AOC P13 (**Table 4-3**). Sample locations at each AOC are presented on **Figures 4-1** and **4-2**. **Exhibit 4-3** below presents the rationale for the sample locations.

***Exhibit 4-3 Summary of Surface Water and Sediment Sample Locations at AOC A9 and AOC P13***

| Site | Sample Locations | Description |
|---|---|---|
| AOC A9 | 4 | Four surface water and four sediment samples were collected along the site's boundary with the Assabet River. |
| AOC P13 | 5 | Five surface water and five sediment samples, and one field duplicate for both surface water and sediment were collected in the wetlands across AOC P13. |

Surface water samples were collected in two laboratory-supplied non-preserved 250-mL HDPE jars with non-Teflon lids and were stored on ice. Sediment samples were collected in a laboratory-supplied 4-ounce HDPE jar with a non-Teflon lid and also stored on ice. Surface water samples were collected by dipping the HDPE jars into the water then capping them. Sediment samples were collected with a hand auger then transferred to the jars with a stainless-steel trowel.

Between samples, both the hand auger and trowel were decontaminated as follows: First the tool was washed well in PFAS-free water mixed with Alconox to remove any residual sediment. After the initial wash, the tool was rinsed in clean PFAS-free water to remove any residual wash. Finally, fresh PFAS-free, laboratory-grade, deionized water was used for a final rinse before the auger was wrapped in non-treated foil to be transported to the next location. A fresh piece of foil was used each time. In addition, equipment blanks and field reagent blanks were collected for QA/QC in accordance with the SSI Work Plan (KGS 2021). Collection of QA/QC samples is discussed in **Section 6**.

Field parameters were measured before each set of surface water samples was collected and included temperature, specific conductance, pH, dissolved oxygen, ORP, and turbidity. This was done by submerging the YSI probe into the adjacent water and allowing it to stabilize before collecting the sample. Surface water samples were collected before sediment samples to avoid cross contamination.

Sample containers were filled to below the bottle lip and capped tightly. Samples were stored on ice after collection and were picked up onsite by courier and transported to Eurofins TestAmerica Edison where they were kept in cold storage and subsequently transported by courier to Eurofins Lancaster Laboratories Env, LLC for PFAS analysis in accordance with USEPA PFAS by Modified Method 537 in compliance with DoD QSM Version 5.3, Table B-15 (DoD 2019). Sediment samples were also analyzed for grain size and total organic carbon (TOC) content. Results of the TOC analysis are included in **Table 5-5**.

## 4.3 Investigation-Derived Waste

Investigation-derived waste was handled in accordance with the SSI Work Plan (KGS 2021). Waste soil generated from soil sampling activities was returned to the ground at the site of generation. Purged water generated during sampling was containerized, and upon completion of sampling, discharged back to the ground at the site of generation.

## 4.4 Deviations from the Work Plan

In general, samples were collected in accordance with the SSI Work Plan (KGS 2021) and the QAPP Addendum (S-A JV 2021), with the exception of the following deviations.

Proposed soil samples were collected in accordance with the SSI Work Plan, with the exception of the following locations:

- Location A9-21-34 (0 to 1 foot and 1 to 3 feet bgs) was sampled on December 7, 2021, and was inadvertently sampled again on December 10, 2021. Samples collected from both dates were analyzed and are presented in this report.
- Soil samples were not collected from the two soil piles located southeast of the maintenance building which were observed during a site walk conducted in 2020 (locations A9-21-41 and A9-21-42). During the SSI field activities, Tom Eagle of the Eastern Massachusetts National Wildlife Refuge Complex informed the Army that the two piles were from off-site sources, with one containing clean sand used for concrete mix and the second containing gravel used for road cover.

The groundwater profiles (i.e., sample collection intervals) proposed at each location in Table 3 of the SSI Work Plan were modified to reflect the depth to groundwater encountered during the sampling event. Although the actual sample collection intervals differed from the intervals outlined in the SSI Work Plan, groundwater samples were collected from screened intervals every 10 feet from the water table to the depth of refusal as prescribed in the SSI Work Plan.

In addition to adjusting the sample collection intervals based on depth to groundwater encountered during the sampling event, the following sample locations had deviations:

- At locations A9-21-01, P13-21-03, P13-21-05, P13-21-06, and P13-21-10, the second interval of the profile was collected before the first interval because the depth to groundwater was shallower than anticipated from the previous SI data. In some cases, this resulted in overlap of the first and second intervals.

# 5 Summary of Results and Data Analysis

Analytical results for soil, groundwater, surface water, and sediment sampling at AOCs A9 and P13 are presented in the following subsections.

## 5.1 Sample Analysis

Soil, groundwater, surface water, and sediment samples collected at AOCs A9 and P13 were submitted for PFAS analysis by USEPA PFAS by Modified Method 537. The following 25 compounds were analyzed:

- PFBS
- PFDA
- PFHpA
- PFHxS
- PFNA
- PFOS
- PFOA
- N-Ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
- N-Methyl heptadecafluorooctanesulfonamide (NMeFOSA)
- N-Methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutanoic acid (PFBA)
- Perfluorodecanesulfonic acid (PFDS)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptanesulfonic acid (PFHpS)
- Perfluorohexanoic acid (PFHxA)
- Perfluorononanesulfonic acid (PFNS)
- Perfluorooctanesulfonamide (PFOSA)
- Perfluoropentanesulfonic acid (PFPeS)
- Perfluoropentanoic acid (PFPeA)
- Perfluorotetradecanoic acid (PFTeDA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoroundecanoic acid (PFUnA)
- 4:2 Fluorotelomer sulfonic acid (4:2 FTS)
- 6:2 Fluorotelomer sulfonic acid (6:2 FTS)
- 8:2 Fluorotelomer sulfonic acid (8:2 FTS)

Soil analytical results for AOC A9 samples collected during the SI and the SSI are summarized in **Table 5-1** and results of comparing the analytical results to screening criteria at AOC A9 are presented on **Figure 5-1**. Screening of analytical results for AOC P13 samples collected during the SI are presented on **Figure 5-2**. Groundwater analytical results for AOCs A9 and P13 samples collected during the SI and the SSI are summarized in **Tables 5-2** and **5-3**, and results of comparing the analytical results to screening criteria are presented on **Figures 5-3** through **5-5**. The surface water analytical results for AOCs A9 and P13 are summarized in **Table 5-4**. The sediment analytical results for AOCs A9 and P13 are summarized in **Table 5-5**. Results of comparing the analytical results to screening criteria for surface water and sediment samples collected at AOCs A9 and P13 are presented on **Figures 5-6** and **5-7**, respectively. Field duplicate analytical results for each media are presented next to their respective parent samples in **Tables 5-1** through **5-5**.

## 5.2 Screening Criteria

In accordance with DoD 2022 Memo, PFAS analytical results from AOCs A9 and P13 for groundwater, soil, sediment, and surface water were screened against the 2022 Devens SSSLs (USEPA Region 1 2022) for PFOS, PFOA, PFBS, PFNA, and PFHxS developed by USEPA Region 1 in June 2022 (**Table 5-6**). USEPA Region 1 developed an SSSL for HFPO-DA, however, HFPO-DA was manufactured and used after 1995 when Fort Devens was identified for closure and was not analyzed for in PFAS methods utilized to date. PFAS analytical results from AOCs A9 and P13 for groundwater were also screened against the MassDEP MCP GW-1 PFAS screening criteria for informational purposes only.

## 5.3 Soil Sampling Results

Soil sample analytical results for AOC A9 are summarized in **Table 5-1** and results of screening criteria are presented on **Figure 5-1**.

### 5.3.1 AOC A9 – POL Burn Area (Former Massachusetts Firefighting Academy Training Area)

Soil samples were collected at AOC A9 from four depth intervals at 12 locations (plus seven field duplicates) and from 28 locations at two depth intervals (plus four field duplicates). A second set of two samples was inadvertently collected from location A9-21-34. A total of 106 primary samples and 11 duplicates were collected during the SSI field activities.

One or more PFAS with SSSLs (PFOS, PFOA, PFBS, PFNA, and PFHxS) were detected at 39 of the 40 locations sampled. Samples collected from location A9-21-06 had no detections of PFAS. PFBS was not detected in soil samples collected at AOC A9.

Because the likely source of PFAS contamination at AOC A9 was AFFF used during historic fire training activities performed by MFA in this area, PFOS is considered to be the primary PFAS constituent, with PFOA as a secondary constituent. Concentrations of PFOS exceeded its 2022 Devens SSSL in 22 of the soil samples and PFOA exceeded its SSSL in one sample. **Exhibit 5-1** below presents the maximum PFOS detections in each depth interval, the associated PFOA concentration, and the sample location. PFOS detected during the SI and SSI were generally an order of magnitude higher than the concentrations of PFOA detected.

***Exhibit 5-1 AOC A9 Maximum PFOS and PFOA Soil Detections***

| Depth Interval (bgs) | Number of Primary Samples | Maximum PFOS Detection (ng/g) | Associated PFOA Detection (ng/g) | Sample Location |
|---|---|---|---|---|
| 0-1 foot | 41 | 520 | 2.6 | A9-21-33 |
| 1-3 feet | 41 | 190 | 1.5 | A9-21-31 |
| 3-7 feet | 12 | 32 | 6.4 | A9-21-03 |
| 7-15 feet | 12 | 6.4 | 26 | A9-21-03 |

### 5.3.2 AOC P13 – Former Massachusetts Firefighting Academy

Because PFAS were not detected in soil samples collected at AOC P13 during the SI (KGS 2020), no soil samples were collected at AOC P13 during the SSI. Results of soil sampling at AOC P13 during the SI are presented on **Figure 5-2**.

## 5.4 Groundwater Sampling Results

Groundwater analytical results for AOCs A9 and P13 are summarized in **Tables 5-2** and **5-3**, and exceedances of screening criteria are presented on **Figures 5-3** and **5-5**, respectively. A cross-section showing PFAS concentration by depth along the primary groundwater flow pathway at AOC A9 is presented on **Figure 5-4**.

Prior to collection of groundwater samples, estimated depths to water were measured (**Table 4-2**) at each sampling location. Depths to water at AOCs A9 and P13 are summarized below:

- AOC A9 (POL Burn Area; MFA Training Area) – The depth to water ranged from 0.98 feet bgs at A9-21-09 to 37.30 feet bgs at A9-21-05.
- AOC P13 (Former MFA) – The depth to water ranged from 0.56 feet bgs at P13-21-07 to 16.30 feet bgs at P13-21-03.

### 5.4.1 AOC 9 – POL Burn Area (Former Massachusetts Firefighting Academy Training Area)

Groundwater analytical results for AOC A9 are summarized in **Table 5-2** and results of screening criteria are presented on **Figure 5-3**.

Groundwater samples were collected at multiple depths from nine temporary wells and from two permanent wells at AOC A9. Groundwater samples were collected from screened intervals every 10 feet from the top of the water table to the depth of refusal. One or more PFAS with screening criteria (SSSLs: PFOS, PFOA, PFBS, PFNA, and PFHxS; and PFAS6: PFOS, PFOA, PFHxS, PFNA, PFHpA, PFDA) were detected at each of the locations sampled. Five of the nine temporary wells had no exceedances of screening criteria.

Samples collected at four of the temporary wells (A9-21-03, A9-21-05, A9-21-07, and A9-21-08) and the two permanent wells also had concentrations of PFOS, PFOA, PFNA, and/or PFHxS that exceeded 2022 Devens SSSLs. PFBS concentrations in groundwater at AOC A9 did not exceed the Devens SSSL.

Samples from four of the nine temporary wells and the two permanent wells had a cumulative concentration of PFAS6 exceeding the MCP PFAS6 screening criteria in the sample collected from the first interval sampled (i.e., top 10 feet of water table). Samples collected lower in the water table did not exceed the MCP screening criteria.

The highest concentrations of PFOS, PFOA, and cumulative PFAS6 were identified in a parent and duplicate sample from temporary well A9-21-03 collected from 14 to 18 feet bgs. Concentrations for PFOS were 1,200 ng/L (1,300 ng/L DUP), PFOA were 28 ng/L (28 ng/L DUP), and PFAS6 were 1,561 ng/L (1,665 ng/L DUP). As shown on **Figure 5-4**, PFAS concentrations in groundwater were highest in the shallow depth intervals of sampling locations within, and immediately downgradient (north) the former fire training area. As expected, PFAS concentrations generally decreased with both depth and distance from the former fire training area.

### 5.4.2 AOC P13 – Former Massachusetts Firefighting Academy

Groundwater analytical results for AOC P13 are summarized in **Table 5-3** and results of screening criteria are presented on **Figure 5-5**.

Groundwater samples were collected from 10 temporary wells at AOC P13. One or more PFAS with screening criteria (SSSLs: PFOS, PFOA, PFBS, PFNA, and PFHxS and PFAS6: PFOS, PFOA, PFHxS, PFNA, PFHpA, PFDA) were detected at eight of the 10 locations sampled. There were no detections of PFAS in samples collected from locations P13-21-01 and P13-21-07. Five of the 10 temporary wells had no exceedances of SSSL screening criteria. Samples collected at five of the temporary wells (P13-21-02, P13-21-03, P13-21-04, P13-21-05, and P13-21-10) had concentrations of PFOS, PFOA, PFNA, and/or PFHxS that exceeded 2022 Devens SSSLs. Samples with exceedances of screening criteria were collected from multiple depths at the five temporary wells. PFBS concentrations in groundwater at AOC P13 did not exceed the Devens SSSL. Samples from four of the 10 temporary wells had a cumulative concentration of PFAS6 exceeding the MCP PFAS6 screening criteria.

In general, detected cumulative concentrations of PFAS6 in groundwater declined as distance from the identified source (the former burn pit) increased, decreasing from 893 ng/L for PFAS6 collected at 36-40 feet bgs at temporary well P13-21-10, located adjacent to the source area, to no detections of PFAS6 at temporary well P13-21-09 to the east, temporary wells P13-21-07 and P13-21-08 to the south, and temporary wells P13-21-05 and P13-21-06 to the west. In well P13-21-10 (source area) and well P13-21-03 (located northwest of the source area), the highest concentrations of PFAS6 were detected in the fourth interval in the water column, with concentrations decreasing quickly below that interval. In well P13-21-04 located northwest of the source area, the highest concentration of PFAS6 were detected in the second interval in the water column. The highest concentrations of PFOS, PFOA, and cumulative PFAS6 were identified in a sample from temporary well P13-21-02, collected from the second sampling interval at 25 to 29 feet bgs. Temporary well P13-21-02 is located approximately 450 feet to the north-northwest of the source area. The concentration of PFOS at this location was 17,000 ng/L, PFOA 550 ng/L, and PFAS6 29,581 ng/L.

## 5.5 Surface Water Sampling Results

Surface water samples were collected from four locations at AOC A9 and five locations at AOC P13. The analytical results for surface water samples were screened against the 2022 Devens SSSLs for PFOS, PFOA, PFBS, PFNA, and PFHxS. The surface water analytical results for AOCs A9 and P13 are summarized in **Table 5-4**. Surface water and sediment analytical results for AOCs A9 and P13 are presented together on **Figures 5-6** and **5-7**, respectively.

At AOC A9, PFOS, PFOA, PFBS, PFNA, and PFHxS were detected in the four samples collected, but concentrations did not exceed Devens SSSLs.

At AOC P13, PFOS, PFOA, PFBS, PFNA, and PFHxS were detected in the six samples (five parent and one duplicate) collected. Concentrations in four samples did not exceed Devens SSSLs. The parent sample and duplicate collected at P13-21-05 had concentrations of PFOS (1,400 ng/L and 1,000 ng/L, respectively) and PFNA (640 ng/L and 640 ng/L, respectively) that exceeded Devens SSSLs.

## 5.6 Sediment Sampling Results

Sediment samples were collected from four locations at AOC A9 and five locations at AOC P13. The analytical results for sediment samples were screened against the USEPA SSLs for PFOS, PFOA, PFBS, PFNA, and PFHxS. The sediment analytical results for AOCs A9 and P13 are summarized in **Table 5-5**.

Surface water and sediment analytical results for AOCs A9 and P13 are presented together on **Figures 5-6** and **5-7**, respectively.

At AOC A9, PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the four samples collected.

At AOC P13, PFOS was detected at four of the five locations sampled, with collocated detections of PFOA, PFNA, and/or PFHxS. One location had a detection of PFHxS only (P13-21-04 SED). PFBS was not detected in any of the samples from the five locations. The 2022 Devens SSSLs were not exceeded in the six samples (five parent and one duplicate).

# 6 Quality Assurance/Quality Control

QA/QC samples were collected according to the SSI Work Plan (KGS 2021) and QAPP Addendum for PFAS (S-A JV 2021) and consisted of field duplicate samples, matrix spike/matrix spike duplicate samples, field reagent blanks, and equipment blanks. Field duplicate analytical results are presented next to their respective parent samples in **Tables 5-1** through **5-5**. Laboratory analytical reports are included in **Appendix B**. Data validation was performed by KGS, a third party who was not associated with sample analysis, interpretation of sample data, or any decision-making process for this project. Validation reports are included in **Appendix C** and include discussion of associated QC sample results.

During SSI field activities, a total of 91 groundwater samples with nine field duplicate samples, 106 soil samples with 11 field duplicate samples, nine surface water samples with one field duplicate sample, and nine sediment samples with one field duplicate sample were collected. The samples were analyzed in accordance with the QAPP Addendum for PFAS analyses (S-A JV 2021), with the following noted:

- TOC analysis was requested for sediment samples after the fourteen-day holding time specified in the analytical method had expired. The TOC results were qualified as estimated (J qualifiers) with a possible low bias.
- Due to their high particulate content, vertical profile groundwater samples from locations A9-21-01 through A9-21-09 and P13-21-01 through P13-21-10 were centrifuged, and the supernatant (aqueous phase) was processed in the sample extraction. Groundwater samples collected from permanent wells OHM-A9-53 and OHM-A9-58, as well as the surface water samples, were not centrifuged.
- The laboratory noted that several groundwater and surface water samples contained particulates and vacuum was needed during extraction.
- When the laboratory noted mismatches between the chain of custody form and sample labels, the JV was contacted for resolution, and where necessary, revised chain of custody forms were provided.

Sixteen equipment blank (EB) samples and 13 field blank (FB) samples were submitted with samples during the SSI field sampling activities. The EB samples were prepared by pouring PFAS-free water poured over decontaminated sampling equipment. The FB samples were prepared by pouring PFAS-free water into sample containers in the field to measure ambient conditions.

Matrix spike/matrix spike duplicate (MS/MSD) samples were also collected. Seven groundwater, six soil, one surface water, and one sediment MS/MSD sample were submitted during the SSI field sampling activities.

The samples collected at AOCs A9 and P13 were submitted for PFAS analysis in accordance with USEPA PFAS by Modified Method 537 in compliance with DoD QSM Version 5.3, Table B-15 (DoD 2019) and analyzed by Eurofins Lancaster Laboratories Env, LLC following their SOP: *Per- and Polyfluorinated Substances (PFAS) in Water, Soils, Sediment and Tissues* (SOP WS-LC-0025, Rev 2.9 [11/22/2017]). Eurofins Lancaster Laboratories Env, LLC is accredited for PFAS analysis under DoD QSM Version 5.3, Table B-15 (DoD 2019).

Data validation was performed on the data for the soil, groundwater, surface water, and sediment samples collected from AOCs A9 and P13 at the Former Sudbury Training Annex in accordance with the *U.S. DoD Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3* (2019), *U.S. DOD General*

*Data Validation Guidelines* (November 2019) and *U.S. DoD Data Validation Guidelines Module 3: Data Validation Procedure for PFAS Analysis by QSM Table B-15* (May 2020). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience. The sample results were subjected to Stage 2B data validation, which includes evaluation of preparatory batch and instrument-related QC results.

Laboratory analytical reports are included in **Appendix B**. Detailed data validation reports are included in **Appendix C**.

Overall, the sample analyses were completed with QA/QC protocols met. The dataset is considered usable and meets project DQOs with the exceptions summarized below and provided with more detail in the data validation reports included in **Appendix C**.

A total of 715 results were qualified as estimated (J/UJ qualifiers) out of 6,660 results. Sample results qualified as estimated (J/UJ) due to QC exceedances are usable with an understanding of the quality issues identified in the data validation report. The J/UJ qualifiers were assigned for the following QC exceedances: extracted internal standard (EIS) recoveries outside of control limits but greater than 20%, field duplicate results outside of the control limit of 50% for solid matrices and 30% for aqueous matrices, matrix spike/matrix spike duplicate results and/or relative percent differences outside of the DoD QSM Version 5.3, Table B-15 specified control limits, ion ratios outside of the specified limits, and/or holding time exceedances.

A total of 185 results were X qualified out of 6,660 results during data validation. As stated in the DoD Data Validation Guidelines (2019b), “Sample results (including non-detects) qualified as X were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.” The X qualifiers were assigned during data validation as required by the Module 3 data validation procedures for EIS recoveries less than 20%. A total of 185 results were qualified as X due to EIS recoveries less than 20%, as follows:

- NEtFOSAA results were qualified as X in 54 soil samples.
- NMeFOSAA results were qualified as X in 66 soil samples, four groundwater samples, and ten surface water samples.
- 6:2 FTS results were qualified as X in five soil samples.
- PFBA results were qualified as X in four soil samples.
- PFPeA, PFDoA, PFTeDA, PFTrDA, and PFUnA results were each qualified as X in two soil samples.
- 4:2 FTS results were qualified as X in seven soil samples.
- 8:2 FTS, PFBS, PFDA, PFPeS, PFHpA, PFHxA, PFNA, and PFOA were each qualified as X in one soil sample.
- PFOSA was qualified as X in two groundwater samples.
- PFTeDA was qualified as X in one groundwater sample and six surface water samples.
- PFDoA and PFTrDA were each qualified as X in three surface water samples.
- PFUnA and PFOSA were each qualified as X in one surface water sample.

The JV project team recommends that the 185 results that were X qualified during data validation be excluded from the SSI data set. These excluded data points are presented in **Tables 5-1** through **5-4** with

“R” as final qualifiers. Despite the data recommended for rejection, the overall project DQOs and analytical completeness were met. Except for soil sample A9-21-13-SO-1-3, which required exclusion of the PFDA, PFHpA, PFNA, and PFOA results, the compounds with rejected results were not USEPA or MassDEP regulated compounds. In addition, the majority of rejected compounds were for non-detections. Any data gaps caused by rejected results will be accounted for in subsequent sampling activities at the sites.

For PFDA, PFHxS, and PFNA in soil, the limits of detection in the samples were slightly greater than the MCP PFAS S-1/GW-1 screening criteria.

Based on the Stage 2B data validation, results that are not excluded are considered valid and usable.

# 7 Migration/Exposure Pathways and Targets

## 7.1 SI Migration/Exposure Pathway Evaluation

Risk/exposure pathways were initially evaluated during preparation of the SI preliminary CSM (KGS 2020). The conclusions of the SI CSM migration/exposure pathway evaluation are briefly summarized in this section.

### 7.1.1 Soil

Complete soil pathways were defined as potentially complete when a concentration of PFOS or PFOA above the 2018 Devens SSSL was detected.

- AOC A9 - Soil exposure pathways are potentially complete at AOC A9.
- AOC P13 - Soil exposure pathways are not potentially complete at AOC P13 because PFAS were not detected; therefore, no further action is warranted.

### 7.1.2 Groundwater

Complete potential drinking water pathways were defined as actionable when a detected concentration of PFOS, PFOA or PFOS+PFOA above the 2018 LHA was confirmed in drinking water. A drinking water pathway was considered incomplete when there was a detected concentration of PFOS, PFOA or PFOS+PFOA above the LHA, but there were no drinking water receptors.

The Sudbury Annex is not within a current Drinking Water Source Area (310CMR 40.0006), however, in April 2016, the USFWS installed a bedrock water supply well at AOC A9 to support a maintenance building at the ARNWR (USFWS, personal communication, May 3, 2022).

In July 2022, the Army informed the USFWS that given the presence of PFAS in the overburden aquifer at the site, the Army did not support or recommend use of the USFWS well because, based on hydraulic conditions at the site, there is a potential for migration of groundwater from the overburden to the bedrock during pumping. The Army acknowledged they had no authority to prevent the USFWS from using the well for domestic water supply use but, if USFWS use of the well facilitates migration of PFAS compounds into a currently uncontaminated aquifer, the USFWS will be responsible for remediation (Army 2022).

- AOC A9 - Groundwater exposure pathways were considered potentially complete at AOC A9 because detected concentrations of PFOS and PFOA exceeded the 2016 LHA in groundwater; and the drinking water exposure pathway was potentially complete because the existing USFWS well could be used as a domestic water supply well. The impacted overburden groundwater at the site is discharging to the Assabet River.
- AOC P13 - Groundwater exposure pathways were considered potentially complete at AOC P13; because detected concentrations of PFOS and PFOA exceed the LHA in groundwater however, the drinking water exposure pathway was not complete at AOC P13 because water supply wells are not present in the immediate vicinity of AOC P13, and overburden groundwater is discharging to nearby surface water.

## 7.2 SSI Migration/Exposure Pathway Evaluation

The risk/exposure pathways evaluation from the SI CSM summarized above was re-visited after completion of the SSI.

### 7.2.1 Soil

Complete soil pathways are defined as potentially complete when a concentration of PFOS, PFOA, PFBS, PFNA, or PFHxS above the 2022 Devens SSSLs screening criteria are detected.

The data from the SSI confirms the conclusions of the SI soil exposure pathways evaluations for AOCs A9 and P13:

- AOC A9 - Soil exposure pathways are potentially complete at AOC A9 because concentrations of PFOS, PFOA, PFBS, PFNA, or PFHxS above the Devens SSSLs were detected at 10 of 40 locations sampled during the SSI and two locations during the SI (**Figure 5-1**).
- AOC P13 - Soil exposure pathways are potentially complete, but no further action is warranted because PFOS, PFOA, or PFBS were not detected in samples collected during the SI (**Figure 5-2**).

### 7.2.2 Groundwater

Complete drinking water pathways are defined as actionable when a detected concentration of PFOS, PFOA, PFBS, PFNA, or PFHxS exceeds the 2022 Devens SSSLs screening criteria.

The data from the SSI confirmed that groundwater exposure pathways for AOCs A9 and P13 are still potentially complete because detected concentrations of PFOS, PFOA, PFBS, PFNA, or PFHxS exceeded Devens SSSLs (**Figures 5-3** through **5-5**).

- The drinking water exposure pathway for AOC A9 is potentially complete because the existing USFWS well could be used as a water supply well.
- The drinking water exposure pathway for AOC P13 is not complete because no existing water supply wells are currently operational at the site.

### 7.2.3 Surface Water/Sediment

As discussed in **Section 3.3**, Groundwater at AOC A9 discharges to the Assabet River and groundwater at AOC P13 discharges to nearby surface water bodies (e.g., a spring and wetland approximately 400 feet northwest of AOC P13 and Honey Brook located approximately 400 feet south of AOC P13 [E&E 1995]) and then eventually to the Assabet River.

- At AOC A9 the surface water and sediment exposure pathways are potentially complete, but the detected concentrations of PFOS, PFOA, PFBS, PFNA, and PFHxS do not exceed the associated 2022 Devens SSSLs (**Figures 5-6** and **5-7**).

- At AOC P13:
  - The surface water exposure pathway is potentially complete and detected concentrations of PFOS and PFNA exceed the associated Devens SSSLs (**Figure 5-7**).
  - The sediment exposure pathway is potentially complete, but detected concentrations of PFOS, PFOA, PFBS, PFNA, and/or PFHxS do not exceed the associated Devens SSSLs.

# 8 Conclusions

The SSI was conducted to further evaluate the extent of PFOS, PFOA, PFBS, PFNA, and PFHxS and PFAS6 at AOCs A9 and P13 and confirm/refine the CSM at the AOCs to update the evaluation of potential risk pathways to receptors at those sites.

PFAS was detected in groundwater, surface water, and sediment samples collected at AOCs A9 and P13, and soil samples collected at AOC A9. The detected concentrations for PFOS, PFOA, PFBS, PFNA, and PFHxS in soil, groundwater, surface water, and sediment samples were compared to the 2022 Devens SSSLs (**Table 5-6**) to assess potential human health risks. Groundwater data were compared to MCP PFAS6 screening criteria for informational purposes.

The surface water and sediment exposure pathways are potentially complete at AOCs A9 and P13, but the detected concentrations of PFOS, PFOA, PFBS, PFNA, and PFHxS in surface water and sediment at AOC A9 and in sediment at AOC P13 do not exceed the associated 2022 Devens SSSLs and do not pose an unacceptable risk to human health. At AOC P13, the surface water exposure pathway is potentially complete and detected concentrations of PFOS and PFNA exceed the associated Devens SSSLs, which may pose a potential risk to human health or the environment.

Groundwater exposure pathways are potentially complete at AOCs A9 and P13 and detected groundwater concentrations of PFOS, PFOA, PFNA, and/or PFHxS exceed 2022 Devens SSSLs. In addition, detected concentrations of PFOS, PFOA, PFNA, and/or PFHxS in soil at AOC A9 exceed 2022 Devens SSSLs. Therefore, additional investigation of soil at AOC A9 and groundwater at AOCs A9 and P13 under a remedial investigation phase of the CERCLA process is recommended. The most current PFAS guidance will be used during development of the remedial investigation report.

## 8.1 AOC A9 – POL Burn Area (Former Massachusetts Firefighting Academy Training Area)

One or more PFAS with SSSLs (PFOS, PFOA, PFBS, PFNA, and PFHxS) were detected in soil samples collected at 39 of the 40 sample locations (**Table 5-1** and **Figure 5-1**). Samples collected from location A9-21-06 had no detections of PFAS. PFBS was not detected in soil samples collected at AOC A9.

Because the likely source of PFAS contamination at AOC A9 was AFFF used during historic fire training activities performed by MFA in this area, PFOS is considered to be a primary PFAS constituent, with PFOA as a secondary constituent. Concentrations of PFOS exceeded its associated 2022 Devens SSSL in 22 of the soil samples and PFOA exceeded its SSSL in one sample. PFOS detected during the SI and SSI were generally an order of magnitude higher than the concentrations of PFOA detected.

- The soil exposure pathway is considered to be potentially complete at AOC A9 because concentrations of PFOS, PFOA, PFBS, PFNA, or PFHxS above the 2022 Devens SSSLs were detected at 10 of 40 soil sample locations during the SSI and two locations sampled during the SI (**Figure 5-1**).

Groundwater samples from four of the nine temporary vertical profile wells installed at AOC A9 and from the two permanent wells had concentrations of PFOS, PFOA, PFNA, and PFHxS that exceeded Devens SSSLs. Additional temporary wells (A9-21-01, A9-21-02, A9-21-06, and A9-21-09) had concentrations of PFHxS that exceeded its Devens SSSL. PFBS concentrations in groundwater at AOC A9 did not exceed the Devens SSSL. The same wells had cumulative concentrations of PFAS6 exceeding the MCP PFAS6 screening criteria in the sample collected from first interval sampled (i.e., top 10 feet of water table) (**Table 5-2** and **Figure 5-3**). As shown on **Figure 5-4**, PFAS concentrations in groundwater were highest in the shallow depth intervals of sampling locations within, and immediately downgradient (north) the former fire training area. As expected, PFAS concentrations generally decreased with both depth and distance from the former fire training area. The highest concentrations of PFOS, PFOA, and cumulative PFAS6 were identified in a sample from temporary well A9-21-03, collected from 14 to 18 feet bgs. The concentration for PFOS was 1,300 ng/L, PFOA was 28 ng/L, and PFAS6 was 1,658 ng/L.

- The data from the SSI confirmed the groundwater CSM exposure pathway for AOC A9 is potentially complete because detected concentrations of PFOS and PFOA exceed 2022 Devens SSSLs screening criteria and that the drinking water exposure pathway is potentially complete because the USFWS well could be used as a domestic water supply well.
- The surface water and sediment exposure pathways at AOC A9 are potentially complete, but the detected concentrations of PFOS, PFOA, PFBS, PFNA, and PFHxS do not exceed the associated 2022 Devens SSSLs (**Figure 5-6**).

Based on DoD Guidance, and in accordance with 40 CFR 300.420(c)(5)(v), a remedial investigation is recommended for soil and groundwater at AOC A9.

## 8.2 AOC P13 – Former Massachusetts Firefighting Academy

Groundwater samples from five of the 10 temporary vertical profile wells installed at AOC P13 had exceedances of at least one 2022 Devens SSSL. PFBS concentrations in groundwater at AOC P13 did not exceed the 2022 Devens SSSL. Samples from four of the 10 temporary wells had a cumulative concentration of PFAS6 exceeding the MCP PFAS6 screening criteria (**Table 5-3** and **Figure 5-5**). Samples with exceedances of screening criteria were collected from multiple depths at the four temporary wells.

In general, detected concentrations of PFAS6 in groundwater declined as distance from the identified source (the former burn pit) increased, decreasing from 896 ng/L collected at 36 to 40 feet bgs at temporary well P13-21-10, located adjacent to the source area, to no detections of PFAS at temporary well P13-21-09 to the east, temporary wells P13-21-07 and P13-21-08 to the south, and temporary wells P13-21-05 and P13-21-06 to the west. In well P13-21-10 (source area) and well P13-21-03 (located northwest of the source area), the highest concentrations of PFAS6 were detected in the fourth interval in the water column, with concentrations decreased quickly below that interval. In well P13-21-04 located northwest of the source area, the highest concentration of PFAS6 were detected in the second interval in the water column. The highest concentrations of PFOS, PFOA, and cumulative PFAS6 were identified in a sample from temporary well P13-21-02, collected from the second sampling interval at 25 to 29 feet bgs. Temporary well P13-21-02 is located approximately 450 feet to the north-northwest of the source area. The concentration for PFOS was 17,000 ng/L, PFOA was 550 ng/L, and PFAS6 was 29,581 ng/L.

The data from the SSI confirmed the groundwater CSM exposure pathway for AOC P13 is still potentially complete because detected concentrations of PFOS and PFOA exceed 2022 Devens SSSLs; however, the drinking water exposure pathway is not complete as no existing water supply wells are currently or are likely to be impacted.

- At AOC P13 (**Figure 5-7**):
    - The surface water exposure pathway is potentially complete and detected concentrations of PFOS and PFNA exceed the associated 2022 Devens SSSLs.
    - The sediment exposure pathway is potentially complete, but detected concentrations of PFOS, PFOA, PFBS, PFNA, and/or PFHxS do not exceed the associated 2022 Devens SSSLs.

Based on DoD Guidance, and in accordance with 40 CFR 300.420(c)(5)(v), a remedial investigation is recommended for groundwater and surface water at AOC P13.

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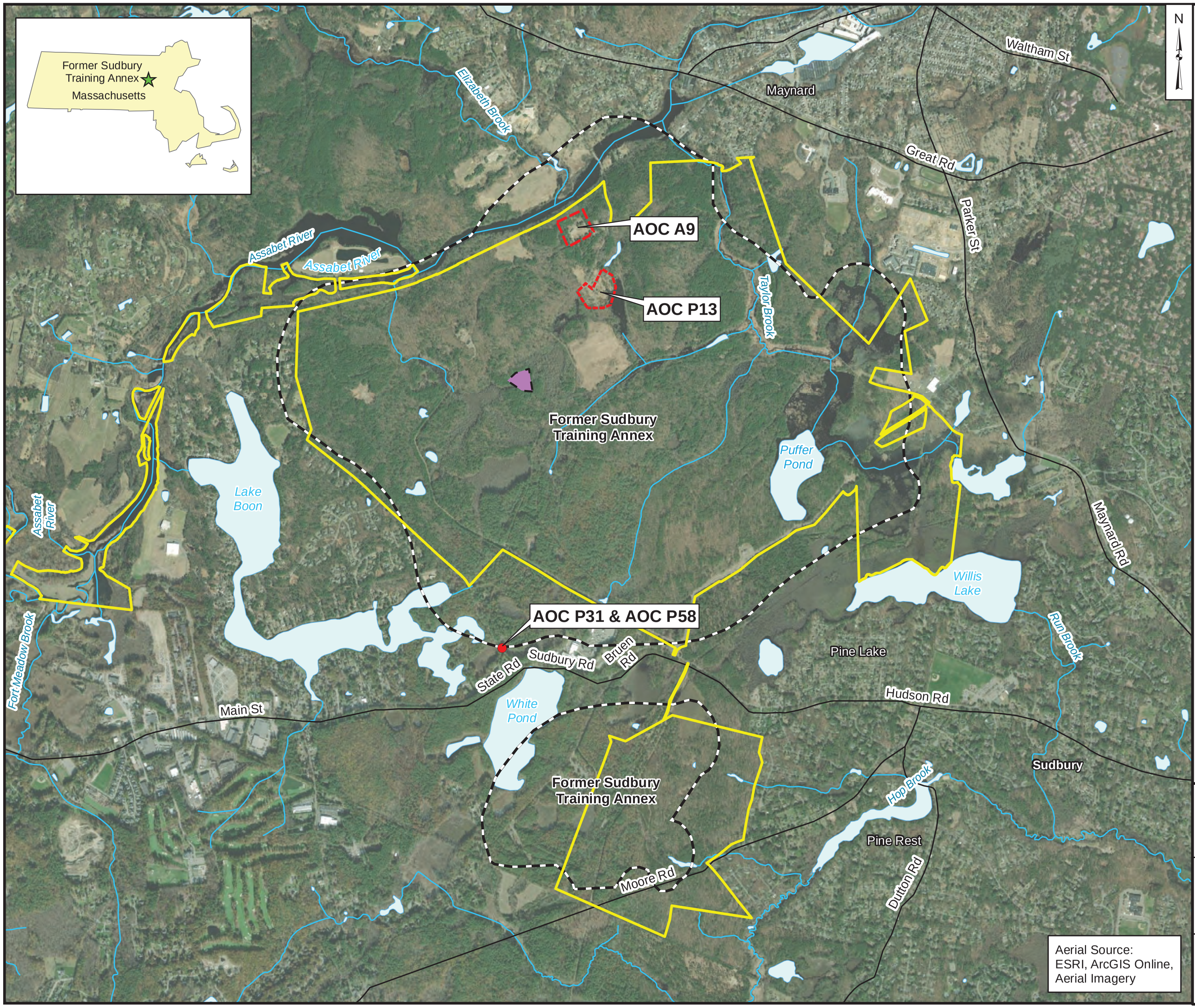
# Figures



Aerial Source:
ESRI, ArcGIS Online,
Aerial Imagery

Legend

- Former Sudbury Training
- ● Area of Contamination (AOC)
- Area of Contamination Perimeter
- Major Road
- FEMA-Owned Parcel
- Assabet River National Wildlife Refuge
- River/Stream
- Water Body

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

**Site Location**
**Former Sudbury Training Annex**

SERES ARCADIS a joint venture

**Figure 1-1**

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

**LEGEND**

- ✕ Former Fence Line
- — Former Site Feature
- ▨ Former Fire Fighting Training Area
- ▭ Historical Feature

NOTE:
USFWS: U.S. Fish and Wildlife Service

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC A9 Site Layout

SERES ARCADIS
a joint venture

FIGURE
2-1

Document Path: T:_ENV\Devens_RFTA\Seed_Task_Order\MXDs\AR2021 - SUD\Final\Figure 2-1 - AOC A9 Site Layout.mxd Date Saved: 7/1/2022 9:50:02 AM User Name: Sharmayh4948

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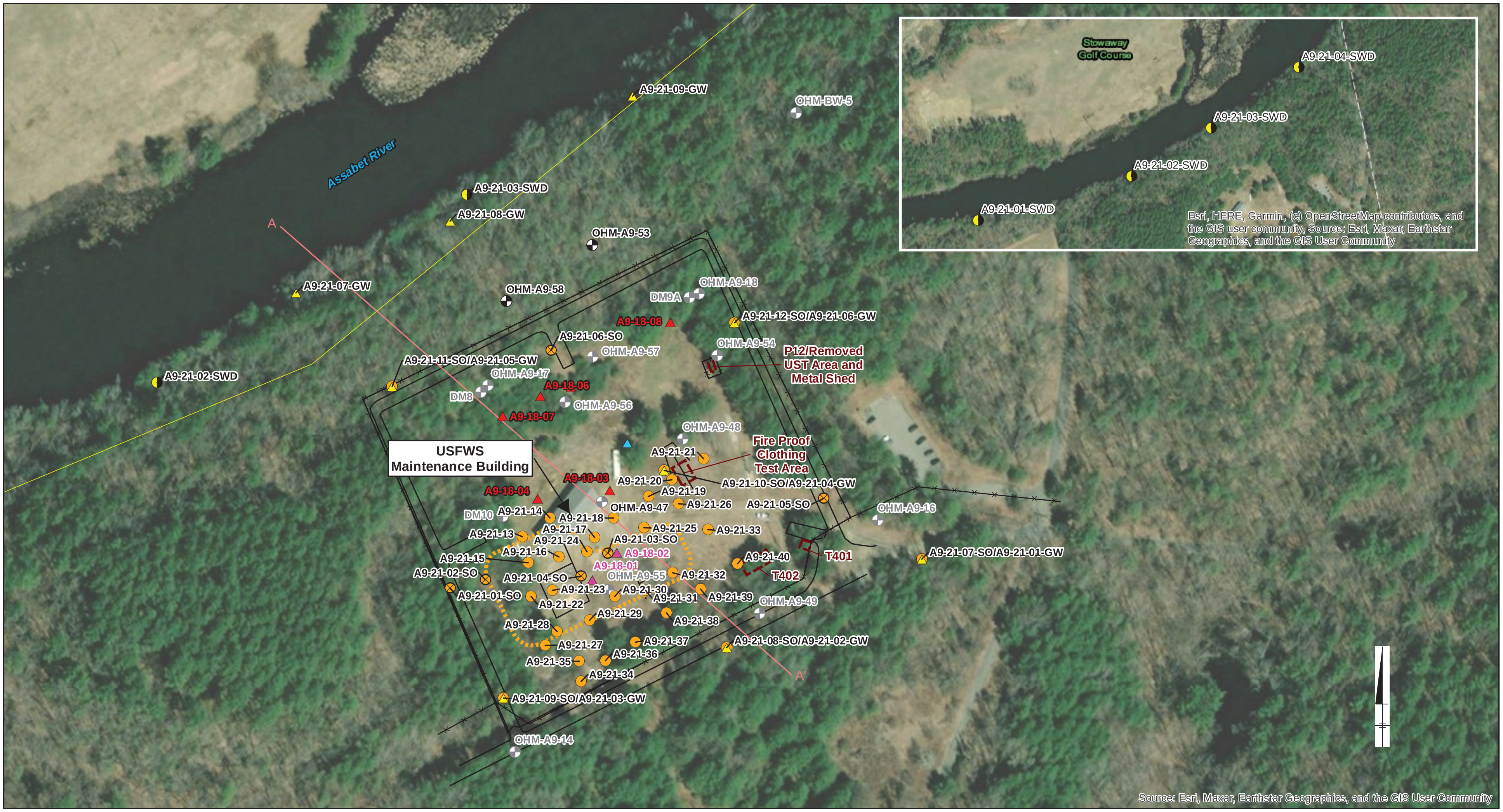
Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC P13 Site Layout

SERES
ARCADIS
a joint venture

FIGURE
**2-2**



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Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

**LEGEND**

- ● Soil Sampling Location (Surficial)
- ◐ Surface Water + Sediment Sampling Location
- ⊗ Soil Sampling Location (Surficial and Subsurface)
- △ Vertical Aquifer Profiling Location
- ▲ USFWS Water Supply Well
- ▲ Soil Sample and Temporary Well Location (2018)
- ▲ Temporary Well Location (2018)
- ◍ Existing Monitoring Well Location
- ◍ Abandoned Monitoring Well Location
- —×— Former Fence Line
- —— Former Site Feature
- ⬚ Former Fire Fighting Training Area
- ⬚ Historical Feature

NOTE:
USFWS: U.S. Fish and Wildlife Service

0 200 400 Feet
GRAPHIC SCALE

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC A9 Sample Locations

SERES ARCADIS a joint venture

FIGURE
4-1

Document Path: T:_ENV\Devens_RFTA\Seed_Task_Order\MXDs\AR2021 - SUD\Final\Figure 4-1 - AOC A9 Sample Locations.mxd Date Saved: 7/1/2022 10:21:37 AM User Name: Sharmayh4948

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**LEGEND**

- ◐ Surface Water + Sediment Sampling Location
- ▲ Vertical Aquifer Profiling Location
- ▲ Soil Sample and Temporary Well Location (2018)
- ▲ Temporary Well Location (2018)
- ◍ Abandoned Monitoring Well Location
- —×— Former Fenceline
- ▨ Former Burn Pit Area
- ☐ Former Building

0 200 400 Feet

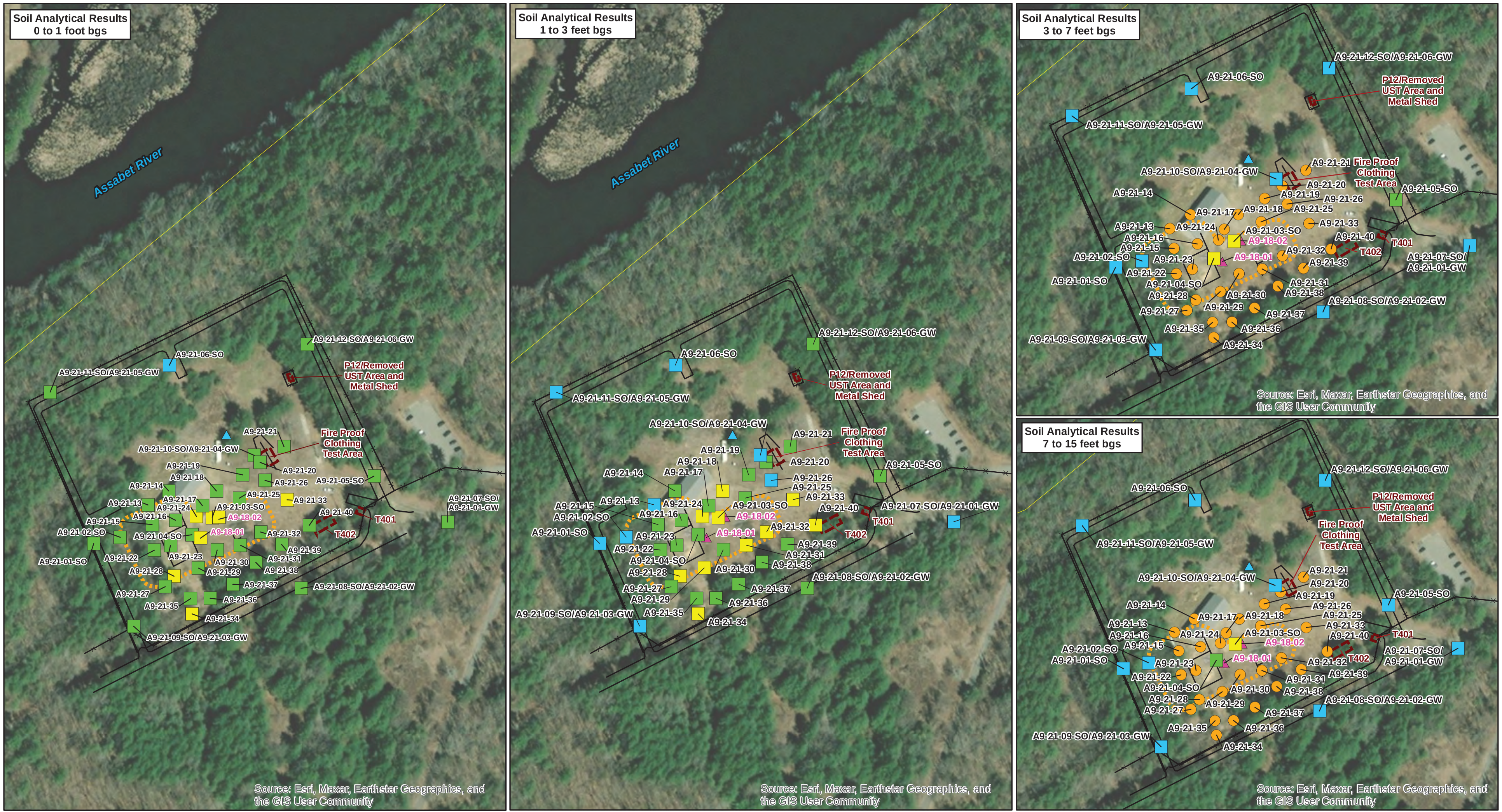
GRAPHIC SCALE

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC P13 Sample Locations

SERES ARCADIS
a joint venture

FIGURE
4-2



**LEGEND**

- ● Soil Sampling Location (Surficial)
- ⊗ Soil Sampling Location (Surficial and Subsurface)
- ▲ USFWS Water Supply Well
- ▲ Soil Sample and Temporary Well Location (2018)
- —×— Former Fence Line
- —— Former Site Feature
- ⬚ Former Fire Fighting Training Area
- ⬚ Historical Feature

**Soil Analytical Results**

- 🟦 No detection of PFAS with SSSLs
- 🟩 One of more detections of PFAS with SSSLs - no exceedances
- 🟨 One or more PFAS SSSL exceeded

| Per- and Polyfluoroalkyl Substances (PFAS) | 2022 USEPA SSSLs (ng/g) |
|---|---|
| Perfluorobutanesulfonic acid (PFBS) | 1900 |
| Perfluorohexanesulfonic acid (PFHxS) | 126 |
| Perfluorononanoic acid (PFNA) | 19 |
| Perfluorooctanesulfonic acid (PFOS) | 12.6 |
| Perfluorooctanoic acid (PFOA) | 19 |

NOTE:
USEPA = United States Environmental Protection Agency
SSSL = Site-specific screening levels
MCP = Massachussetts Contingency Plan
ng/g = nanograms per gram
NE = screening level not established

0 200 400 Feet
GRAPHIC SCALE

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC A9 Soil Sample Results

SERES
ARCADIS

FIGURE
5-1

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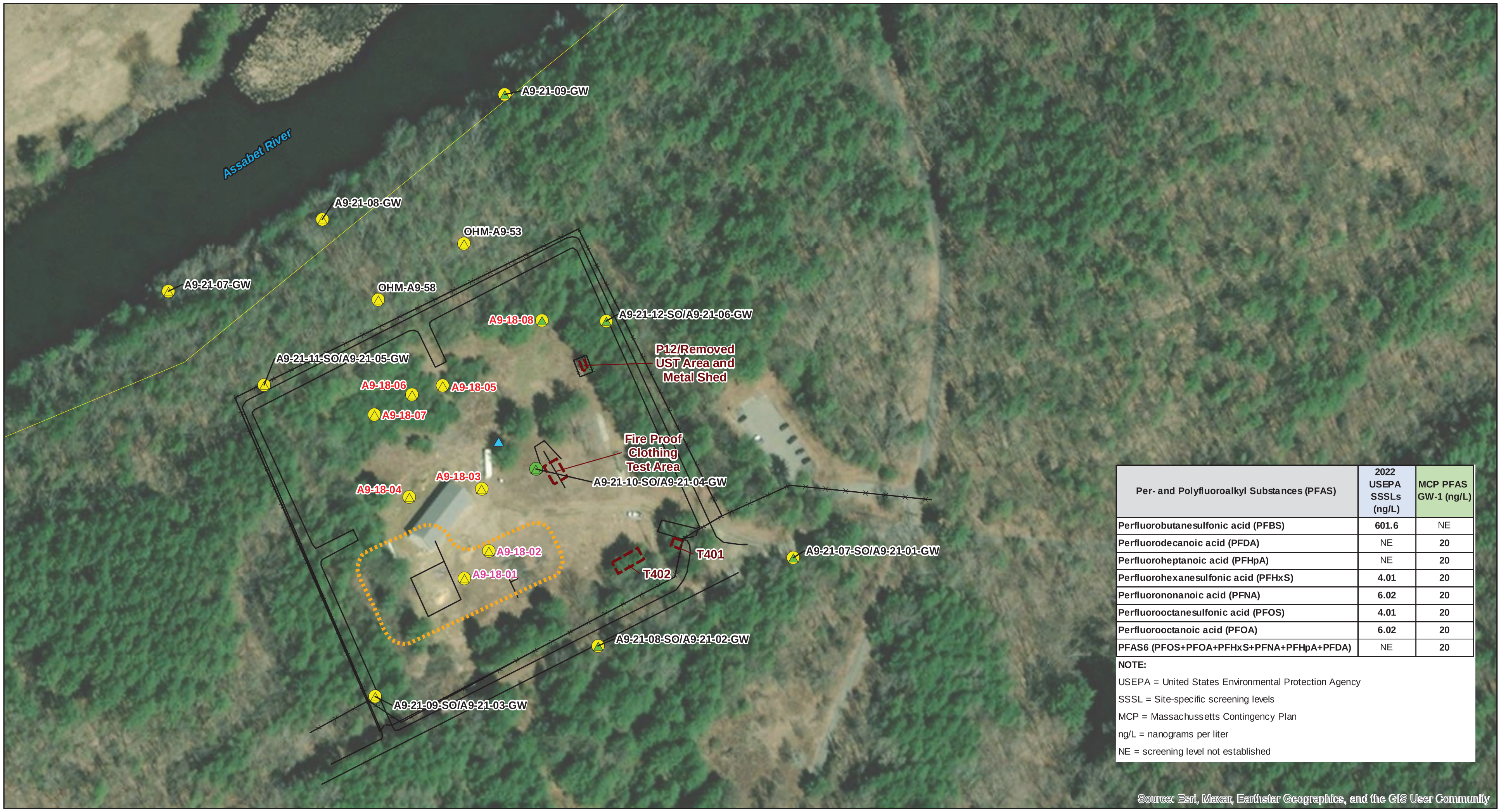
Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC P13 Soil Sample Results

SERES
ARCADIS
a joint venture

FIGURE
5-2



| Per- and Polyfluoroalkyl Substances (PFAS) | 2022 USEPA SSSLs (ng/L) | MCP PFAS GW-1 (ng/L) |
|---|---|---|
| Perfluorobutanesulfonic acid (PFBS) | 601.6 | NE |
| Perfluorodecanoic acid (PFDA) | NE | 20 |
| Perfluoroheptanoic acid (PFHpA) | NE | 20 |
| Perfluorohexanesulfonic acid (PFHxS) | 4.01 | 20 |
| Perfluorononanoic acid (PFNA) | 6.02 | 20 |
| Perfluorooctanesulfonic acid (PFOS) | 4.01 | 20 |
| Perfluorooctanoic acid (PFOA) | 6.02 | 20 |
| PFAS6 (PFOS+PFOA+PFHxS+PFNA+PFHpA+PFDA) | NE | 20 |

NOTE:

USEPA = United States Environmental Protection Agency

SSSL = Site-specific screening levels

MCP = Massachussetts Contingency Plan

ng/L = nanograms per liter

NE = screening level not established

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

**LEGEND**

- △ Vertical Aquifer Profiling Location
- △ USFWS Water Supply Well
- △ Soil Sample and Temporary Well Location (2018)
- ▲ Temporary Well Location (2018)
- ◕ Existing Monitoring Well Location
- —×— Former Fence Line
- —— Former Site Feature
- ▨ Former Fire Fighting Training Area
- ▭ Historical Feature

**Groundwater Analytical Results**

- ▲ No detection of individual PFAS6
- ▲ One or more PFAS6 detected - no exceedances
- ▲ Sum of PFAS6 exceeds screening criteria
- ● No detection of PFAS with SSSLs
- ● One of more detections of PFAS with SSSLs - no exceedances
- ● One or more PFAS SSSL exceeded

0 200 400 Feet

GRAPHIC SCALE

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

# AOC A9 Groundwater Sample Results

FIGURE
5-3

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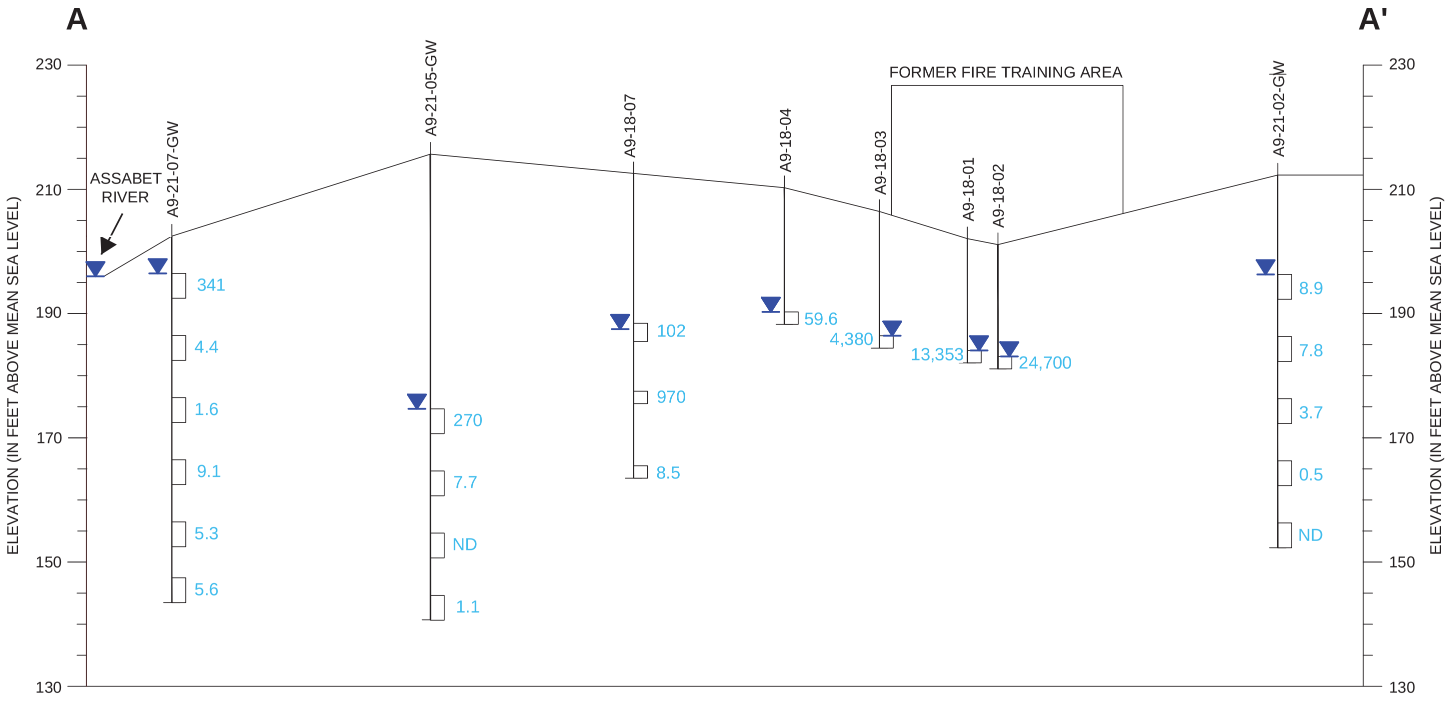

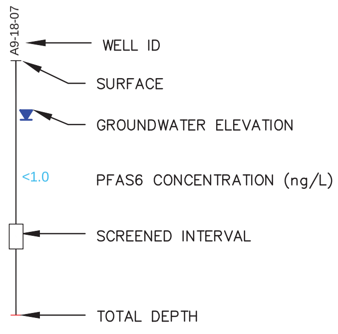

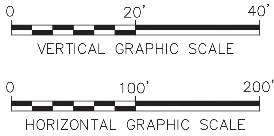

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC
P13 Sudbury, Massachusetts

## CROSS SECTION A-A'

FIGURE
**5-4**

| Per- and Polyfluoroalkyl Substances (PFAS) | 2022 USEPA SSSLs (ng/L) | MCP PFAS GW-1 (ng/L) |
|---|---|---|
| Perfluorobutanesulfonic acid (PFBS) | 601.6 | NE |
| Perfluorodecanoic acid (PFDA) | NE | 20 |
| Perfluoroheptanoic acid (PFHpA) | NE | 20 |
| Perfluorohexanesulfonic acid (PFHxS) | 4.01 | 20 |
| Perfluorononanoic acid (PFNA) | 6.02 | 20 |
| Perfluorooctanesulfonic acid (PFOS) | 4.01 | 20 |
| Perfluorooctanoic acid (PFOA) | 6.02 | 20 |
| PFAS6 (PFOS+PFOA+PFHxS+PFNA+PFHpA+PFDA) | NE | 20 |

**NOTE:**

USEPA = United States Environmental Protection Agency

SSSL = Site-specific screening levels

MCP = Massachussetts Contingency Plan

ng/L = nanograms per liter

NE = screening level not established

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**LEGEND**

| | |
|---|---|
| ▲ | Vertical Aquifer Profiling Location |
| ▲ | Soil Sample and Temporary Well Location (2018) |
| ▲ | Temporary Well Location (2018) |
| —×— | Former Fenceline |
| ▨ | Former Burn Pit Area |
| ☐ | Former Building |

**Groundwater Analytical Results**

| | |
|---|---|
| ▲ | No detection of individual PFAS6 |
| ▲ | One or more PFAS6 detected - no exceedances |
| ▲ | Sum of PFAS6 exceeds screening criteria |
| ● | No detection of PFAS with SSSLs |
| ● | One of more detections of PFAS with SSSLs - no exceedances |
| ● | One or more PFAS SSSL exceeded |

0 200 400 Feet

GRAPHIC SCALE

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC P13 Groundwater Sample Results

FIGURE
5-5

| Per- and Polyfluoroalkyl Substances (PFAS) | Surface Water | Sediment |
|---|---|---|
| | 2022 USEPA SSSLs (ng/L) | 2022 USEPA SSSLs (ng/g) |
| Perfluorobutanesulfonic acid (PFBS) | 30400 | 9140 |
| Perfluorohexanesulfonic acid (PFHxS) | 1930 | 60.9 |
| Perfluorononanoic acid (PFNA) | 287 | 91.4 |
| Perfluorooctanesulfonic acid (PFOS) | 203 | 61 |
| Perfluorooctanoic acid (PFOA) | 304 | 91 |

NOTE:

USEPA = United States Environmental Protection Agency

SSSL = Site-specific screening levels

ng/L = nanograms per liter

NE = screening level not established

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

**LEGEND**

- ◑ Surface Water + Sediment Sampling Location
- ▲ USFWS Water Supply Well
- ◉ Existing Monitoring Well Location
- —x— Former Fence Line
- —— Former Site Feature
- ⬚ Former Fire Fighting Training Area
- ⬚ Historical Feature

**Surface Water (SW) and Sediment (Sed) Analytical Results SW Sed**

- 🟦 No detection of PFAS with SSSLs
- 🟩 One of more detections of PFAS with SSSLs - no exceedances
- 🟨 One or more PFAS SSSL exceeded

0 200 400 Feet

GRAPHIC SCALE

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC A9 Surface Water and Sediment Sample Results

SERES
ARCADIS

FIGURE
5-6

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| Per- and Polyfluoroalkyl Substances (PFAS) | Surface Water<br>2022 USEPA SSSLs (ng/L) | Sediment<br>2022 USEPA SSSLs (ng/g) |
|---|---|---|
| Perfluorobutanesulfonic acid (PFBS) | 30400 | 9140 |
| Perfluorohexanesulfonic acid (PFHxS) | 1930 | 60.9 |
| Perfluorononanoic acid (PFNA) | 287 | 91.4 |
| Perfluorooctanesulfonic acid (PFOS) | 203 | 61 |
| Perfluorooctanoic acid (PFOA) | 304 | 91 |

NOTE:

USEPA = United States Environmental Protection Agency

SSSL = Site-specific screening levels

ng/L = nanograms per liter

NE = screening level not established

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**LEGEND**

| | |
|---|---|
| ◑ | Surface Water + Sediment Sampling Location |
| —×— | Former Fenceline |
| ▨ | Former Burn Pit Area |
| ▭ | Former Building |

**Surface Water (SW) and Sediment (Sed) Analytical Results** SW | Sed

| | |
|---|---|
| 🟦 | No detection of PFAS with SSSLs |
| 🟩 | One of more detections of PFAS with SSSLs - no exceedances |
| 🟨 | One or more PFAS SSSL exceeded |

0 200 400 Feet

GRAPHIC SCALE

Supplemental Site Inspection Report for PFAS
Former Sudbury Training Annex, AOC A9 and AOC P13
Sudbury, Massachusetts

## AOC P13 Surface Water and Sediment Sample Results

SERES
ARCADIS

FIGURE
5-7