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

Former Joliet Army Ammunition Plant, Illinois

Prepared For:
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EXECUTIVE SUMMARY

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

The former JOAAP facility is located in Will County, Illinois, approximately 10 miles south of Joliet and 40 miles southwest of Chicago. The former JOAAP facility, which is divided by Illinois Route 53, encompasses 36,000 acres.

The former JOAAP PA identified three AOPIs for investigation during the SI phase. SI sampling results from the three AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, PFBS, PFNA, and PFHxS. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at former JOAAP because HFPO-DA is generally not a component of military specification aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS. Finally, the former installation was declared excess in 1993 and it is unlikely that GenX would have been present. PFOS, PFOA, PFBS, PFNA and/or PFHxS were not detected in soil or groundwater at any of the AOPIs. **Table ES-1** below summarizes the PA/SI sampling results and provides recommendations at each AOPI. The recommendation for all AOPIs is no action at this time.

Table ES-1. Summary of AOPIs Identified during the PA, PFOS, PFOA, PFBS, PFNA, and PFHxS Sampling at Former JOAAP, and Recommendations

AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)		Recommendation
	GW	SO	
Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)	ND	ND	No action at this time
Former Fire Training Area at L18	ND	ND	No action at this time
Fire Station at L32 (Building 60-7)	ND	ND	No action at this time

Notes:
GW – groundwater
ND – non-detect
SO – soil

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12580 and is conducting the PA/SI consistent with its authority under CERCLA, 42 United States Code §§ 9600, et seq. (as amended), and the Defense Environmental Restoration Program, 10 United States Code §§ 2701, et seq. The PFAS PA/SI included two distinct efforts. The PA identified locations that are areas of potential interest (AOPIs) at former Joliet Army Ammunition Plant (JOAAP) based on the use, storage and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the analytical results were compared to the Office of the Secretary of Defense (OSD) PFOS, PFOA, PFBS, PFNA, and PFHxS risk screening levels to determine whether further investigation is warranted. HFPO-DA was not in the suite of PFAS compounds analyzed during the SI; therefore, there are no HFPO-DA SI analytical results to screen against the OSD risk screening levels. This report provides the PA/SI for former JOAAP and was completed in accordance with CERCLA and The National Oil and Hazardous Substances Pollution Contingency Plan.

1.1 Project Background

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

In 2016, the United States Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016). On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water and soil, calculated using the USEPA's Regional Screening Level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 08 April 2021, USEPA published an updated toxicity assessment for PFBS (USEPA 2021). Based on the updated toxicity assessment for PFBS, the OSD issued a memorandum on 15 September 2021 to include updated PFBS risk screening levels (OSD 2021). On 18 May 2022, the USEPA published an update to the RSLs table. The May 2022 RSL table included six PFAS constituents: PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA (USEPA 2022). On 06 July 2022, the OSD issued a memorandum to include

revised risk screening levels based on the May 2022 USEPA RSLs (OSD 2022). The July 2022 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. These screening criteria are discussed further in **Section 6.5**.

1.2 PA/SI Objectives

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

1.2.1 PA Objectives

During the PA, investigators collected readily available information and conducted site reconnaissance. The PA evaluates and documents areas where PFAS-containing materials were used, stored, and/or disposed, so the Army can distinguish between sites that pose little or no threat to human health and the environment and sites that require further investigation.

1.2.2 SI Objectives

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

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

1.3 PA/SI Process Description

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

1.3.1 Pre-Site Visit

First, a former installation kickoff teleconference was held between applicable points of contact (POCs) from United States Army Environmental Command (USAEC), United States Army Corps of Engineers (USACE), and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 10 February 2021 to discuss the goals and scope of the PA, project scheduling, former installation access, timeline for the site visit (if a site visit were to occur), access to installation-specific databases, and to request available records.

A records review was conducted to obtain electronically available documents from the former installation representatives and external sources for review. The purpose of the records research was to identify any

area on the former installation that may have been a location where PFAS-containing materials were used, stored, and/or disposed, as well as to gather information on the physical setting and site history at former JOAAP.

A research summary report (RSR) was prepared to document and summarize all information regarding the current and historical use, storage, and/or disposal of PFAS-containing materials obtained during the research activities conducted from February through August 2021. This report included the following:

- A list of interviewed personnel, affiliation, roles, and contact information
- Interview logs detailing all interviews that took place during the PA
- A list of the data sources collected and reviewed
- A table of sites identified during research with description and relevance
- An operations timeline
- A site figure with potential AOPIs

1.3.2 Preliminary Assessment Site Visit

The former installation is not active, and at the time of this report, operated by the U.S. Forest Service and contractors, and some buildings and/or facilities of interest are abandoned or are reported to have been demolished. Therefore, a site visit was not conducted.

1.3.3 Post Research

After the RSR was submitted, a teleconference was scheduled to discuss the preliminary findings and finalize the list of any potential AOPIs. The post-RSR teleconference took place 01 February 2022 and determined that SI phase sampling was warranted. The information collected during the PA research was compiled to develop the installation-specific PA portion of the PA/SI report (**Section 3**). Site data obtained during the PA were used to develop preliminary conceptual site models (CSMs) for each AOPI, which serve as the basis for developing the SI scope of work presented in an installation-specific Quality Assurance Project Plan (QAPP) Addendum.

1.3.4 Site Inspection Planning and Field Work

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

The objectives of the SI kickoff and scoping teleconference were to:

- discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI
- gauge regulatory involvement requirements or preferences
- identify overlapping unexploded ordnance or cultural resource areas

- confirm the plan for investigation derived waste (IDW) handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- discuss general SI deliverable and field work schedule information and logistics

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

The DQOs, sampling design and rationale, and field methods employed for the SI are summarized from the QAPP Addendum developed for former JOAAP (Arcadis 2022) in **Sections 6.1** through **6.3**.

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

1.3.5 Data Analysis, Validation, and Reporting

Environmental samples collected during the SI were submitted to a laboratory which is DoD Environmental Laboratory Accreditation Program (ELAP) accredited for PFOS, PFOA, PFBS, PFNA, and PFHxS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.4 (DoD and Department of Energy 2021). Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of OSD risk screening levels (defined in **Section 6.5**).

2 INSTALLATION OVERVIEW

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

2.1 Site Location

The former JOAAP facility is located in Will County, Illinois, approximately 10 miles south of Joliet and 40 miles southwest of Chicago (**Figures 2-1 and 2-2**). The former JOAAP facility, which is divided by Illinois Route 53, encompasses 36,000 acres. JOAAP was divided into two major function areas with the section west of Illinois Route 53 referred to as the Manufacturing (MFG) Area and the area to the east of Illinois Route 53 referred to as the Load Assemble Package (LAP) Area. All three AOPIs discussed in this report are within the LAP Area (USAEC 2017).

2.2 Mission and Brief Site History

Former JOAAP was an Army munitions production facility that operated from 1940 to 1999, when all defense contractor leases ended. Prior to military use, the land comprising former JOAAP was used for agricultural purposes. In 1940, the Army bought land from local farmers to develop the Elwood Ordnance Plant and the Kankakee Ordnance Works. In 1945, these two facilities were consolidated to form the Joliet Arsenal, which would later become JOAAP (USAEC 2017).

Former JOAAP was divided into two main functional areas, including the MFG Area and the LAP Area. The MFG Area was placed on the National Priorities List in July 1987. This portion of the former installation was used to manufacture trinitrotoluene (TNT), dinitrotoluene, 2,4,6-trinitrophenylmethylnitramine, and other chemical constituents of munitions, propellants, and explosives. The production facilities were located in the northern part of the MFG Area, and an extensive explosives storage facility occupied the southern half of the MFG Area. The LAP Area was placed on the National Priorities List in March 1989. The LAP Area was used to load, assemble, and pack bombs, shells, mines, and supplementary charge munitions for shipping, and included a demilitarization area. Chemical Warfare Material was not produced in either the LAP or the MFG Areas at any time in the history of JOAAP and its predecessors (USAEC 2017).

The majority of the original 36,000 acres comprising the former JOAAP facility has been transferred from military ownership. Approximately 13,000 acres were transferred in the early 1960s prior to CERCLA and other environmental regulations. When the Army declared former JOAAP excess property in 1993, government officials assembled a 24-person Joliet Arsenal Citizens Planning Commission to formulate a reuse plan for the remaining property. This group, which included members from federal, state, and local governments and non-governmental organizations, was designed to ensure that the reuse plan would be thoroughly evaluated. In accordance with the Illinois Land Conservation Act of 1995 and following the Joliet Arsenal Citizens Planning Commission's reuse plan, the Army cleaned up and transferred excess property to various federal, state, and local state jurisdictions from 1996 until 2005 (USAEC 2017).

2.3 Current and Projected Land Use

Approximately 1,444 acres of former JOAAP have yet to be conveyed (Office of the Deputy Chief of Staff, G-9 2019). The Midewin National Tallgrass Prairie now occupies approximately 19,100 acres of the former JOAAP. Midewin National Tallgrass Prairie lands are owned by the U.S. Department of Agriculture and managed by the U.S. Forest Service. These lands consist mostly of open fields, agricultural areas, or undeveloped woodlands. Other major property owners include the Department of Veterans Affairs (Abraham Lincoln National Veterans Cemetery), State of Illinois Industrial Parks (various uses), and Will County (Prairie View Recycling and Disposal Facility) (USAEC 2017).

2.4 Climate

According to the National Oceanographic and Atmospheric Administration Climatic Data Center, the average summer temperatures at former JOAAP are in the 70 to 80 degrees Fahrenheit (°F) range and average winter temperatures are in the 20 to 30°F range. July is the warmest month of the year with an average maximum temperature of 85°F. January is the coldest month of the year with an average minimum temperature of 16°F. Precipitation is generally distributed evenly throughout the year, but June and July tend to be the wettest months, receiving an average of 4.2 inches of rain. Average annual precipitation is 37 inches, including an average of 20 inches of snow per year. Average frost depths in northeastern Illinois range from 4 inches to as deep as 30 inches below grade during the winter (USAEC 2017).

2.5 Topography

Former JOAAP is located within the northern part of the extensive Central Lowlands physiographic province, which is characterized by relatively flat topography and low relief (**Figure 2-3**). The present topography in this area is largely the result of relatively recent glaciation; therefore, topography is very closely related to the surface geological material. The most prominent topographic feature at former JOAAP is an approximately 50-foot-high escarpment that trends generally north-south through the former installation. It extends from north of the TNT lines in the MFG Area to the south-central boundary of the LAP Area. The surface elevation of the land east of the escarpment is higher than that to the west (Dames and Moore, Inc. 1993).

2.6 Geology

Former JOAAP lies within an area that was part of the Wisconsin glaciation period, characterized by unconsolidated glacial drift deposits of varying thicknesses (Henry and Wedron Formations) overlying dolomitic bedrock. The Henry Formation is 5 to 25 feet thick and includes sandy and gravelly silts as well as distinct beds of sand and gravel. The Wedron Formation is extensive in upland areas of former JOAAP and is composed of clayey silt with minor sand. The combined thickness of the Wedron and Henry formations is generally less than 25 feet in the western part of former JOAAP and increases to 60 to 70 feet in the central part (USAEC 2017).

The shallow bedrock aquifer system at former JOAAP consists of undifferentiated Silurian dolomite. Lithologic logs of monitoring wells that are located just west of the Henry Formation outcrop at former

JOAAP indicate that 5 to 10 feet of soil overlies the dolomite. This soil is likely a mix of alluvium and residuum developed from weathering of the dolomite. The Silurian dolomite thins to a feather edge a few miles west of former JOAAP, where the Maquoketa Formation outcrops, and it thickens to the northeast to more than 450 feet in the vicinity of Chicago Heights. The thickness of the Silurian dolomite at former JOAAP varies from approximately 50 feet in the west to approximately 100 feet at the eastern boundary (Dames and Moore, Inc. 1993).

The Ordovician Maquoketa Group, composed primarily of plastic shales with interbedded limestone and dolomite, underlies the Silurian dolomite and acts as a confining bed between the shallow bedrock aquifer system and the Cambrian-Ordovician Aquifer System. Interbedded carbonate rocks are more common in the upper portion of the group, while the base of the Maquoketa has a greater proportion of shale. Overall, the Maquoketa Group is approximately 150 feet thick in the vicinity of former JOAAP, though it attains its maximum thickness of approximately 250 feet around Chicago, 25 miles northeast of former JOAAP (Dames and Moore, Inc. 1993).

The Cambrian-Ordovician Aquifer System, consisting primarily of sandstone and dolomite with some limestone and shale, is the most important source of groundwater in northeastern Illinois. The Galena-Platteville dolomite and Glenwood-St. Peter sandstone are rock units within the Cambrian-Ordovician Aquifer System. Separating the Cambrian-Ordovician Aquifer System from the underlying Mount Simon Aquifer System is the Eau Claire Formation, consisting of shale and siltstones (Dames and Moore, Inc. 1993).

Northeastern Illinois is on the Kankakee Arch, a structural high that is between the Michigan Basin to the northeast and the Illinois Basin to the south. The regional dip is to the east and south at approximately 10 feet per mile. An anticlinal axis trending northeast-southwest passes through the western portion of former JOAAP. This anticline is opposite to the trend of other anticlines and synclines in the region (Dames and Moore, Inc. 1993).

The principal fault zone in the region, the Sandwich Fault Zone, trends northwest-southeast and passes through the eastern portion of former JOAAP. This is a gravity fault, with the northern block being the upthrown block. Northwest along the fault, where the Sandwich Fault is known to be fully developed, a series of parallel faults are present in a zone up to 10 miles wide on either side of the main fault. Structural contour maps indicate that vertical displacement of the fault increases with depth in the vicinity of former JOAAP. Displacement is approximately 100 feet on top of the Eau Claire Formation but is approximately 50 feet at the top of the Glenwood-St. Peter sandstone. The Sandwich Fault Zone may locally restrict groundwater flow; however, potentiometric contour maps do not indicate any regional effects (Dames and Moore, Inc. 1993).

A review of aerial photography taken in 1939 revealed a bedrock fracture system in the vicinity of former JOAAP. There are two major trends, northwest-southeast and northeast-southwest; the fractures trending northwest are more numerous than those trending northeast. It is not uncommon to have one fracture set paralleling the general dip and one set paralleling the general strike of the area. The depths of the fractures are unknown. It is probable that they do not extend through the plastic shales of the Maquoketa Group because these shales reportedly seal fractures in underlying carbonate rocks. Consequently, fractures within the shales themselves are expected to be self-sealing. The fracture traces vary from approximately 600 feet long to slightly more than 2.5 miles long; however, most of them are approximately 2,000 feet long (Dames and Moore, Inc. 1993).

2.7 Hydrogeology

The hydrogeology of the area is subdivided into four separate aquifer systems and major confining beds. The aquifer systems are, from uppermost to lowermost (USACE 2015):

- Shallow overburden (Pleistocene glacial drift deposits)
- Shallow bedrock (Silurian dolomites)
- Cambrian-Ordovician sandstones and dolomites
- Mount Simon sandstone (Cambrian sandstone)

Groundwater occurs in several aquifers beneath the former JOAAP facility. Regional groundwater flow is generally westward, but is locally influenced by streams, including Prairie Creek. A shallow overburden aquifer is located within glacial drift soils. Below the glacial drift is a Silurian dolomite water-bearing zone. Deeper Cambrian and Ordovician bedrock aquifers are isolated from the shallow aquifers by low-permeability shale beds of the Maquoketa Group.

Groundwater at the former JOAAP facility has been determined by the Illinois Environmental Protection Agency (IEPA) to be both Class I (potable) and Class II (non-potable general resource). Groundwater from the shallow bedrock aquifer (Silurian dolomite) is deemed a Class I groundwater resource by the IEPA and is used as a potable water source on a limited basis near former JOAAP despite elevated levels of sulfate and iron. The IEPA has classified the glacial drift aquifer as Class II because its low yield does not supply usable quantities of potable groundwater (USAEC 2017). See **Section 2.10** for more details on potable water at former JOAAP.

2.8 Surface Water Hydrology

Former JOAAP lies within the fork of the confluence of the Des Plaines and Kankakee Rivers. Most of the LAP area drains to the Kankakee River. The Grant Creek and Prairie Creek drainage basins cover approximately 70 percent (%) of the former installation, and the Jackson Creek drainage basin covers the remainder. Jackson and Grant creeks are tributaries to the Des Plaines River, whereas Prairie Creek eventually discharges to the Kankakee River (USACE 2015). Prairie Creek flows to the south and west through the entire site and eventually discharges to the Kankakee River just outside the former JOAAP facility boundary. Prairie Creek lies within a Federal Emergency Management Agency 100-year floodplain and is subject to flooding. Although limited information on the history of flooding exists, flooding at Prairie Creek is assumed to be limited to inland flooding events linked to significant precipitation events where precipitation accumulates over several days or intense precipitation falls over a short period of time. Man-made ditches facilitate drainage to these creeks from the sites (USAEC 2017).

2.9 Relevant Utility Infrastructure

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

2.9.1 Stormwater Management System Description

The storm drainage system at former JOAAP consists of natural drainage features with storm sewers and ditches used to increase the runoff rates in areas where the rapid removal of storm water was considered essential, or in areas where the natural runoff is exceptionally slow. Sewers and ditches extend only as far as necessary to connect with adequate natural drainage features. The storm sewer systems were abandoned with the termination of explosive production. There are approximately 16.5 miles of clay tile sewer pipe ranging from 8 inches to 24 inches and about 29 miles of ditches (Plexus Scientific Corporation 1996).

The LAP area uses sewer pipe and drainage ditches to accelerate natural runoff. Ditches conduct water to Prairie and Jordan Creeks. In 1989, former JOAAP had eight National Pollutant Discharge Elimination System permitted stormwater outfalls. Vitrified clay pipe was used in all of the manufacturing groups to collect storm water and discharge it to the nearby drainage ditches (Plexus Scientific Corporation 1996).

2.9.2 Sewer System Description

All major areas of former JOAAP were served by the sanitary sewer system which consists of vitreous clay tile with hand caulked joints. The MFG area was served by a sewage treatment plant on the west side of the MFG area and the LAP area was served by a sewage treatment plant on the west side of the LAP area. One additional sewage treatment plant was located on the north end of the MFG area and served the Brown Circle residential area. There was a total of 574,292 linear feet of sanitary and industrial waste lines at former JOAAP. In 1979, there were 39,000 linear feet of sanitary waste lines. In many cases, isolated buildings were not connected to the sanitary sewage system and instead used septic tanks and drain tile fields for sewage disposal. Septic tanks were located in both the LAP area and MFG areas. The MFG area septic tanks in residential areas were replaced by a central sewage system in 1959 (Plexus Scientific Corporation 1996).

Cooling water drains constructed of concrete and vitrified clay pipes served the tetryl and acid areas. All pipe 24 inches and larger were encased in concrete. Wastewater sewers served the TNT and tetryl areas for disposal waste cooling water and wastewater from manufacturing processes. Hand caulked vitrified clay pipe was used throughout the system. Prior to construction of the Red Water Plant, the wastewater sewers emptied into an open flume (wooden box flume 3 feet by 4 feet by 3,000 feet) constructed as a contour ditch on the west side of the ridge where the plants were located. The flume discharged into Grant Creek west of the 811 magazine area (Plexus Scientific Corporation 1996).

The LAP area treatment plant was built in the 1940s and utilized Imhoff tanks and a trickling filter to provide treatment. The design capacity was initially 0.65 million gallons per day. The plant received waste from several of the LAP area Groups, including the Group 60 administration area and the White Circle Housing area in Group 60. The sewer system consisted of 18 miles of sewer lines in 1959 (Plexus Scientific Corporation 1996).

A television inspection of this sewer system was conducted in 1967 and revealed groundwater infiltration in portions due to broken and leaking pipes, especially along the line from Groups 2 and 3. A treatment plant to serve Groups 2 and 3 was scheduled for completion in 1973 and was to remove from service much of the damaged line. Flow in excess of the design capacity bypassed the treatment plant and was discharged directly to Prairie Creek (Plexus Scientific Corporation 1996).

A new LAP area sewage treatment plant (STP) was built in 1984 with a design capacity of 1.2 million gallons per day. The new STP used the Imhoff tank process, which includes a trickling filter, secondary settling, chlorine contact and effluent pumping to adjacent Prairie Creek (Plexus Scientific Corporation 1996).

The Brown Circle STP, a package sewage treatment plant, received waste solely from the Brown Circle Housing Area. The plant was built in the early 1950s and utilized the activated sludge process for treatment. Design flow was reportedly 7,500 gallons per day. The sanitary sewer lines serving the Brown Circle Plant were also television inspected in 1967. The inspection substantiated infiltration into the system. After 1984, effluent was pumped to the new MFG area STP. Effluent from this plant was discharged into Jackson Creek until 1986 (Plexus Scientific Corporation 1996).

2.10 Potable Water Supply and Drinking Water Receptors

Groundwater at the former JOAAP facility has been determined by the IEPA to be both Class I (potable) and Class II (non-potable general resource); however, the IEPA has classified the glacial drift aquifer as Class II because its low yield does not supply usable quantities of potable groundwater. The Silurian dolomite aquifer is considered a Class I groundwater resource and it is used as a potable water source on a limited basis in the vicinity of the former JOAAP facility despite elevated levels of sulfate and iron (USAEC 2017).

Potable water is supplied to the entities on the former installation grounds by the city of Wilmington, which is approximately 2 miles south of the former installation boundary. The primary source of drinking water is surface water from the Kankakee River, which runs along the southwest portion of the former installation boundary and directly through Wilmington. The surface water intake is located upstream of the former JOAAP boundary. However, the city of Wilmington retains a deep bedrock groundwater well for emergencies (City of Wilmington 2020).

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

2.11 Ecological Receptors

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

Former JOAAP represents the ancient natural community of an Illinois tall-grass prairie. It lies within two subdivisions of the Grand Prairie Natural Division comprised of the Grand Prairie Section and Kankakee Sand Area Section. The latter is differentiated from the Grand Prairie Section by having sandy soils that were deposited during the Kankakee torrent. Prior to settlement approximately 86% of the former installation was described as prairie while 14% as forested and less than 1% as swamp. Land use practices which were predominately agricultural have drastically changed the pre-settlement conditions.

Less than 1% of original prairie remains. The upland woods were removed and replaced with such crops as corn, soybeans, and alfalfa. Areas less suitable for cropping due to soil type, rockiness or drainage, were used for grazing (Plexus Scientific Corporation 1996).

General resources for aquatic habitats consist primarily of the four creeks (Jackson, Grant, Prairie, and a branch of Jordan Creek) which discharge to the Des Plaines or Kankakee River. The National Wetlands Inventory identified various wetland areas at, and in the vicinity of, former JOAAP. The majority of wetlands are classified as Palustrine Forested, emergent, unconsolidated bottom or scrub-shrub, or riverine lower perennial unconsolidated bottom or intermittent streambed. The Palustrine System consists of vegetated wetlands-marshes, swamps, bogs, fens, and prairies. The flora of Palustrine wetlands is dominated by trees, shrubs, persistent emergents, emergent mosses or lichens. The Riverine system includes wetlands and deep-water habitats contained within a channel, except where wetlands are dominated by the flora described above for the Palustrine system (Plexus Scientific Corporation 1996).

Some of the natural resource areas of former JOAAP are the Drummond Dolomite Prairie, TNT Wetland, Hof Woods, Star Grove, and Prairie Creek Woods. The Grant Creek Prairie Nature Preserve is located between the Des Plaines Wildlife Conservation Area and the western boundary of former JOAAP. Its size, about 119 acres, makes it one of the largest tracts of wet prairie remaining in Illinois. It is under the control of the Illinois Nature Preserves Commission. Other natural areas may also exist, some of which have been degraded by agricultural practices. The presence of natural areas and management of disturbed areas containing Eurasian grasses and old crop lands is considered essential to the maintenance of animal species at former JOAAP (Plexus Scientific Corporation 1996).

A total of 401 plants species have been identified for the former JOAAP area, including 347 native Illinois species. Although this is a large number of species it is not considered a complete listing. Two federal candidates and State of Illinois endangered insect species were identified at former JOAAP: the Eryngium root borer moth (Papipema eryngii) and red-veined leafhopper (Aflexia rubranurd). Nineteen other insects were located in the former JOAAP listing. It is believed that additional surveys will identify more species. A total of 32 fish and mussel species were identified. No species of federal or State of Illinois concern were identified. Previous studies have identified 27 mammals at former JOAAP and a total of 108 avian species known to breed at the former installation grounds. Former JOAAP provides important breeding and wintering habitat for these species and the extensive grasslands provide a large prey base for these species during both the breeding season and winter. Few other areas in the state provide as large a foraging habitat as the former JOAAP for breeding and wintering of raptors. The scattered pine plantations of the former JOAAP provide roosting sites for some of these raptors. Cooper's hawks and great-horned owls have also used these pine plantings (Plexus Scientific Corporation 1996).

2.12 Previous PFAS Investigations

PFAS sampling has not previously been conducted at the former JOAAP.

3 SUMMARY OF PA ACTIVITIES

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

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

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during records review, personnel interviews, and/or site reconnaissance) and were categorized as AOPIs or as areas not retained for further investigation at this time based on a combination of information collected (e.g., records reviewed, personnel interviews, internet searches). A summary of the observations made, and data collected through records reviews (**Appendix D**) and former installation personnel interviews (**Appendix E**), during the PA process for former JOAAP is presented in **Section 4**. Further discussion regarding rationale for not retaining areas for further investigation is presented in **Section 5.1**, and further discussion regarding categorizing areas as AOPIs is presented in **Section 5.2**.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program (IRP) administrative record documents, compliance documents, former JOAAP Fire Department documents, former JOAAP Directorate of Public Works documents, and geographic information system files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for former JOAAP is provided in **Appendix D**.

3.2 Personnel Interviews

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

- Elwood Fire Department Fire Chief
- Former JOAAP Fire Department Fire Chief
- Former JOAAP Fire Department Fire Marshall
- Prairie View Landfill Environmental Engineer
- Will County Land Use Department Director of Resource Recovery and Energy Division

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

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

Former JOAAP was evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. As such, this section is organized to summarize the aqueous film-forming foam (AFFF)-related uses.

4.1 AFFF Use, Storage, and Disposal Areas

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

During the PA, several areas were identified as having the potential for use, storage, and/or disposal of AFFF. Two areas were identified as fire training areas where AFFF was used [Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) and Former Fire Training Area at L18]; two areas were identified as fire stations in areas with known AFFF use and storage [Fire Station at L32 (Building 60-7) and Reichert Fire Station (Building 24-1)]; and two areas were identified as storage facilities that potentially contained AFFF [Fire Extinguisher Service Building (Building 24-2) and Inert Storage Fireproof B].

4.1.1 Fire Training Areas

While former JOAAP was active, two fire training areas were identified and located that had AFFF usage according to records research and interviews with former personnel. From the 1940s to 1970s, the Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) discharged and potentially disposed of AFFF. A portion of this area was used as a fire training area, which consisted of a small depression enclosed by an earthen berm. There was a small wooden shed, several pieces of scrap metal, and a stripped automobile that were used for fire training operations, which included suppressing fire from wood pallets ignited with oil. Additionally, the area adjacent to the fire training area contained drums with a chalky white solid substance potentially enclosed in the drums. The Former Fire Training Area at L18 was suspected to have discharged AFFF according to an interview with the former JOAAP Fire Marshall. AFFF was suspected to have been used in the fire training exercises at and/or around what appears to be a concrete pad shown in historical aerials.

4.1.2 Fire Stations and AFFF Storage Areas

While former JOAAP was active, two fire training areas and two AFFF storage facilities were identified and located that had potential AFFF usage and/or storage according to records research and interviews with former personnel. According to an interview with the former JOAAP Fire Marshall, fire stations at the former installation stored approximately 25 to 50 gallons of AFFF and each fire engine carried approximately 5 gallons of AFFF while the Fire Marshall was active (1986 to 1988). The Fire Station at L32 (Building 60-7) was not located near the fire stations specifically mentioned in the interview but was active during this time interval and suspected to have used and stored AFFF. The Reichert Fire Station (Building 24-1) was active from 1942 to a time before 1986, as it was not operational when the Fire Marshall was at the former installation. This building was used to fill fire extinguishers, but reports indicate that the contents of the fire extinguishers did not contain PFAS materials. The Fire Extinguisher Service Building (Building 24-2) was active from 1942 to a time before 1986 and was used to store fire extinguisher materials, including fire extinguisher powder. Similarly, reports indicate that the contents of the fire extinguishers did not contain PFAS materials. Inert Storage Fireproof B was active from 1942 to a time before 1986 and contained various firefighting equipment on the east end of the building. This equipment included hard hats, respiratory equipment, and fire extinguishers. However, no available information on the contents of the fire extinguishers and no specific evidence was identified confirming fire extinguishers contain PFAS materials.

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

Following document research and personnel interviews at former JOAAP, other PFAS source types such as metal plating operations, photo-processing areas, WWTPs, landfills, etc. were not identified. Specific discussion regarding areas not retained for further investigation is presented in **Section 5.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.2**.

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at former JOAAP) is not part of the PA/SI. However, potential off-post PFAS sources within a 5-mile radius of the former installation that were identified during the PA research are as follows:

Nearby fire departments or stations within close proximity of former JOAAP could potentially be off-post PFAS sources if they use, store, or dispose AFFF. Approximately five fire stations or fire departments appear to be within 5 miles from the former installation boundary.

5 SUMMARY AND DISCUSSION OF PA RESULTS

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

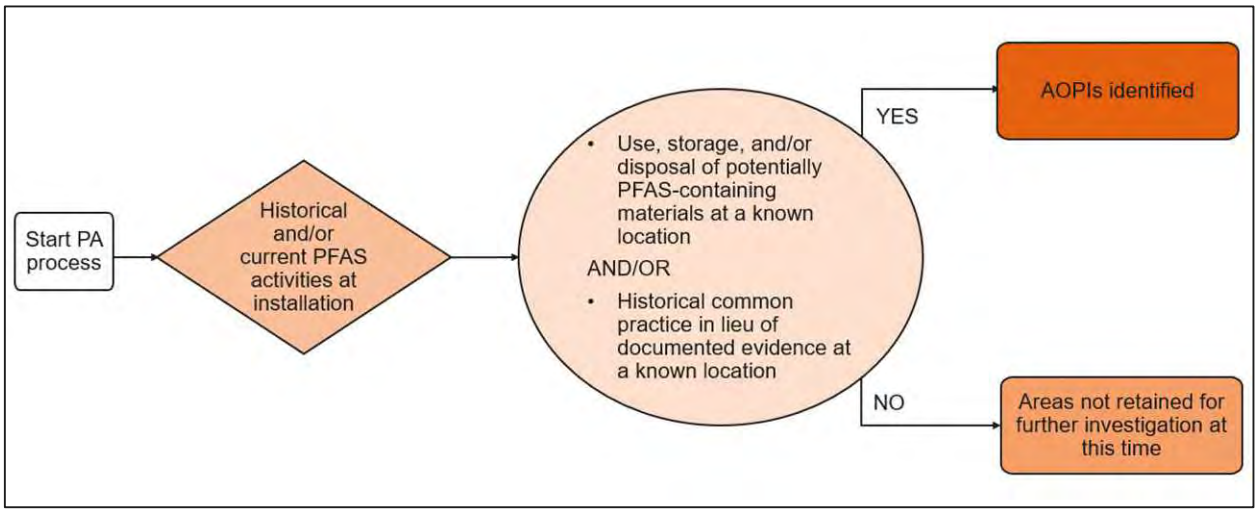

Figure 5-1: AOPI Decision Flowchart

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

Data limitations for this PA/SI at former JOAAP are presented in **Section 8**.

5.1 Areas Not Retained for Further Investigation

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

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

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

Area Description	Dates of Operation	Relevant Site History	Rationale
Reichert Fire Station (Building 24-1)	1942 to unknown	This building was used to fill fire extinguishers.	There is no evidence of PFAS-containing materials, used, stored, and/or disposed of at this building. Reports indicate the fire extinguishers were not being filled with PFAS-containing materials.
Fire Extinguisher Service Building (Building 24-2)	1942 to unknown	This building was used to store fire extinguisher materials, including fire extinguisher powder.	There is no evidence of PFAS-containing materials, used, stored, and/or disposed of at this building. Reports indicate the fire extinguishers were not being filled with PFAS-containing materials.
Inert Storage Fireproof B	1942 to unknown	This building contained various firefighting equipment on the east end of the building. This equipment included hard hats, respiratory equipment, and fire extinguishers.	There is no evidence of PFAS-containing materials used, stored, and/or disposed of at this building. There is no available information on the contents of the fire extinguishers and no specific evidence was identified confirming AFFF was used, stored, and/or disposed.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. One of the AOPIs overlap with former JOAAP IRP sites and/or Headquarters Army Environmental System sites (**Figure 5-2**). The AOPI, overlapping IRP site identifier, Headquarters Army Environmental System number, and current site status are discussed within each AOPI subsection presented below. At the time of this PA, none of the former JOAAP IRP sites have historically been investigated or are currently being investigated for the possible presence of PFAS.

The AOPI locations are shown on **Figure 5-2**. Aerial photographs of each AOPI are presented on **Figures 5-3 through 5-5**.

5.2.1 Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)

The Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) is identified as an AOPI following records research and personnel interviews due to the discharge and potential disposal of AFFF (**Figure 5-3**). From the 1940s to 1970s, part of the AOPI was used as a fire training area. Fire training operations included suppressing fire from wood pallets ignited with oil. The fire training area consisted of a small depression enclosed by an earthen berm. It contained a small wooden shed, several pieces of scrap metal, and a stripped automobile. Features within L3, including the fire training area and a drum burial ground, were removed during previous remedial actions performed under the IRP. The drums, containing a chalky white solid substance, were removed then disposed of at an offsite facility. This AOPI is bounded to the west by Prairie Creek, to the south by an unnamed tributary to Prairie Creek and to the east by Road 1 West. Groundwater and surface water flow west toward Prairie Creek, which flows southwest near the AOPI.

5.2.2 Former Fire Training Area at L18

The Former Fire Training Area at L18 is identified as an AOPI following records research and personnel interviews due to suspected AFFF discharge (**Figure 5-4**). According to an interview with the former JOAAP Fire Marshall, AFFF was suspected to have been used in the fire training exercises at this AOPI. As shown on the Former Fire Training Area at L18 aerial, the footprint of the fire training area is still visible. This AOPI is surrounded by grassland and the groundwater and surface flow directions are both generally to the south.

5.2.3 Fire Station at L32 (Building 60-7)

The Fire Station at L32 (Building 60-7) is identified as an AOPI following records research and personnel interviews due to the suspected use and storage of AFFF (**Figure 5-5**). According to an interview with the former JOAAP Fire Marshall, fire stations at the former installation stored approximately 25 to 50 gallons of AFFF and each fire engine carried approximately 5 gallons of AFFF. This fire station had a concrete driveway in the front or south side of the building, adjacent to the unnamed road, with the rest of the area around the building being grassland. The fire station was demolished between 2005 and 2006. Groundwater flows to the south and surface water flows east and west away from the building parallel to the unnamed road.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at former JOAAP, an SI for PFOS, PFOA, PFBS, PFNA, and PFHxS was conducted in accordance with CERCLA. SI sampling was completed at former JOAAP at all three AOPIs to evaluate presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS in comparison with the OSD risk screening levels. As such, an installation-specific QAPP Addendum (Arcadis 2022) was developed to supplement the general information provided in the PQAPP (Arcadis 2019) and to detail the site-specific proposed scopes of work for the SI. A preliminary CSM was prepared for each of the former installation's AOPIs in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-1-12 (USACE 2012). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonably anticipated future land uses. The preliminary CSMs identified 12 soil, groundwater, surface water, and/or sediment pathways as potentially complete which guided the SI sampling. The QAPP Addendum details the sampling design and rationale based on each AOPI's preliminary CSM. The SI scope of work was completed in March 2023 through the collection of field data and analytical samples.

The SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addendum (Arcadis 2022) and PQAPP (Arcadis 2019). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at former JOAAP. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the site-specific QAPP Addendum (Arcadis 2022), the objective of the SI is to identify whether there has been a release to the environment at the AOPIs identified in the PA and to determine if further investigation is warranted. This SI evaluated groundwater, and soil for PFOS, PFOA, PFBS, PFNA, and PFHxS presence or absence at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

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

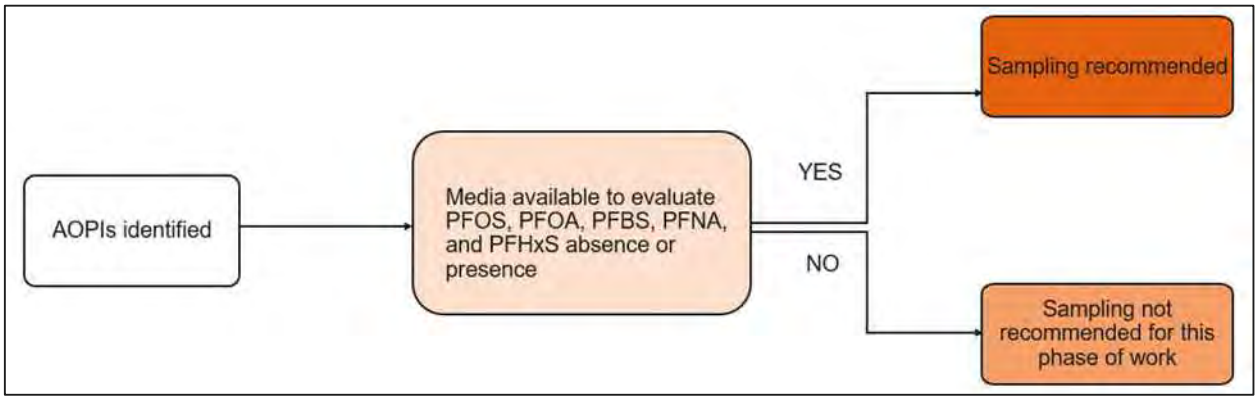

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at former JOAAP is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2022). Briefly, groundwater samples were collected to inform the interpretation of presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS and to update the individual AOPI CSMs. Soil samples were collected to evaluate the presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS, to evaluate the potential for those areas to be sources to surface water and groundwater as an influence to drinking water, and to update the individual AOPI CSMs.

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), the SOPs and TGIs included as Appendix A to the PQAPP, the QA/QC requirements identified in Worksheet #20 of the PQAPP, the approved scope and sampling methods outlined in the site-specific QAPP Addendum (Arcadis 2022), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2022). The sampling methods described in the SOPs and TGIs establish equipment requirements, procedures for preparing equipment and containers before sampling, sampling procedures under various conditions, and procedures for storing samples to ensure that sample contamination does not occur during collection, and transport. In general, sampling techniques used in the SI were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2019) and QAPP Addendum (Arcadis 2022). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes and field forms (i.e., soil boring logs, groundwater purging logs, equipment calibration forms, tailgate health and safety forms, and sample collection logs) documenting the SI sampling activities are included in **Appendices F and G**, respectively.

6.3.1 Field Methods

Groundwater samples were collected following the installation of temporary monitoring wells via sonic drilling. Shallow (first encountered) groundwater was sampled but when groundwater was not

encountered immediately, a temporary well was set to recharge. Groundwater samples were analyzed for select PFAS, and field parameters were measured during purging and allowed to stabilize or purge for a maximum of 20 minutes, whichever came sooner, to ensure a representative sample is collected and, potentially, to inform the interpretation of analytical data. If low-flow purging was not possible, a bailer was used to collect the groundwater sample. Coordinates for each borehole's groundwater sampling location were recorded using a handheld global positioning system.

Composite shallow subsurface soil samples (0-2 feet bgs [below ground surface]) were collected via hand auger from native soil. Soil samples were analyzed for select PFAS, and total organic carbon (TOC), pH, and grain size were analyzed in one soil sample per AOPI. Soil lithological descriptions were logged and documented. Coordinates for each soil sampling location were recorded using a handheld global positioning system (approximately 10-ft accuracy).

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

6.3.2 Quality Assurance/Quality Control

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

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2022), typically at a rate of 1 per 20 parent samples. FD and MS/MSD samples were collected for media sampled for PFOS, PFOA, PFBS, PFNA, and PFHxS, and TOC only. EBs were collected for media sampled for PFOS, PFOA, PFBS, PFNA, and PFHxS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2022). The decontaminated reusable equipment from which EBs were collected include stainless-steel trowels, water-level meters, tubing, bailers, and drill casing, as applicable to the sampled media. Source blanks were collected from the water used to pressure-wash drill tooling. Analytical results for blank samples are discussed in **Section 7.5**.

6.3.3 Field Change Reports

In some cases, clarifications to the established scope of work were needed but do not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum. Minor modifications from and clarifications for the procedures and scope of work detailed in the QAPP Addendum and PQAPP and that did not affect DQOs are documented in Field Change Reports (FCRs) included as **Appendix H** and are summarized below:

FCR-JOAAP-01

- FD, MS, and MSD groundwater samples were collected at JOAAP-L32-1-GW instead of JOAAP-L3-1-GW.

FCR-JOAAP-02

- Monitoring wells MW-411 and MW-412 were not sampled at the Fire Training Area and Drum Burial Area at L3 (JAAP-001-R01) because they were abandoned. As mentioned in the QAPP Addendum, these would only be sampled if they were not abandoned.

6.3.4 Decontamination

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

6.3.5 Investigation-Derived Waste

Solid IDW, including soil cuttings from the drill rig, was placed back in the originating boring. Liquid IDW, including groundwater and decontamination fluids, was collected and placed in a high-density polyethylene 5-gallon bucket. Liquid IDW composite samples were collected from the 5-gallon bucket for the required suite of waste characterization parameters. After these samples were collected, there was no liquid IDW remaining due to the lack of water produced from the investigation. Equipment IDW was collected in bags and disposed in municipal waste receptacles. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, and high-density polyethylene and silicon tubing) that may have come in contact with sampling media.

6.4 Data Analysis

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

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Pace South Carolina (formerly Shealy Environmental Services, Inc.), an ELAP accredited laboratory for PFAS analysis, including PFOS, PFOA, PFBS, PFNA, and PFHxS, by liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). Eighteen PFAS-related compounds, including PFOS, PFOA, PFBS, PFNA, and PFHxS, were analyzed for in groundwater and soil samples using an analytical method that is ELAP-accredited and compliant with QSM 5.4 (DoD and Department of Energy 2021), Table B-15.

Additionally, the following general chemistry and physical characteristic analyses were completed for select soil and sediment samples in accordance with Worksheet #18 of the QAPP Addendum (Arcadis 2022) by the analytical method noted:

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

- pH by Solid Waste Test Method 846 9045D.

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

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

6.4.2 Data Validation

All analytical data generated during the SI, except grain size, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.4 (DoD and Department of Energy 2021). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix I**. The Level IV analytical reports are included within **Appendix I** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

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

Based on the final data usability assessment, the environmental data collected at former JOAAP during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix I**), and as indicated in the full analytical tables (**Appendix J**) provided for the SI results. These data are of sufficient quality to meet the objectives and requirements of the PQAPP (Arcadis 2019) and former JOAAP QAPP Addendum (Arcadis 2022). Data qualifiers applied to laboratory analytical results for samples collected during the SI at former JOAAP are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/

commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-1**.

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

Chemical	Residential Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator		Industrial/Commercial Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator
	Tap Water (ng/L or ppt) [1]	Soil (mg/kg or ppm) [1,2]	Soil (mg/kg or ppm) [1,2]
PFOS	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6
HFPO-DA[3]	6	0.023	0.35

Notes:
1. Risk screening levels for tap water and soil provided by the OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July 06 (**Appendix A**).
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet bgs), regardless of the current and projected land use of the AOPI.
3. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at former JOAAP because HFPO-DA is generally not a component of military specification AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.
mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

The OSD residential tap water risk screening levels will be used to compare all groundwater for this Army PFAS PA/SI. While the current and reasonably anticipated future land uses of the AOPIs at former JOAAP are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, PFBS, PFNA, and PFHxS will be used to evaluate detected soil concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, PFBS, PFNA, or PFHxS are detected greater than the applicable OSD risk screening levels, further study in a remedial investigation is recommended in **Section 8**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at former JOAAP (FD results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addendum (Arcadis 2022). The sample results discussion below focuses on the PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

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

Field parameters measured for groundwater during low-flow purging and sample collection are provided on the field forms in **Appendix G**. Soil descriptions are provided on the field forms in **Appendix G**. The results of the SI are grouped by AOPI and discussed for each medium as applicable. Groundwater was generally first encountered at depths of approximately 11 to 22 feet bgs.

Table 7-3 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No)
Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)	No
Former Fire Training Area at L18	No
Fire Station at L32 (Building 60-7)	No

7.1 Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)

The subsections below summarize the soil and groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with the Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) AOPI (**Figure 7-1**).

7.1.1 Groundwater

Three groundwater samples were collected from temporary wells via sonic drilling at first encountered groundwater at the Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) AOPI (JOAAP-L3-1-

GW, JOAAP-L3-2-GW, JOAAP-L3-3-GW). The groundwater analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS are shown on **Figure 7-1** and **Table 7-1**, and are summarized below:

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the groundwater samples collected.

7.1.2 Soil

Two soil samples were collected via stainless-steel trowel at the Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) AOPI (JOAAP-L3-1-SO, JOAAP-L3-2-SO). The soil analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS are shown on **Figure 7-1** and **Table 7-2**, and are summarized below:

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the soil samples collected.

7.2 Former Fire Training Area at L18

The subsections below summarize the soil and groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with the Former Fire Training Area at L18 AOPI (**Figure 7-2**).

7.2.1 Groundwater

One groundwater sample was collected from a temporary well via sonic drilling at first encountered groundwater at the Former Fire Training Area at L18 AOPI (JOAAP-L18-1-GW). The groundwater analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS are shown on **Figure 7-2** and **Table 7-1**, and are summarized below:

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the groundwater sample collected.

7.2.2 Soil

Four soil samples were collected via stainless-steel trowel at the Former Fire Training Area at L18 AOPI (JOAAP-L18-1-SO, JOAAP-L18-2-SO, JOAAP-L18-3-SO, JOAAP-L18-4-SO). The soil analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS are shown on **Figure 7-2** and **Table 7-2**, and are summarized below:

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the soil samples collected.

7.3 Fire Station at L32 (Building 60-7)

The subsections below summarize the soil and groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with the Fire Station at L32 (Building 60-7) AOPI (**Figure 7-3**).

7.3.1 Groundwater

One groundwater sample was collected from a temporary well via sonic drilling at first encountered groundwater at the Fire Station at L32 (Building 60-7) AOPI (JOAAP-L32-1-GW). The groundwater analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS are shown on **Figure 7-3** and **Table 7-1**, and are summarized below:

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the groundwater sample collected.

7.3.2 Soil

Four soil samples were collected via stainless-steel trowel at the Fire Station at L32 (Building 60-7) AOPI (JOAAP-L32-1-SO, JOAAP-L32-2-SO, JOAAP-L32-3-SO, JOAAP-L32-4-SO). The soil analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS are shown on **Figure 7-3** and **Table 7-2**, and are summarized below:

- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the soil samples collected.

7.4 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, PFBS, PFNA, and PFHxS, one soil sample per AOPI was analyzed for TOC, pH, and grain size data as they may be useful in future fate and transport studies. The TOC in the soil samples ranged from 250 to 22,500 mg/kg. The TOC at the former installation was mostly within range of values typically observed in topsoil: 5,000 to 30,000 mg/kg. The combined percentage of fines (i.e., silt and clay) in soils at former JOAAP ranged from 53.2 to 83.5% with an average of 70.1%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The pH of the soil was slightly alkaline (average of 7.6 standard units). While PFAS constituents are relatively less mobile in soils with high percentages of fines, depleted TOC may allow for enhanced mobility of the constituents in soil. The full analytical results for TOC, pH, and grain size collected during the SI are included in **Appendix J**.

7.5 Blank Samples

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

7.6 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2022) were re-evaluated and updated based on the SI sampling results. The CSMs presented on **Figures 7-4 and 7-5** and in this section therefore represent the current understanding of the potential for human exposure. For some AOPIs, the source media, potential migration pathways and exposure media, and human exposure pathway determinations are the same, and thus, the CSMs are shown on the same figure.

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

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

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

Figure 7-4 shows the CSM for the Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) and Former Fire Training Area at L18 AOPIs. At both AOPIs, AFFF was historically released to soil and paved surfaces during firefighter training exercises. Additionally, AFFF was potentially stored in drums at the Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) AOPI. At both AOPIs, constituents in soil could migrate to Prairie Creek via surface water runoff or shallow groundwater discharge.

Figure 7-5 shows the CSM for the Fire Station at L32 (Building 60-7) AOPI. AFFF was historically stored at the fire station and potentially released to soil and paved surfaces from fire engines that also stored AFFF. The AOPI is located on a commercial property, and there are no surface water bodies near this AOPI to which surface runoff could flow.

The following exposure pathway determinations apply to both CSM figures:

- There are no residents at the former installation currently, and future residential use of the AOPIs is unlikely due to current land use and ownership. Therefore, all exposure pathways for on-installation residents are incomplete.
- PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in soil samples collected at the AOPIs. Based on the SI non-detect sample results, the soil exposure pathways for all potential human receptors are incomplete.
- JOAAP obtains its drinking water from the city of Wilmington, which sources water from an intake on the Kankakee River upstream of the former installation. Groundwater was used as a limited, potable water source in the past at JOAAP and a potable well or wells could potentially be

installed in the future. However, PFOS, PFOA, PFBS, PFNA, and PFHxS were not detected in the groundwater samples collected from temporary wells at the AOPIs. Based on the SI non-detect sample results, the groundwater exposure pathways for all potential human receptors are incomplete.

- Surface water bodies flow off-post through various streams (primarily Prairie Creek) to Kankakee River, which is used by the city of Wilmington for its primary drinking water source. The surface water intake is located upstream of the former JOAAP. Based on the non-detect results for soil and groundwater samples, the surface water and sediment exposure pathways for all potential human receptors are incomplete.

Following the SI sampling, none of the AOPIs were considered to have complete or potentially complete exposure pathways.

8 CONCLUSIONS AND RECOMMENDATIONS

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

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

Groundwater at the former JOAAP facility has been determined by the IEPA to be both Class I (potable) and Class II (non-potable general resource). Potable water is supplied to the entities on the former installation grounds by the city of Wilmington, which is approximately 2 miles south of the former installation boundary.

All AOPIs were sampled during the SI at former JOAAP to identify presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS at each AOPI. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at former JOAAP because HFPO-DA is generally not a component of military specification AFFF and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the former JOAAP QAPP Addendum (Arcadis 2022).

None of the AOPIs had detections of PFOS, PFOA, PFBS, PFNA, and PFHxS in groundwater or soil and no AOPIs exceeded OSD risk screening levels. Following the SI sampling, none of the AOPIs were considered to have complete or potentially complete exposure pathways.

The recommendation for no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS to the OSD risk screening levels (**Table 6-2**). **Table 8-1** below summarizes: the AOPIs identified at former JOAAP; the PFOS, PFOA, PFBS, PFNA, and PFHxS sampling results; and the recommendations for each AOPI.

Table 8-1 Summary of AOPIs Identified during the PA, PFOS, PFOA, PFBS, PFNA, and PFHxS Sampling at Former JOAAP, and Recommendations

AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/ND/NS)		Recommendation
	GW	SO	
Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)	ND	ND	No action at this time
Former Fire Training Area at L18	ND	ND	No action at this time
Fire Station at L32 (Building 60-7)	ND	ND	No action at this time

Notes:
GW – groundwater
ND – non-detect
SO – soil

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

The former installation is not active, is now operated by the U.S. Forest Service and contractors, and some buildings and/or facilities of interest are abandoned or are reported to have been demolished. Therefore, a site visit was not conducted and site records are limited.

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

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

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

Finally, the available PFOS, PFOA, PFBS, PFNA, and PFHxS analytical data is limited to groundwater and soil samples from the three AOPIs identified during the PA. Available data, including PFOS, PFOA, PFBS, PFNA, and PFHxS, are listed in **Appendix J**, which were analyzed per the selected analytical method. HFPO-DA was not in the suite of PFAS compounds analyzed during the SI at former JOAAP; therefore, there are no HFPO-DA SI analytical results to screen against the 2022 OSD risk screening levels.

Results from this PA/SI indicate further study in a remedial investigation is not warranted at former JOAAP in accordance with the guidance provided by the OSD.

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ACRONYMS

°F	degrees Fahrenheit
%	percent
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
DQO	data quality objective
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
FCR	Field Change Report
FD	field duplicate
HFPO-DA	hexafluoropropylene oxide dimer acid
IDW	investigation-derived waste
IEPA	Illinois Environmental Protection Agency
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
JOAAP	Joliet Army Ammunition Plant
LAP	Load Assemble Package
LOD	limit of detection
LOQ	limit of quantitation
MFG	Manufacturing
mg/kg	milligrams per kilogram (parts per million)
MS	matrix spike

MSD	matrix spike duplicate
ng/L	nanograms per liter (parts per trillion)
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexane sulfonate
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
RSR	research summary report
SI	site inspection
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
STP	Sewage Treatment Plant
TGI	technical guidance instruction
TOC	total organic carbon
TNT	trinitrotoluene
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency

TABLES

Table 7-1 - Groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Former Joliet Army Ammunition Plant, Illinois

AOPI	Location	Sample/ Duplicate ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)		PFNA (ng/L)		PFHxS (ng/L)	
				OSD Tapwater Risk Screening Level	4		6		601		6		39	
				Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
--	Equip Blank	JOAAP-EB-1-032823	03/28/2023	N	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
		JOAAP-EB-2-032823	03/28/2023	N	3.8	U	3.8	U	3.8	U	3.8	U	3.8	U
		JOAAP-EB-3-032823	03/28/2023	N	3.9	U	3.9	U	3.9	U	3.9	U	3.9	U
		JOAAP-EB-4-032823	03/28/2023	N	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
		JOAAP-EB-5-032823	03/28/2023	N	3.5	U	3.5	U	3.5	U	3.5	U	3.5	U
--	Field Blank	JOAAP-FB-1-032823	03/28/2023	N	3.7	U	3.7	U	3.7	U	3.7	U	3.7	U
Former Fire Training Area at L18	JOAAP-L18-1-GW	JOAAP-L18-1-GW-032923	03/29/2023	N	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)	JOAAP-L3-1-GW	JOAAP-L3-1-GW-032823	03/28/2023	N	3.5	U	3.5	U	3.5	U	3.5	U	3.5	U
	JOAAP-L3-2-GW	JOAAP-L3-2-GW-032823	03/28/2023	N	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
	JOAAP-L3-3-GW	JOAAP-L3-3-GW-032823	03/28/2023	N	3.6	U	3.6	U	3.6	U	3.6	U	3.6	U
Fire Station at L32 (Building 60-7)	JOAAP-L32-1-GW	JOAAP-L32-1-GW-032823	03/28/2023	N	4.1	U	4.1	U	4.1	U	4.1	U	4.1	U
		JOAAP-FD-1-GW-032823	03/28/2023	FD	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U

Table 7-1 - Groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Former Joliet Army Ammunition Plant, Illinois

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Gray shaded values indicate the result was detected greater than the 2022 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).

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

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

Table 7-2 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Former Joliet Army Ammunition Plant, Illinois

AOPI	Location	Sample ID / Duplicate ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)		PFNA (mg/kg)		PFHxS (mg/kg)	
				OSD Industrial/Commercial Risk Screening Level	0.16		0.25		25		0.25		1.6	
				OSD Residential Risk Screening Level	0.013		0.019		1.9		0.019		0.13	
				Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Former Fire Training Area at L18	JOAAP-L18-1-SO	JOAAP-L18-1-SO-032923	03/29/2023	N	0.0014	U	0.0014	U	0.0014	U	0.0014	U	0.0014	U
	JOAAP-L18-2-SO	JOAAP-L18-2-SO-032923	03/29/2023	N	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
	JOAAP-L18-3-SO	JOAAP-L18-3-SO-032923	03/29/2023	N	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
	JOAAP-L18-4-SO	JOAAP-L18-4-SO-032923	03/29/2023	N	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)	JOAAP-L3-1-SO	JOAAP-L3-1-SO-032823	03/28/2023	N	0.0012	U	0.0012	U	0.0012	U	0.0012	U	0.0012	U
		JOAAP-FD-1-SO-032823	03/28/2023	FD	0.0012	U	0.0012	U	0.0012	U	0.0012	U	0.0012	U
	JOAAP-L3-2-SO	JOAAP-L3-2-SO-032823	03/28/2023	N	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Fire Station at L32 (Building 60-7)	JOAAP-L32-1-SO	JOAAP-L32-1-SO-032723	03/27/2023	N	0.001	U	0.001	U	0.001	U	0.001	U	0.001	U
	JOAAP-L32-2-SO	JOAAP-L32-2-SO-032723	03/27/2023	N	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
	JOAAP-L32-3-SO	JOAAP-L32-3-SO-032723	03/27/2023	N	0.0012	U	0.0012	U	0.0012	U	0.0012	U	0.0012	U
	JOAAP-L32-4-SO	JOAAP-L32-4-SO-032723	03/27/2023	N	0.0012	U	0.0012	U	0.0012	U	0.0012	U	0.0012	U

Table 7-2 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Former Joliet Army Ammunition Plant, Illinois

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for both the residential as well as the industrial/commercial scenarios (OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).
3. Gray shaded values indicate the result was detected greater than the residential scenario risk screening levels (OSD 2022).
4. Gray shaded and italicized values indicate the result was detected greater than the industrial/commercial scenario (i.e., and therefore greater than the residential scenario) risk screening levels (OSD 2022).

Acronyms/Abbreviations:
-- = not applicable
AOPI = area of potential interest
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier

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

FIGURES

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Joliet Army Ammunition Plant, IL

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Figure 2-1
Site Location

Legend

Former Installation Boundary

Data Sources:
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 16 North

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Joliet Army Ammunition Plant, IL

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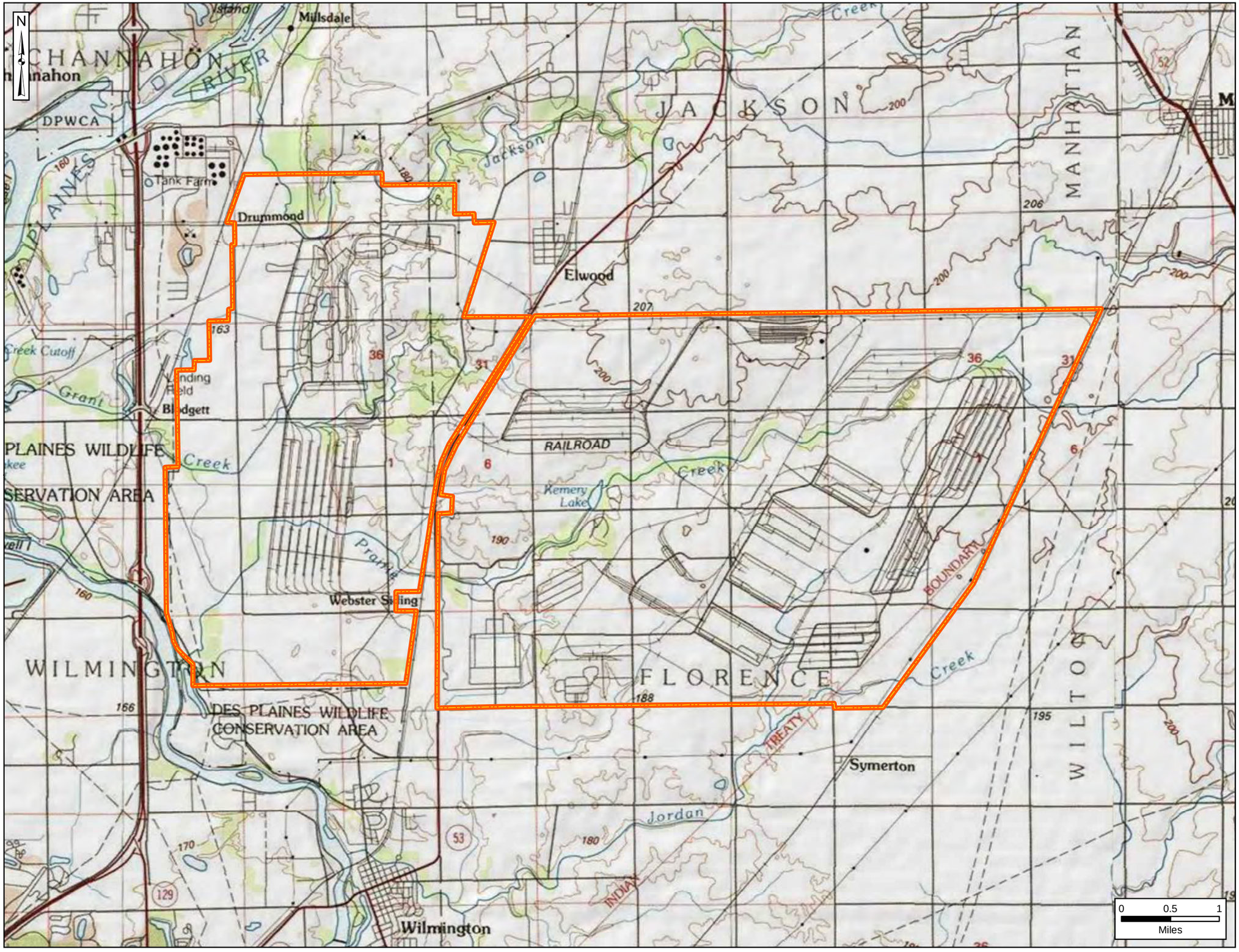
Figure 2-2
Site Layout

Legend

- Former Installation Boundary
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Regional Groundwater Flow Direction
- Potable Surface Water Intake

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North



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Joliet Army Ammunition Plant, IL

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Figure 2-3
Topographic Map

Legend

Former Installation Boundary

Note: Elevations shown are in feet.

Data Sources:
ESRI ArcGIS Online, USA Topo Map

Coordinate System:
WGS 1984, UTM Zone 16 North

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Joliet Army Ammunition Plant, IL

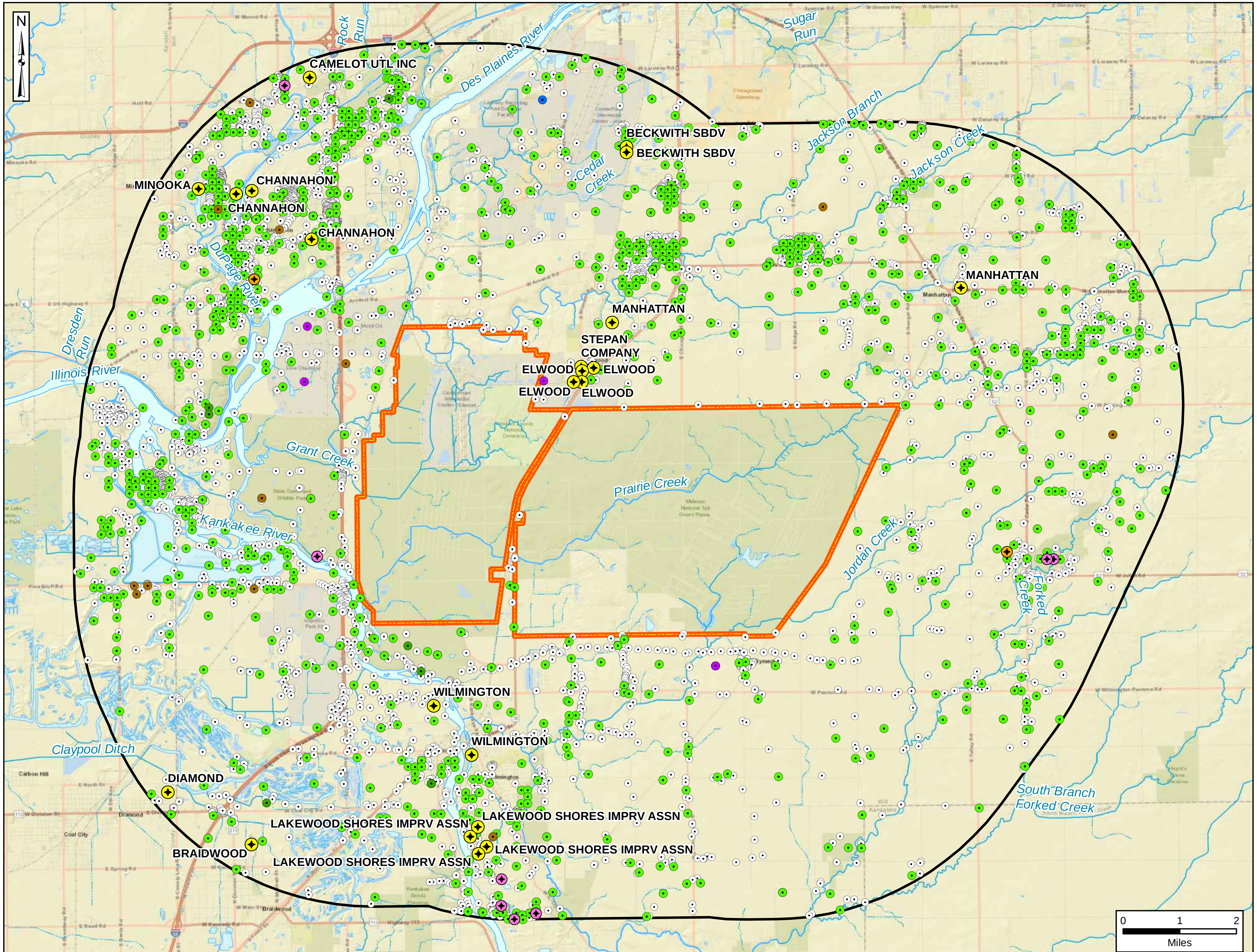

Figure 2-4
Off-Post Potable Supply Wells

Legend

- Former Installation Boundary
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Public Water Supply System Well
- Community Supply
- Municipal
- Non-Community
- Domestic
- Irrigation
- Park
- School
- Not Reported / Unknown

Data Sources:
EDR, Well Data, 2021
USGS, NHD Data, 2021
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 16 North

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Figure 5-2
AOPI Locations

Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)

Former Fire Training Area at L18

Fire Station at L32 (Building 60-7)

Legend

- Former Installation Boundary
- AOPI
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Regional Groundwater Flow Direction
- Potable Surface Water Intake

AOPI = area of potential interest

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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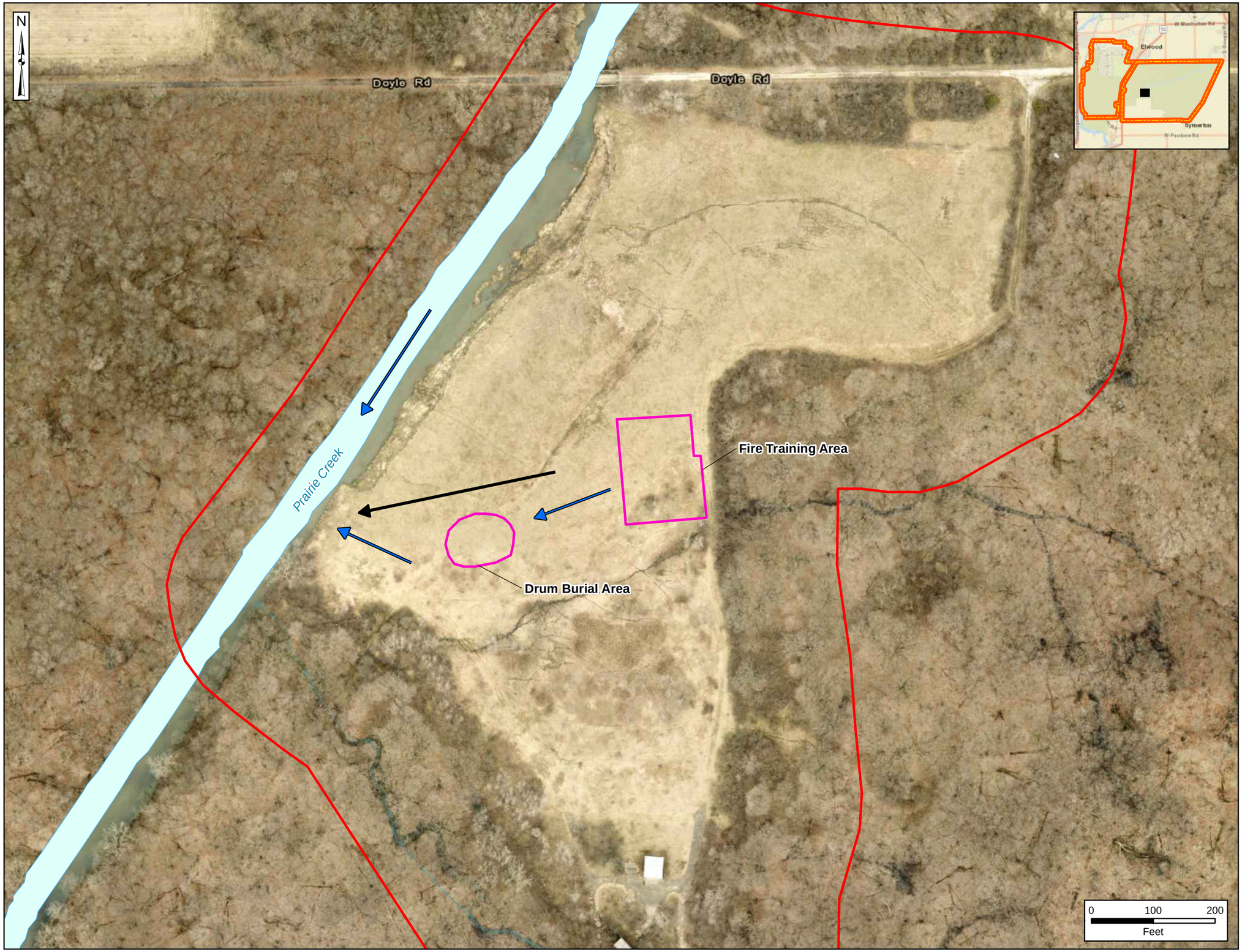
Figure 5-3
Aerial Photo of Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01)



Legend

- Former Installation Boundary
- MRS Boundary
- AOPI
- Water Body
- Surface Water Flow Direction
- Local Groundwater Flow Direction

AOPI = area of potential interest
MRS = munitions response site

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

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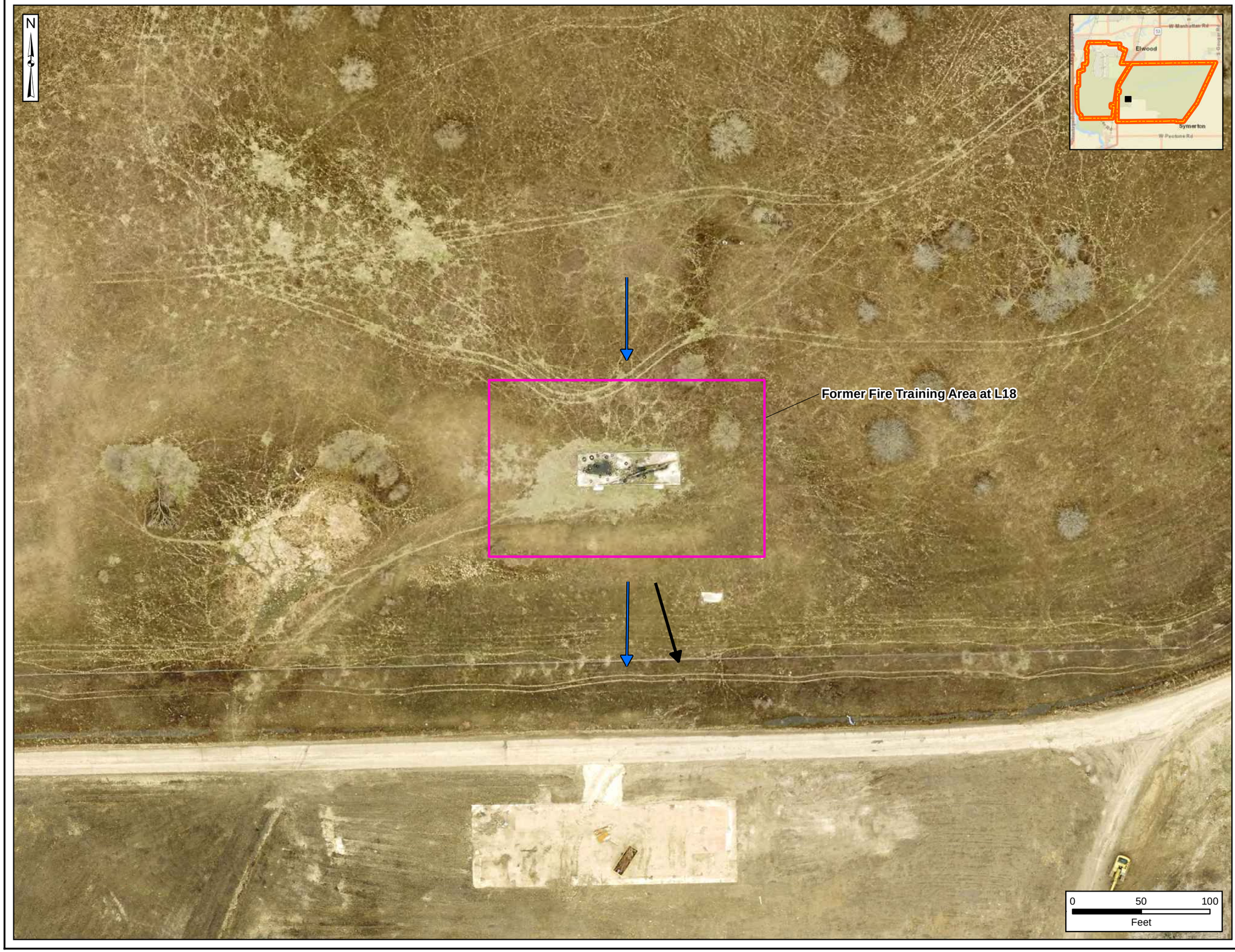

Figure 5-4
Aerial Photo of Former Fire Training Area at L18

Legend

- Former Installation Boundary
- AOPI
- Surface Water Flow Direction
- Local Groundwater Flow Direction

AOPI = area of potential interest

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

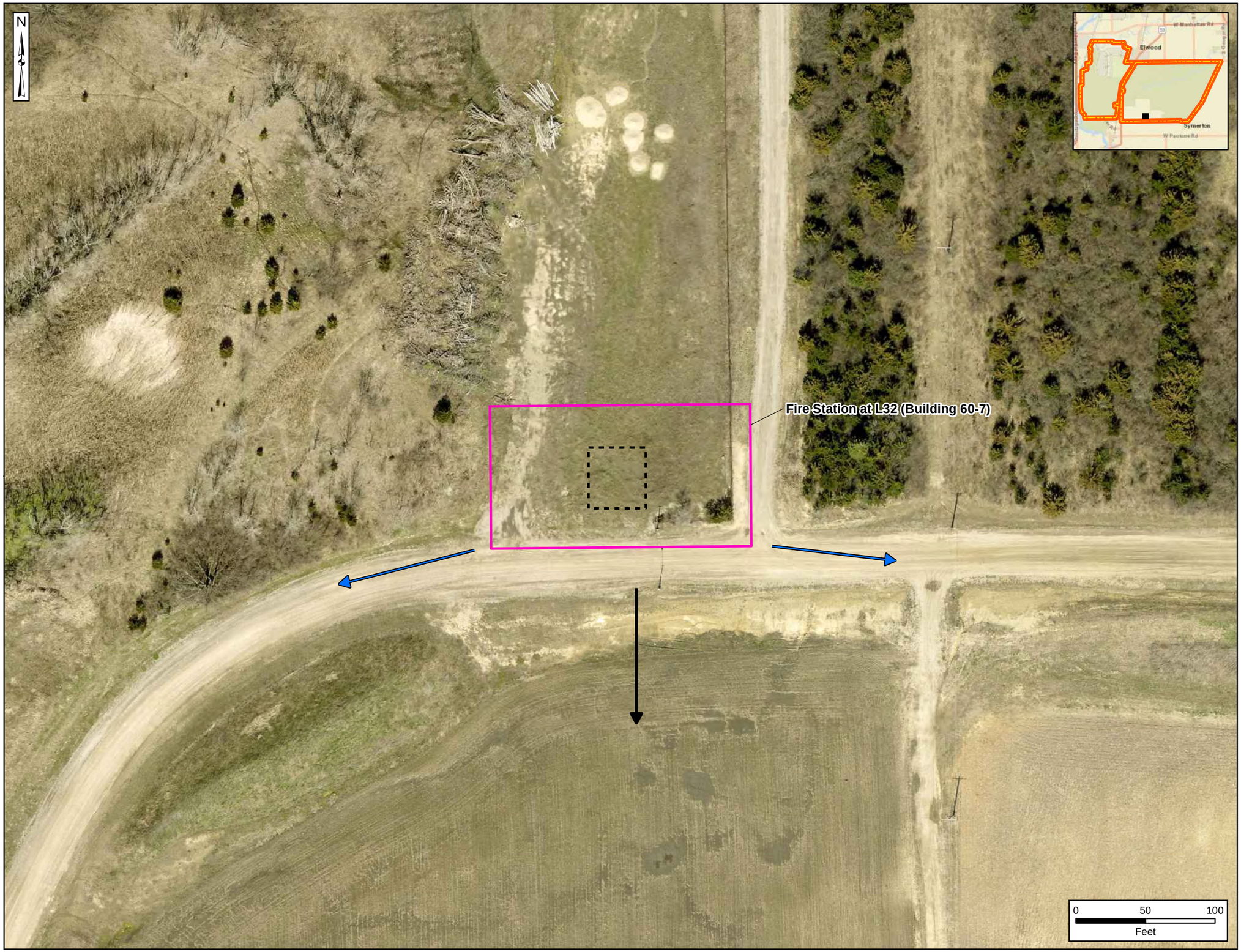

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Figure 5-5
Aerial Photo of
Fire Station at L32
(Building 60-7)

Legend

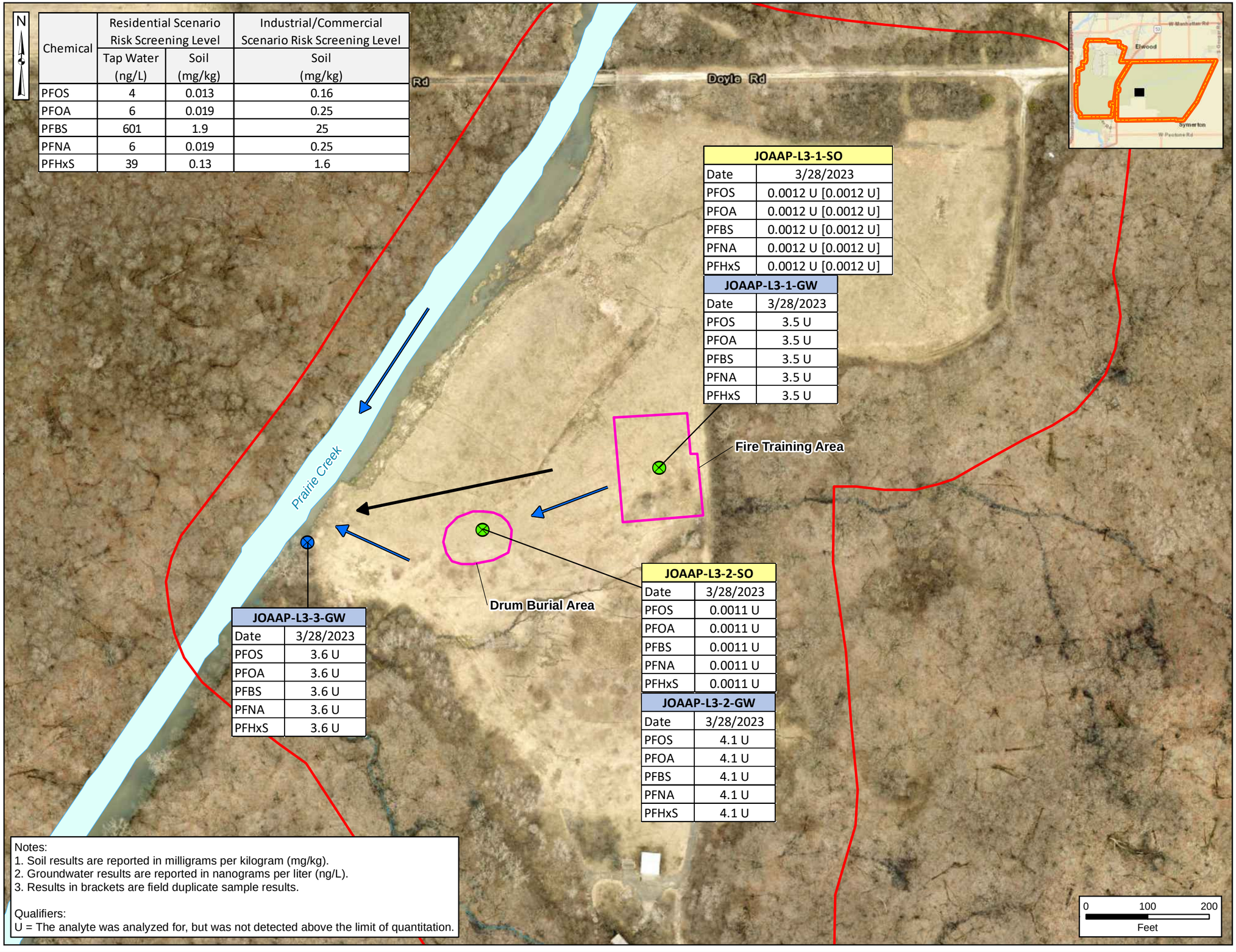
- Former Installation Boundary
- AOPI
- Former Building Footprint
- Surface Water Flow Direction
- Local Groundwater Flow Direction

AOPI = area of potential interest

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

Chemical	Residential Scenario Risk Screening Level		Industrial/Commercial Scenario Risk Screening Level
	Tap Water (ng/L)	Soil (mg/kg)	Soil (mg/kg)
PFOS	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6



JOAAP-L3-1-SO	
Date	3/28/2023
PFOS	0.0012 U [0.0012 U]
PFOA	0.0012 U [0.0012 U]
PFBS	0.0012 U [0.0012 U]
PFNA	0.0012 U [0.0012 U]
PFHxS	0.0012 U [0.0012 U]

JOAAP-L3-1-GW	
Date	3/28/2023
PFOS	3.5 U
PFOA	3.5 U
PFBS	3.5 U
PFNA	3.5 U
PFHxS	3.5 U

JOAAP-L3-2-SO	
Date	3/28/2023
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U
PFNA	0.0011 U
PFHxS	0.0011 U

JOAAP-L3-2-GW	
Date	3/28/2023
PFOS	4.1 U
PFOA	4.1 U
PFBS	4.1 U
PFNA	4.1 U
PFHxS	4.1 U

JOAAP-L3-3-GW	
Date	3/28/2023
PFOS	3.6 U
PFOA	3.6 U
PFBS	3.6 U
PFNA	3.6 U
PFHxS	3.6 U

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Groundwater results are reported in nanograms per liter (ng/L).
3. Results in brackets are field duplicate sample results.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation.

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Figure 7-1
Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Legend

- Former Installation Boundary
- MRS Boundary
- AOPI
- Water Body
- Surface Water Flow Direction
- Local Groundwater Flow Direction

Sampling Locations

- Groundwater (Temporary Well)
- Groundwater/Shallow Soil (Temporary Well)

AOPI = area of potential interest
GW = groundwater
MRS = munitions response site
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

Chemical	Residential Scenario Risk Screening Level		Industrial/Commercial Scenario Risk Screening Level
	Tap Water (ng/L)	Soil (mg/kg)	Soil (mg/kg)
PFOS	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6

JOAAP-L18-2-SO	
Date	3/29/2023
PFOS	0.0011 U
PFOA	0.0011 U
PFBS	0.0011 U
PFNA	0.0011 U
PFHxS	0.0011 U

JOAAP-L18-1-SO	
Date	3/29/2023
PFOS	0.0014 U
PFOA	0.0014 U
PFBS	0.0014 U
PFNA	0.0014 U
PFHxS	0.0014 U

Former Fire Training Area at L18

JOAAP-L18-3-SO	
Date	3/29/2023
PFOS	0.0013 U
PFOA	0.0013 U
PFBS	0.0013 U
PFNA	0.0013 U
PFHxS	0.0013 U

JOAAP-L18-4-SO	
Date	3/29/2023
PFOS	0.0013 U
PFOA	0.0013 U
PFBS	0.0013 U
PFNA	0.0013 U
PFHxS	0.0013 U

JOAAP-L18-1-GW	
Date	3/29/2023
PFOS	3.6 U
PFOA	3.6 U
PFBS	3.6 U
PFNA	3.6 U
PFHxS	3.6 U

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Groundwater results are reported in nanograms per liter (ng/L).

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation.

0 50 100
Feet

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Figure 7-2
Former Fire Training Area at L18 PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Legend

- Former Installation Boundary
- AOPI
- Surface Water Flow Direction
- Local Groundwater Flow Direction

Sampling Locations

- Groundwater/Shallow Soil (Temporary Well)
- Shallow Soil

AOPI = area of potential interest
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North

Chemical	Residential Scenario Risk Screening Level		Industrial/Commercial Scenario Risk Screening Level
	Tap Water (ng/L)	Soil (mg/kg)	Soil (mg/kg)
PFOS	4	0.013	0.16
PFOA	6	0.019	0.25
PFBS	601	1.9	25
PFNA	6	0.019	0.25
PFHxS	39	0.13	1.6

JOAAP-L32-1-SO	
Date	3/29/2023
PFOS	0.0010 U
PFOA	0.0010 U
PFBS	0.0010 U
PFNA	0.0010 U
PFHxS	0.0010 U

JOAAP-L32-1-GW	
Date	3/28/2023
PFOS	4.1 U [4.0 U]
PFOA	4.1 U [4.0 U]
PFBS	4.1 U [4.0 U]
PFNA	4.1 U [4.0 U]
PFHxS	4.1 U [4.0 U]

JOAAP-L32-2-SO	
Date	3/29/2023
PFOS	0.0013 U
PFOA	0.0013 U
PFBS	0.0013 U
PFNA	0.0013 U
PFHxS	0.0013 U

JOAAP-L32-3-SO	
Date	3/29/2023
PFOS	0.0012 U
PFOA	0.0012 U
PFBS	0.0012 U
PFNA	0.0012 U
PFHxS	0.0012 U

JOAAP-L32-4-SO	
Date	3/29/2023
PFOS	0.0012 U
PFOA	0.0012 U
PFBS	0.0012 U
PFNA	0.0012 U
PFHxS	0.0012 U

Fire Station at L32 (Building 60-7)

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Groundwater results are reported in nanograms per liter (ng/L).
3. Results in brackets are field duplicate sample results.

Qualifiers:
U = The analyte was analyzed for, but was not detected above the limit of quantitation.

0 50 100
Feet

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Figure 7-3
Fire Station at L32 (Building 60-7) PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Legend

- Former Installation Boundary
- AOPI
- Former Building Footprint
- Surface Water Flow Direction
- Local Groundwater Flow Direction

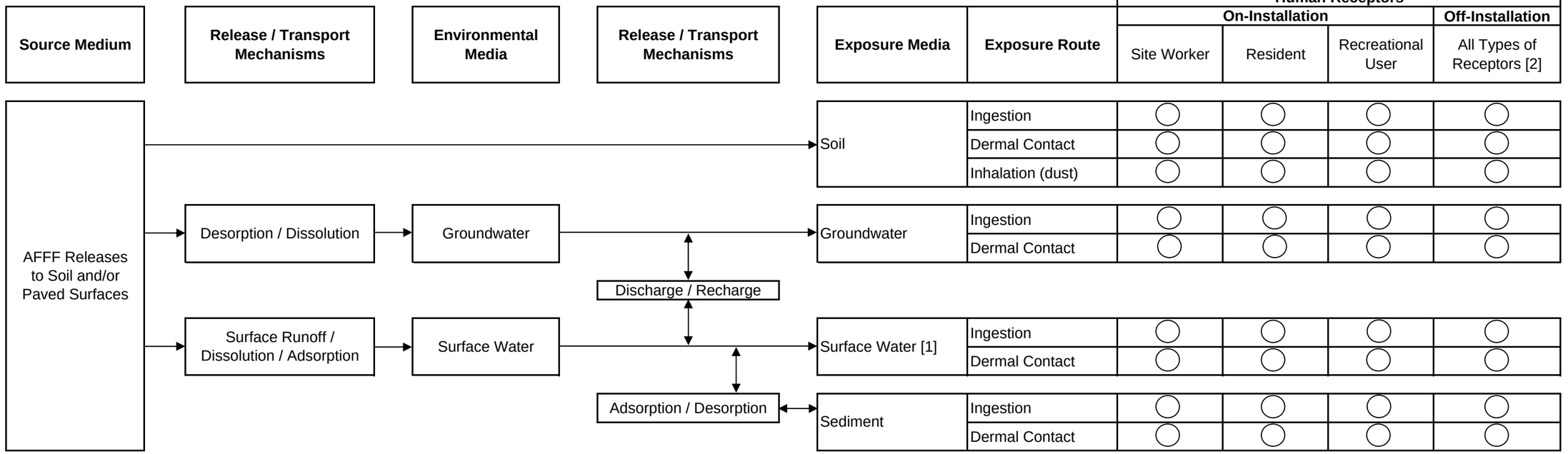
Sampling Locations

- Groundwater/Shallow Soil (Temporary Well)
- Shallow Soil

AOPI = area of potential interest
GW = groundwater
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SO = soil

Data Sources:
USGS, NHD Data, 2021
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 16 North



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF = aqueous film-forming foam
AOPI = area of potential interest

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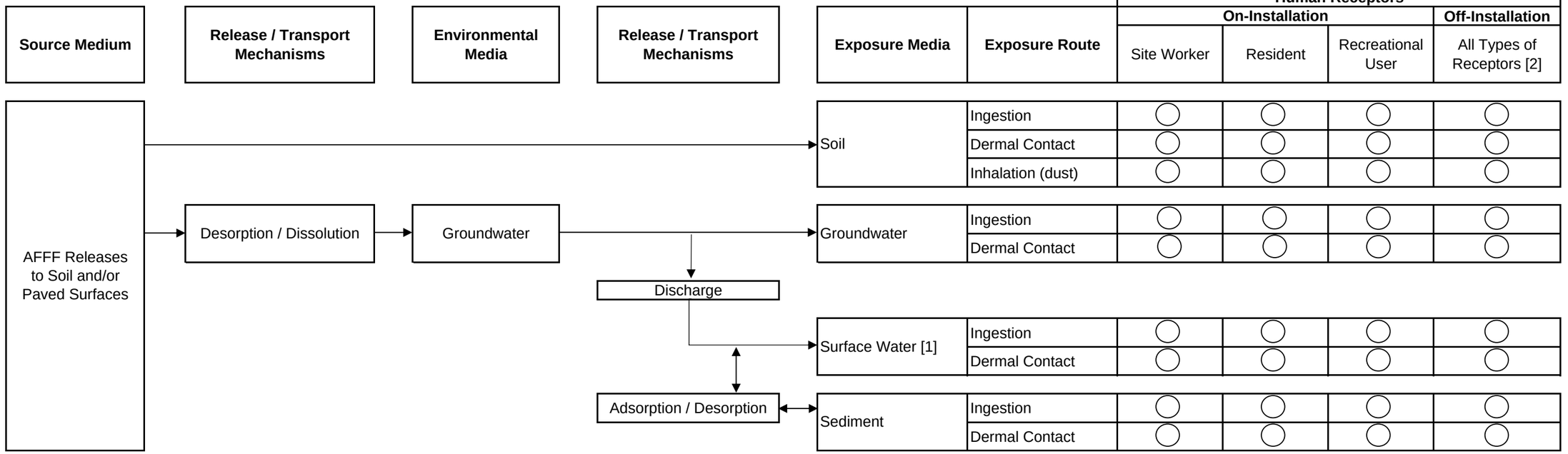
Conceptual Site Model - Fire Training Area and Drum Burial Area at L3 (JAAP-001-R-01) and Former Fire Training Area at L18 AOPIs
USAEC PFAS Preliminary Assessment / Site Inspection
Joliet Army Ammunition Plant, Illinois

Figure 7-4



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF = aqueous film-forming foam
AOPI = area of potential interest

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Conceptual Site Model - Fire Station at L32 (Building 60-7) AOPI
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Figure 7-5

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