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

Tobyhanna Army Depot, Pennsylvania

Prepared For:
U.S. Army Corps of Engineers, Baltimore District
2 Hopkins Plaza
Baltimore, Maryland 21201

September 2022

Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

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Prepared for:

U.S. Army Corps of Engineers

Contract No.: W912DR-18-D-0004

Delivery Order No.: W912DR1818F0685

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September 2022

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EXECUTIVE SUMMARY

The United States Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations 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 Tobyhanna Army Depot (TYAD) 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 policy and guidance.

TYAD is located within Coolbaugh Township, Monroe County, in northeastern Pennsylvania, approximately 75 miles west of New York City and approximately 25 miles southeast of Scranton, Pennsylvania. TYAD is surrounded by the Village of Tobyhanna to the south, Interstate 380 to the west, Gouldsboro State Park to the northwest, Tobyhanna State Park to the north, and State Game Lands 127 to the east. TYAD encompasses approximately 1,300 acres. More than half of TYAD, the northern portion, remains predominantly undeveloped wooded rolling hills and protected wetland areas. Within the installation, there is an unexploded ordnance area (i.e., Former Artillery Range A), two streams, a 5.7-acre lake (Barney's Lake), and 159-acre wetland habitat areas. Approximately 400 acres of the installation are improved grounds consisting of a variety of land uses (e.g., industrial complex, community area, housing areas).

The TYAD PA identified seven AOPIs for investigation during the SI phase. SI sampling results from the seven AOPIs were compared to risk-based screening levels calculated by the Office of the Secretary of Defense (OSD) for PFOS, PFOA, and PFBS. PFOS, PFOA, and/or PFBS were detected in soil, groundwater, surface water, and/or sediment at all seven AOPIs; and five of the seven AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The TYAD PA/SI identified the need for further study in a CERCLA remedial investigation. **Table ES-1** below summarizes the PA/SI sampling results and provides recommendations for further study in a remedial investigation or no action at this time at each AOPI.

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

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/NA/NS)				Recommendation
	GW	SO	SW	SE	
Historical Fire Training Area – Burn Pit	Yes	No	NA	NA	Further study in a remedial investigation.
Building 17 – Fire Station	Yes	No	NS	NS	Further study in a remedial investigation.
Building 1A/1BB1 Former Chromium Plating and Industrial Wastewater Pre-treatment Plant	Yes	NS	NS	NS	Further study in a remedial investigation.
Temporary Dewatered Sludge Storage Site	No	No	NA	NA	No action at this time.
Operable Unit (OU)-5 Inactive Sanitary Landfill	Yes	No	NS	NS	Further study in a remedial investigation.
OU-1 Area B Former Drum Storage Area	No	NS	NS	NS	No action at this time.
Building 74 – Aqueous film-forming foam Storage	Yes	No	NS	NS	Further study in a remedial investigation.

Notes:
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
NA – the OSD risk screening level is not applicable to the media sampled.
NS – not sampled
SE – sediment
SO – soil
SW – surface water

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12580 and is conducting the PA/SI consistent with its authority under CERCLA, 42 United States Code §§ 9600, et seq. (as amended), and the Defense Environmental Restoration Program, 10 United States Code §§ 2701, et seq. The PFAS PA/SI included two distinct efforts. The PA identified locations that are areas of potential interest (AOPIs) at Tobyhanna Army Depot (TYAD) based on the use, storage and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the PFOS, PFOA, and PFBS results were compared to the Office of the Secretary of Defense (OSD) PFOS, PFOA, and PFBS risk screening levels to determine whether further investigation is warranted. This report provides the PA/SI for TYAD and was completed in accordance with CERCLA and The National Oil and Hazardous Substances Pollution Contingency Plan.

1.1 Project Background

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

In 2016, the United States Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016). On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water or soil, calculated using the USEPA's Regional Screening Level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 08 April 2021, USEPA published an updated toxicity assessment for PFBS (USEPA 2021). Based on the updated toxicity assessment for PFBS, the OSD issued a memorandum on 15 September 2021 to include updated PFBS risk screening levels. The September 2021 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. The OSD risk screening levels for tap water (also used to evaluate groundwater or surface water used as drinking water sources) are 40 ng/L for PFOS and PFOA, and 600 ng/L for PFBS. The PFOS and PFOA soil screening levels for the residential and industrial/commercial scenarios are 0.13 milligrams per kilogram (mg/kg) (residential) and 1.6 mg/kg (industrial/commercial). The soil

screening levels for PFBS are 1.9 mg/kg (residential) and 25 mg/kg (industrial/commercial). These screening criteria are discussed further in **Section 6.5**

1.2 PA/SI Objectives

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

1.2.1 PA Objectives

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

1.2.2 SI Objectives

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

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

1.3 PA/SI Process Description

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

1.3.1 Pre-Site Visit

An installation kickoff teleconference was held between applicable points of contact (POCs) from United States Army Environmental Command (USAEC), United States Army Corps of Engineers (USACE), TYAD, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 01 June 2019 to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

Records review was conducted before the site visit to obtain electronically available documents from the installation and external sources for review. The purpose of the records review was to identify any area on the installation that may have been a location where PFAS-containing materials were used, stored, and/or disposed, as well as to gather information on the physical setting and site history at TYAD.

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

- The Army Materiel Command (AMC) operation order
- The Army PA Operations Security requirements package, which includes the antiterrorism/operations security review cover sheet (**Appendix C**)
- The PFAS PA kickoff call minutes
- An information paper on the PA portion of the Army's PFAS PA/SI
- Contact information for key POCs
- A list of the data sources requested and reviewed
- A list of preliminary locations identified during the kickoff call and pre-site visit records review to be evaluated for use, storage, and/or disposal of PFAS-containing materials, where additional information on those areas will be collected through personnel interviews, additional document review, and site reconnaissance.
- A list of roles for the installation POC to consider when recommending potential interviewees.

1.3.2 Preliminary Assessment Site Visit

The site visit was conducted on 19 to 20 August 2019. An in-brief meeting was held to provide installation staff with the objectives of the site visit and team introductions.

Personnel interviews were conducted with individuals having significant historical knowledge at TYAD. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, corroborating other interviewees' information. **Section 3** includes information regarding personnel interviewed.

Site reconnaissance included visual surveys that assessed the points of potential use, storage, and/or disposal of PFAS-containing materials, as well as potential secondary impacts, and the migration potential from each AOPI (e.g., stormwater drains, building drains and sumps, cracks in the floor/pavement). Physical attributes of the preliminary locations were documented, including local slope and ground and floor conditions (i.e., paved, unpaved, visual staining), surface water bodies and surface flow, potential receptors, and the distance to the installation boundary. Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for SI sampling. Photo documentation of the preliminary locations was collected, and access limitations or advantages related to potential future sampling activities were noted.

An exit briefing was offered to installation personnel at the conclusion of the site visit to raise any items identified during the site visit, discuss any follow-up items, and review the schedule for submitting deliverables. The exit briefing was conducted on 20 August 2019 with the installation, USAEC, and USACE to discuss preliminary findings of the PA site visit.

1.3.3 Post-Site Visit

Information collected before, during, and after the site visit was reviewed and corroborated by cross-referencing records and reviewing interview details and observations noted during site visit reconnaissance. A site visit trip report was completed and provided to the installation POC, applicable USAEC POCs, and USACE regional POCs following the site visit. The information collected during the pre-site visit and site visit activities was compiled to develop the installation-specific PA portion of the PA/SI report (**Section 3**). Site data obtained during the PA were used to develop preliminary conceptual site models (CSMs) for each AOPI, which serve as the basis for developing the SI scope of work presented in an installation-specific Quality Assurance Project Plan (QAPP) Addendum.

1.3.4 Site Inspection Planning and Field Work

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

The objectives of the SI kickoff teleconference were to:

- discuss the AOPIs selected for sampling
- gauge regulatory involvement (USEPA and Pennsylvania Department of Environmental Protection [PADEP]) requirements or preferences
- identify overlapping unexploded ordnance (UXO) areas
- identify specific installation access requirements and potential schedule conflicts
- discuss general SI deliverable and field work schedule information and logistics

Following development of the SI sampling technical approach, an SI scoping teleconference was held between USAEC, USACE, TYAD, USEPA, and PADEP. The objectives of the SI Scoping teleconference were to:

- discuss and obtain concurrence on the SI sampling plan for each AOPI from call attendees
- confirm the plan for investigation-derived waste (IDW) handling and disposal
- provide an updated SI deliverable and field work schedule.

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) was developed and finalized in October 2019 for the USAEC PFAS PA/SI (Arcadis 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 (herein referred to as 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 QAPP Addendum (Arcadis 2020a). A Site Safety and Health Plan (SSHP) was also developed as an attachment to the QAPP Addendum to identify specific health and safety hazards that may be encountered at the installation during sampling. The SSHP was designed to supplement the Accident Prevention Plan

(Arcadis 2018), which was developed for Army installations nationwide. The QAPP Addendum and SSHP were submitted to the installation and finalized before commencement of field work.

The DQOs, sampling design and rationale, and field methods employed for the SI are summarized from the QAPP Addendum developed for TYAD (Arcadis 2020a) in **Sections 6.1** through **6.3**.

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

1.3.5 Data Analysis, Validation, and Reporting

Environmental samples collected during the SI were submitted to a laboratory which is DoD Environmental Laboratory Accreditation Program (ELAP)-accredited for PFOS, PFOA, and PFBS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.1.1 Table B-15 (DoD 2018). Laboratory analytical results were then validated and verified by a project chemist to assess the usability of the data collected. Validated analytical results were summarized in the context of OSD risk screening levels (defined in **Section 6.5**).

2 INSTALLATION OVERVIEW

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

2.1 Site Location

TYAD is located within Coolbaugh Township, Monroe County, in northeastern Pennsylvania, approximately 75 miles west of New York City and approximately 25 miles southeast of Scranton, Pennsylvania (**Figure 2-1**). TYAD is surrounded by the Village of Tobyhanna to the south, Interstate 380 to the west, Gouldsboro State Park to the northwest, Tobyhanna State Park to the north, and State Game lands 127 to the east (**Figure 2-2**) (Biohabitats, Inc. 2013).

2.2 Mission and Brief Site History

In 1913, the Tobyhanna Military Reservation was first established and used by Army and National Guard troops as a field artillery training site. Through World War II, the reservation was primarily used as a field artillery training site and had a variety of other uses throughout this time such as tank and ambulance training center, processing center and encampment for the Civilian Conservation Corps, anti-aircraft training, storage of gliders, and as a camp for prisoners of war (Biohabitats, Inc. 2013). In 1951, the Army acquired 1,420 acres of the former Tobyhanna Military Reservation, which later became TYAD.

The communications-electronics production facility was formally dedicated to TYAD and became a large part of the TYAD mission. TYAD has provided a range of support and supplies to U.S. military operations and has received workload from numerous military installations. Current industrial operations at TYAD include painting, plating, blasting, and equipment cleaning (Biohabitats, Inc. 2013). As of 2016, TYAD was the DoD's largest facility for the overhaul, repair, fabrication and systems integration of command, control, communications, computers, intelligence, surveillance, and reconnaissance systems. Radios, radars, satellite communications, airborne surveillance and navigation, aircraft survivability equipment, and tactical missile guidance and control systems are among the supported systems at TYAD. Additionally, TYAD operates forward repair activities at installations and in support of deployed forces (USAEC 2016).

2.3 Current and Projected Land Use

TYAD encompasses approximately 1,300 acres and employs a workforce of approximately 3,800 personnel. More than half of TYAD's property, the northern portion, remains predominantly undeveloped wooded rolling hills and protected wetland areas. Within the installation is a large UXO area (i.e., Former Artillery Range A), two streams, a 5.7-acre lake (Barney's Lake), and 159-acres of wetland habitat areas (**Figure 2-2**). Approximately 400 acres of the installation are improved grounds consisting of a variety of land uses (e.g., industrial complex, community area, housing areas) (Biohabitats, Inc. 2013).

Current land use on TYAD is divided broadly into two functional areas: The Industrial Area and the Community Area. The Community Area comprises the southeast portion of TYAD, east of Hap Arnold Boulevard. The Industrial Area is situated west of Hap Arnold Boulevard and comprises the majority of TYAD and is subdivided into three areas in support of the following functions: 1) testing, 2) storage and supply, and 3) maintenance and production. Barney's Lake and surrounding forest area buffer the Community Area from the Industrial Area. Recreational facilities include outdoor athletic and entertainment facilities (e.g., playgrounds, baseball fields, picnic areas, tennis courts) (Biohabitats, Inc. 2013).

There are no anticipated major land use changes at TYAD. Within the Industrial Area, future development plans include consolidating and co-locating industrial facilities to improve functionality and to provide expansion capability. In the Community Area future development plans include improving existing facilities and services utilized by the community members (Biohabitats, Inc. 2013).

2.4 Climate

TYAD is located in the Pocono Mountain Region, therefore the climate includes variability typical of relatively high elevation areas. Due to its higher position along the plateau, temperatures at the site are cooler than lower nearby areas (Biohabitats, Inc. 2013). Average monthly temperatures range from the low 20s degrees Fahrenheit in January to the upper 60s degrees Fahrenheit in July. Cumulative snowfall can reach 50 to 60 inches during an average winter. The installation experiences long, cold winters and mild summers, typical of this region. The local monthly and yearly precipitation averages are 4.1 inches and approximately 49.5 inches, respectively. The greatest amount of rainfall occurs during the months of May, June, and September (U.S. Climate Data 2021).

2.5 Topography

TYAD lies in the Pocono Mountains on the Allegheny Plateau west of the Appalachian Ridge. Within TYAD, relief is most pronounced in the northwestern half of the site, where Powder Smoke Ridge trends across the site. At the southwest base of the ridgeline in a bowl-like depression is Oakes Swamp. The southeastern portion of the site includes TYAD buildings and Barney's Lake to the far south. Overall, elevations range from 2,141 feet on Powder Smoke Ridge near Border Drive down to 1,925 feet near Hummler Run south of Barney's Lake (**Figure 2-3**) (Biohabitats, Inc. 2013).

2.6 Geology

The geology of TYAD consists of glacial deposits overlying sedimentary bedrock. Overburden thickness typically ranges from 5 to 75 feet with an average thickness of 35 feet (EA Engineering, Science, and Technology, Inc., PBC [EA] 2018). The shallow, geologic materials present at TYAD include materials derived from continental glaciation (i.e., differentially scoured bedrock or deposited glacial material). Various deposits of Pleistocene age have been identified throughout TYAD, such as Boulder field material (i.e., poorly sorted boulders up to a meter in diameter), end moraine material (comprised of materials ranging from till to ice-contact stratified drift materials), and ground moraines (i.e., unsorted mixture of clay, silt, sand, and gravel). Holocene age peat occurs in level, undrained, or poorly drained

swampy areas in natural lowland depressions. Soils covering much of the southeastern portion of TYAD consist primarily of cut and fill materials (Environmental Science and Engineering, Inc. 1988).

The bedrock underlying TYAD is sedimentary rock of the Upper Devonian Catskill Formation. The rocks within the Upper Devonian Catskill Formation are gently folded with the axis of the folds striking to the northeast (Weston Solutions, Inc. 2003). The formation includes two members underlying parts of TYAD: the Duncannon and Poplar Gap (Biohabitats, Inc. 2013). The Duncannon Member, present in the northern portion of TYAD, mostly consists of red and gray sandstones with incidental conglomerate occurring at the base of some fining-upward depositional cycles (USGS n.d.). The Poplar Gap Member, present beneath Oakes Swamp and the developed portions of TYAD, consists of fine to medium grained gray sandstones well-indurated to quartzite, with some beds of siltstone or shale (Environmental Science and Engineering, Inc. 1988). The Duncannon Member is stratigraphically above the Poplar Gap Member (Lehigh Earth Observatory 2005).

2.7 Hydrogeology

Groundwater at TYAD occurs both in overburden and bedrock. Overburden groundwater is intermittently present at the base of moraine deposits, in saturated sand and gravel deposits, and in perched zones close to the land surface (5 to 10 feet below ground surface [bgs]) where unconsolidated fill overlies native soil. These isolated zones may or may not be interconnected horizontally. Glacial till deposits at TYAD are relatively impermeable and do not rapidly transmit flow either horizontally or vertically. Due to the intermittent presence, low yields, and low permeability, water in the glacial overburden deposits is not used as a source of potable water (EA 2018). Shallow groundwater at TYAD (i.e., overburden groundwater within glacial till deposits) southeast of the industrial area of TYAD is encountered at an average depth of 10 feet bgs. Shallow groundwater west of the industrial area is encountered at an average depth of 15 feet bgs (Environmental Resources Management 1997).

The sandstone Catskill Formation forms the bedrock aquifer underlying TYAD. Groundwater flow in the sandstone is controlled by fractures (e.g., bedding planes and joints). The bedrock aquifer serves as the major source of the potable water supply for the depot and surrounding area. The depth to groundwater in the bedrock averages approximately 50 feet (Weston Solutions, Inc. 2012). Based on previous groundwater investigations in the industrial portion of TYAD, groundwater flow in the bedrock aquifer is from north to south-southeast (EA 2018). Groundwater flow north of the industrial portion of TYAD has not been investigated, therefore groundwater flow is inferred from topographic relief. Shallow groundwater is estimated to flow to the north-northwest towards Oakes Swamp. However, due to the lack of groundwater investigation in this area, shallow and bedrock groundwater may flow to the south, consistent with general groundwater flow at TYAD.

Groundwater throughout the region generally occurs under unconfined conditions with the groundwater surface being a subdued reflection of the surface topography (Weston Solutions, Inc. 2003).

2.8 Surface Water Hydrology

TYAD lies in a divide between two watersheds: Tobyhanna Creek in the southern and eastern portion and Gouldsboro Lake in the northern portion. Both watersheds are part of the headwaters of the Lehigh River Drainage. The Lehigh River is located approximately 2.8 miles north of the TYAD northern boundary.

There are four drainages within TYAD, all of which are tributaries of the upper Lehigh River Drainage. The streams include the headwaters of Hummler Run, Cross Keys Run, an unnamed stream which flows into Gouldsboro Lake, and the upper reaches of Tobyhanna Creek (Malcolm Pirnie, Inc. 2004).

Approximately 285 acres in the eastern portion of TYAD drain into Hummler Run (**Figure 2-2**). Approximately 580 acres in the northwestern portion of TYAD drain into Oakes Swamp. Tributaries of an unnamed creek originate in these northern wetlands and flow into Gouldsboro Lake, located approximately 1 mile north of the TYAD northern boundary. Most of this drainage is undeveloped and lies in the northern and northwestern portion of TYAD. Approximately 225 acres of TYAD drain into Tobyhanna Creek directly or through wetlands, Tobyhanna Lake, or Mill Pond #1. This area is in the eastern and northeastern sections of TYAD. Drainage from the western and/or southwestern portion of TYAD is conveyed to Cross Keys Run on the southwestern TYAD boundary (Malcolm Pirnie, Inc. 2004).

No through-flowing drainage ways exist on TYAD. Surface drainage originating within the installation boundaries flow principally into Cross Keys Run, Barney's Lake, and Hummler Run to the southwest, south, and southeast, respectively. Oakes Swamp receives drainage from the western and northern portions of the installation, and discharges to the north/northwest (Environmental Resources Management 1997). Surface water is not used as a potable water source at TYAD.

2.9 Relevant Utility Infrastructure

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

2.9.1 Stormwater Management System

Stormwater drainage from the TYAD property flows to several surrounding water bodies. Stormwater drainage flows over primarily impervious surfaces to catch basins where it enters the storm sewer system, ultimately discharging to Barney's Lake, Hummler Run, Cross Keys Run, Oakes Swamp, and to unnamed wetlands. In the southeastern portion of TYAD, drainage occurs primarily by overland flow in isolated storm sewers, and within roadside ditches, discharging to Tobyhanna Creek and Mill Pond #1. In the northern areas which are undeveloped, stormwater drainage flows by overland flow and within drainage ditches to Oakes Swamp, Tobyhanna Lake, and Gouldsboro Lake (Tobyhanna Army Depot 2006). Storm drains from the northwest section of the industrial area also drain into Oakes Swamp.

Currently, TYAD operates under National Pollutant Discharge Elimination System Permit No. PA-0010987. This permit covers a total of nine outfalls discharging to Oakes Swamp, Barney's Lake, Hummler Run, Cross Keys Run, and to an unnamed wetland. Three of these permitted outfalls (001, 101, and 002) are associated with specific industrial activities including the sewage treatment plant (STP), metal finishing operations, and coal pile, respectively. Six additional outfalls (SW-I through SW-VI) comprise the discharges associated with TYAD's individual stormwater permit. There are twelve other, unpermitted stormwater outfalls which do not receive drainage from any of the industrial activities evaluated (Tobyhanna Army Depot 2006).

2.9.2 Sewer System

Wastes generated at TYAD have historically and currently are treated at an on-post STP, located northwest of Barney's Lake. The current STP has been in operation since 1953 and had system upgrades in 2014.

Prior to 2014, the STP consisted of a group of buildings with a variety of functions (e.g., influent building, digester, sand filters and pump storage, air compressor building, sludge beds building). Other temporary features included the temporary dewatered sludge storage site (1980 to 1984) and the settlement pond/septic lagoon (1981 to 1983). Historically, STP sludges were disposed of within the Operable Unit (OU)-5 Inactive Sanitary Landfill until 1979 and were then disposed of off-post by a contractor. Effluent wastewater has historically and is currently discharged to a permitted outfall on Hummler Run on-post.

Following the system upgrades in 2014, the STP now consists of a group of buildings with a variety of functions (e.g., influent building, laboratory, an office and chemical storage, sludge press, primary and secondary clarifiers, overflow tank). Sludges are pressed every three to four months and then removed off-post by a contractor.

2.10 Potable Water Supply and Drinking Water Receptors

Potable water at TYAD is supplied by groundwater wells on-post. Currently, there are six active potable supply wells on-post (Wells 2, 6, 7, 8, 9, and 10) (**Figure 2-2**). Historically, TYAD utilized other on-post potable wells to supply drinking water (Wells 1, 3, 4, and 5); however, these wells are now decommissioned. Select potable wells at TYAD were sampled for PFOS, PFOA, and PFBS in 2016, 2020, and 2021 (**Section 2.12**).

All the existing potable supply wells are screened within the bedrock aquifer, the Poplar Gap Member of the Catskill Formation. The Poplar Gap Member of the Catskill Formation is the major source of potable water supply at TYAD and the surrounding regions. This aquifer produces large yields (up to 215 gallons per minute) from wells located on fracture traces. Considerable variation in well depth within the Catskill Formation is typical and is related to the thickness of the surficial cover, with an average depth to bedrock of 50 feet bgs.

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 TYAD, which along with the state water well database output (i.e., PADEP's Pennsylvania Groundwater Information System [PAGWIS]) and GIS provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-4**). However, TYAD personnel noted that most off-post potable wells located across the southern boundary of TYAD are not used for potable purposes, as the residences have been connected to the TYAD potable water supply system. There is one off-post potable well location, near the southwestern boundary of TYAD that is not connected to the TYAD potable water supply (**Figure 2-4**). Regional groundwater flow for the majority of TYAD is assumed to flow off-post to the south, although localized groundwater flow paths may differ. Regional groundwater flow for the northern portion of TYAD is suspected to flow to the north/northwest. The EDR report providing well search results provided as **Appendix E**.

As stated in **Section 2.8**, there are no potable-use surface water bodies at TYAD. Additionally, surface water bodies originating at TYAD which flow off-post do not have known potable uses. Lastly, off-post surface water bodies that may receive drainage from water bodies originating at TYAD were not identified to have potable uses.

2.11 Ecological Receptors

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

A variety of wildlife habitats exist at TYAD, including mesic Hardwood, Conifer forest, ruderal shrubland and grassland cover and wetland -aquatic vegetation. There are also non-native invasive species like common reed, multiflora rose, Japanese barberry, garlic mustard, oriental bittersweet, autumn olive and Himalayan blackberry. Beneficial resources at TYAD include the forest and wildlife corridor offered by the dense forests and wetland areas providing habitat for many of the 20 mammalian,16 amphibian and reptile, and 13 fish species known to occur at TYAD (Biohabitats, Inc. 2013).

Barney's Lake, located near the southern boundary of TYAD, is the primary fishing resource accessed by the public. There are fisheries and a total of 36 wetlands within TYAD. Wildlife habitat, especially large mammal habitat, is predominantly found in the northern portion of TYAD and is primarily a forested parcel interspersed with openings created by access roads, firebreaks and large wetland communities including Oakes Swamp. Forest communities on TYAD are located primarily in UXO areas to the north of TYAD. The forested and wetland areas serve as the primary habitat for flora and fauna; however, the industrial area does provide some habitat including nesting sites for neotropical migratory birds, other migratory birds, and some resident avian and small mammal species (Biohabitats, Inc. 2013).

2.12 Previous PFAS Investigations

Previous (i.e., pre-PA) PFAS investigations relative to TYAD, including both those conducted and not conducted by the Army, are summarized to provide full context of available PFAS data for TYAD. However, only data collected by the Army will be used to make recommendations for further investigation.

2.12.1 Potable Water Data

The USEPA conducted the third Unregulated Contaminant Monitoring Rule (UCMR3) monitoring between 2013 and 2015. UCMR3 is a national program that collects data for contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act. The laboratory which analyzed samples under UCMR3 met the USEPA's UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1. The UCMR3 published in 2012 included the analysis of PFOS, PFOA, and PFBS in public water systems serving more than 10,000 people between 2013 and 2015. Of those public water systems sampled during UCMR3 and within a 5-mile radius of TYAD, none had detections of PFOS, PFOA, or PFBS. The reporting limit at the time of UCMR3 sampling was 40 ng/L for PFOS, 20 ng/L for PFOA, and 90 ng/L for PFBS.

In response to IMCOM Operations Order 16-088, issued in 2016, AMC directed drinking water sampling for PFOS/PFOA at AMC installations. The analytical method used in the 2016 drinking water sampling was USEPA Method 537.1 (Tetrahedron, Inc. 2018a). All PFOS, PFOA, and PFBS analytical results for both active and inactive potable wells at TYAD are included in **Table 2-1**. On 07 November 2016, potable supply Wells 1, 2, 5, and 6 were sampled for PFOS, PFOA, and PFBS during an AMC drinking water investigation (Tetrahedron, Inc. 2018a). Wells 1, 2, 5, and 6 were the active potable wells at the time of sampling, however, Well 1 and Well 5 were decommissioned the week of 10 May 2021 (**Section 2.10**). PFOS, PFOA, and PFBS were not detected in samples collected from Wells 1, 2, 5, and 6 in November 2016 (**Table 2-1**). The reporting limit at the time of the sampling was 40 ng/L for PFOS, 20 ng/L for PFOA, and 90 ng/L for PFBS (Tetrahedron, Inc. 2018a).

On 24 September 2020, the entry point to the TYAD water supply system was sampled for 18 PFAS constituents, including PFOS, PFOA, and PFBS, by the PADEP Bureau of Safe Drinking Water. The entry point at the time of this sampling event consisted of a mixed sample from Wells 1, 2, 5, and 6. PFOS was detected at 12.1 ng/L, below the OSD risk screening levels for tap water (40 ng/L). PFOA and PFBS were not detected in the September 2020 entry point sample (**Table 2-1**). The analytical method used to analyze the September 2020 samples was not specified.

On 10 March 2021, TYAD sampled various potable (i.e., active at the time of sampling) source wells (Wells 1, 2, 5, and 6) and the entry point to the TYAD water supply system for 18 PFAS constituents, including PFOS, PFOA, and PFBS. The analytical method used in March 2021 was USEPA Method 537.1. PFOS detections ranged from 2.6 ng/L at Well 2 to 15 ng/L at Well 6, below the OSD risk screening levels for tap water (40 ng/L). PFOA detections ranged from 1.6 J ng/L at the entry point to 2.3 ng/L at Well 5, below the OSD risk screening levels for tap water (40 ng/L). PFBS was not detected in any of the March 2021 samples (**Table 2-1**).

Currently active potable wells (Wells 2, 6, 7, 8, 9, and 10) were sampled by the Army and PADEP on 14 July 2021. The analytical method used in July 2021 was USEPA Method 537.1. PFOS was detected in Well #6 at 25.7 ng/L, which is below the OSD risk screening levels for tap water (40 ng/L). PFOS was not detected in any other potable well samples collected in July 2021. PFOA and PFBS were not detected in any of the July 2021 samples (**Table 2-1**).

2.12.2 Groundwater Data

In August to September 2017, AMC performed groundwater sampling at TYAD at 10 select existing monitoring wells that were within or downgradient of suspected PFAS-containing material use, storage, and/or disposal based on site history (Tetrahedron, Inc. 2018b). The analytical method used in the 2017 groundwater sampling was USEPA Method 537 modified (Tetrahedron, Inc. 2018b). Groundwater samples were collected downgradient (on-post) of Building 1A/ Bay 1 of Building 1B(1BB1) – Former Chromium Plating and industrial wastewater pre-treatment plant (IWWPTP) and Building 17 – Fire Station, downgradient (off-post) of the OU-5 Inactive Sanitary Landfill, and within and downgradient (on and off-post) of OU-1 Area B- Former Drum Storage Area. All four of these areas are identified as AOPIs at TYAD and are discussed further in **Sections 4** and **5**. A summary of PFOS, PFOA, and PFBS results collected during the 2017 AMC Investigation is listed in **Table 2-2** (Tetrahedron, Inc. 2018b). Historical groundwater data is shown on **Figure 2-5**. A summary of PFOS, PFOA, and PFBS detections in groundwater compared to the OSD risk screening levels is provided below:

- Building 1A/1BB1 – Former Chromium Plating and IWWPTP: Four groundwater samples (TYAD-MW-UA6D, TYAD-MW-UA8D, TYAD-MW-PU1, TYAD-MW-UA4D) were collected from existing monitoring wells surrounding Building 1A/1BB1 – Former Chromium Plating and IWWPTP (Tetrahedron, Inc. 2018b).
    - PFOA was detected in three out of the four groundwater samples collected. Of the three groundwater samples with PFOA detections, only one exceeded the OSD risk screening level for tap water (40 ng/L) at 64 ng/L; the other two samples with detections were below the OSD risk screening level for tap water (**Table 2-2**, **Figure 2-5**).
    - PFOS and PFBS were detected in three out of the four groundwater samples collected. None of the PFOS and PFBS detections exceeded the OSD risk screening levels for tap water (40 ng/L and 600 ng/L, respectively).
- Building 17 – Fire Station: One groundwater sample (TYAD-MW-US7D) was collected at an existing monitoring well proximal to Building 17 – Fire Station. The sampled monitoring well is also located downgradient of Building 1A/1BB1 – Former Chromium Plating and IWWPTP (Tetrahedron, Inc. 2018b).
    - PFOS, PFOA, and PFBS were detected in the groundwater sample collected, each at concentrations below the applicable OSD risk screening level for tap water (40 ng/L for PFOS and PFOA, 600 ng/L for PFBS) (**Table 2-2**, **Figure 2-5**).
- OU-5 Inactive Sanitary Landfill: Two groundwater samples (TYAD-MW-LF27, TYAD-MW-LF29) were collected from existing, downgradient (off-post) monitoring wells (Tetrahedron, Inc. 2018b).
    - PFOA was detected in both groundwater samples collected. One of the two groundwater samples exceeded the OSD risk screening level for tap water (40 ng/L) at 65 ng/L; the other sample had a PFOA detection below the OSD risk screening level for tap water (**Table 2-2**, **Figure 2-5**).
    - PFOS and PFBS were detected in both groundwater samples collected. Neither of the PFOS and PFBS detections exceeded the OSD risk screening levels for tap water (40 ng/L and 600 ng/L, respectively) (**Table 2-2**, **Figure 2-5**).
- OU-1 Area B- Former Drum Storage Area: Three groundwater samples (TYAD-MW-MW11, TYAD-MW-MW21, TYAD-MW-MW23) were collected from existing monitoring wells within (on-post) and downgradient (off-post) of OU-1 Area B- Former Drum Storage Area.
    - PFOS, PFOA, and PFBS were detected in all three groundwater samples collected, each at concentrations below the applicable OSD risk screening level for tap water (40 ng/L for PFOS and PFOA, 600 ng/L for PFBS) (**Table 2-2**, **Figure 2-5**).

3 SUMMARY OF PA ACTIVITIES

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

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

Preliminary locations of potential use, storage, and/or disposal of PFAS-containing materials were then evaluated in the PA (during records review, personnel interviews, and/or site reconnaissance) and were categorized as AOPIs or as areas not retained for further investigation at this time based on a combination of information collected (e.g., records reviewed, personnel interviews, internet searches). A summary of the observations made, and data collected through records reviews (**Appendix F**), installation personnel interviews (**Appendix G**), and site reconnaissance logs (**Appendix I**) during the PA process for TYAD 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, TYAD fire department documents, TYAD directorate of public works documents, and GIS files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for TYAD is provided in **Appendix F**.

3.2 Personnel Interviews

Interviews were conducted during the site visit. The list of roles for the installation personnel interviewed during the PA process for TYAD is presented below (affiliation is with TYAD unless otherwise noted).

- Fire Department Chief
- Legal Counsel
- Environmental Branch Chief
- Industrial Hygienist
- Plating Shop Chemist
- Process Chemist
- Environmental Engineer
- Wastewater Treatment Plant and Water Treatment Plant Operator

- Real Property/Master Planning Staff
- Retired Chemist

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

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at TYAD during the records review process, the installation in-brief meeting, and/or during the installation personnel interviews. A photo log from the site reconnaissance is provided in **Appendix H**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix I**.

Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for SI sampling.

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

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

4.1 AFFF Use, Storage, and Disposal Areas

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

4.1.1 Fire Stations

Building 17, constructed in 1954, is the only current and historical fire station at TYAD. In 2012, Building 17A was built as an additional equipment storage area for the TYAD Fire Department. In 2014, Building 17 was remodeled to add space to the existing building, however there were no excavations associated with the construction.

4.1.2 AFFF Use

At TYAD, AFFF is suspected to have been used only in relation to the TYAD Fire Department equipment testing and personnel training (e.g., no AFFF fire responses). However, there were no TYAD Fire Department records available for review and no retired personnel (prior to 2000) available for interviews. Therefore, AFFF use at TYAD prior to 2000 is not completely known.

During the PA site visit, interviews were conducted with the current TYAD Fire Chief, who has been present at TYAD since 2000. The Fire Chief did not note any fire responses involving AFFF, however it is unknown whether AFFF had been used for fire responses prior to 2000 when they started. The TYAD Fire Chief also did not note any equipment testing or personnel training using AFFF during his time at TYAD. However, a historical firefighter training area that was previously identified as TBAD-058 in the TYAD IRP was identified during document review. The entire fire training area consisted of a tower used for smoke bomb training and a burn pit area used for firefighting training from the 1970s to 1993. The

TYAD Fire Department began use of the burn pit specifically in the 1970s and fire training exercises were conducted several times a year and monthly in summer. The PA team was unable to confirm the use of AFFF at this location, however, knowledge gaps from the fire department operations in the 1970s and common practice of using AFFF in these types of training operations indicates likely repeated AFFF use in this area. The Historical Fire Training Area- Burn Pit is further discussed in **Section 5.2**. The TYAD Fire Chief stated that current equipment testing, such as foam induction testing, is performed annually by a third-party vendor off-post and has also been performed at the Monroe County Training Center. The exact materials used during the foam induction testing are unknown. The TYAD Fire Chief stated that since they began in 2000, personnel training is performed with training foam, noted to be similar to Dawn® dish soap, to simulate foam use.

4.1.3 AFFF Storage

During document review, the PA team reviewed USAEC and AMC provided records which indicated that TYAD stores a total of 150 gallons of 3 to 6% National Foam Universal Gold AFFF at Building 17-Fire Station and within Rescue Engine 47.

During the PA site visit the TYAD Fire Chief stated alcohol-resistant AFFF (AR-AFFF) is currently stored within 5-gallon buckets inside a locker at Building 17- Fire Station. The PA team performed site reconnaissance at Building 17- Fire Station and observed twenty-six 5-gallon buckets of AR-AFFF stored inside the locker, for a total of 130 gallons. Specifically, the 5-gallon buckets were Ansulite® 3 to 6% AR-AFFF or Chemguard® 3 to 6% AR-AFFF. At the time of the PA site visit, AR-AFFF was also stored within a foam cell on Rescue Engine 47 in the Building 17- Fire Station bay. All other AR-AFFF storage is on fire truck engines within the 5-gallon pails, not within the foam cell tanks. According to TYAD Fire Department staff, AFFF has not been stored at Building 17A.

During the TYAD PFAS PA kick-off call, TYAD personnel stated that Building 74 contained a historical AFFF-suppression system when the building was in use by the Defense Logistics Agency. The AFFF was removed around 2009 and is currently stored in two 55-gallon drums at Building 74. Building 74 serves as a hazardous materials storage facility and has secondary containment infrastructure. The PA team did not identify any suppression system testing or known releases of AFFF related to this suppression system. Building 74 utilized the only AFFF suppression system at TYAD.

4.1.4 AFFF Disposal

During the PA site visit, the TYAD Fire Chief stated that in approximately 2009, the TYAD Fire Department switched out older AFFF with AR-AFFF and the old AFFF foam was disposed of off-post through the TYAD Environmental Division. The TYAD Fire Chief stated during the AFFF switch out, the fire truck foam cells were filled by opening the tank and transferring AFFF from a 5-gallon bucket into the tank using a pump or by filling directly from the 5-gallon bucket. The AFFF switch out occurred within the Building 17 fire station bays. Within the fire station bay floors are collection drains that lead to an oil water separator prior to being discharged to the TYAD sanitary system. The TYAD Fire Chief does not recall any spills or releases of AFFF at Building 17- Fire Station since they had been at TYAD.

Additionally, TYAD fire trucks have been washed within the fire station bays since the fire chief began in 2000, where internal collection drains are located.

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

Following document research, personnel interviews, and site reconnaissance at TYAD, metal plating facilities, landfills, and drum disposal areas were identified at the installation as preliminary locations of use, storage, and/or disposal of PFAS-containing materials.

4.2.1 Metal Plating

Potential PFAS use associated with metal plating activities may also be relevant to Army installations. During metal plating operations, a metal surface may be treated with a layer of electrochemically deposited metals in an acid bath. PFAS, specifically PFOS, have been used in metal plating operations as surface tension-reducing wetting agents to mitigate the release of aerosolized chemicals into a working environment. Hard chromium plating is one type of metal plating operation where PFAS-containing mist suppressants were commonly used. Historically, it was common for spent plating baths from metal plating operations to be disposed of in a lined or unlined pit or into a sanitary or storm sewer. Therefore, PFAS chemicals present in mist suppressants during the metal plating process could be released to the environment.

Chromium plating historically occurred at TYAD. The plating shop was located in Building 1A and operated from 1954 until 2005. It utilized metal or plastic tanks of different sizes in six process lines. Plating and rinse tanks were surrounded by wooden and metal walkways that were approximately 2 feet above building grade level. Cyanides were used in cadmium and chromium plating operations until the mid-1980s, although a separate cyanide collection and pretreatment system was installed in the 1970s to properly manage these wastes prior to discharge to the IWWPTP. The process tanks utilized a downdraft ventilation system that drew vapors from the surface of the tank contents downward through metal ductwork and into three acid-resistant brick-lined trenches that ranged in depth from 3.5 to 5 feet below the shop floor. The process tank exhaust trenches were connected through ductwork at the eastern wall of the shop to fans located on the mezzanine level, which discharged to the atmosphere through vents that extended up to 15 feet above the roof level. The entire shop floor was lined with acid-resistant brick. In the plating process area, the brick floor was sloped toward the wastewater conveyance trenches to direct process tank drag-out and rinse waters to the sump pit where pumps transferred these liquid wastes to the IWWPTP (Weston Solutions, Inc. 2005).

A plating chemist who worked at Building 1A beginning in 1984 was interviewed during the PA site visit. The chemist noted that upon their arrival, there was one 100-gallon hexavalent hard chromium plating tank that was not being used and the tank was later decommissioned. Since their arrival in 1984, the plating chemist did not note any mist suppressant use or storage at Building 1A. However, it is possible that mist suppressants were used with the hexavalent chromium tank before 1984. Records of mist suppressants, if used at Building 1A prior to 1984, were not available for review.

The IWWPTP was located within Bay 1 of Building 1B (1BB1), along 3rd Street. The IWWPTP was constructed in 1982 and collected wastewater from several different shops, including the chromium plating shop in Building 1A, treated wastewater from a chromium sump, an acid/alkali sump, and an acid/cadmium sump. The IWWPTP effluent combined with other wastewater flows for further treatment in at the TYAD STP. Floors in the IWWPTP were cement, numerous stains appeared beneath the various tanks and vats used in the treatment process (Weston Solutions, Inc. 2005). PFAS-containing mist

suppressants, if used in historical Building 1A chromium plating operations, would have passed through the IWWPTP prior to being discharged to the STP.

At the time of the PA site visit, the only current metal plating operations at TYAD occur in Building 1E. Building 1E took over plating operations from Building 1A in the early 2000s. Plating personnel who have been present at Building 1E since it began operation indicated chromium conversion occurs at Building 1E. Plating personnel added all plating operations at Building 1E utilize scrubbers, not mist suppressants.

4.2.2 Landfills and Waste Disposal Areas

There are two historical landfills at TYAD. One landfill was historically used to dispose of construction-related wastes during sporadic time periods, not continually, between 1939 and 1981. The other landfill, referred to as OU-5 Inactive Sanitary Landfill, reportedly received a variety of wastes generated at TYAD, including plating wastes and sludge, STP sludge, ashes from trash burning pits, construction rubble, paints, solvents, oils, sanitary wastes, and pesticide containers during the operational period of 1963 to 1979. After each daily operation, soil was placed over the disposed material and compacted. There are no active landfills at TYAD.

As described in **Section 2.9**, there is an active STP at TYAD that has been in operation since 1954 and had system updates in 2014. The TYAD STP has received a variety of sanitary and industrial wastes (i.e., post pre-treatment) prior to and following the system upgrades in 2014. Currently, sludges are disposed off-post by a contractor, and effluent water is discharged to Hummler Run on-post. Records reviewed during the PA identified an original STP at TYAD, which operated in the 1920s to 1950s, prior to the active STP.

OU-1 Area B Former Drum Storage Area at TYAD was used for drum staging and disposal during the construction of the depot in the 1950s and is approximately 320 feet by 350 feet. Although there are no known storage or release of PFAS-containing materials at OU-1 Area B Former Drum Storage area, groundwater sampled within and downgradient of a historical drum storage area referred to as OU-1 Area B Former Drum Storage Area in 2017. PFOS, PFOA, and PFBS were detected in these groundwater samples collected in 2017, as described in **Section 2.12**.

4.2.3 Pesticide Areas

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

4.2.4 Vehicle Maintenance Areas

Buildings 104 and 214 are vehicle maintenance areas that were evaluated as preliminary locations for use, storage, and/or disposal of PFAS-containing materials related to AFFF tanks being

emptied/serviced. The TYAD Fire Chief stated all fire truck maintenance is performed by a third-party contractor, Glick Fire Equipment Company, Inc. and TYAD Fire Department vehicles are sent off-post by contract since the on-post vehicle maintenance facilities are not certified to work on fire apparatuses. Fire truck maintenance locations at TYAD prior to 2000 (i.e., beginning of interview knowledge) are unknown.

4.2.5 Photo-Processing Operations

Building 11 was identified as a preliminary location for use, storage, and/or disposal of PFAS-containing materials related to photo-processing operations. Records reviewed identified a photo laboratory in Building 11, however, TYAD personnel stated photo-processing was performed on a small scale (i.e., not a full-scale photo processing facility) and within a laboratory (i.e., contained) setting. Additionally, safety data sheets were not available to confirm PFAS-materials involved with this operation.

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

TYAD Fire Chief noted the TYAD Fire Department is a part of various mutual aid agreements, however they are not a part of the foam task force and therefore do not use AFFF on any off-post mutual aid responses. Therefore, it is unlikely that TYAD used AFFF off-post in relation to fire responses. The TYAD Fire Chief did not recall any off-post fires or crashes where AFFF was used or could have been used during the fire response. The Coolbaugh Township Volunteer Fire Company is located less than 2 miles from TYAD and may store and/or use AFFF related to fire department activities.

5 SUMMARY AND DISCUSSION OF PA RESULTS

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

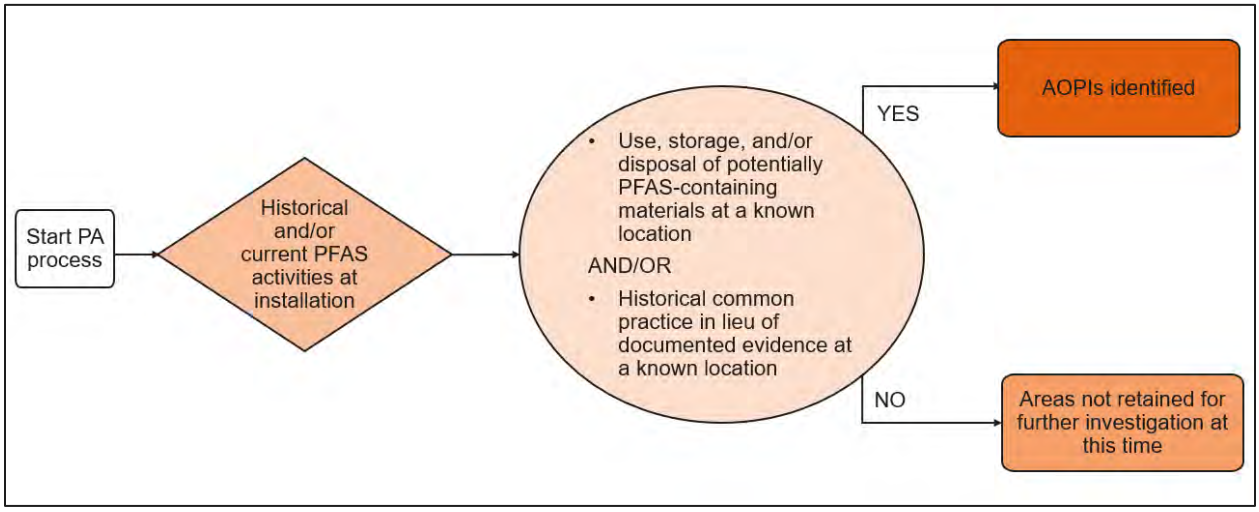

Figure 5-1: AOPI Decision Flowchart

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 TYAD are presented in **Section 9**.

5.1 Areas Not Retained for Further Investigation

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

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

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

Area Description	Dates of Operation	Relevant Site History	Rationale
Fire Station Support Building 17A	2009 to present	Building 17A was constructed in 2012 as an additional fire station support facility. Neither AFFF nor AFFF-carrying fire trucks have been stored within or outside of Building 17A since it was constructed. There are no drains in Building 17A. The PA team performed site reconnaissance at Building 17A and noted miscellaneous equipment storage, no PFAS-containing materials.	The PA team did not identify any use, storage, and/or disposal of PFAS-containing materials since its construction in 2012.
Rotary Wing Heli Pad	1978 to present	The Rotary Wing Heli Pad was initially identified in the TYAD current assets file during records review. During PA site visit interviews with the TYAD fire department, personnel confirmed there is no record or knowledge of use, storage, and/or disposal of PFAS-containing materials at this location currently or historically.	The PA team did not identify any use, storage, and/or disposal of PFAS-containing materials at this location.
Betts Army Airfield	1950s to 1967	The Betts Army Airfield was identified during records review as an on-post airfield. During PA site visit interviews, TYAD personnel confirmed the Betts Army Airfield historically included a hangar, but the airfield closed in 1967 and the historical airfield is now a parking lot.	The dates of operation of Betts Army Airfield (1950s to 1967) predate the use of a common PFAS-containing material present at airfields/hangars (i.e., AFFF). No current or historical use, storage, and/or disposal of PFAS-containing materials was identified at this location.
Building 1E	2002 to present	Building 1E is the only location of current plating operations at TYAD. Building 1E took over for plating operations from Building 1A in 2002. Interviews conducted during the PA site visit with TYAD plating personnel (who have been working at Building 1E since it began operation) indicated that while chromium conversion occurs at Building 1E, there is no use of mist suppressants. All plating operations at Building 1E utilize scrubbers for air contaminant prevention.	The PA team did not identify use, storage, and/or disposal of PFAS-containing materials at Building 1E.

Area Description	Dates of Operation	Relevant Site History	Rationale
Building 72	1993	Building 72 was identified in a records review worksheet provided by USAEC as a location of electroplating for less than 1.5 years. However, PA interviews were conducted with TYAD plating personnel who were present while plating operations potentially occurred in Building 72 (1993). Personnel stated they have no knowledge of plating operations at Building 72. TYAD personnel added if there were plating operations at Building 72, they were likely bench scale operations that did not involve tanks, vents, or mist suppressants. No other operations potentially involving the use, storage, and/or disposal of PFAS-containing materials were identified at this location.	The PA team did not identify use, storage, and/or disposal of PFAS-containing materials at Building 72.
Building 95	1985 to unknown	Building 95 was identified during records review as a storage building for the chemicals used at the plating shop Building 1A, including chromic acid. The PA team interviewed retired TYAD personnel regarding the use of Building 95 for hazardous materials storage and was unable to confirm that Building 95 was ever used to store chemicals related to Building 1A plating operations.	No evidence of use, storage, and/or disposal of PFAS-containing materials.
Army Reserve and National Guard	1960s to present	Various Army Reserve and National Guard operated buildings at TYAD were identified in the current assets file during records reviewed. During PA site visit interviews, TYAD personnel confirmed neither the Army Reserves nor National Guard ran missions at TYAD that relate to the use, storage, and/or disposal of PFAS-containing materials.	No evidence of use, storage, and/or disposal of PFAS-containing materials.
Pesticide Use Areas	2019 to present	The 2019 pesticide use proposal provided by TYAD was reviewed by the Army PA team. No PFAS-containing pesticides were identified.	No use, storage, and/or disposal of PFAS-containing materials related to pesticides at TYAD.

Area Description	Dates of Operation	Relevant Site History	Rationale
Active STP (Buildings 24, 241, 242, 243, 244)	1954 to present	Buildings 24: currently a lab, formerly a digester. Building 241: office and chemical storage. Building 242: sludge press. Building 243: air compressor building. Building 244: influent building. All listed buildings are part of the current STP at TYAD. Following PA site visit interviews and site reconnaissance, the Army PA team concluded wastes directed to these buildings during the water treatment process are contained within the system infrastructure due to the integrity of their structures.	No direct evidence of use, storage, and/or disposal of PFAS-containing materials; additionally, wastes would be contained within the system infrastructure part of the active STP components (i.e., not a source for release).
Closed STP Building 245	1954 to 2014	Former Building 245 historically served as a trickling filter tower at the TYAD STP. Following PA site visit interviews and records review, the Army PA team concluded wastes directed to this building were contained within the facility infrastructure due to the integrity of the structure when decommissioned in 2014.	No evidence of use, storage, and/or disposal of PFAS-containing materials; additionally; wastes were likely contained within the former Building 245 components (i.e., not a source for release).
Indoor and Outdoor Sludge Drying Beds	1953-present (indoor) 1953 to 2014 (outdoor)	The indoor sludge drying beds are lined with sand, gravel, and a 45-millimeter plastic membrane. Since the major system upgrades in 2014 (**Section 2.9.2**), sludges are pressed every three to four months and then removed off-post by a contractor. The outdoor uncovered beds were equipped with crushed stone walls and underlain by sand, gravel, and a 45-millimeter plastic liner. Following PA site visit interviews and records review, the Army PA team concluded wastes directed to these sludge drying beds were contained within the facility infrastructure.	There is no direct evidence of use, storage, and/or disposal of PFAS-containing materials within the relevant operational history timeframe (1981-1984). Additionally, wastes were likely contained within the sludge drying beds system components due to the nature of the holding infrastructure and previous environmental assessments, which did not indicate any environmental impacts from the sludge storages (i.e., not a source for release).
Vehicle Maintenance Facilities (Building 104 and 214)	Unknown to present	As noted during an interview with the TYAD Fire Chief, all fire truck maintenance is performed by a third-party contractor, Glick Fire Equipment Company, Inc. Fire department vehicles are sent off-post by contract since the on-post vehicle maintenance facilities are not certified to work on fire apparatuses. Fire truck maintenance locations at TYAD prior to	No use, storage, and/or disposal of PFAS-containing materials related to vehicle maintenance facilities at TYAD.

Area Description	Dates of Operation	Relevant Site History	Rationale
		2000 (i.e., beginning of interview knowledge) are unknown.	
OU-1 Area A	1950s to 1960s	The site history of OU-1 Area A includes trench excavation, waste burning (i.e., not AFFF), and burial of ash residue, which does not relate to the use, storage, or disposal of PFAS-containing materials. OU-1 Area A was identified in the 2018 AMC AFFF report during records review as an area where downgradient groundwater wells were previously sampled and had PFOS and PFOA detections. The Army PA team evaluated the location of the groundwater wells sampled in 2017 and concluded the sample detections are likely not representative of OU-1 Area A impacts but are representative of OU-1 Area B (**Section 5.2.6**).	No confirmed use, storage, and/or disposal of PFAS-containing materials at OU-1 Area A.
Potential Plating Material Storage Areas (Buildings 10C, 56, 91, 92, 96)	1954 to unknown	Initially identified during document research and site visit interviews as potential areas of plating material storage or other hazardous materials storage. Interviews with TYAD plating personnel could not confirm materials or wastes from Building 1A were ever stored in these buildings. TYAD staff also noted there is no record of release of chemicals to the environment from these buildings.	No confirmed use, storage, or disposal of PFAS-containing materials in any of the potential storage buildings.
Landfill Area TBAD-002	1939 to 1981	Landfill area that was historically used to dispose of construction-related wastes during sporadic time periods, not continually. The exact wastes in this landfill have not been indicated.	No confirmed use, storage, and/or disposal of PFAS-containing materials.
Original burning area TBAD-005	1913 to 1945	TBAD-005 was historically used to burn wastes generated by on-site activities. The nature of these activities is unknown. However, the operational period pre-dates PFAS-containing materials.	The dates of operation pre-date the period of PFAS-containing materials.
Oil Burning Pit	1953 to 1963	The Oil Burning Pit is located within the western portion of TYAD and was used for firefighting demonstrations.	The dates of use for the Oil Burning Pit predate the period of use for AFFF. No other PFAS-containing materials were identified at the Oil Burning Pit.

Area Description	Dates of Operation	Relevant Site History	Rationale
Original STP TBAD-019	1920s to 1950s	The original STP operated prior to the current STP. No additional information was available on the original STP operations. PFAS-containing wastes coming through the active STP from site operations were not relevant until the 1970s/1980s.	The dates of operation predate the period of use for PFAS-containing wastes at TYAD.
Photo Lab Building 11 TBAD-054	After 1980 to unknown	Identified as a photo laboratory at TYAD in the Installation Action Plan during records review. Safety data sheets related to photo processing operations at TYAD were not available for review. TYAD personnel stated this operation was performed on a small scale given this was a lab, not a full-scale photo processing facility.	No evidence of PFOS, PFOA, or PFBS containing products used, stored, and/or disposed of at this location.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. Five of the seven AOPIs overlap with TYAD IRP sites and/or Headquarters Army Environmental System sites. The AOPI, overlapping IRP site identifier, Headquarters Army Environmental System number, and current site status are discussed within each AOPI subsection presented below.

The AOPI locations are shown on **Figure 5-2**. Aerial photographs of each AOPI that also show the approximate extent of AFFF use (if applicable) are presented on **Figures 5-3** through **5-9** and include active monitoring wells in the vicinity of each AOPI.

5.2.1 Historical Fire Training Area – Burn Pit (TBAD-058, 42780.1058)

The Historical Fire Training Area – Burn Pit is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to likely repetitive AFFF application related to TYAD Fire Department personnel training and equipment testing operations in the 1970s to 1993. The entire training area was approximately 50 feet by 50 feet and consisted of a tower used for smoke bomb training and a burn pit area used for firefighting training. The burn pit was constructed with a burn pan, which consisted of a 6-foot diameter section of 3/8-inch thick steel with a welded bottom, and a depth of approximately 4.5 feet. No piping was associated with the burn pan. Surrounding the burn pit was approximately a 20-foot diameter area of crushed stone and gravel cover. Usage began in the 1970s and fire training exercises were conducted several times a year and monthly in summer. According to records reviewed, the TYAD Fire Department trained by placing fuel oils on water and igniting the fuel oils in the pit. When not in use, the pit was covered, however the pit was left uncovered for about 1 year. A heavy layer of black sludge beneath the water in the container had been noted in installation records reviewed. As stated in **Section 4.1**, interviewed TYAD fire department staff had knowledge of fire department operations going back to 2000, and former/retired fire department staff with potential knowledge of burn pit operations (i.e., 1970s-1993) were not available for interviews. Therefore, reliable information regarding use of the burn pit training and operations relative to AFFF is not known. However, based on common Army fire department

training practices (i.e., using AFFF for Class B oil fires in these types of training operations), it is expected AFFF was repetitively used in this area. The exact location of the AOPI was inferred following review of historical aerials and installation records.

The AOPI is located north of the industrial complex area of TYAD within the Former Artillery Range A area south of Oakes Swamp (**Figure 5-3**). The AOPI is adjacent to current range operations which does not involve the use of live ammunition (industrial use). Groundwater flow within this area has not been investigated, therefore groundwater flow is inferred from topographic relief. Shallow groundwater is estimated to flow to the north-northwest towards Oakes Swamp. However, due to the lack of groundwater investigation in this area, shallow and bedrock groundwater may flow to the south, consistent with general groundwater flow at TYAD.

A Verification Study (VS) was conducted in 1995 for other constituents (i.e., not PFAS constituents) related to firefighting training activities at the burn pit and consisted of a soil gas survey, subsurface soil sampling, and sediment sampling. The AOPI was addressed as TBAD-058 in the TYAD IRP at the time of the VS. The VS determined soils associated with historical firefighter training operations did not represent an unacceptable human health risk, however, the Army decided to remove the burn pan (Program Management Company 1999).

5.2.2 Building 17 - Fire Station

The Building 17 – Fire Station is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to likely AFFF releases related to fire truck washing, maintenance and other TYAD Fire Department operations. Building 17 currently and historically has served as the only fire station at TYAD. The current TYAD Fire Chief, who has been present at TYAD since 2000, was interviewed during the PA site visit. Retired TYAD Fire Department personnel were not available for interviews to obtain pre-2000 AFFF history/practices. Therefore, TYAD Fire Department practices are unknown prior to 2000. The PA team performed site reconnaissance at Building 17- Fire Station and observed twenty-six 5-gallon buckets of AR-AFFF stored inside the storage locker within the fire station bay, for a total of 130 gallons. Specifically, the 5-gallon buckets were Ansulite® 3-6% AR-AFFF or Chemguard® 3-6% AR-AFFF. Additionally, AR-AFFF is stored within a foam cell on Rescue Engine 47 in the Building 17- Fire Station bay. The current fire chief noted that in approximately 2009, the fire department switched out the previous AFFF with the AR-AFFF, and the old AFFF was disposed of off-post. Foam transfers occur within the bays of the fire station. Historically and currently, AFFF-carrying trucks are washed within the station bays, where drains lead to an oil water separator prior to discharging to the sanitary system.

The AOPI is located just south of the industrial cantonment area of TYAD and is an active fire station (industrial use) (**Figure 5-4**). Groundwater is estimated to flow to the south-southeast.

PFOS, PFOA, and PFBS were detected in monitoring well US-7D (located cross-gradient of Building 17-Fire Station and downgradient of Building 1A/1BB1 Former Chromium Plating and IWWPTP) in 2017.

5.2.3 Building 1A/1BB1 Former Chromium Plating and IWWPTP (TBAD-067, 42780.1067)

The Building 1A/1BB1 Former Chromium Plating and IWWPTP is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to potential use of PFAS-containing mist suppressants in historical chromium plating operations and associated wastes. Building 1A historically hosted chromium plating, a plating chemistry laboratory, a photo fabrication shop, and a printed circuit board shop from 1954 until 2005. Plating operations in Building 1E began in 2002, starting the transfer of plating operations from Building 1A to Building 1E, and Building 1A and associated operations were officially decommissioned in 2006. A plating chemist who worked at Building 1A in 1984 noted upon their arrival, there was one 100-gallon hexavalent hard chromium plating tank that was not being used and the tank was later decommissioned. The plating chemist did not recall any mist suppressant use or storage at Building 1A. It is possible that mist suppressants were used prior to 1984 with the hexavalent chromium tank and during chromium plating operations, consistent with their use encountered at other installations in this operational timeframe.

1BB1 was located on the eastern side of Building 1B along 3rd Street. 1BB1 was constructed in 1982 and operated until 2005. Plating operations in Building 1E began in 2002 and Building 1B and associated operations were officially decommissioned in 2006. 1BB1 historically collected wastewater from several different shops, including wastes from Building 1A. The facility treated wastewater from a chromium plating sump and other sumps. The effluent was combined with other wastewater prior to flowing to the TYAD STP for further treatment.

The AOPI is located within the industrial cantonment area of TYAD, proximal to the eastern installation boundary (industrial use) (**Figure 5-5**). Groundwater flows to the south-southwest. As described in **Section 2.12**, PFOS, PFOA, and PFBS were detected in groundwater monitoring wells located downgradient of the AOPI (**Table 2-2** and **Figure 5-5**).

The AOPI is part of the TYAD IRP for other constituents (i.e., not PFAS constituents) related to industrial operations at Building 1A and is addressed as TBAD-067 in the TYAD IRP. A PA for non-PFAS constituents was conducted in 2001 to 2002, and an SI was conducted in 2002 to 2004. In 2006, a soil vapor extraction system was installed in Building 1A as an interim remedial action (USAEC 2016). A remedial investigation and feasibility study was finalized in October 2018 (EA 2018).

5.2.4 Temporary Dewatered Sludge Storage Site (TBAD-033, 42780.1033)

The Temporary Dewatered Sludge Storage Site is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the receipt of potentially PFAS-containing wastes in sludges originating from the Building 1A/1BB1 Former Chromium Plating and IWWPTP (see **Section 5.2.3**) and other commercial uses. During renovations at the STP sludge drying beds, dewatered sewage sludge (approximately 100 feet by 50 feet) was stored in an open area across from the plant. Sludge was stored on a plastic sheet placed on the ground. The extent of the dewatered sludge pile eventually exceeded the size of the plastic sheet and runoff from the site was uncontrolled. Sludge piling at this location began in 1981 and ceased in 1984. Stockpiled sludge was removed in 1985. During removal of the stockpiled sludge, 2 to 3 inches of soil were removed from the general area and disposed off-post.

The AOPI is located west of Barney's Lake, just south of the industrial area of TYAD. The AOPI is located proximal to the current STP (industrial use) (**Figure 5-6**). Groundwater flows to the southeast towards Barney's Lake.

The AOPI was identified as TBAD-033 in the TYAD IRP as a result of open storage of sludge generated at the TYAD STP. Remedial actions performed at the AOPI include soil excavation and disposal at an off-post hazardous waste disposal facility, sampling and analysis of soil to confirm removal of sludge, and backfilling with clean soil. No additional monitoring was conducted following the remedial actions described above (United States Army Environmental Hygiene Agency 1990).

5.2.5 OU-5 Inactive Sanitary Landfill (TBAD-001, 42780.1001)

The OU-5 Inactive Sanitary Landfill is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to the receipt of potentially PFAS-containing sludges originating from the Building 1A/1BB1 Former Chromium Plating and IWWPTP and existing PFOS, PFOA, and PFBS data. The OU-5 Inactive Sanitary Landfill is approximately 2,000 feet by 600 feet and consisted of two landfill cells (A and B) during operation. The landfill reportedly received a variety of wastes generated at TYAD, including plating wastes and sludge, STP sludge, ashes from trash burning pits, construction rubble, paints, solvents, oils, sanitary wastes, and pesticide containers during the operational period of 1963 to 1979. After each daily operation, soil was placed over the disposed material and compacted. Leachate from the AOPI had been historically observed to enter Cross Keys Run. During the landfill closure process, a stormwater drainage pipe was placed where a surface drainage feature had previously traversed the landfill to reduce surface water infiltration into groundwater within the landfill. The stormwater drainage pipe consists of an underground concrete pipe and numerous inlet structures on the surface. The stormwater drainage pipe does not collect leachate or shallow groundwater within the landfill. The stormwater drainage pipe traverses the landfill from the northeast to the southwest and discharges to Cross Keys Run off-post.

The AOPI is located along the northwestern installation boundary, adjacent to inactive rail classification yards and is an inactive sanitary landfill (industrial use) (**Figure 5-7**). Groundwater flows to the southwest. As described in **Section 2.12**, PFOS, PFOA, and PFBS were detected in groundwater monitoring wells located downgradient of the AOPI (**Table 2-2**, **Figure 5-7**).

The AOPI is part of the TYAD IRP for other constituents (i.e., not PFAS constituents) related to landfilling operations and is addressed as TBAD-001 in the TYAD IRP. In 1997, a remedial investigation was completed for the site, which included human health and ecological risk assessments. The record of decision for this site was signed in September 2000; the selected remedy was monitored natural attenuation, long term monitoring, and institutional controls. Remedial action operations have been ongoing since 2001 and 5-year reviews have been completed since 2002 (USAEC 2016).

5.2.6 OU-1 Area B Former Drum Storage Area (TBAD-007, 42780.1007)

The OU-1 Area B Former Drum Storage Area is identified as an AOPI following records review, personnel interviews, and site reconnaissance due to previous detections of PFOS, PFOA, and PFBS during the 2017 AMC investigation (Tetrahedron, Inc. 2018b). OU-1 Area B was used for drum staging and disposal during the construction of the TYAD in the 1950s and is approximately 320 feet by 350 feet. Additionally,

the OU-1 Area B- Former Drum Storage Area was noted in the TYAD administrative record as the source of the off-post drinking water contamination of volatile organic compounds (VOCs). In 1995, TYAD completed a source soil removal action at Area B, removing 2,100 cubic yards of VOC impacted soil. VOC impacted soil was removed and disposed off-post. During the same time period, several 55-gallon drums were removed from the site and properly disposed.

The AOPI is located in the southern portion of TYAD, proximal to the installation boundary. The AOPI is an active IRP site (industrial use) (**Figure 5-8**). Groundwater flows to the southeast. As described in **Section 2.12**, PFOS, PFOA, and PFBS were detected in groundwater monitoring wells located downgradient of the AOPI (**Table 2-2** and **Figure 5-8**).

The AOPI is part of the TYAD IRP for other constituents (i.e., not PFAS constituents) related to historical drum disposal activities and is addressed as TBAD-007 in the TYAD IRP. As noted above, constituents migrating from the AOPI are associated with contamination of off-post drinking water wells across the southern TYAD boundary and in 1990, water lines from the TYAD potable water supply were extended off-post to 23 residents and one business located south and southeast of TYAD. A 55-gallon drum removal as well as contaminated soil removal and treatment were conducted at the AOPI between 1995 and 1996. The record of decision for this site was signed in September 1997; the selected remedy was monitored natural attenuation, long term monitoring and institutional controls. Remedial action operations have been ongoing since 2001 and 5-year reviews have been completed since 2002.

5.2.7 Building 74 – AFFF Storage

Building 74 – AFFF Storage is identified as an AOPI following records review and personnel interviews, due to storage of AFFF and the historical use of AFFF as a fire suppression system within the building. Building 74 held the only AFFF suppression system at TYAD. The AFFF within the suppression system was removed around 2009 and is currently stored in 55-gallon drums at Building 74. Building 74 serves as a hazardous materials storage facility and has secondary containment infrastructure (i.e., containerized sumps within the building). The PA team did not identify any testing or known releases of AFFF from this suppression system, however due to the historical and current storage of AFFF, it is possible AFFF was released to the environment at some point in the operational history of the AFFF suppression system or current AFFF storage.

The AOPI is located in the northwestern portion of the industrial area at TYAD and is surrounded by other industrial use buildings (**Figure 5-9**). Groundwater at the AOPI is anticipated to flow to the south-southwest.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at TYAD, an SI for PFOS, PFOA, and PFBS was conducted in accordance with CERCLA. SI sampling was completed at TYAD at all seven AOPIs to evaluate presence or absence of PFOS, PFOA, and PFBS in comparison with the OSD risk screening levels. As such, a QAPP Addendum (Arcadis 2020a) 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 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 groundwater, soil, 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 November 2020 through January 2021 through the collection of field data and analytical samples. An additional field mobilization was conducted in August and September 2021 to install and sample two monitoring wells, one at Building 17 – Fire Station and one at Building 74 – AFFF Storage, where groundwater could not be collected during the November 2020 to January 2021 mobilization.

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 2020a) 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 TYAD. Non-conformances to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.3**. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the QAPP Addendum (Arcadis 2020a), the objective of the SI is to identify whether there has been a release to the environment at the AOPIs identified in the PA and to determine if further investigation is warranted. This SI evaluated groundwater, soil, surface water, and sediment for PFOS, PFOA, and PFBS presence or absence at each of the sampled AOPIs.

6.2 Sampling Design and Rationale

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

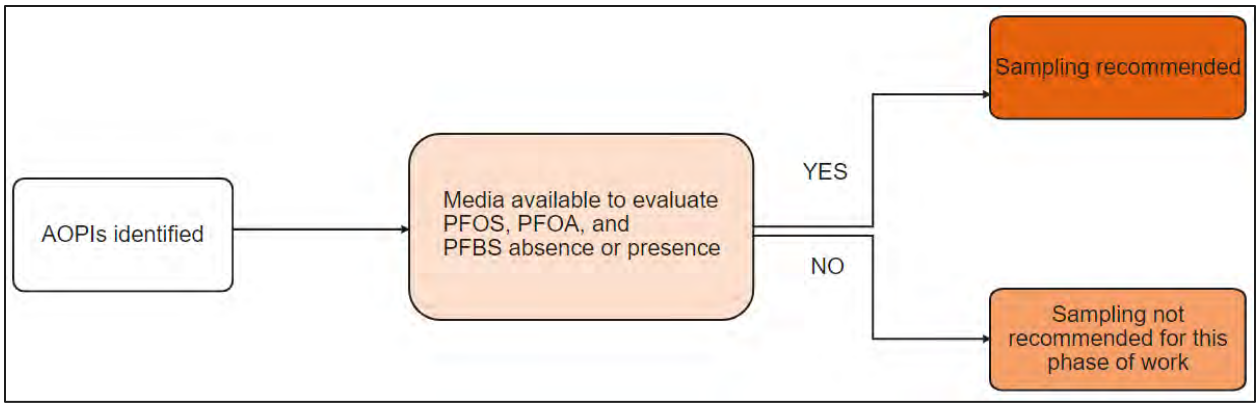

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at TYAD is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2020a). The areas of focus for this SI (i.e., all seven AOPIs) were selected based on records review, and information obtained throughout the PA. A combination of groundwater, surface soil, surface water, and sediment samples were collected from each of the seven sampled AOPIs. Sampling points were positioned at locations of known of suspected use, storage, and/or disposal of PFAS-containing materials, at downgradient or downstream locations, and/or where surface runoff was observed at each AOPI, as applicable. The sampling depths at monitoring wells were at approximately the center of the saturated screened interval. **Table 6-1** includes the monitoring well construction details for the wells sampled during the SI. Specific sampling rationale for each AOPI, as agreed upon with TYAD, USAEC, USACE, PADEP, and USEPA (Arcadis 2020a) is presented in **Table 6-2,** below.

Table 6-2. SI Sampling Rationale at TYAD

AOPI Name	SI Sampling Rationale
Historical Fire Training Area- Burn Pit **(TBAD-058, 42780.1058)**	• Three surface soil samples were collected within the suspected AOPI. • One shallow monitoring well installation/groundwater sample was co-located with the northernmost (downslope) soil boring where AFFF may have been released or overflowed during AFFF equipment testing activities. A second shallow monitoring well installation/groundwater sample was located downgradient of the suspected AOPI area prior to shallow groundwater discharge to Oakes Swamp to capture potential impacts to shallow groundwater from AFFF equipment testing activities and to evaluate shallow groundwater flow direction in this area. • Two co-located surface water and sediment samples were collected from Oakes Swamp, where surface runoff may have flowed from the Historical Fire Training Area- Burn Pit following AFFF equipment testing activities and during precipitation events. Oakes Swamp also likely receives shallow groundwater discharges from the AOPI.

AOPI Name	SI Sampling Rationale
Building 17- Fire Station	• One groundwater sample was planned from existing bedrock monitoring well US-7D, however the SI field team could not sample US-7D (see **Section 6.3.3**). One groundwater sample was collected from the AOPI following sonic drilling and monitoring well installation during a second mobilization. • Two surface soil samples were collected on the edge of the parking lot pavement, where field staff observed runoff collection points or low-lying areas where AFFF may have collected. • Shallow groundwater originating at the AOPI potentially discharges to surface water bodies on post (e.g., Barney's Lake, Hummler Run). Surface water and sediment was sampled from Hummler Run (immediately downgradient of Barney's Lake), as seen in the sampling rationale for the Temporary Dewatered Sludge Storage Site AOPI.
Building 1A/1BB1 Former Chromium Plating and IWWPTP **(TBAD-067, 42780.1067)**	• Two groundwater samples were collected from existing monitoring wells PD-1 and UA-6D. A groundwater sample was planned from US-7D; however, the field team could not sample US-7D (see **Section 6.3.3**). PD-1 is a shallow monitoring well located closest to the potential PFOS, PFOA, and PFBS source area, and is the source area monitoring well for other constituents related to historical Building 1A/1BB1 Former Chromium Plating and IWWPTP environmental releases. UA-6D is a bedrock monitoring well that is located downgradient of the AOPI. • Shallow groundwater originating at the AOPI potentially discharges to surface water bodies on post (e.g., Barney's Lake, Hummler Run). Surface water and sediment were sampled from Hummler Run (immediately downgradient of Barney's Lake), as seen in the sampling rationale for the Temporary Dewatered Sludge Storage Site AOPI. • Surface soil is not anticipated to be impacted from historical operations at the AOPI since the area is surrounded by pavement/other buildings and the suspected releases are through subsurface infrastructure. Since the subsurface soil is located under buildings and pavement, subsurface soil sampling will not be pursued in the SI phase.
Temporary Dewatered Sludge Storage Site **(TBAD-033, 42780.1033)**	• Three surface soil samples were collected, one within the suspected AOPI where sludge was placed, and two on the southern edge of the AOPI to capture potential soil and surface water runoff during precipitation events. • One shallow monitoring well installation/groundwater sample was located downgradient of the suspected AOPI area prior to shallow groundwater discharge to Barney's Lake. • One co-located surface water and sediment sample from Hummler Run, where the TYAD STP effluent is located, which would have captured potentially PFAS-containing materials associated with chromium plating,

AOPI Name	SI Sampling Rationale
	and Hummler Run is downstream of Barney's Lake, where shallow groundwater originating at the AOPI likely discharges.
OU-5 Inactive Sanitary Landfill **(TBAD-001, 42780.1001)**	• Five groundwater samples were collected from existing wells at the AOPI. LF-13 is the northernmost shallow monitoring well that is located within the AOPI; it was sampled to obtain shallow groundwater data within the northern portion of the landfill. LF-10 is a bedrock monitoring well that is located in the central portion of the landfill and proximal to the subsurface stormwater drainage pipe, where the highest levels of other constituents related to landfill environmental releases have previously been detected in recent sampling events. LF-11 is a bedrock monitoring well that is located near the western end of the AOPI boundary and close to the installation boundary. LF-11 is also proximal to the subsurface stormwater drainage pipe, where the highest levels of other constituents related to landfill environmental releases have previously been detected in recent sampling events. LF-23 is the southernmost shallow monitoring well that is located within the AOPI and close to the AOPI and installation boundary; it was sampled to obtain shallow groundwater data within the southern portion of the landfill. LF-29 is a bedrock monitoring well that is located downgradient of the AOPI and off-post. • Since the AOPI consists of a landfill, surface and subsurface soil sampling within landfills will not be pursued during the SI phase, consistent with USAEC direction.
OU-1 Area B- Former Drum Storage Area **(TBAD-007, 42780.1007)**	• Three groundwater samples were collected from existing wells at the AOPI. MW-10 is a shallow monitoring well that is located within the downgradient AOPI boundary and close to the installation boundary which was sampled to obtain shallow groundwater data within the southeastern portion of the AOPI. MW-11 is a shallow monitoring well that is located within the western portion of the AOPI. MW-23 is a bedrock monitoring well that is located downgradient of the AOPI and off-post. • Due to the previous soil excavation activities at this AOPI for other constituents, the boundaries of potentially impacted soils are unknown and surface and subsurface soil sampling will not be pursued during this SI.
Building 74: AFFF Storage	• Three surface soil samples were collected in the low-lying surface drainage collection points, adjacent to the Building 74 loading dock pavement to capture potential AFFF releases to soil during loading/unloading activities as well as historical releases to the pavement related to the historical AFFF fire suppression system.

AOPI Name	SI Sampling Rationale
	• One groundwater sample was collected from the AOPI following sonic drilling and monitoring well installation during a second mobilization.

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 QAPP Addendum (Arcadis 2020a), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2020b). 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 2020a). 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 J** and **K**, respectively.

6.3.1 Field Methods

Groundwater samples were collected at all seven AOPIs following the installation of new monitoring wells by air-rotary or sonic drilling, or via existing monitoring wells. A total of five new monitoring wells (two at Historical Fire Training Area – Burn Pit, one at Building 17 – Fire Station, one at Temporary Dewatered Sludge Storage Site, and one at Building 74 – AFFF Storage) were installed once first groundwater was encountered. Three of the five new monitoring wells were completed in the overburden (i.e., bedrock was not encountered at any of the boring locations) and are located at the Historical Fire Training Area – Burn Pit and Temporary Dewatered Sludge Storage Site AOPIs. Two of the five new monitoring wells were completed across the bedrock/overburden interface and are located at the Building 17 – Fire Station and Building 74 – AFFF Storage AOPIs. Well construction details and design (e.g., screen length and slot size, depth, filter pack material) for the newly installed monitoring wells are included in **Appendix K**. New monitoring wells were developed using a monsoon pump. Following well development and consistent with PADEP guidance, a 2-week waiting period elapsed before the new wells were purged using low-flow purging methods with a peristaltic pump/high-density polyethylene (HDPE) tubing. A total of 10 existing monitoring wells were sampled (two at Building 1A/1BB1 Former Chromium Plating and IWWPTP, five at OU-5 Inactive Sanitary Landfill, and three at OU-1 Area B Former Drum Storage Area). Existing equipment (e.g., sample tubing) was removed from each of the existing monitoring wells at least two weeks prior to purging. Existing monitoring wells were also purged using low-flow purging methods with a peristaltic pump or bladder pump and HDPE sample tubing. Field parameters (e.g., temperature, pH, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) were measured during purging of new and existing monitoring wells and allowed to stabilize prior to sampling to ensure a

representative sample was collected. Coordinates for the top of casing at each new groundwater monitoring well were surveyed by a Pennsylvania licensed surveyor.

Surface soil samples were collected at a total of 11 discrete points using a stainless-steel hand auger. At each surface soil sampling point, a composite soil sample was collected within the 0.5 to 2 feet bgs interval. Coordinates for each soil sampling location were recorded using a handheld global positioning system.

A total of three surface water samples were collected using direct-fill methods just below the water surface. Surface water samples were co-located with select sediment sampling locations. Surface water samples were collected prior to sediment sample collection to reduce siltation. Field parameters (e.g., temperature, pH, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) were measured at the time during surface water sampling.

A total of three sediment samples were collected during the TYAD SI. Sediment samples were collected from the upper 10 centimeters using a decontaminated Lexan tube and stainless-steel trowel; sediment samples were decanted before bottling for laboratory analysis.

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

In addition to the new and existing monitoring wells that were sampled during the SI, the SI field team and professional land surveyor calibrated historical surveyed elevations with that of the newly installed monitoring wells present at TYAD. The SI field staff collected water levels from the newly installed monitoring wells, as well as from a subset of existing wells present across the entire installation to evaluate groundwater flow patterns at installation-scale and evaluate whether groundwater from the AOPIs at TYAD could flow off-post to potential downgradient drinking water receptors (**Section 2.10**). A total of 36 monitoring wells were gauged and surveyed based on available well construction information (i.e., including both overburden and bedrock screened wells) and accessibility and condition. Where possible, a combination of overburden and bedrock grouped/nested wells were gauged. Results of the installation-wide groundwater flow evaluation are discussed in **Section 7.10**.

6.3.2 Quality Assurance/Quality Control

Worksheets #20 of the PQAPP and QAPP Addendum provide QA/QC requirements for field duplicates, matrix spike/matrix spike duplicates, equipment blanks (EBs), 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 2020a), typically at a rate of 1 per 20 parent samples. Field duplicates and matrix spike/matrix spike duplicate samples were collected for media sampled for PFOS, PFOA, and PFBS only. EBs were collected for media sampled for PFOS, PFOA, and PFBS, at a frequency of one per piece of relevant equipment for each sampling event, as specified in the QAPP Addendum (Arcadis 2020a). The decontaminated reusable equipment from which EBs were collected include the drill bit, hand augers, water-level meters, and bladder pumps as applicable to the sampled media. Source blanks were collected from the water used to pressure-wash drill tooling, which was sourced from the TYAD water supply. Analytical results for blank samples (i.e., EBs, source blanks, field blanks) are discussed in **Section 7.9**.

6.3.3 Field Change Reports

No instances of major scope modifications (i.e., those that may have had a significant impact on the project scope and/or data usability/quality, or required stop-work, and warranted discussion with USACE) were encountered during the TYAD SI work.

In some cases, clarifications to the established scope of work were needed but do not necessarily constitute a non-conformance from the sampling plans described in the QAPP Addendum. 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 L** and are summarized below:

- FCR-TYAD-01: An additional field mobilization was conducted in August and September 2021 at TYAD to install monitoring wells and subsequently collect groundwater samples at both the Building 17 – Fire Station AOPI and the Building 74- AFFF Storage AOPI. The original planned field work and additional mobilization scope for each AOPI is described below:
    - Building 17 – Fire Station- During the first field mobilization, field staff planned to collect groundwater samples from existing monitoring well US-7D at the Building 17 – Fire Station AOPI. Upon field assessment of existing monitoring well US-7D, field staff noted a blockage approximately 10 feet below grade in the monitoring well. Field staff attempted to remove the blockage but were unsuccessful. Field staff then located and assessed the condition of existing monitoring well US-7S as a potential alternative. However, monitoring well US-7S was dry during two separate well integrity assessments and field staff determined the well could not be sampled. As a third alternative, field staff scheduled the drillers to install a new monitoring well during the first mobilization. TYAD marked out an approved boring location and an 811 ticket was called in for clearing. Upon hand clearing, field staff noted a large boulder at 5 feet bgs and the air rotary/hollow-stem auger drilling equipment were unable to move past the boulder. The team could not step out due to lack of alternative utility-approved areas and over 1 foot of snow covering the already marked out utilities. Because groundwater data at Building 17 – Fire Station is necessary to achieve the goals of the SI and make recommendations for the AOPI, an additional mobilization was conducted in August 2021. During this mobilization, a groundwater boring was installed via sonic drilling techniques and was located off of the southern portion of the fire station driveway pavement in order to capture potential runoff from fire department operations outside of the bays. In accordance with PADEP guidelines, the new monitoring well was sampled in early September 2021 (at least 2 weeks following well installation/development).
    - Building 74 – AFFF Storage- During the first field mobilization, an attempted monitoring well could not be installed at Building 74 - AFFF Storage AOPI due to repeated drilling refusal and utility limitations. Therefore, a groundwater sample was not collected. During monitoring well installation attempt #1, a utility was identified during soft digging that had not been identified during a private utility markout, 811 markout, and the TYAD dig permit process. The boring was moved away from the original location and to an approved location closer to Building 74. The team remobilized on 21 December 2020 to advance the boring at location #2 and hit refusal on a boulder approximately 10 feet bgs.

The air rotary bit was able to pass the boulder, however the augers could not. The team could not step out due to lack of alternative approved areas and over 1 foot of snow covering the already marked out utilities. The drillers brought wider (6 inches) diameter augers on 22 December 2020 in an attempt to move past the boulders and was able to advance the augers to a total depth of 22 feet bgs before reaching another boulder and ultimately refusal. The final depth reached with the air rotary bit was 32 feet bgs, and no water was encountered. The boulders encountered at boring location #2 ranged in diameter of 1 to 2 feet. The approved boring location could not be advanced with the air-rotary/hollow-stem auger drilling method on-site, and an alternative location could not be picked due to surface and utility conditions. Because groundwater data at Building 74 – AFFF Storage is necessary to achieve the goals of the SI and make recommendations for the AOPI, an additional mobilization was conducted in August 2021. During this mobilization, a groundwater boring was installed via sonic drilling techniques and was located on the southern edge of Building 74, downgradient of AFFF storage within the building and downgradient of the driveway/pavement where runoff could have occurred. In accordance with PADEP guidelines, the new monitoring well was sampled in early September 2021 (at least 2 weeks following well installation/development).

6.3.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., hand augers, water-level meters, bladder pumps, drill cutting shoes, rods, and casing) 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

IDW, including soil cuttings and groundwater, were disposed on the ground at the point of collection as directed by TYAD and as outlined in the TYAD QAPP Addendum (Arcadis 2020a). Decontamination fluids were collected and disposed in the TYAD sanitary sewer (i.e., connected to the TYAD STP) at the request of the installation. Disposable equipment IDW was collected in bags and disposed in municipal waste receptacles. Disposable equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, Lexan tubes, and HDPE and silicon tubing) that may 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 Eurofins Lancaster Laboratories Environmental, an ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, and PFBS, by

liquid chromatography with tandem mass spectrometry. Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). Eighteen PFAS-related compounds, including PFOS, PFOA, and PFBS, were analyzed for in groundwater, soil, surface water, and sediment samples using an analytical method that is ELAP-accredited and compliant with QSM 5.1.1 (DoD 2018), 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 2020a) by the analytical method noted:

- Total organic carbon (TOC) by Solid Waste Test Method 846 9060A
- Grain size analysis by American Society for Testing and Materials D422-63
- pH by Solid Waste Test Method 846 9045D

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

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

6.4.2 Data Validation

All analytical data generated during the SI, except grain size, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.3 (DoD and Department of Energy 2019). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix M**. The Level IV analytical reports are included within **Appendix M** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

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

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

6.5 Office of the Secretary of Defense Risk Screening Levels

The OSD risk screening levels for PFOS, PFOA, and PFBS in groundwater (tap water) and soil were calculated using the USEPA's RSL calculator for residential and industrial/commercial worker receptor scenarios and current toxicity values. These risk screening levels are shown in **Table 6-3**.

Table 6-3 OSD Risk Screening Levels Calculated for PFOS, PFOA, and PFBS in Tap Water and Soil Using USEPA's Regional Screening Level Calculator

Chemical	Residential Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator		Industrial/Commercial Scenario Risk Screening Levels Calculated Using USEPA RSL Calculator
	Tap Water (ng/L or ppt) [1]	Soil (mg/kg or ppm) [1,2]	Soil (mg/kg or ppm) [1,2]
PFOS	40	0.13	1.6
PFOA	40	0.13	1.6
PFBS	600	1.9	25

Notes:

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

The OSD residential tap water risk screening levels will be used to compare all groundwater for this Army PFAS PA/SI. While the current and most likely future land uses of the AOPIs at TYAD are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, and PFBS will be used to evaluate detected soil concentrations. The data from the SI sampling event are compared to the OSD risk screening levels in **Section 7**. If concentrations of PFOS, PFOA, or PFBS are detected greater than the applicable OSD risk screening levels, further study in a remedial investigation is recommended in **Section 9**.

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at TYAD (field duplicate results are provided in the associated tables). Sampled media and QA/QC samples were analyzed for the constituents prescribed per Worksheet #18 of the QAPP Addendum (Arcadis 2020a). The sample results discussion below focuses on the PFOS, PFOA, and PFBS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

Tables 7-1 through **7-4** provide a summary of the groundwater, soil, surface water, and sediment analytical results for PFOS, PFOA, and PFBS. **Table 7-5** summarizes AOPIs and whether their SI results exceed the OSD risk screening levels. **Appendix N** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at TYAD with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** through **7-8** show the PFOS, PFOA, and PFBS analytical results in groundwater, soil, surface water, and sediment for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, and/or PFBS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. Final qualifiers applied to the data by the laboratory and the project chemist (as defined in **Section 6.4.3**) are presented on the analytical tables. Groundwater and surface water data collected during the SI are reported in ng/L, or parts per trillion, and soil and sediment data are reported in mg/kg, or parts per million.

Field parameters measured for groundwater during low-flow purging and sample collection and for surface water during sample collection are provided on the field forms in **Appendix K**. Soil and sediment descriptions are provided on the field forms in **Appendix K**. The results of the SI are grouped by AOPI and discussed for each medium as applicable.

Table 7-5 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No)
Historical Fire Training Area – Burn Pit	Yes
Building 17 – Fire Station	Yes
Building 1A/1BB1	Yes
Temporary Dewatered Sludge Storage Site	No
OU-5 Inactive Sanitary Landfill	Yes
OU-1 Area B Former Drum Storage Area	No
Building 74 – AFFF Storage	Yes

7.1 Historical Fire Training Area – Burn Pit (TBAD-058, 42780.1058)

The subsections below summarize the groundwater, soil, surface water, and sediment PFOS, PFOA, and PFBS analytical results associated with Historical Fire Training Area – Burn Pit.

7.1.1 Groundwater

One shallow groundwater sample, TYAD-BurnPit-1-GW, was collected and co-located with the downslope soil boring (TYAD-BurnPit-1-SO) where AFFF may have been released or overflowed during AFFF equipment testing activities. A second shallow groundwater sample, TYAD-BurnPit-2-GW, was collected downgradient of the suspected AOPI prior to shallow groundwater discharge to Oakes Swamp (**Figure 7-2**).

PFOS was detected in TYAD-BurnPit-1-GW and TYAD-BurnPit-2-GW at concentrations above the OSD risk screening level for tap water (40 ng/L) at 240 DM ng/L and 350 DM ng/L, respectively (**Table 7-1**).

PFOA was detected in TYAD-BurnPit-1-GW and TYAD-BurnPit-2-GW at concentrations below the OSD risk screening level for tap water at 21 M ng/L and 9.9 M ng/L, respectively (**Table 7-1**).

PFBS was detected in TYAD-BurnPit-1-GW and TYAD-BurnPit-2-GW at concentrations below the OSD risk screening level for tap water at 19 ng/L and 9.3 M ng/L, respectively (**Table 7-1**).

7.1.2 Soil

Three surface soil samples (TYAD-BurnPit-1-SO, TYAD-BurnPit-2-SO, TYAD-BurnPit-3-SO) were collected within the suspected AOPI where AFFF may have been released or overflowed during AFFF equipment testing activities (**Figure 7-2**).

PFOS was detected in TYAD-BurnPit-1-SO, TYAD-BurnPit-2-SO, and TYAD-BurnPit-3-SO at 0.0018 mg/kg, 0.0049 mg/kg, and 0.0019 mg/kg, respectively, which are each below the applicable residential OSD risk screening level (0.13 mg/kg). PFOA and PFBS were not detected in any of the three surface soil samples collected (**Table 7-2**).

7.1.3 Surface Water

Two surface water samples, TYAD-BurnPit-1-SW and TYAD-BurnPit-2-SW, were collected from Oakes Swamp, where surface runoff may have flowed from the Historical Fire Training Area- Burn Pit following AFFF equipment testing activities and during precipitation events. Oakes Swamp also likely receives shallow groundwater discharges from the AOPI (**Figure 7-2**).

PFOS, PFOA, and PFBS were detected in TYAD-BurnPit-1-SW at 28 ng/L, 4.5 M ng/L, and 5.4 M ng/L, respectively (**Table 7-3**).

PFOS, PFOA, and PFBS were detected in TYAD-BurnPit-2-SW at 37 ng/L, 2.4 ng/L, and 3.1 M ng/L, respectively (**Table 7-3**).

7.1.4 Sediment

Two sediment samples, TYAD-BurnPit-1-SE and TYAD-BurnPit-2-SE, were collected from Oakes Swamp, where surface runoff may have flowed from the Historical Fire Training Area- Burn Pit following AFFF equipment testing activities and during precipitation events. Oakes Swamp also likely receives shallow groundwater discharges from the AOPI. Sediment samples TYAD-BurnPit-1-SE and TYAD-BurnPit-2-SE were co-located with surface water samples TYAD-BurnPit-1-SW and TYAD-BurnPit-2-SW (**Figure 7-2**).

PFOS, PFOA, and PFBS were not detected in TYAD-BurnPit-1-SE (**Table 7-4**).

PFOS was detected in TYAD-BurnPit-2-SE at 0.0011 mg/kg. PFOA and PFBS were not detected in TYAD-BurnPit-2-SE (**Table 7-4**).

7.2 Building 17 – Fire Station

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results associated with Building 17 – Fire Station.

7.2.1 Groundwater

One groundwater sample, TYAD-B17FS-1-GW, was collected on the southern portion of the fire station driveway pavement to capture potential AFFF runoff from fire department operations outside of the bays (**Figure 7-3**).

PFOS (1,200 D ng/L), PFOA (610 DM ng/L), and PFBS (840 D ng/L) were each detected in TYAD-B17FS-1-GW at concentrations above their respective OSD risk screening level for tap water (40 ng/L for PFOS and PFOA, 600 ng/L for PFBS) (**Table 7-1**).

7.2.2 Soil

Two surface soil samples, TYAD-B17FS-1-SO and TYAD-B17FS-2-SO, were collected on the edges of the fire station parking lot where field staff observed runoff collection points/low-lying areas where AFFF may have collected (**Figure 7-3**).

PFOS was detected in surface soil sample TYAD-B17FS-1-SO at 0.027 mg/kg, which is below the residential OSD risk screening level (0.13 mg/kg). PFOA and PFBS were not detected in surface soil sample TYAD-B17FS-1-SO (**Table 7-2**).

PFOS and PFOA were detected in surface soil sample TYAD-B17FS-2-SO at 0.019 mg/kg and 0.0017 mg/kg, respectively. Both PFOS and PFOA detections in sample TYAD-B17FS-2-SO are less than the residential OSD risk screening level (0.13 mg/kg). PFBS was not detected in surface soil sample TYAD-B17FS-2-SO (**Table 7-2**).

7.3 Building 1A/1BB1 Former Chromium Plating IWWPTP (TBAD-067, 42780.1067)

The subsections below summarize the groundwater PFOS, PFOA, and PFBS analytical results associated with Building 1A/1BB1 Former Chromium Plating IWWPTP.

7.3.1 Groundwater

Two groundwater samples, TYAD-PD-1 and TYAD-UA-6D, were collected from downgradient existing wells, PD-1 and UA-6D (**Figure 7-4**). Monitoring well PD-1 is a shallow monitoring well located most proximal to the AOPI and is the source well for other constituents (i.e., non-PFAS constituents) related to historical operations and environmental releases at the AOPI. Monitoring well UA-6D is a downgradient bedrock monitoring well that was also sampled in 2017 (**Section 2.12**).

PFOS, PFOA, and PFBS were detected in the groundwater sample TYAD-PD-1 at 27 ng/L, 3.4 M ng/L, and 1.1 JM ng/L, respectively. Each of the PFOS, PFOA, and PFBS concentrations in TYAD-PD-1 are below the OSD risk screening levels for tap water (40 ng/L for PFOS and PFOA and 600 ng/L for PFBS) (**Table 7-1**).

PFOA was detected in groundwater sample TYAD-UA-6D at 98 ng/L, above the OSD risk screening level for tap water (40 ng/L). PFOS and PFBS were detected in groundwater sample TYAD-UA-6D at 13 ng/L and 1.4 JM ng/L, respectively. Both the PFOS and PFBS concentrations in TYAD-UA-6D are below the OSD risk screening levels for tap water (40 ng/L for PFOS and 600 ng/L for PFBS) (**Table 7-1**).

7.4 Temporary Dewatered Sludge Storage Site (TBAD-033, 42780.1033)

The subsections below summarize the groundwater, soil, surface water, and sediment PFOS, PFOA, and PFBS analytical results associated with Temporary Dewatered Sludge Storage Site.

7.4.1 Groundwater

One groundwater sample, TYAD-TDSSS-1-GW, was collected downgradient of the suspected area where sludges were placed, and before shallow groundwater discharges to Barney's Lake (**Figure 7-5**).

PFOA was detected at 14 M ng/L, below the OSD risk screening level for tap water (40 ng/L). PFOS and PFBS were not detected in groundwater sample TYAD-TDSSS-1-GW (**Table 7-1**).

7.4.2 Soil

Three surface soil samples, TYAD-TDSSS-1-SO, TYAD-TDSSS-2-SO, and TYAD-TDSSS-3-SO, were collected within and southeast of the Temporary Dewatered Sludge Storage Site. Surface soil sample TYAD-TDSSS-1-SO was collected within the suspected AOPI where sludge was placed. TYAD-TDSSS-2-SO and TYAD-TDSSS-3-SO were collected on the southern edge of the AOPI to assess potential soil and surface water runoff during precipitation events (**Figure 7-5**).

PFOS was detected in TYAD-TDSSS-1-SO, TYAD-TDSSS-2-SO, and TYAD-TDSSS-3-SO at 0.001 mg/kg, 0.031 mg/kg, and 0.0043 mg/kg, respectively, which are each below the residential OSD risk screening level (0.13 mg/kg) (**Table 7-2**).

PFOA was detected in TYAD-TDSSS-2-SO at 0.0006 JM mg/kg, below the residential OSD risk screening level (0.13 mg/kg). PFOA was not detected in TYAD-TDSSS-1-SO and TYAD-TDSSS-3-SO (**Table 7-2**).

PFBS was not detected in TYAD-TDSSS-1-SO, TYAD-TDSSS-2-SO, and TYAD-TDSSS-3-SO (**Table 7-2**).

7.4.3 Surface Water

One surface water sample, TYAD-TDSSS-1-SW, was collected from Hummler Run, where the TYAD STP effluent discharges (i.e., which may have conveyed PFAS-containing materials from Building 1A/1BB1 Former Chromium Plating and IWWPTP). Additionally, shallow groundwater from the Temporary Dewatered Sludge Storage Site discharges to Barney's Lake, which ultimately flows through Hummler Run (**Figure 7-6**). Surface water sample TYAD-TDSSS-1-SW was collected downstream of the TYAD STP effluent discharge location.

PFOS, PFOA, and PFBS were detected in TYAD-TDSSS-1-SW at 17 ng/L, 2.1 M ng/L, and 1.3 JM ng/L, respectively (**Table 7-3**).

7.4.4 Sediment

One sediment sample, TYAD-TDSSS-1-SE, was collected from Hummler Run, where the TYAD STP effluent discharges (i.e., which may have conveyed PFAS-containing materials from Building 1A/1BB1 Former Chromium Plating and IWWPTP). Additionally, shallow groundwater from the Temporary Dewatered Sludge Storage Site discharges to Barney's Lake, which flows through Hummler Run (**Figure 7-6**). Sediment sample TYAD-TDSSS-1-SE was collected downstream of the TYAD STP effluent discharge location, and was co-located with surface water sample TYAD-TDSSS-1-SW.

PFOS was detected in the duplicate sample only at 0.00056 J mg/kg. PFOA and PFBS were not detected in sediment sample TYAD-TDSSS-1-SE (**Table 7-4**).

7.5 OU-5 Inactive Sanitary Landfill (TBAD-001, 42780.1001)

The subsections below summarize the groundwater PFOS, PFOA, and PFBS analytical results associated with Inactive Sanitary Landfill (OU-5).

7.5.1 Groundwater

Five groundwater samples, TYAD-LF-10, TYAD-LF-11, TYAD-LF-13, TYAD-LF-23, and TYAD-LF-29, were collected from existing monitoring wells within and downgradient of the OU-5 Inactive Sanitary Landfill (**Figure 7-6**). Monitoring well LF-13 is located within the upgradient northern edge of the AOPI. Monitoring wells LF-10 and LF-11 are located along the stormwater drainage pipe, where other landfill constituents (i.e., non PFAS constituents) have been observed at higher detections. Monitoring well LF-

23 is located on the southwestern downgradient edge of the AOPI. Monitoring well LF-29 is located off-post and downgradient of the AOPI, and was previously sampled for PFOS, PFOA, and PFBS (**Section 2.12**).

PFOS, PFOA, and PFBS were detected in bedrock monitoring well TYAD-LF-10 at 28 M ng/L, 12 M ng/L, and 14 ng/L, respectively, which are each below the applicable OSD risk screening levels for tap water (40 ng/L for PFOS and PFOA, 600 ng/L for PFBS) (**Table 7-1**).

PFOS, PFOA, and PFBS were detected in bedrock monitoring well TYAD-LF-11 at 6.7 M ng/L, 14 M ng/L, and 2.4 ng/L, respectively, which are each below the applicable OSD risk screening levels for tap water (40 ng/L for PFOS and PFOA, 600 ng/L for PFBS) (**Table 7-1**).

PFOS, PFOA, and PFBS were detected in shallow monitoring well TYAD-LF-13 at 29 ng/L, 5.6 M ng/L, and 1.1JM ng/L, respectively, which are each below the applicable OSD risk screening levels for tap water (40 ng/L for PFOS and PFOA, 600 ng/L for PFBS) (**Table 7-1**).

PFOS and PFOA were detected in shallow monitoring well TYAD-LF-23 at 20 ng/L and 15 J ng/L, respectively, which are each below the OSD risk screening levels for tap water (40 ng/L). PFBS was not detected in TYAD-LF-23 (**Table 7-1**)**.**

PFOS was detected in bedrock monitoring well TYAD-LF-29 at 2.6 ng/L, which is below the OSD risk screening level for tap water (40 ng/L). PFOA was detected in TYAD-LF-29 at 56 M ng/L, which is greater than the OSD risk screening level for tap water (40 ng/L). PFBS was not detected in TYAD-LF-29 (**Table 7-1**)**.**

7.6 OU-1 Area B Former Drum Storage Area (TBAD-007, 42780.1007)

The subsections below summarize the groundwater PFOS, PFOA, and PFBS analytical results associated with Area B Former Drum Storage Area (OU-1).

7.6.1 Groundwater

Three groundwater samples, TYAD-MW-10, TYAD-MW-11, and TYAD-MW-23, were collected within and downgradient of the OU-1 Area B Former Drum Storage Area (**Figure 7-7**). Monitoring well MW-10 is located within the southern downgradient edge of the AOPI. Monitoring well MW-11 is located on the western edge within the AOPI, and was previously sampled for PFOS, PFOA, and PFBS (**Section 2.12**). Monitoring well MW-23 is located off-post and downgradient of the AOPI, and was previously sampled for PFOS, PFOA, and PFBS (**Section 2.12**).

PFOS and PFOA were detected in TYAD-MW-10 at 8.4 ng/L and 2.8 M ng/L, respectively, which are each below the OSD risk screening levels for tap water (40 ng/L). PFBS was not detected in TYAD-MW-10 (**Table 7-1**).

PFOS, PFOA, and PFBS were detected in TYAD-MW-11 at 14 ng/L, 6.2 M ng/L, and 1.7 JM ng/L, respectively, which are each below the applicable OSD risk screening levels for tap water (40 ng/L for PFOS and PFOA, 600 ng/L for PFBS) (**Table 7-1**).

PFOS was detected in TYAD-MW-23 at 1.5 J ng/L, below the OSD risk screening level for tap water (40 ng/L). PFOA and PFBS were not detected in TYAD-MW-23 (**Table 7-1**).

7.7 Building 74 – AFFF Storage

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results associated with Building 74 – AFFF Storage.

7.7.1 Groundwater

One groundwater sample, TYAD-B74-1-GW, was collected on the southern edge of the Building 74 lot, downgradient of AFFF storage within the building and downgradient of the driveway/pavement where runoff could have occurred (**Figure 7-8**).

PFOA (77 ng/L) was detected in groundwater sample TYAD-B74-1-GW at a concentration above the OSD risk screening level for tap water (40 ng/L) (**Table 7-1**).

PFOS (1.7 ng/L) was detected in groundwater sample TYAD-B74-1-GW at a concentration below the OSD risk screening level for tap water (40 ng/L).

PFBS was not detected in groundwater sample TYAD-B74-1-GW.

7.7.2 Soil

Three surface soil samples, TYAD-B74-1-SO, TYAD-B74-2-SO, and TYAD-B74-3-SO, were collected in the low-lying surface drainage collection points near the Building 74 loading dock (**Figure 7-8**).

PFOS and PFOA were detected in TYAD-B74-1-SO at 0.0005 mg/kg and 0.00054 mg/kg, respectively, each below the residential OSD risk screening level (0.13 mg/kg). PFBS was not detected in TYAD-B74-1-SO (**Table 7-2**).

PFOS, PFOA, and PFBS were not detected in TYAD-B74-2-SO and TYAD-B74-3-SO (**Table 7-2**).

7.8 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, and PFBS, one soil sample per AOPI was analyzed for TOC, pH, moisture content, and grain size data as they may be useful in future fate and transport studies. The TOC in the soil samples ranged from 7,230 to 49,400 mg/kg. The average TOC at TYAD was 18,532 mg/kg, which is within range of TOC typically observed in topsoil (5,000 to 30,000 mg/kg). The combined percentage of fines (i.e., silt and clay) in soils at TYAD ranged from 25.2 to 32.1% with an average of 29.3%. In general, PFAS constituents tend to be more mobile in soils with less than 20% fines (silt and clay) and lower TOC. The percent moisture of the soil, 12.7%, was typical for loam (0 to 12% or clay (0 to 20%). The pH of the soil was slightly alkaline (7 to 9 standard units). Based on these geochemical and physical soil characteristics, 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.

7.9 Blank Samples

Detections of PFOS, PFOA, and PFBS constituents are summarized below for blank samples. Other than those noted below, concentrations of PFOS, PFOA, PFBS in all other blank samples were not detected.

- PFOS (9.9 ng/L) and PFOA (2.0 ng/L) were detected in source blank sample TYAD-SB-1 during the first field mobilization. Source blank sample TYAD-SB-1 was collected from a TYAD fire hydrant, which is supplied by the TYAD water supply on-post. The TYAD water supply at the time of the first field mobilization was sourced from potable wells that are now decommissioned (Wells 1, 3, 4, and 5). This water source was used in the initial step of decontamination. However, all EB samples collected during the first field mobilization (i.e., collected after the decontamination process) did not have PFOS, PFOA, or PFBS detections. Therefore, the PFOS and PFOA detections observed in sample TYAD-SB-1 did not impact AOPI sample results.
- PFOS (6.5 ng/L) and PFOA (1.3 JM ng/L) were detected in source blank sample TYAD-SB-3 during the second field mobilization. Source blank sample TYAD-SB-3 was collected from a TYAD fire hydrant, which is supplied by the TYAD water supply on-post. The TYAD water supply at the time of the second field mobilization consisted of the active potable wells (Wells 2, 6, 7, 8, 9, and 10). This water source was used in the initial step of decontamination. However, all EB samples (except for TYAD-EB-6 described below) collected during the second field mobilization (i.e., collected after the decontamination process) did not have PFOS, PFOA or PFBS detections. Therefore, the PFOS and PFOA detections observed in sample TYAD-SB-3 did not impact AOPI sample results.
- PFOS (1.1 MJN ng/L) was detected in EB sample TYAD-EB-6, which was collected from the bladder pump/bladder/sample tubing during the second field mobilization. The PFOS detection in TYAD-EB-6 was less than five times the concentration in the associated groundwater samples, therefore the EB PFOS detection did not impact AOPI sample results.

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

7.10 Installation-Wide Groundwater Flow Evaluation

As discussed in **Section 6.3.1**, a total of 36 monitoring wells were surveyed and gauged during the SI to evaluate groundwater flow patterns at installation-scale and evaluate whether groundwater from the AOPIs at TYAD could flow off-post to potential downgradient drinking water receptors (**Section 2.10**). A total of 16 overburden wells (screened in low permeability till) and 20 bedrock wells (screened in fractured sandstone) were surveyed and gauged in January 2021. Potentiometric surfaces for the overburden and bedrock units based on those water-level measurements are presented on **Figures 7-9 and 7-10**, respectively. The gauging results support the following observations:

- The overburden potentiometric surface (**Figure 7-9**) divides between three separate drainages: Oakes Swamp to the north, Cross-Keys Run to the west and Barney Lake/Hummler Run to the south. Adjacent to these surface water bodies, flow from overburden is expected to discharge to surface water. In the central portion of the industrial area, the saturated thickness of the till is frequently less than 10 ft and the dominant flow direction is likely downward into the bedrock (EA 2018).
- The bedrock potentiometric surface (**Figure 7-10**) divides between Cross-Keys Run to the west and Barney Lake/Hummler Run to the south. Potential gradients northward to Oakes Swamp or east to northeast toward the TYAD production wells cannot be determined based on the existing

well network. In the sandstone bedrock, flow patterns will be influence by the bedrock structural, which is expected to favor flow parallel to the east-northeast to west-southwest bedding strike.

Based on this evaluation, groundwater beneath the Historical Fire Training Area-Burn Pit is expected to discharge to Oakes Swamp on-post. Groundwater beneath the OU-5 Inactive Sanitary Landfill and Building 74 - AFFF storage is likely discharging to Cross-Keys Run, immediately off-post in an undeveloped State Game Lands. Groundwater beneath the remaining AOPIs has the potential to migrate southward off-post to areas with potential downgradient drinking water receptors. As noted in **Section 2.10**, the bedrock aquifer is the major source of potable water supply for regions surrounding TYAD. Information regarding off-post investigations is provided in **Section 8**.

The survey table output data (i.e., monitoring well identifications, coordinates, elevation data) for the 36 monitoring wells surveyed during the SI is provided as **Appendix O**.

7.11 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2020a) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-11** through **7-17** and in this section therefore represent the current understanding of the potential for human exposure. For some AOPIs, the CSM is the same and thus shown on the same figure.

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

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

Human exposure pathways are shown as “complete”, “potentially complete”, or “incomplete” on the CSM figures. A complete exposure pathway consists of a constituent source and release mechanism, a

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

Figure 7-11 shows the CSM for Historical Fire Training Area – Burn Pit. Potential releases of AFFF to soil and/or paved surfaces could migrate to groundwater by desorption and/or dissolution and to surface water and sediment by discharge from shallow groundwater or surface runoff, dissolution, and adsorption.

- PFOS, PFOA, and/or PFBS were detected in soil at the Historical Fire Training Area – Burn Pit and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete. The AOPI is within a restricted UXO fence line and is therefore not likely to be regularly accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in shallow groundwater at the Historical Fire Training Area – Burn Pit. Shallow groundwater originating at this AOPI likely flows to the north-northwest towards Oakes Swamp, away from active on-post potable wells. It is unlikely groundwater flow from the AOPI flows east-southeast towards on- post potable wells. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater. Recreational users are not likely to contact groundwater. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- PFOS, PFOA, and/or PFBS were detected in shallow groundwater at the Historical Fire Training Area – Burn Pit and groundwater originating at this AOPI potentially flows off-post through the installation’s northwestern boundary as well as potentially off-post through the installation’s southern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- PFOS, PFOA, and/or PFBS were detected in surface water and sediment collected from Oakes Swamp, which is not used for drinking water. On-installation receptors are not likely to contact surface water and sediment in Oakes Swamp since it is located within a UXO fence line (i.e., restricted access) and does not have any operational uses at TYAD; therefore, these exposure pathways are incomplete.
- Surface water from Oakes Swamp flows off-post through the northwestern installation boundary, which is not known to be used for drinking water off-post. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 7-12 shows the CSM for the Building 17- Fire Station. Potential releases of AFFF to soil and/or paved surfaces could migrate to soil via surface runoff, groundwater via desorption and/or dissolution, and to surface water and sediment via discharge from shallow groundwater, dissolution, and adsorption.

- PFOS, PFOA, and/or PFBS were detected in soil at Building 17 – Fire Station and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete. The AOPIs are not likely to be regularly accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at Building 17 – Fire Station. Building 17 – Fire Station is downgradient of active potable wells at TYAD. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater. Recreational users are not likely to contact groundwater. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at Building 17 – Fire Station. Groundwater originating at the AOPI eventually flows off-post through the installation's southern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Shallow groundwater at the AOPI potentially discharges into surface water bodies on post (i.e., Barney's Lake/Hummler Run). PFOS, PFOA, and/or PFBS were detected in surface water and sediment collected in Hummler Run during the SI. Surface water bodies on-post are not used for drinking water, however the effluent discharge location of the TYAD STP is located on Hummler Run. On-installation site workers who may perform work related to the effluent discharge location could potentially contact surface water and sediment in Hummler Run. Therefore, the surface water and sediment exposure pathways (via incidental ingestion and dermal contact) are complete for on-installation site workers. The residential exposure scenario does not consider direct contact with surface water and sediment; therefore, these exposure pathways are incomplete. However, recreational users (who are likely to be residents engaged in recreational activities) could contact constituents in surface water bodies through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are complete.
- Surface water from Barney's Lake/Hummler Run flows off post through the southern boundary via the Hummler Run, which is not known to be used for drinking water off-post. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 7-13 shows the CSM for Building 1A/1BB1 Former Chromium Plating and IWWPTP. Potential releases of PFAS-containing chemicals related to chromium plating operations at TYAD to subsurface soil via an industrial sump could migrate to groundwater via desorption and/or dissolution.

- Subsurface soil at the AOPI and associated utility lines immediately surrounding the AOPI could potentially be accessed by on-installation site workers (e.g., utility workers or future construction workers); therefore, the soil exposure pathway for on-installation site workers is potentially complete. Subsurface soil at the AOPIs is not likely to be accessed by on-installation residents, on-installation recreational users, or by off- installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at Building 1A/1BB1 Former Chromium Plating and IWWPTP. Groundwater originating at this AOPI flows to the south, to the west of active on-post potable wells at TYAD. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater. Recreational users are not likely to contact groundwater. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at Building 1A/1BB1 Former Chromium Plating and IWWPTP. Groundwater originating at the AOPI eventually flows off-post through the installation's southern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Shallow groundwater at the AOPI potentially discharges into surface water bodies on post (i.e., Barney's Lake/Hummler Run). PFOS, PFOA, and/or PFBS were detected in surface water and sediment collected in Hummler Run during the SI. Surface water bodies on-post are not used for drinking water, however the effluent discharge location of the TYAD STP is located on Hummler Run. On-installation site workers who may perform work related to the effluent discharge location could potentially contact surface water and sediment in Hummler Run. Therefore, the surface water and sediment exposure pathways (via incidental ingestion and dermal contact) are complete for on-installation site workers. The residential exposure scenario does not consider direct contact with surface water and sediment; therefore, these exposure pathways are incomplete. However, recreational users (who are likely to be residents engaged in recreational activities) could contact constituents in surface water bodies through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are complete.
- Surface water from Barney's Lake/Hummler Run flows off post through the southern boundary via the Hummler Run, which is not known to be used for drinking water off-post. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 7-14 shows the CSM for the Temporary Dewatered Sludge Storage Site. Potential releases of PFAS- containing chemicals in sludges to soil could migrate to soil via surface runoff, groundwater via desorption and/or dissolution, and to surface water and sediment via discharge from shallow groundwater, dissolution, and adsorption.

- PFOS, PFOA, and/or PFBS were detected in soil at the Temporary Dewatered Sludge Storage Site and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete. The AOPIs are not likely to be regularly accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in shallow groundwater at the Temporary Dewatered Sludge Storage Site. Groundwater originating at this AOPI likely flows to the south, away from active on-post potable wells. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater. Recreational users are not likely to contact groundwater. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at the Temporary Dewatered Sludge Storage Site. Groundwater originating at the AOPI eventually flows off-post through the installation's southern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Shallow groundwater at the AOPI potentially discharges into surface water bodies on post (i.e., Barney's Lake/Hummler Run). PFOS, PFOA, and/or PFBS were detected in surface water and sediment collected in Hummler Run during the SI. Surface water bodies on-post are not used for drinking water, however the effluent discharge location of the TYAD STP is located on Hummler Run. On-installation site workers who may perform work related to the effluent discharge location could potentially contact surface water and sediment in Hummler Run. Therefore, the surface water and sediment exposure pathways (via incidental ingestion and dermal contact) are complete for on-installation site workers. The residential exposure scenario does not consider direct contact with surface water and sediment; therefore, these exposure pathways are incomplete. However, recreational users (who are likely to be residents engaged in recreational activities) could contact constituents in surface water bodies through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are complete.
- Surface water from Barney's Lake/Hummler Run flows off post through the southern boundary via the Hummler Run, which is not known to be used for drinking water off-post. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 7-15 shows the CSM for the OU-5 Inactive Sanitary Landfill. Potential releases of PFAS-containing chemicals in wastes to subsurface soil could migrate to groundwater via desorption and/or dissolution and to surface water and sediment via shallow groundwater discharge, dissolution, and adsorption.

- Subsurface soil at the AOPI could potentially be accessed by on-installation site workers (e.g., utility workers or future construction workers); therefore, the soil exposure pathway for on-installation site workers is potentially complete. Subsurface soil at the AOPIs is not likely to be accessed by on-installation residents, on- installation recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at the AOPI. The AOPI is not proximal to active on-post potable wells. The AOPI is located proximal to (i.e., less than 150 feet from) the western TYAD boundary and inactive railroad tracks, and it is unlikely a potable well will be installed between the AOPI and the installation boundary in the future. Therefore, the groundwater exposure pathway for on-installation receptors is incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at the OU-5 Inactive Sanitary Landfill. Groundwater originating at the AOPI eventually flows off-post through the installation's western-southwestern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at the OU-5 Inactive Sanitary Landfill. Shallow groundwater originating at this AOPI could discharge to surface water bodies to the north and south of the AOPI. Surface water bodies on-post are not used for drinking water. On-installation site workers who may perform work near the permitted discharge location off-post could potentially contact surface water and sediment in Cross Keys Run. Therefore, the surface water and sediment exposure pathways (via incidental ingestion and dermal contact) for on-installation site workers are potentially complete. The residential exposure scenario does not consider direct contact with surface water and sediment; therefore, these exposure pathways are incomplete. However, recreational users (who are likely to be residents engaged in recreational activities) could contact constituents in on-post surface water bodies through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are potentially complete.
- Surface water bodies flow off-post through Cross Keys Run and/or Oakes Swamp, neither of which are known to be used for drinking water. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 16 shows the CSM for OU-1 Area B- Former Drum Storage Area. Potential releases of possibly PFAS-containing wastes related to the drum storage area to subsurface soil could migrate to groundwater via desorption and/or dissolution and to surface water and sediment via shallow groundwater discharge, dissolution, and adsorption.

- Subsurface soil at the AOPI could potentially be accessed by on-installation site workers (e.g., utility workers or future construction workers); therefore, the soil exposure pathway for on-installation site workers is potentially complete. Subsurface soil at the AOPIs is not likely to be accessed by on-installation residents, on-installation recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at the AOPI. The AOPI is not proximal to active on-post potable wells. The AOPI is located proximal to (i.e., less than 100 feet from) the southwestern TYAD boundary, and it is unlikely a potable well will be installed between the AOPI and the installation boundary in the future. Therefore, the groundwater exposure pathway for on-installation receptors is incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at OU-1 Area B- Former Drum Storage Area. Groundwater originating at the AOPI eventually flows off-post through the installation's western-southwestern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Shallow groundwater at the AOPI potentially discharges into surface water bodies on post (i.e., Barney's Lake/Hummler Run). PFOS, PFOA, and/or PFBS were detected in surface water and sediment collected in Hummler Run during the SI, upstream of the AOPI. OU-1 Area B- Former Drum Storage Area is located downstream of the effluent location (which may require maintenance) on Hummler Run. Therefore, on-installation site workers are not likely to contact surface water and sediment in Hummler Run proximal to the AOPI, and these exposure pathways are incomplete. The residential exposure scenario does not consider direct contact with surface water and sediment; therefore, these exposure pathways are incomplete. However, recreational users (who are likely to be residents engaged in recreational activities) could contact constituents in surface water bodies through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are potentially complete.
- Surface water from Barney's Lake/Hummler Run flows off post through the southern boundary via the Hummler Run, which is not known to be used for drinking water off-post. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users off-post could contact constituents in surface water and sediment through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for off-installation recreational users are potentially complete.

Figure 7-17 shows the CSM for Building 74: AFFF Storage. Potential releases of AFFF from a historical AFFF suppression system and/or current AFFF storage to paved surfaces and/or surrounding soils could migrate to groundwater via desorption and dissolution and to surface water and sediment via discharge from the stormwater outfall and via shallow groundwater discharge, dissolution, and adsorption.

- PFOS, PFOA, and/or PFBS were detected in soil at Building 74: AFFF Storage and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete. The AOPIs are not likely to be regularly accessed by on-installation residents and recreational users, or by off-installation receptors. Therefore, the soil exposure pathways for these receptors are incomplete.

- PFOS, PFOA, and/or PFBS were detected in groundwater at Building 74: AFFF Storage. Groundwater originating at this AOPI likely flows to the south-southwest, away from active on-post potable wells. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for site workers and residents are potentially complete to account for potential future use of the downgradient on-post groundwater. Recreational users are not likely to contact groundwater. Therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- Groundwater originating at the AOPI eventually flows off-post through the installation's southwestern boundary. Due to the absence of land use controls preventing potable use of groundwater in this area, the groundwater exposure pathway (via drinking water ingestion and dermal contact) for off-installation receptors is potentially complete.
- Surface water runoff into stormwater drains adjacent to the AOPI is conveyed via the TYAD stormwater system to outfall 005, which discharges off-post at the western installation boundary prior to draining into a tributary to Cross Keys Run. The stormwater outfall is located off-post. Therefore, the surface water and sediment exposure pathways for on-installation receptors are incomplete.
- Cross Keys Run is not known to be used for drinking water. Therefore, the surface water exposure pathway (via drinking water ingestion and dermal contact) for off-installation drinking water receptors is incomplete. However, recreational users could contact constituents in surface water and sediment through incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways for off- installation recreational users are potentially complete.

Following the SI sampling, all seven AOPIs were considered to have complete or potentially complete exposure pathways. Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for remedial investigation is based on the comparison of analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-3**).

8 OFF-POST PRIVATE POTABLE WELL INVESTIGATION

Based on SI sampling results, off-post private potable wells were identified for potential sampling as part of the PA/SI investigation at TYAD to determine whether there are off-post impacts to drinking water due to Army operations. These wells are downgradient of groundwater wells in the central portion of the installation where PFOS and/or PFOA were detected at concentrations greater than the USEPA lifetime health advisory. To identify potential potable wells that were downgradient of the western/southwestern installation boundary to include in this sampling effort, an off-post well survey was completed using readily available information from the online PAGWIS and EDR resources. County records were also reviewed to identify wells that may not be included in the PAGWIS and EDR databases, and relevant parcels were reviewed to compile a list of property owners. After reviewing the available information for the area, one off-post private potable well was identified for possible sampling as part of this investigation based on the understanding of the relationship between on- and off-post hydrogeological conditions.

Community outreach and notification will be coordinated between the Army PA/SI team, TYAD, Headquarters of the Department of the Army, and USAEC Divisions to sample one well located within the 1-mile radius area downgradient of the installation boundary. A letter report presenting a summary of the off-post private well investigation results and the associated laboratory reports will be included in a subsequent addendum (when available).

9 CONCLUSIONS AND RECOMMENDATIONS

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

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

As discussed in **Section 2.12**, currently active TYAD potable wells (Wells 2, 6, 7, 8, 9, and 10) were sampled by the Army and PADEP on 14 July 2021. The analytical method used in July 2021 was USEPA Method 537.1. PFOS was detected in Well #6 at 25.7 ng/L, which is below the OSD risk screening levels for tap water (40 ng/L). PFOS was not detected in any other potable well samples collected in July 2021. PFOA and PFBS were not detected in any of the July 2021 samples (**Table 2-1**).

All seven AOPIs were sampled during the SI at TYAD to identify presence or absence of PFOS, PFOA, and PFBS at each AOPI. The SI scope of work was completed in accordance with the Final PQAPP (Arcadis 2019) and the TYAD QAPP Addendum (Arcadis 2020a).

All seven AOPIs had detections of PFOS, PFOA, and PFBS in groundwater, soil, surface water, and/or sediment, and five AOPIs exceeded OSD risk screening levels. The maximum concentration of PFOS, PFOA, and PFBS in each sampled media are summarized below:

- Groundwater: The maximum detections of PFOS (1,200 D ng/L), PFOA (610 DM ng/L), and PFBS (840 D ng/L) were all observed at the Building 17 – Fire Station AOPI. The maximum detections of PFOS, PFOA, and PFBS were each greater than the OSD risk screening level for tap water (**Section 6.5**).
- Soil: The maximum detection of PFOS (0.031 mg/kg) was observed at the Temporary Dewatered Sludge Storage Site AOPI. The maximum detection of PFOA (0.0017 mg/kg) was observed at the Building 17 – Fire Station AOPI. PFBS was not detected in any soil samples collected during the TYAD SI. The maximum detections of PFOS and PFOA were less than the OSD risk screening levels for soil (**Section 6.5**).
- Surface Water: The maximum detections of PFOS (37 ng/L), PFOA (4.5 ng/L), and PFBS (5.4 ng/L) were observed at the Historical Fire Training Area – Burn Pit AOPI.
- Sediment: The maximum detection of PFOS (0.0011 mg/kg) was observed at the Historical Fire Training Area – Burn Pit AOPI. PFOA and PFBS were not detected in any sediment samples collected during the TYAD SI.

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

- The soil exposure pathways for on-installation site workers are complete for four out of seven AOPIs: Historical Fire Training Area – Burn Pit, Building 17 – Fire Station, Temporary Dewatered Sludge Storage Site, and Building 74 – AFFF Storage. The subsurface soil exposure pathways for on-installation site workers are potentially complete for three out of seven AOPIs: Building 1A/1BB1 Former Chromium Plating and IWWPTP, OU-5 Inactive Sanitary Landfill, and OU-1 Area B Former Drum Storage Area.
- The drinking water exposure pathway via groundwater for on-installation site workers and residents is complete for five out of seven AOPIs where PFOS, PFOA, and PFBS were detected in groundwater at the AOPIs and downgradient groundwater could hypothetically be used as a source of on-post drinking water in the future: Historical Fire Training Area – Burn Pit, Building 17 – Fire Station, Building 1A/1BB1 Former Chromium Plating and IWWPTP, Temporary Dewatered Sludge Storage Site, and Building 74 – AFFF Storage.
- Due to a lack of land use controls off-post, the drinking water exposure pathway via groundwater for off-installation receptors is potentially complete for all seven AOPIs where PFOS, PFOA, and PFBS were detected in groundwater at the AOPIs.
- The surface water and sediment exposure pathways for on-installation site workers and recreational users are complete for three AOPIs: Building 17 – Fire Station, Building 1A/1BB1 Former Chromium Plating and IWWPTP, and Temporary Dewatered Sludge Storage Site. The surface water and sediment exposure pathways for on-installation recreational users are potentially complete for two AOPIs: OU-5 Inactive Sanitary Landfill and OU-1 Area B Former Drum Storage Area
- The surface water and sediment exposure pathways for off-installation receptors is potentially complete for all seven AOPIs where PFOS, PFOA, and/or PFBS were detected in shallow groundwater that may discharge to off-post surface water bodies and/or where PFOS, PFOA, and/or PFBS were detected in on-post surface water/sediment collected from surface water bodies that eventually flow off-post.

Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for future study in a remedial investigation or no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-3**). **Table 9-1** below summarizes the AOPIs identified at TYAD, PFOS, PFOA, and PFBS sampling and recommendations for each AOPI; further investigation is warranted at TYAD. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

Table 9-1 Summary of AOPIs Identified during the PA, PFOS, PFOA, and PFBS Sampling at TYAD, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels? (Yes/No/NA/NS)				Recommendation
	GW	SO	SW	SE	
Historical Fire Training Area – Burn Pit	Yes	No	NA	NA	Further study in a remedial investigation.
Building 17 – Fire Station	Yes	No	NS	NS	Further study in a remedial investigation.
Building 1A/1BB1	Yes	NS	NS	NS	Further study in a remedial investigation.
Temporary Dewatered Sludge Storage Site	No	No	NA	NA	No action at this time.
OU-5 Inactive Sanitary Landfill	Yes	No	NS	NS	Further study in a remedial investigation.
OU-1 Area B Former Drum Storage Area	No	NS	NS	NS	No action at this time.
Building 74 – AFFF Storage	Yes	No	NS	NS	Further study in a remedial investigation.

Notes:
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
NA – the OSD risk screening level is not applicable to the media sampled.
NS – not sampled
SE – sediment
SO – soil
SW – surface water

Data collected during the PA (**Sections 3** through **5**) and SI (**Sections 6** through **8**) were sufficient to draw conclusions and recommendations summarized above. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, and PFBS at TYAD are discussed below.

Records gathered for the use, storage and/or disposal of PFAS-containing materials were reviewed during the PA process. Documentation specific to AFFF may have been limited (e.g., each AFFF use; procurement records, documentation of AFFF used during crash responses or fire training activities) due to lack of recordkeeping requirements for the full timeline of common AFFF practices. Anecdotal accounts of AFFF use (and therefore likely PFOS, PFOA, and PFBS use) were limited to available installation personnel, whose knowledge of AFFF use may have been restricted by their time spent at the installation or previous roles held that limited their relevant knowledge of potential AFFF (or other PFAS-containing material) use. Additionally, records reviewed during the PA did not specify which mist suppressants were potentially used during hexavalent chromium plating operations (i.e., pre-1984) and whether they contained PFAS-containing materials.

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

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

Finally, the available PFOS, PFOA, and PFBS analytical data are limited to results from on-post drinking water well sources, results from historical investigations, and groundwater, soil, surface water, and sediment data collected during the SI. Available data, including PFOS, PFOA, and PFBS, are listed in **Appendix N**, which were analyzed per the selected analytical method.

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

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ACRONYMS

%	percent
AFFF	aqueous film-forming foam
AMC	Army Materiel Command
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
AR-AFFF	alcohol resistant-aqueous film-forming foam
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
GIS	geographic information system
GW	groundwater
HDPE	high-density polyethylene
IDW	investigation-derived waste
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
IWWPTP	industrial wastewater pretreatment plant
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram (parts per million)
ng/L	nanograms per liter (parts per trillion)
NA	the OSD risk screening level is not applicable to the media sampled.

ng/L	nanograms per liter (parts per trillion)
NS	not sampled
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PAGWIS	Pennsylvania Groundwater Information System
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
SE	sediment
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
STP	sewage treatment plant
SW	surface water
TBD	to be determined
TGI	technical guidance instruction
TOC	total organic carbon
TYAD	Tobyhanna Army Depot
UCMR3	Unregulated Contaminant Monitoring Rule
U.S.	United States

USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VOC	volatile organic compound
VS	verification study

TABLES

Table 2-1 Historical PFOS, PFOA, and PFBS Analytical Results
Potable Water
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, PA

Location		EPTDS [1]	Well #1[1]	Well #2[1]	Well #5[1]	Well #6[1]	EPTDS Effluent[2]	EPTDS Effluent[3]	Well #1[3]
Sample ID		TYAD-GW-EPT01	TYAD-GW-Well1	TYAD-GW-Well2-FW	TYAD-GW-Well5-FW	TYAD-GW-Well6-FW	NP	TYAD-E01	TYAD-S01
Sample Date		11/7/2016	11/7/2016	11/7/2016	11/7/2016	11/7/2016	9/24/2020	3/10/2021	3/10/2021
Units	OSD risk screening level for tap water	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctanoic acid (PFOA)	40	< 20	< 20	< 20	< 20	< 20	ND	**1.6 J**	**2.0**
Perfluorobutanesulfonic acid (PFBS)	600	NP	NP	NP	NP	NP	ND	< 1.4	< 1.3
Perfluorooctane sulfonate (PFOS)	40	< 40	< 40	< 40	< 40	< 40	**12.1**	**8.6**	**4.0**

Table 2-1 Historical PFOS, PFOA, and PFBS Analytical Results
Potable Water
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, PA

Location		Well #2[3]	Well #5[3]	Well #6[3]	Well #2[4]	Well #6[4]	Well #7[4]	Well #8[4]	Well #9[4]	Well #10[4]
Sample ID		TYAD-S02	TYAD-S05	TYAD-S06	O2021004624	O2021004625	O2021004626	O2021004627	O2021004628	O2021004629
Sample Date		3/10/2021	3/10/2021	3/10/2021	7/14/2021	7/14/2021	7/14/2021	7/14/2021	7/14/2021	7/14/2021
Units	OSD risk screening level for tap water	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctanoic acid (PFOA)	40	**1.8**	**2.3**	< 1.3	< 4.0	< 4.0	< 3.7	< 4.0	< 4.2	< 3.9
Perfluorobutanesulfonic acid (PFBS)	600	< 1.3	< 1.3	< 1.3	< 3.6	< 3.5	< 3.3	< 3.5	< 3.8	< 3.4
Perfluorooctane sulfonate (PFOS)	40	**2.6**	**7.0**	**15**	< 3.7	**25.7**	< 3.4	< 3.7	< 3.9	< 3.6

Table 2-1 Historical PFOS, PFOA, and PFBS Analytical Results
Potable Water
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, PA

Notes and Acronyms:

1. **Bolded** values indicate the result was detected greater than the laboratory limit of detection

2. Grey shaded values indicate the result was detected greater than the OSD risk screening levels for tap water [5]

< - the compound was not detected above the associated limit of quantification

EPTDS - entry point to distribution system

J - The analyte was positively identified; however the associated numerical value is an estimated concentration only.

ND not detected. The associated limit of quantification was not provided.

NP - not provided in the data reviewed

ng/L - nanograms per liter

OSD - Office of the Secretary of Defense

TYAD - Tobyhanna Army Depot

Data sources:

[1] Tetrahedron, Inc. 2018. Updated Drinking Water Quality Assessment Related to Perfluorinated Compounds (PFCs) at U.S. Army Material Command Installations. January.

[2] Data provided by TYAD and collected by Pennsylvania Department of Environmental Protection in September 2020

[3] Data provided by and collected by TYAD in March 2021

[4] Data provided by TYAD and collected by Pennsylvania Department of Environmental Protection in July 2021

[5] OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.

Table 2-2 Historical PFOS, PFOA, and PFBS Analytical Results
Groundwater
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, PA

Location		Building 1A/1BB1				Building 17-Fire Station	OU-1 Area B			OU-5 Inactive Sanitary Landfill	
Sample ID		TYAD-MW-UA6D	TYAD-MW-UA8D	TYAD-MW-PU1	TYAD-MW-UA4D	TYAD-MW-US7D	TYAD-MW-MW11	TYAD-MW-MW21	TYAD-MW-MW23	TYAD-MW-LF29	TYAD-MW-LF27
Sample Date		8/30/2017	8/31/2017	8/31/2017	8/31/2017	9/5/2017	9/5/2017	9/6/2017	9/5/2017	9/5/2017	9/5/2017
Units	OSD risk screening level for tap water	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Perfluorooctanoic acid (PFOA)	40	**64**	**5.6**	< 2.4	**11**	**21**	**7.8**	**2.3 J**	**2.0 J**	**65**	**11**
Perfluorobutanesulfonic acid (PFBS)	600	**2.0 J**	**3.9**	< 2.4	**7.4**	**4.3**	**3.7**	**0.94 J**	**2.4**	**1.0 J**	**7.3**
Perfluorooctane sulfonate (PFOS)	40	**13**	**1.5 J**	< 2.4	**7.3**	**4**	**28**	**8.5**	**11**	**2.9 J**	**9.1**

Notes and Acronyms:

1. **Bolded** values indicate the result was detected greater than the laboratory limit of detection

2. Grey shaded values indicate the result was detected greater than the OSD risk screening levels for tap water (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15).

< - the compound was not detected above the associated limit of quantification
J - The analyte was positively identified; however the associated numerical value is an estimated concentration only.
ng/L - nanograms per liter
OSD - Office of the Secretary of Defense

Data Sources:
Tetrahedron, Inc. 2018. Field Activity Report Related to Perfluorinated Compounds at Facilities Involved in Chrome Plating Operations at U.S. Army Materiel Command Installations. January.

Table 6-1 - Monitoring Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, Pennsylvania

Area of Potential Interest	Sampling Location ID[1]	Total Well Depth (ft bgs)	Measuring Point Elevation (ft amsl)	Measuring Point	Depth to Groundwater from MP (ft)	Groundwater Elevation (ft amsl)	Screened Interval (ft bgs)	Casing Diameter (inches)
Historical Fire Training Area - Burn Pit[1]	TYAD-BURNPIT-1-GW-011221	34	35.401	TOC	19.8	15.6	24-34	2
	TYAD-BURNPIT-2-GW-011221	25	25.76	TOC	13.2	12.6	14-24	2
Building 17 - Fire Station[1]	TYAD-B17FS-1-GW-090221	75.7	NM	TOC	36.22	NM	65-75	2
Building 1A/1BB1 Former Chromium Plating and IWWPTP	TYAD-PD-1-120120	NM	38.28	TOC	19.5	18.8	20-40	4
	TYAD-UA-6D-120120	92	91.24	TOC	38.8	52.4	82-92	2
Temporary Dewatered Sludge Storage Site[1]	TYAD-TDSSS-1-011221	30	30.25	TOC	12.7	17.6	86-106	2
OU-5 Inactive Sanitary Landfill	TYAD-LF-10-011121	75	77.71	TOC	3.9	73.8	55-75	4
	TYAD-LF-11-011121	60	62.45	TOC	11.7	50.8	40-60	4
	TYAD-LF-13-120220	NM	25.5	TOC	5.1	20.4	14-24	4
	TYAD-LF-23-011121	35	36.68	TOC	24.4	12.3	24-34	4
	TYAD-LF-29-011221	79.5	80.76	TOC	artesian	80.76	UNK	4
OU-1 Area B Former Drum Storage Area	TYAD-MW-10-120220	NM	19.11	TOC	5.2	13.9	7.7-17.4	4
	TYAD-MW-11-120220	NM	27.54	TOC	2.6	24.9	10.2-25	4
	TYAD-MW-23-120220	145	144.14	TOC	35.2	108.9	UNK	4
Building 74 - AFFF Storage[1]	TYAD-B74-1-GW-090221	50	NM	TOC	29.35	NM	40-50	2

Notes:
1. Newly installed as part of the SI. All other monitoring wells were already existing monitoring wells.

Acronyms/Abbreviations:
amsl - above mean sea level
bgs - below ground surface
ft - feet
ID - identification
MP - measuring point
NM - not measured (not surveyed)
TOC - top of casing
UNK- Unknown
TYAD- Tobyhanna Army Depot

Sources:
Tobyhanna Army Depot Site Inspection Field Notes and well development logs
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Table 7-1 - Groundwater PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, Pennsylvania

AOPI	Sample/ Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
			OSD Risk Screening Level - Tapwater	40		40		600	
			Sample Type	Result	Qual	Result	Qual	Result	Qual
Historical Fire Training Area - Burn Pit	TYAD-BURNPIT-1-GW-011221	01/12/2021	N	**240**	DM	**21**	M	**19**	
	TYAD-FD-1-GW-011221 / TYAD-BURNPIT-1-GW-011221	01/12/2021	FD	**250**	DM	**20**	M	**21**	
	TYAD-BURNPIT-2-GW-011221	01/12/2021	N	**350**	DM	**9.9**	M	**9.3**	M
Building 17 - Fire Station	TYAD-B17FS-1-GW-090221	09/02/2021	N	**1,200**	D	**610**	DM	**840**	D
	TYAD-FD-1-GW-090221 / TYAD-B17FS-1-GW-090221	09/02/2021	FD	**1,300**	D	**630**	DM	**880**	D
Building 1A/1BB1 Former Chromium Plating and IWWPTP	TYAD-PD-1-120120	12/01/2020	N	**27**		**3.4**	M	**1.1**	JM
	TYAD-UA-6D-120120	12/01/2020	N	**13**		**98**		**1.4**	JM
Temporary Dewatered Sludge Storage Site	TYAD-TDSSS-1-011221	01/12/2021	N	1.7	U	**14**	M	1.7	U
OU-5 Inactive Sanitary Landfill	TYAD-LF-10-011121	01/11/2021	N	**28**	M	**12**	M	**14**	
	TYAD-LF-11-011121	01/11/2021	N	**6.7**	M	**14**	M	**2.4**	
	TYAD-LF-13-120220	12/02/2020	N	**29**		**5.6**	M	**1.1**	JM
	TYAD-LF-23-011121	01/11/2021	N	**20**		**15**	J	19	U
	TYAD-LF-29-011221	01/12/2021	N	**2.6**		**56**	M	1.8	U
OU-1 Area B Former Drum Storage Area	TYAD-MW-10-120220	12/02/2020	N	**8.4**		**2.8**	M	1.9	U
	TYAD-MW-11-120220	12/02/2020	N	**14**		**6.2**	M	**1.7**	JM
	TYAD-MW-23-120220	12/02/2020	N	**1.5**	J	1.8	U	1.8	U
Building 74 - AFFF Storage	TYAD-B74-1-GW-090221	09/02/2021	N	**1.7**		**77**		1.7	U

Notes:

1. **Bolded** values indicate the result was detected greater than the limit of detection

2. Grey shaded values indicate the result was detected greater than the Office of the Secretary of Defense (OSD) risk screening levels for tap water (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September.).

Acronyms/Abbreviations:

-- = not applicable
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
IWWPTP = industrial wastewater pretreatment treatment plant
N = primary sample
ng/L = nanograms per liter (parts per trillion)
OSD = Office of the Secretary of Defense
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier
TYAD = Tobyhanna Army Depot

Qualifier Descriptions:

D = the reported value is from a dilution
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
M = manually integrated compound
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, Pennsylvania

AOPI	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
			OSD Industrial/Commercial Risk Screening Level	1.6		1.6		25	
			OSD Residential Risk Screening Level	0.13		0.13		1.9	
			Sample Type	Result	Qual	Result	Qual	Result	Qual
Historical Fire Training Area - Burn Pit	TYAD-BURNPIT-1-SO-(0.5-2)-113020	11/30/2020	N	**0.0018**		0.00067	U	0.0022	U
	TYAD-BURNPIT-2-SO-(0.5-2)-113020	11/30/2020	N	**0.0049**		0.00064	U	0.0021	U
	TYAD-BURNPIT-3-SO-(0.5-2)-113020	11/30/2020	N	**0.0019**		0.00066	U	0.0022	U
Building 17 - Fire Station	TYAD-B17FS-1-SO-(0.5-2)-120420	12/04/2020	N	**0.027**	J	0.00066	U	0.0022	U
	TYAD-FD-1-SO-120420 / TYAD-B17FS-1-SO-(0.5-2)-120420	12/04/2020	FD	**0.015**	J	0.00069	U	0.0023	U
	TYAD-B17FS-2-SO-(0.5-2)-120420	12/04/2020	N	**0.019**		**0.0017**		0.0021	U
Temporary Dewatered Sludge Storage Site	TYAD-TDSSS-1-SO-(0.5-2)-120320	12/03/2020	N	**0.0010**		0.00065	U	0.0022	U
	TYAD-TDSSS-2-SO-(0.5-2)-120320	12/03/2020	N	**0.031**		**0.00060**	JM	0.0028	U
	TYAD-TDSSS-3-SO-(0.5-2)-120320	12/03/2020	N	**0.0043**		0.00069	U	0.0023	U
Building 74 - AFFF Storage	TYAD-B74-1-S0-(0.5-2)-120720	12/07/2020	N	**0.00050**		**0.00054**		0.0016	U
	TYAD-B74-2-S0-(0.5-2)-120720	12/07/2020	N	0.00062	U	0.00062	U	0.0021	U
	TYAD-B74-3-S0-(0.5-2)-120720	12/07/2020	N	0.00063	U	0.00063	U	0.0021	U

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. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September). No concentrations of PFBS, PFOS, or PFOA exceeded the OSD risk screening levels.

Acronyms/Abbreviations:

AFFF - aqueous film-forming foam
AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
TYAD = Tobyhanna Army Depot
Qual = qualifier

Qualifier Descriptions:

J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
M = manually integrated compound
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.

Table 7-3 - Surface Water PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, Pennsylvania

AOPI	Sample/Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
			Sample Type	Result	Qual	Result	Qual	Result	Qual
Historical Fire Training Area- Burn Pit	TYAD-BURNPIT-1-SW-120120	12/01/2020	N	**28**		**4.5**	M	**5.4**	M
	TYAD-BURNPIT-2-SW-120120	12/01/2020	N	**37**		**2.4**		**3.1**	M
Temporary Dewatered Sludge Storage Site	TYAD-TDSSS-1-SW-120420	12/04/2020	N	**17**		**2.1**	M	**1.3**	JM
	TYAD-FD-1-SW-120420 / TYAD-TDSSS-1-SW-120420	12/04/2020	FD	**18**		**2.3**	M	**1.5**	J

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection

Acronyms/Abbreviations:

AOPI = Area of Potential Interest
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier
TYAD - Tobyhanna Army Depot

Qualifier Descriptions:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
M = manually integrated compound
U = The analyte was analyzed for but the result was not detected above the limit of quantitation.

Table 7-4 - Sediment PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Tobyhanna Army Depot, Pennsylvania

AOPI	Sample/Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
			Sample Type	Result	Qual	Result	Qual	Result	Qual
Historical Fire Training Area- Burn Pit	TYAD-BURNPIT-1-SE-120120	12/01/2020	N	0.00088	U	0.00088	U	0.0029	U
	TYAD-BURNPIT-2-SE-120120	12/01/2020	N	**0.0011**		0.0011	U	0.0035	U
Temporary Dewatered Sludge Storage Site	TYAD-TDSSS-1-SE-120420	12/04/2020	N	0.00069	U	0.00069	U	0.0023	U
	TYAD-FD-1-SE-120420 / TYAD-TDSSS-1-SE-120420	12/04/2020	FD	**0.00056**	J	0.00075	U	0.0025	U

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection

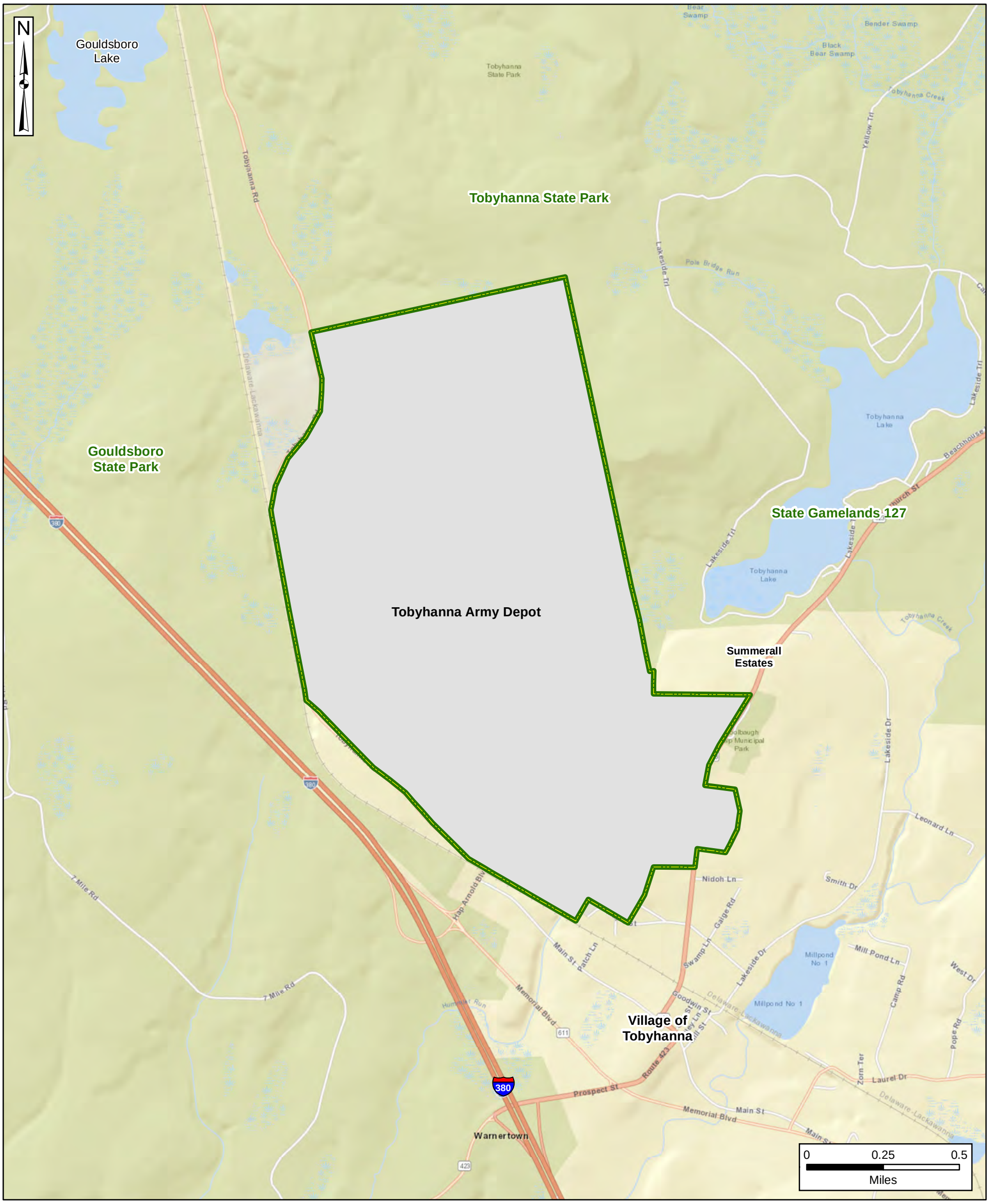
Acronyms/Abbreviations:
AOPI = area of potential interest
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFBS = perfluorobutane sulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid
Qual = qualifier
TYAD = Tobyhanna Army Depot

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

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 2-1
Site Location



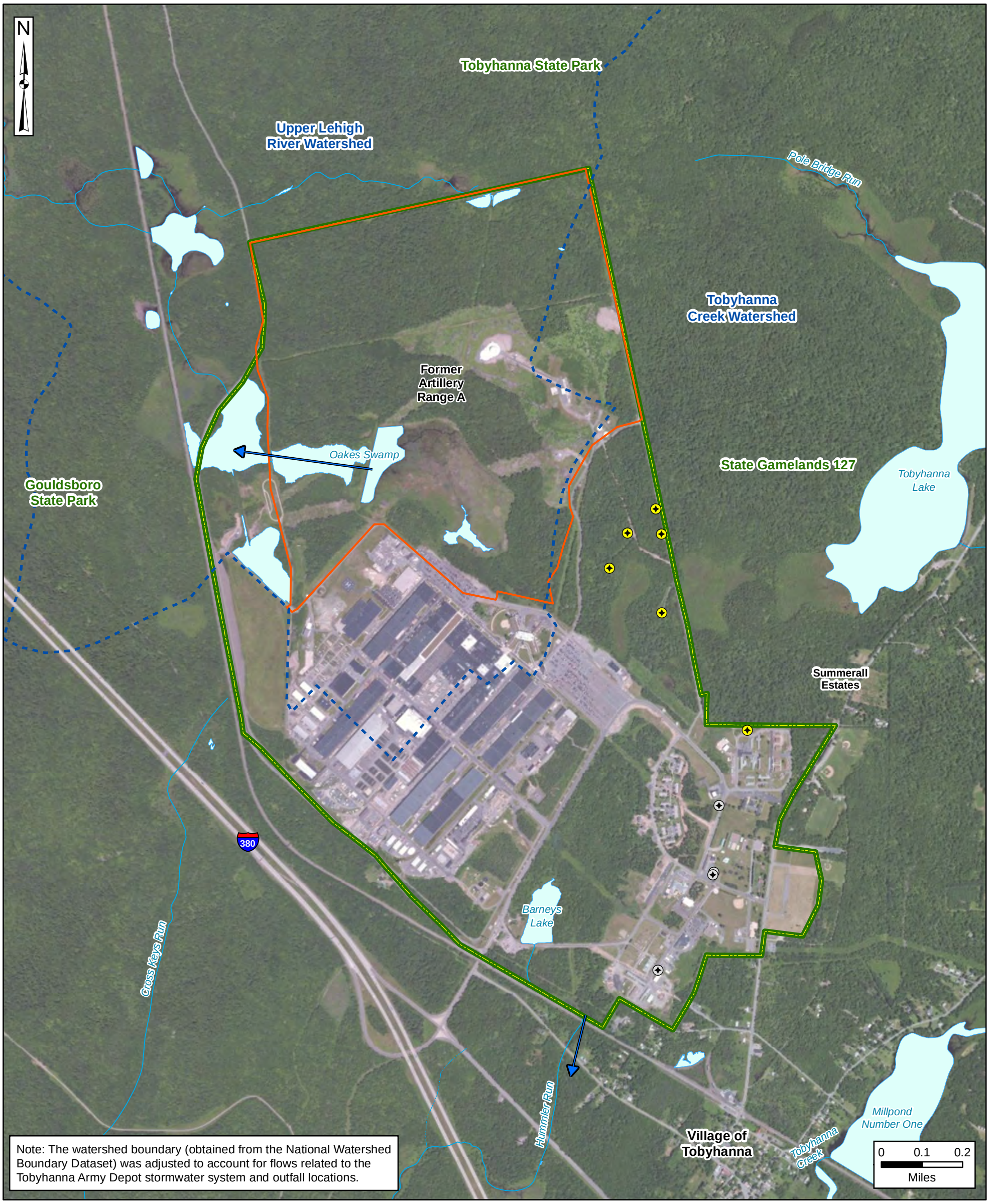
Installation Boundary

Data Sources:
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 2-2
Site Layout



Installation Boundary
Former Artillery Range A
River/Stream (Perennial)
Stream (Intermittent)
Water Body
Watershed Boundary
General Surface Water Flow Direction
Installation Supply Well (Active)
Installation Supply Well (Decommissioned)

IWWPTP = Industrial Wastewater Pretreatment Plant

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 2-3
Site Topography

Installation Boundary

River/Stream (Perennial)

Stream (Intermittent)

Water Body

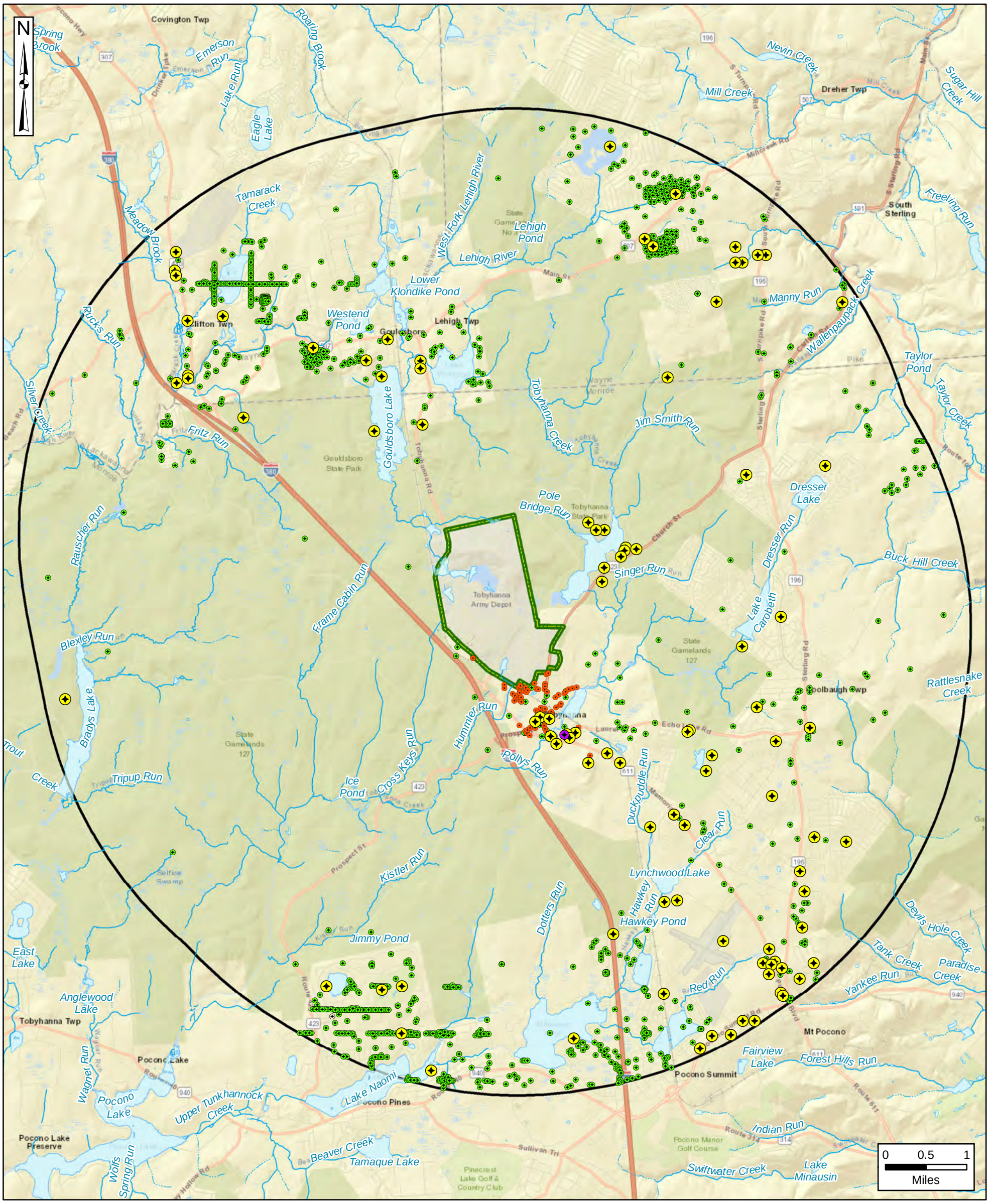
Elevation Contour (feet)

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 2-4
Off-Post Potable Wells



Installation Boundary

5-Mile Radius

River/Stream (Perennial)

Stream (Intermittent)

Water Body

Potable Wells

- Public Water Supply System Well (EDR Data)
- Institutional Well (PaGWIS Data)
- Domestic Well (PaGWIS Data)
- Residential Well (Installation Data) *

* At this time, residential wells located south of Tobyhanna Army Depot are not used for potable purposes and residences are provided potable water by Tobyhanna Army Depot.

EDR = Environmental Data Resources
PaGWIS = Pennsylvania Groundwater Information System

Data Sources:
EDR, Public Water Supply System Wells, 2018
PaGWIS, Institutional & Domestic Wells, 2019
ESRI ArcGIS Online, World Street Map

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 2-5
Historical PFOS, PFOA, and PFBS Groundwater Sampling Results

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.
3. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.
4. Monitoring wells were sampled during the 2017 AMC Investigation.

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

Tobyhanna State Park
Upper Lehigh River Watershed
Tobyhanna Creek Watershed
Former Artillery Range A
Oakes Swamp
State Gamelands 127
Tobyhanna Lake
Inactive Sanitary Landfill (OU-5)
Building 1A/1BB1 Former Chromium Plating and IWWPTP
Gouldsboro State Park
Summerall Estates
Building 17 - Fire Station
Barneys Lake
Area B Former Drum Storage Area (OU-1)
Cross Keys Run
Hummler Run

PU-1	
Date	8/31/2017
Depth	~39 ft
PFOS	2.0 U
PFOA	2.0 U
PFBS	2.0 U

UA-4D	
Date	8/31/2017
Depth	~95 ft
PFOS	**7.3**
PFOA	**11**
PFBS	**7.4**

UA-8D	
Date	8/31/2017
Depth	~100 ft
PFOS	**1.5 J**
PFOA	**5.6**
PFBS	**3.9**

LF-27	
Date	9/5/2017
Depth	~70 ft
PFOS	**9.1**
PFOA	**11**
PFBS	**7.3**

UA-6D	
Date	8/30/2017
Depth	~90 ft
PFOS	**13**
PFOA	**64**
PFBS	**2.0 J**

US-7D	
Date	9/5/2017
Depth	~100 ft
PFOS	**4**
PFOA	**21**
PFBS	**4.3**

LF-29	
Date	9/5/2017
Depth	~78 ft
PFOS	**2.9 J**
PFOA	**65**
PFBS	**1.0 J**

MW-21	
Date	9/5/2017
PFOS	**8.5**
PFOA	**2.3 J**
PFBS	**0.94 J**

MW-11	
Date	9/5/2017
Depth	~25 ft
PFOS	**28**
PFOA	**7.8**
PFBS	**3.7**

MW-23	
Date	9/5/2017
Depth	~143 ft
PFOS	**11**
PFOA	**2.0 J**
PFBS	**2.4**

Note: The watershed boundary (obtained from the National Watershed Boundary Dataset) was adjusted to account for flows related to the Tobyhanna Army Depot stormwater system and outfall locations.

0 0.1 0.2 Miles

- Installation Boundary
- AOPI with Historical PFOS, PFOA, and PFBS Sampling Results
- Former Artillery Range A
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Watershed Boundary
- General Surface Water Flow Direction
- Installation Supply Well (Active)
- Installation Supply Well (Decommissioned)
- Previously Sampled Monitoring Well
- Monitoring Well

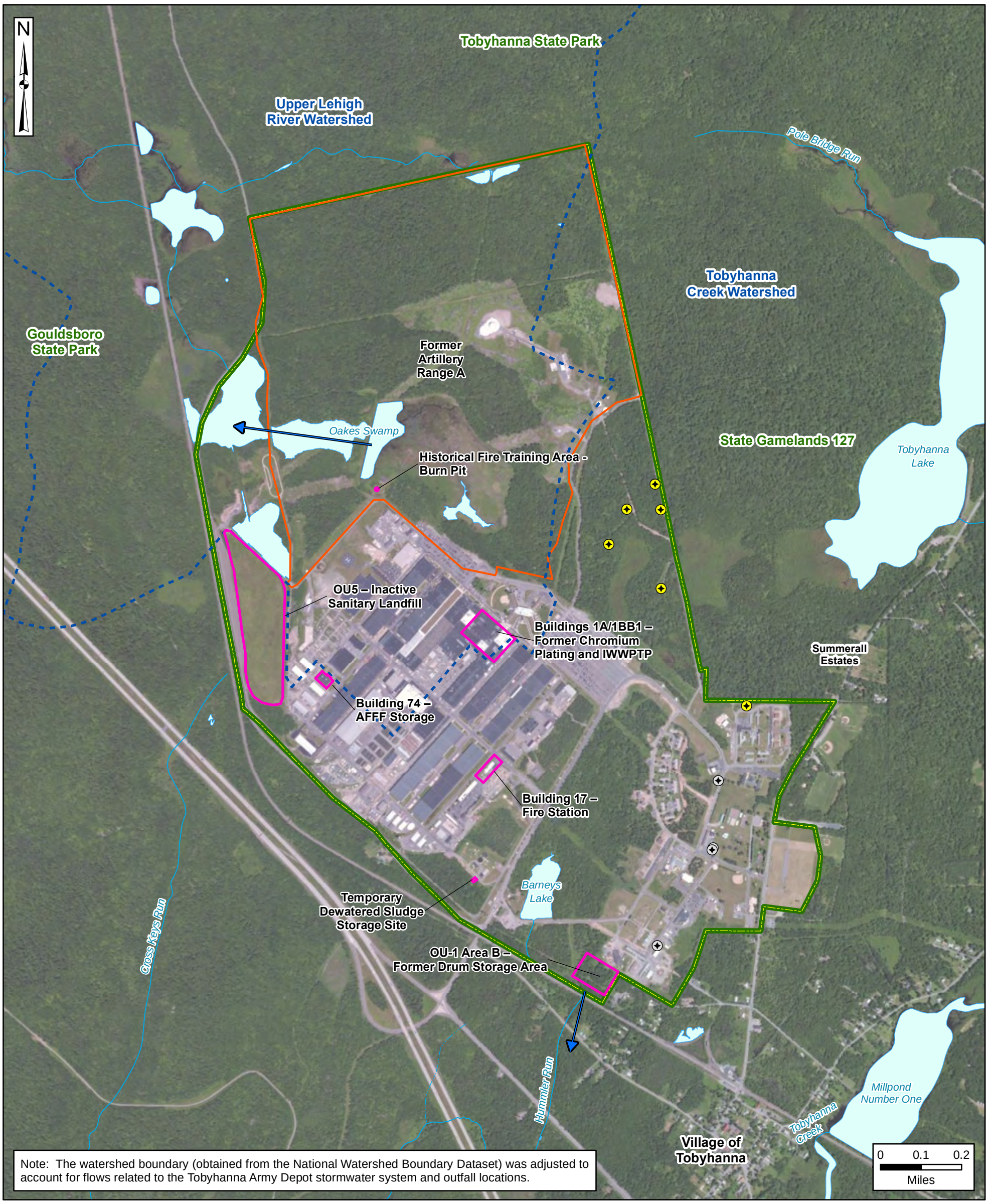
AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
IWWPTP = Industrial Wastewater Pretreatment Plant
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
TYAD = Tobyhanna Army Depot

Data Sources:
Tetrahedron, Inc., *Field Activity Report Related to Perfluorinated Compounds at Faciliities Involved in Chrome Plating Operations at U.S. Army Materiel Command Installations*, January 2018;
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 5-2
AOPI Locations



Note: The watershed boundary (obtained from the National Watershed Boundary Dataset) was adjusted to account for flows related to the Tobyhanna Army Depot stormwater system and outfall locations.

- Installation Boundary
- AOPI
- Former Artillery Range A
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Watershed Boundary
- General Surface Water Flow Direction
- Installation Supply Well (Active)
- Installation Supply Well (Inactive)

AFFF = aqueous film-forming foam
AOPI = Area of Potential Interest
IWWPTP = Industrial Wastewater Pretreatment Plant

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

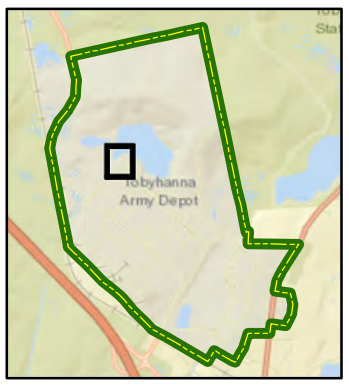
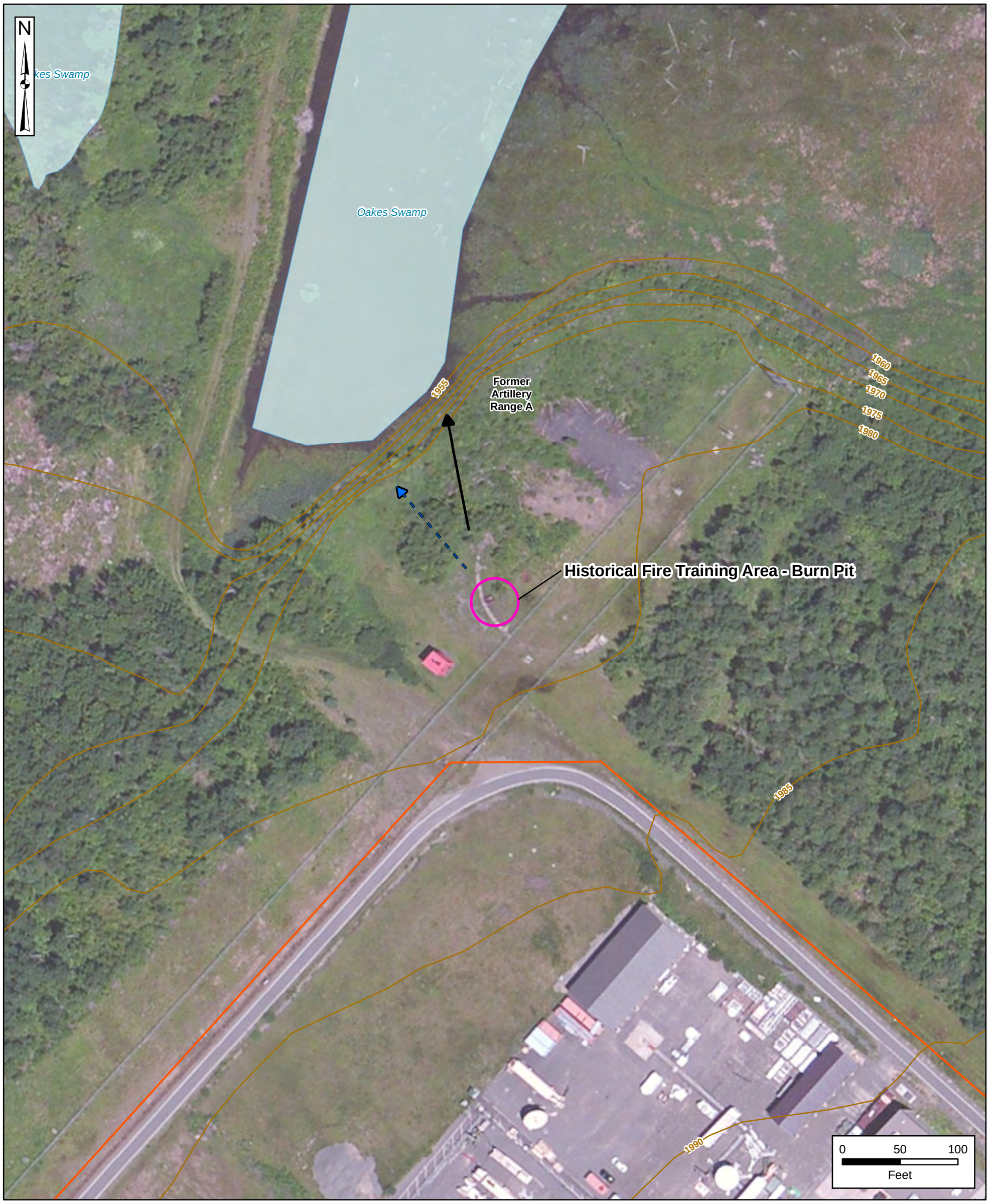


Figure 5-3
Aerial Photo of the Historical Fire Training Area - Burn Pit



Installation Boundary
AOPI
Former Artillery Range A
Elevation Contour (feet)
Surface Runoff Flow Direction
Groundwater Flow Direction (Overburden)

*Exact groundwater flow in this area is unknown.
AOPI = area of potential interest

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

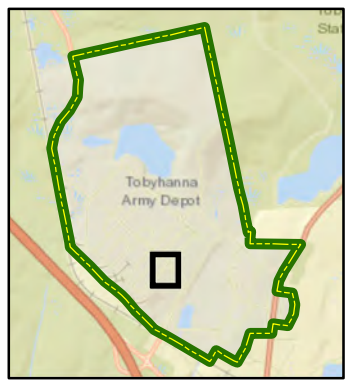
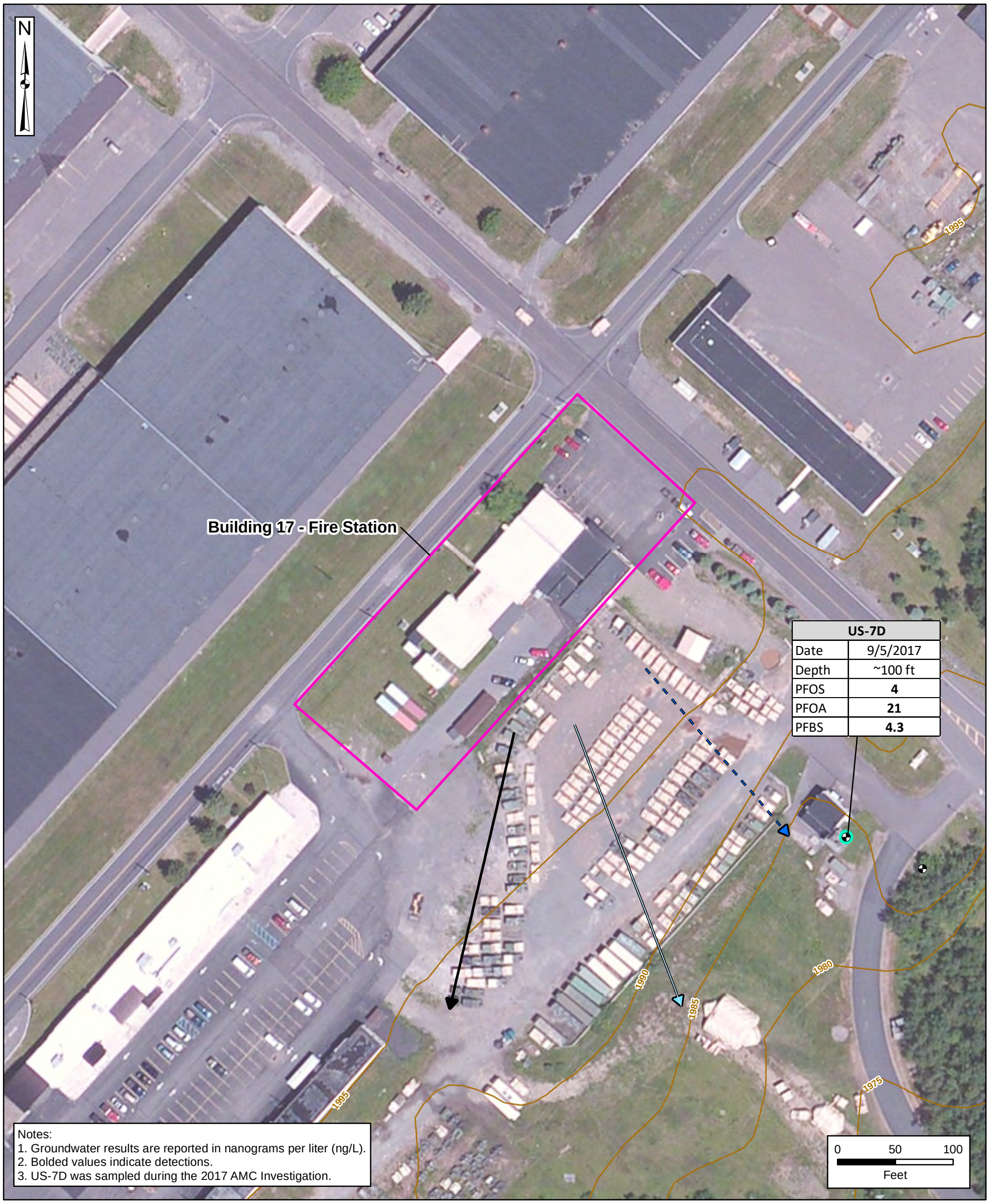


Figure 5-4
Aerial Photo of Building 17 - Fire Station



Installation Boundary
AOPI
Surface Runoff Flow Direction
Groundwater Flow Direction (Overburden)
Groundwater Flow Direction (Shallow Bedrock)
Monitoring Well
Previously Sampled Monitoring Well
Elevation Contour (feet)

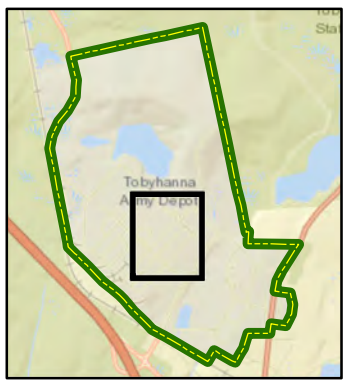
AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
PFOS = perfluorooctane sulfonate
PFOA = perfluorooctanoic acid
PFBS = perfluorobutanesulfonic acid

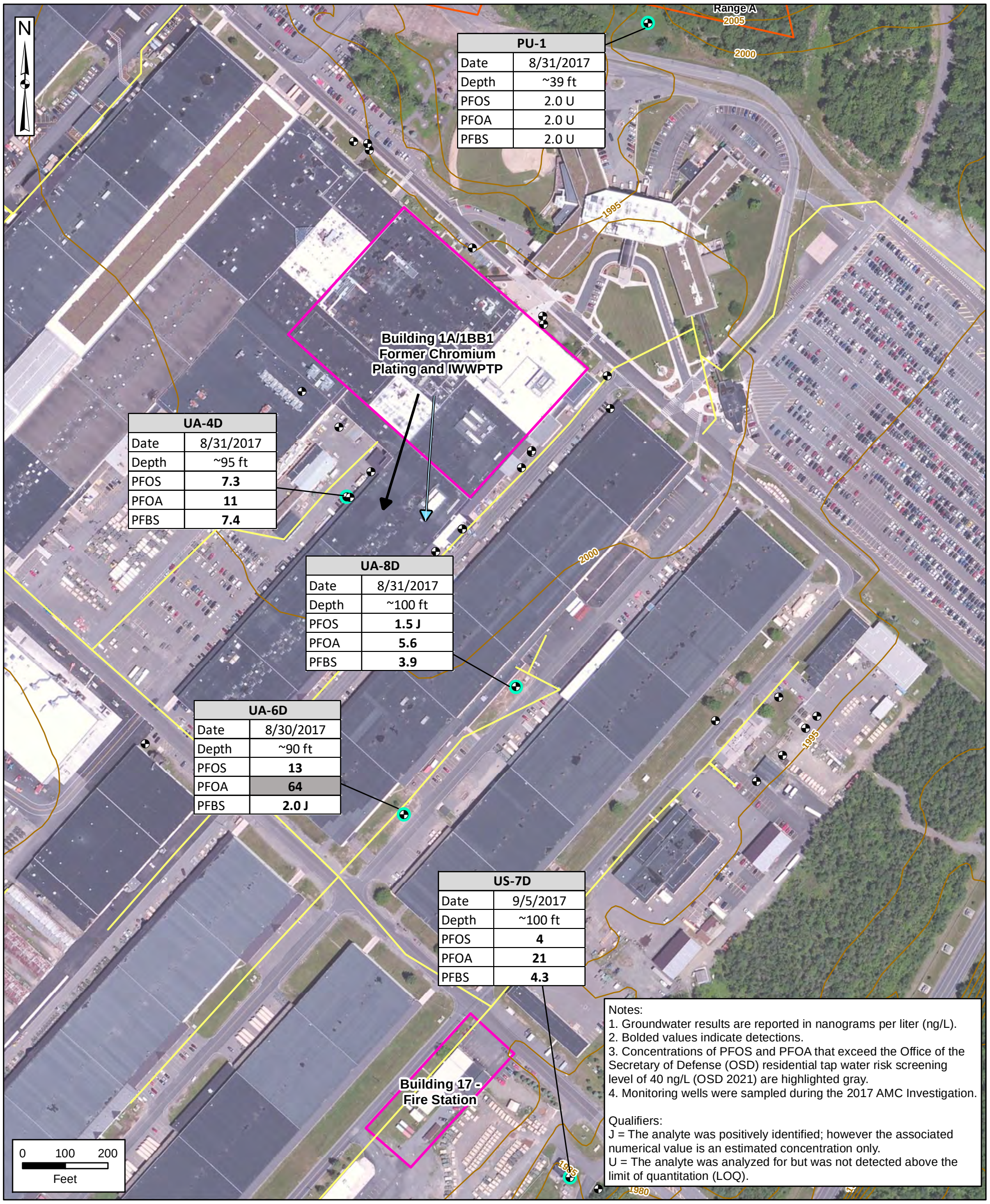
Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 5-5
Aerial Photo of Building 1A/1BB1
Former Chromium Plating and IWWPTP





PU-1	
Date	8/31/2017
Depth	~39 ft
PFOS	2.0 U
PFOA	2.0 U
PFBS	2.0 U

UA-4D	
Date	8/31/2017
Depth	~95 ft
PFOS	**7.3**
PFOA	**11**
PFBS	**7.4**

UA-8D	
Date	8/31/2017
Depth	~100 ft
PFOS	**1.5 J**
PFOA	**5.6**
PFBS	**3.9**

UA-6D	
Date	8/30/2017
Depth	~90 ft
PFOS	**13**
PFOA	**64**
PFBS	**2.0 J**

US-7D	
Date	9/5/2017
Depth	~100 ft
PFOS	**4**
PFOA	**21**
PFBS	**4.3**

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.
3. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.
4. Monitoring wells were sampled during the 2017 AMC Investigation.

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

- Installation Boundary
- AOPI
- Former Artillery Range A
- Sanitary Sewer Line
- Elevation Contour (feet)
- Groundwater Flow Direction (Overburden)
- Groundwater Flow Direction (Shallow Bedrock)
- Monitoring Well
- Previously Sampled Monitoring Well

AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
IWWPTP = Industrial Wastewater Pretreatment Plant
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

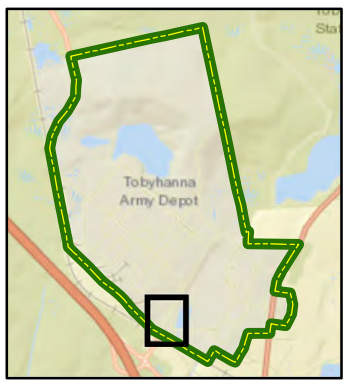
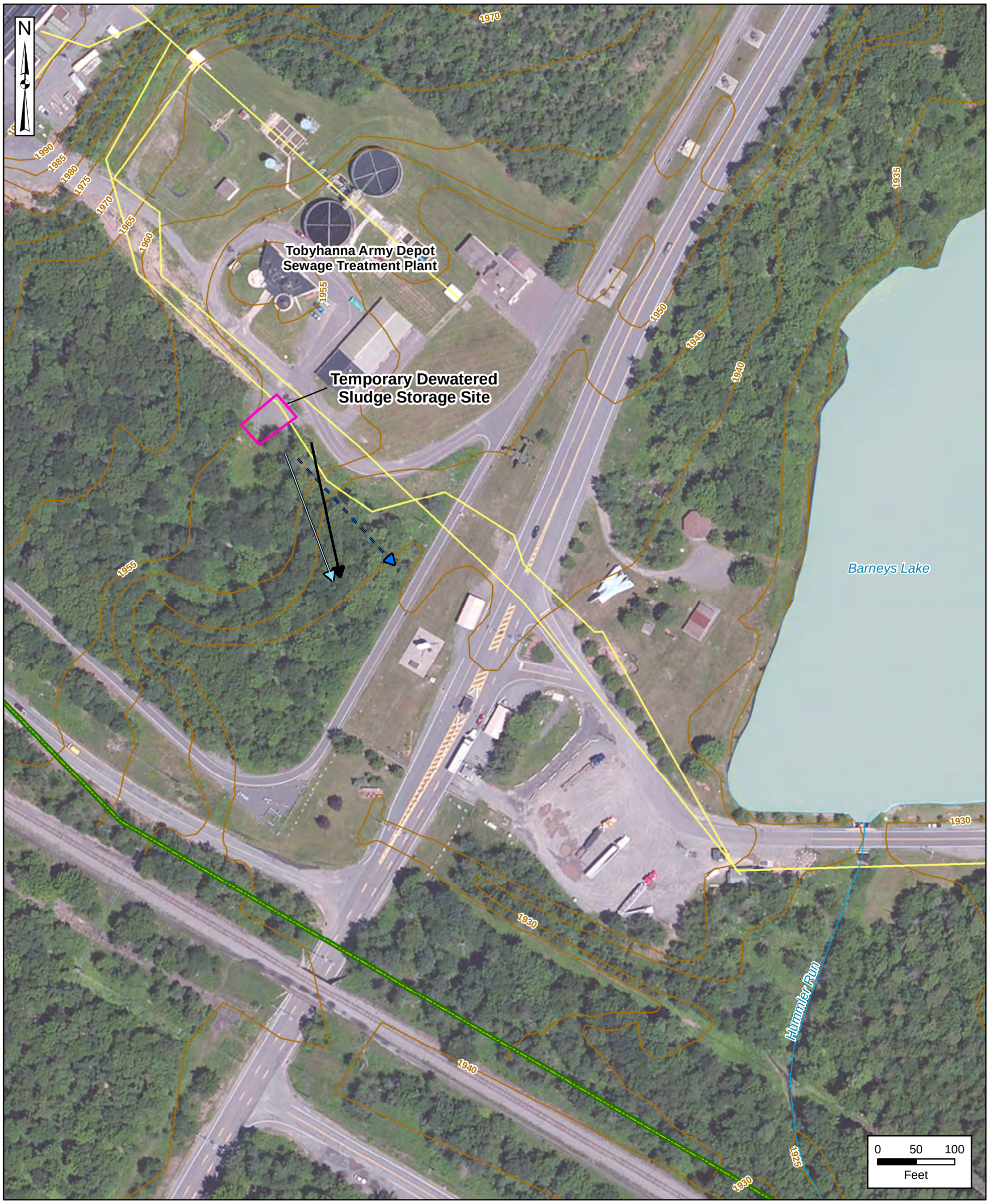


Figure 5-6
Aerial Photo of Temporary Dewatered Sludge Storage Site



Installation Boundary
AOPI
River/Stream (Perennial)
Surface Runoff Flow Direction
Groundwater Flow Direction (Overburden)
Groundwater Flow Direction (Shallow Bedrock)
Elevation Contour (feet)
Sanitary Sewer Line

AOPI = area of potential interest

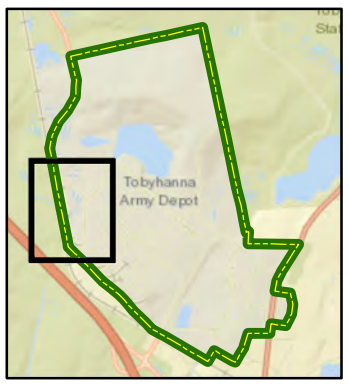
*Exact groundwater flow in this area is unknown.

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 5-7
Aerial Photo of Inactive Sanitary Landfill (OU-5)



Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.
3. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.
4. Monitoring wells were sampled during the 2017 AMC Investigation.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.

LF-27	
Date	9/5/2017
Depth	~70 ft
PFOS	**9.1**
PFOA	**11**
PFBS	**7.3**

LF-29	
Date	9/5/2017
Depth	~78 ft
PFOS	**2.9 J**
PFOA	**65**
PFBS	**1.0 J**

Installation Boundary
AOPI
Former Artillery Range A
River/Stream (Perennial)
Monitoring Well
Previously Sampled Monitoring Well
Surface Runoff Flow Direction
Groundwater Flow Direction (Overburden)
Groundwater Flow Direction (Shallow Bedrock)
Elevation Contour (feet)
Stormwater Drainage Pipe
Stormwater Drainage Pipe Flow Direction

AFFF = aqueous film-forming foam
AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

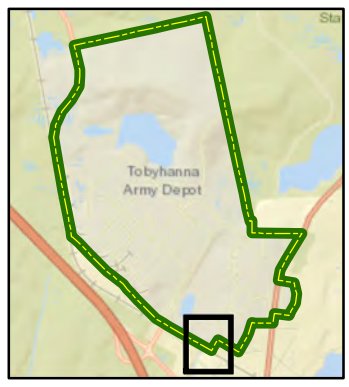


Figure 5-8
Aerial Photo of Area B Former Drum Storage Area (OU-1)

Barneys Lake
N
1930
1935
1940
1945
1950
1955
1960
1965
1970
1970
1940
1940
1940
1925
1920
Hummler Run

MW-11	
Date	9/5/2017
Depth	~25 ft
PFOS	**28**
PFOA	**7.8**
PFBS	**3.7**

Area B Former Drum Storage Area (OU-1)

MW-23	
Date	9/5/2017
Depth	~143 ft
PFOS	**11**
PFOA	**2.0 J**
PFBS	**2.4**

0 100 200
Feet

Notes:
1. Groundwater results are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.
3. Monitoring wells were sampled during the 2017 AMC Investigation.

Qualifiers:
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.

Installation Boundary
AOPI
River/Stream (Perennial)
Elevation Contour (feet)
Monitoring Well
Previously Sampled Monitoring Well
Surface Runoff Flow Direction
Groundwater Flow Direction (Shallow Bedrock)

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

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

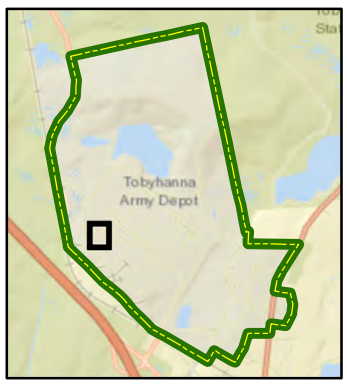


Figure 5-9
Aerial Photo of Building 74 - AFFF Storage

Installation Boundary
AOPI
Elevation Contour (feet)
Surface Runoff Flow Direction
Groundwater Flow Direction (Overburden)
Groundwater Flow Direction (Shallow Bedrock)

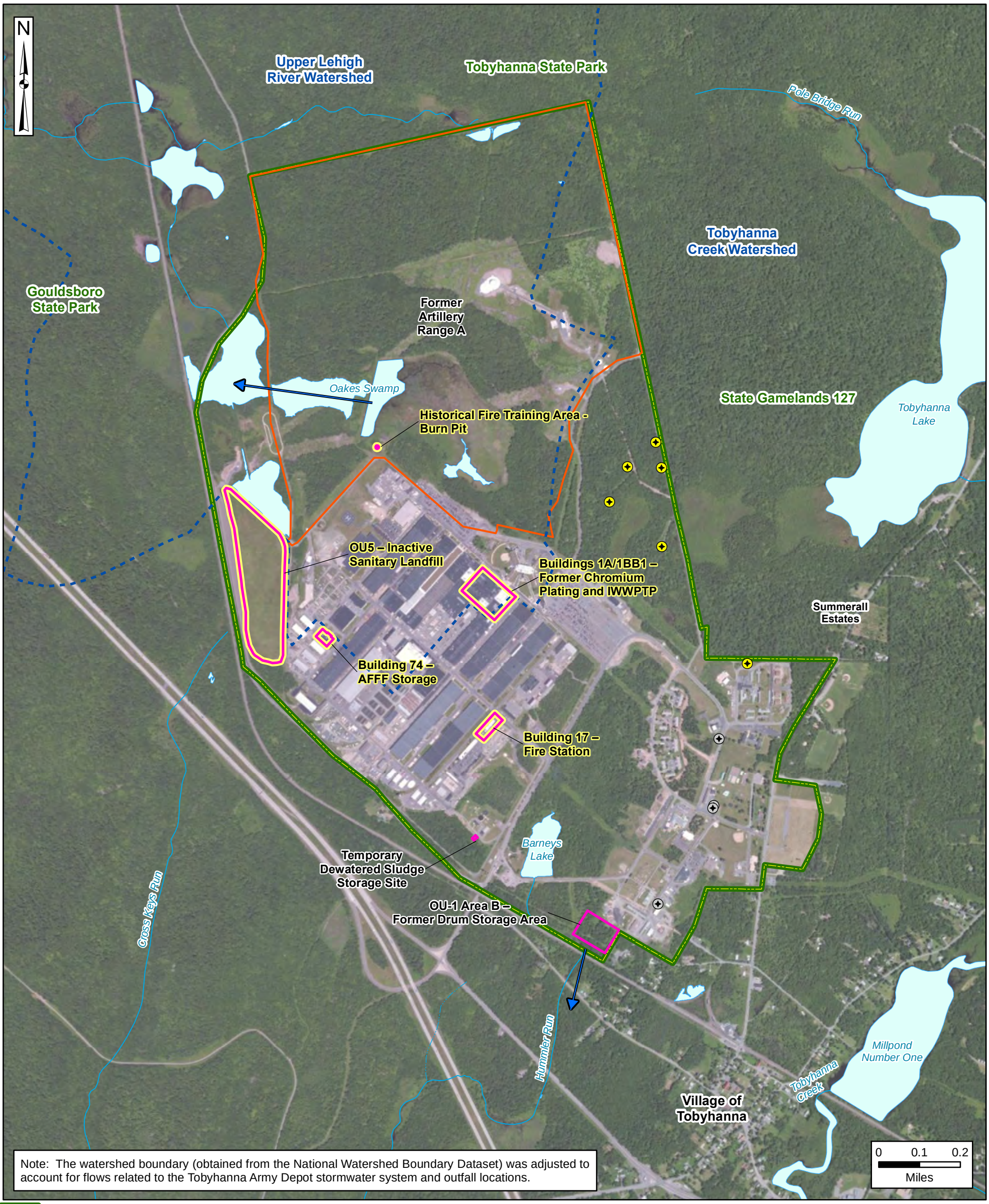
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
Google Earth, Aerial Imagery, 2020

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

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



Note: The watershed boundary (obtained from the National Watershed Boundary Dataset) was adjusted to account for flows related to the Tobyhanna Army Depot stormwater system and outfall locations.

- Installation Boundary
- AOPI
- AOPI with OSD Risk Screening Level Exceedance
- Former Artillery Range A
- River/Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Watershed Boundary
- General Surface Water Flow Direction
- Installation Supply Well (Active)
- Installation Supply Well (Decommissioned)

AFFF = aqueous film-forming foam
AOPI = Area of Potential Interest
IWWPTP = Industrial Wastewater Pretreatment Plant
OSD = Office of the Secretary of Defense
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

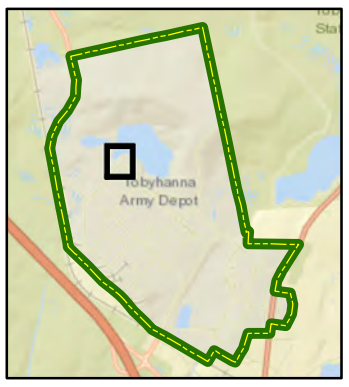


Figure 7-2
Historical Fire Training Area - Burn Pit
PFOS, PFOA, and PFBS Analytical Results

N

Oakes Swamp

Oakes Swamp

TYAD-BurnPit-1-SW	
Date	12/1/2020
PFOS	**28**
PFOA	**4.5 M**
PFBS	**5.4 M**

TYAD-BurnPit-1-SE	
Date	12/1/2020
Depth	0-1 ft
PFOS	0.00088 U
PFOA	0.00088 U
PFBS	0.0029 U

TYAD-BurnPit-2-SW	
Date	12/1/2020
PFOS	**37**
PFOA	**2.4**
PFBS	**3.1 M**

TYAD-BurnPit-2-SE	
Date	12/1/2020
Depth	0-1 ft
PFOS	**0.0011**
PFOA	0.0011 U
PFBS	0.0035 U

TYAD-BurnPit-2-SO	
Date	11/30/2020
Depth	0.5-2 ft
PFOS	**0.0049**
PFOA	0.00064 U
PFBS	0.0021 U

Historical Fire Training Area - Burn Pit

TYAD-BurnPit-2-GW	
Date	1/12/2021
Depth	14-24 ft
PFOS	**350 DM**
PFOA	**9.9 M**
PFBS	**9.3 M**

TYAD-BurnPit-1-SO	
Date	11/30/2020
Depth	0.5-2 ft
PFOS	**0.0018**
PFOA	0.00067 U
PFBS	0.0022 U

TYAD-BurnPit-3-SO	
Date	12/1/2020
Depth	0.5-2 ft
PFOS	**0.0019**
PFOA	0.00066 U
PFBS	0.0022 U

TYAD-BurnPit-1-GW	
Date	1/12/2021
Depth	24-34 ft
PFOS	**240 DM [250 DM]**
PFOA	**21 M [20 M]**
PFBS	**19 [21]**

1955 1960 1965 1970 1975 1980 1985 1990

Former Artillery Range A

0 50 100
Feet

Notes:
1. Groundwater and surface water results (shown in blue) are reported in nanograms per liter (ng/L).
2. Soil results (shown in yellow) and sediment results (shown in green) are reported in milligrams per kilogram (mg/kg).
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate detections.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

Qualifiers:
D = The reported value is from a dilution.
M = Manually integrated compound.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
Former Artillery Range A
Elevation Contour (feet)
Surface Runoff Flow Direction
Groundwater Flow Direction (Overburden)

Groundwater Sampling Location (New Well)
Surface Water / Sediment Sampling Location
Surface Soil Sampling Location
Surface Soil / Groundwater Sampling Location (New Well)

*Exact groundwater flow in this area is unknown.

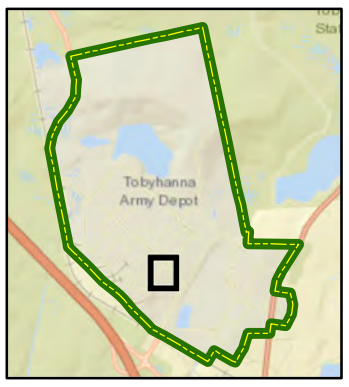
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

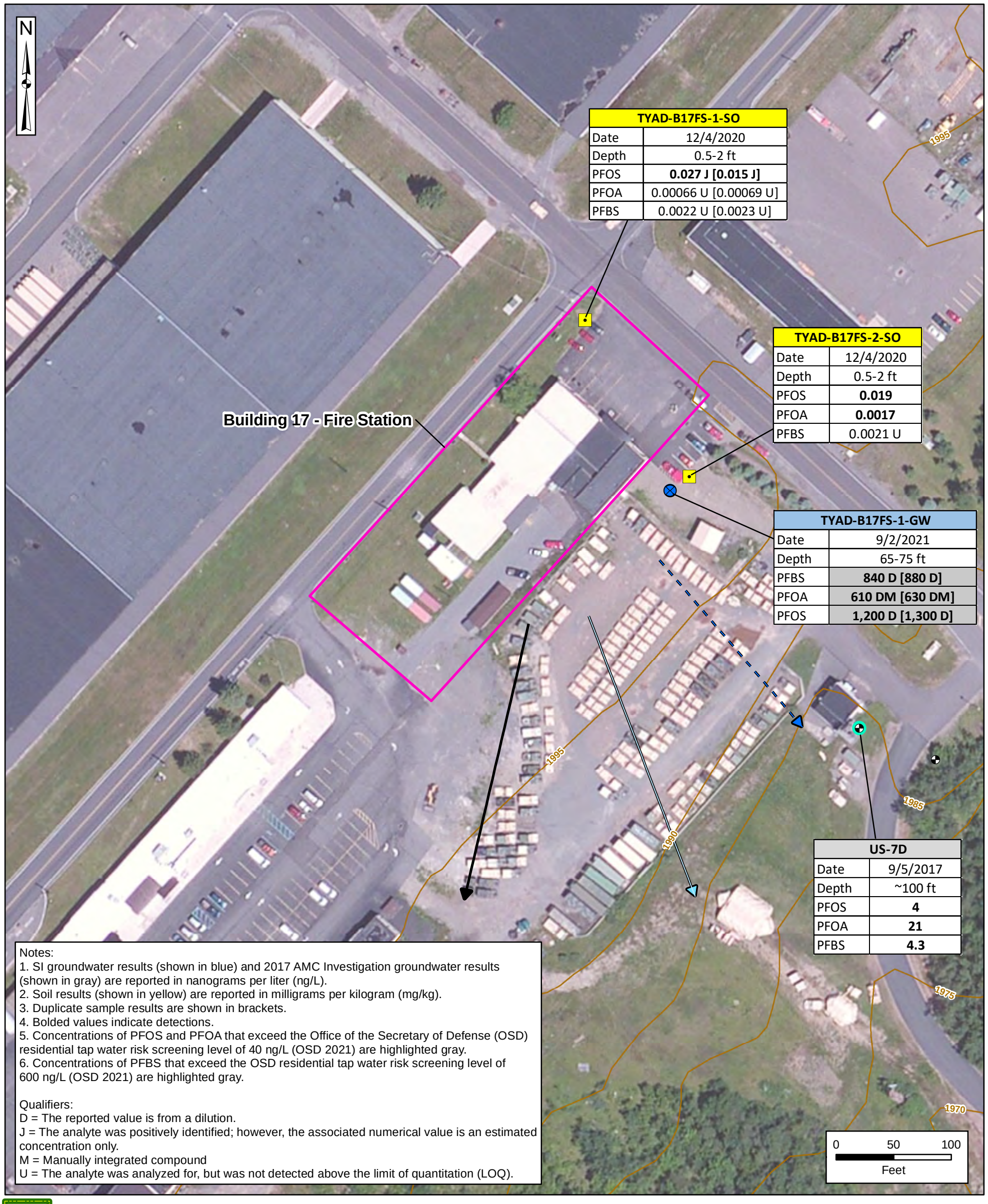
Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 7-3
Building 17 - Fire Station
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. SI groundwater results (shown in blue) and 2017 AMC Investigation groundwater results (shown in gray) are reported in nanograms per liter (ng/L).
2. Soil results (shown in yellow) are reported in milligrams per kilogram (mg/kg).
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate detections.
5. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.
6. Concentrations of PFBS that exceed the OSD residential tap water risk screening level of 600 ng/L (OSD 2021) are highlighted gray.

Qualifiers:
D = The reported value is from a dilution.
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration only.
M = Manually integrated compound
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).

- Installation Boundary
- AOPI
- Elevation Contour (feet)
- Surface Runoff Flow Direction
- Groundwater Flow Direction (Overburden)
- Groundwater Flow Direction (Shallow Bedrock)
- Monitoring Well
- Surface Soil Sampling Location
- Groundwater Sampling Location (New Well)
- Previously Sampled Monitoring Well *

* SI Sampling was planned but not conducted at US-7D.

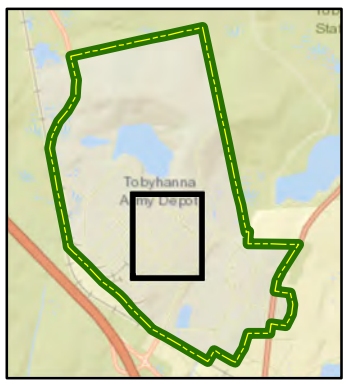
AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SI = Site Inspection

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 7-4
Building 1A/1BB1
Former Chromium Plating and IWWPTP
PFOS, PFOA, and PFBS Analytical Results



PU-1	
Date	8/31/2017
Depth	~39 ft
PFOS	2.0 U
PFOA	2.0 U
PFBS	2.0 U

TYAD-PD-1	
Date	12/1/2020
Depth	~38 ft
PFOS	**27**
PFOA	**3.4 M**
PFBS	**1.1 JM**

UA-4D	
Date	8/31/2017
Depth	~95 ft
PFOS	**7.3**
PFOA	**11**
PFBS	**7.4**

UA-8D	
Date	8/31/2017
Depth	~100 ft
PFOS	**1.5 J**
PFOA	**5.6**
PFBS	**3.9**

UA-6D	
Date	8/30/2017
Depth	~90 ft
PFOS	**13**
PFOA	**64**
PFBS	**2.0 J**

TYAD-UA-6D	
Date	12/1/2020
Depth	~90 ft
PFOS	**13**
PFOA	**98**
PFBS	**1.4 JM**

US-7D	
Date	9/5/2017
Depth	~100 ft
PFOS	**4**
PFOA	**21**
PFBS	**4.3**

Range A
2005
2000
1995
2000
1995
1995
Building 1A/1BB1
Former Chromium
Plating and IWWPTP
Building 17 -
Fire Station
N
0 100 200
Feet

Notes:
1. SI groundwater results (shown in blue) and 2017 AMC Investigation groundwater results (shown in gray) are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.
3. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

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

- Installation Boundary
- AOPI
- Former Artillery Range A
- Sanitary Sewer Line
- Groundwater Flow Direction (Overburden)
- Groundwater Flow Direction (Shallow Bedrock)
- Monitoring Well
- Elevation Contour (feet)
- Previously Sampled Monitoring Well *
- Groundwater Sampling Location (Existing Well)

* UA-6D and US-7D were also previously sampled

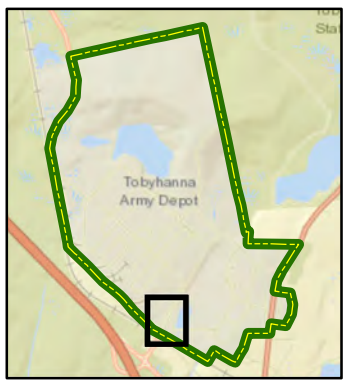
AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
IWWPTP = Industrial Wastewater Pretreatment Plant
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SI = Site Inspection

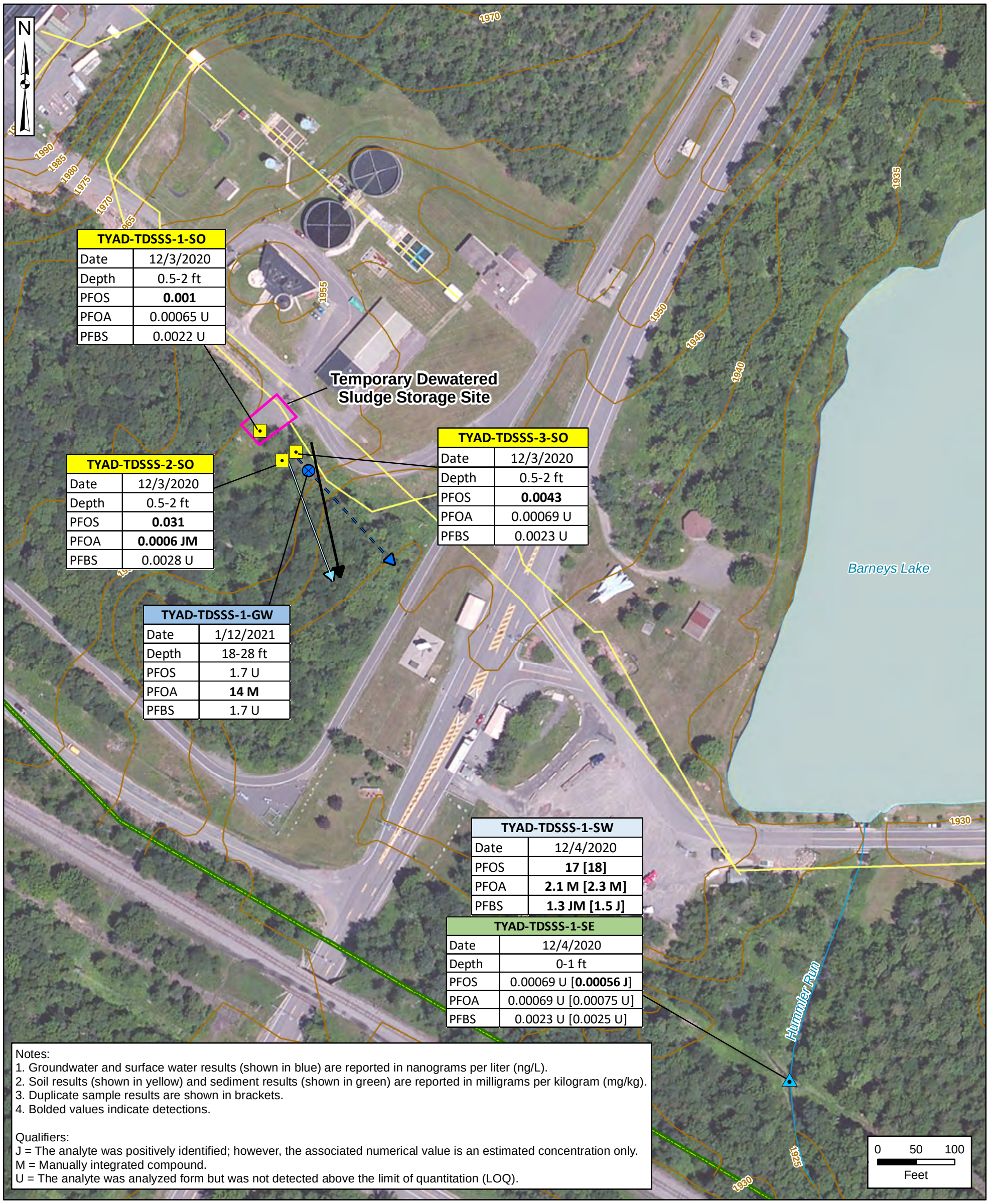
Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 7-5
Temporary Dewatered Sludge Storage Site
PFOS, PFOA, and PFBS Analytical Results





TYAD-TDSSS-1-SO	
Date	12/3/2020
Depth	0.5-2 ft
PFOS	**0.001**
PFOA	0.00065 U
PFBS	0.0022 U

TYAD-TDSSS-2-SO	
Date	12/3/2020
Depth	0.5-2 ft
PFOS	**0.031**
PFOA	**0.0006 JM**
PFBS	0.0028 U

TYAD-TDSSS-3-SO	
Date	12/3/2020
Depth	0.5-2 ft
PFOS	**0.0043**
PFOA	0.00069 U
PFBS	0.0023 U

TYAD-TDSSS-1-GW	
Date	1/12/2021
Depth	18-28 ft
PFOS	1.7 U
PFOA	**14 M**
PFBS	1.7 U

TYAD-TDSSS-1-SW	
Date	12/4/2020
PFOS	**17 [18]**
PFOA	**2.1 M [2.3 M]**
PFBS	**1.3 JM [1.5 J]**

TYAD-TDSSS-1-SE	
Date	12/4/2020
Depth	0-1 ft
PFOS	0.00069 U [**0.00056 J**]
PFOA	0.00069 U [0.00075 U]
PFBS	0.0023 U [0.0025 U]

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

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

- Installation Boundary
- AOPI
- River/Stream (Perennial)
- Elevation Contour (feet)
- Groundwater Flow Direction (Overburden)
- Groundwater Flow Direction (Shallow Bedrock)
- Surface Runoff Flow Direction
- Sanitary Sewer Line
- Groundwater Sampling Location (New Well)
- Surface Water / Sediment Sampling Location
- Surface Soil Sampling Location

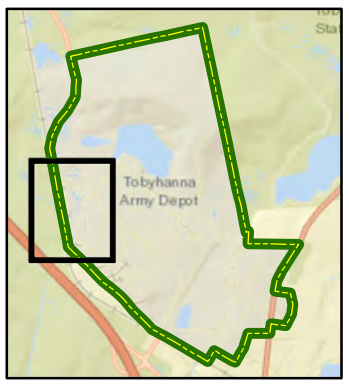
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 7-6
Inactive Sanitary Landfill (OU-5)
PFOS, PFOA, and PFBS Analytical Results



Notes:
1. SI groundwater results (shown in blue) and 2017 AMC Investigation groundwater results (shown in gray) are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.
3. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

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

TYAD-LF-13	
Date	12/2/2020
Depth	~23 ft
PFOS	**29**
PFOA	**5.6 M**
PFBS	**1.1 JM**

TYAD-LF-10	
Date	1/11/2021
Depth	~73 ft
PFOS	**28 M**
PFOA	**12 M**
PFBS	**14**

TYAD-LF-11	
Date	1/11/2021
Depth	~58 ft
PFOS	**6.7 M**
PFOA	**14 M**
PFBS	**2.4**

LF-27	
Date	9/5/2017
Depth	~70 ft
PFOS	**9.1**
PFOA	**11**
PFBS	**7.3**

LF-29	
Date	9/5/2017
Depth	~78 ft
PFOS	**2.9 J**
PFOA	**65**
PFBS	**1.0 J**

TYAD-LF-23	
Date	1/11/2021
Depth	~33 ft
PFOS	**20**
PFOA	**15 J**
PFBS	19 U

TYAD-LF-29	
Date	1/12/2021
Depth	~78 ft
PFOS	**2.6**
PFOA	**56 M**
PFBS	1.8 U

Former Artillery Range A
Inactive Sanitary Landfill (OU-5)
Building 74 - AFFF Storage
Cross Keys Run

0 200 400
Feet

Installation Boundary
AOPI
Former Artillery Range A
River/Stream (Perennial)
Elevation Contour (feet)
Stormwater Drainage Pipe
Monitoring Well
Surface Runoff Flow Direction
Groundwater Flow Direction (Overburden)
Groundwater Flow Direction (Shallow Bedrock)
Stormwater Drainage Pipe Flow Direction
Previously Sampled Monitoring Well *
Groundwater Sampling Location (Existing Well)

* LF-29 was also previously sampled

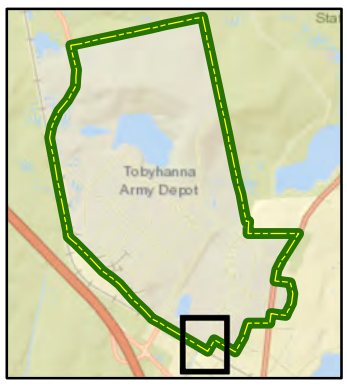
AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SI = Site Inspection

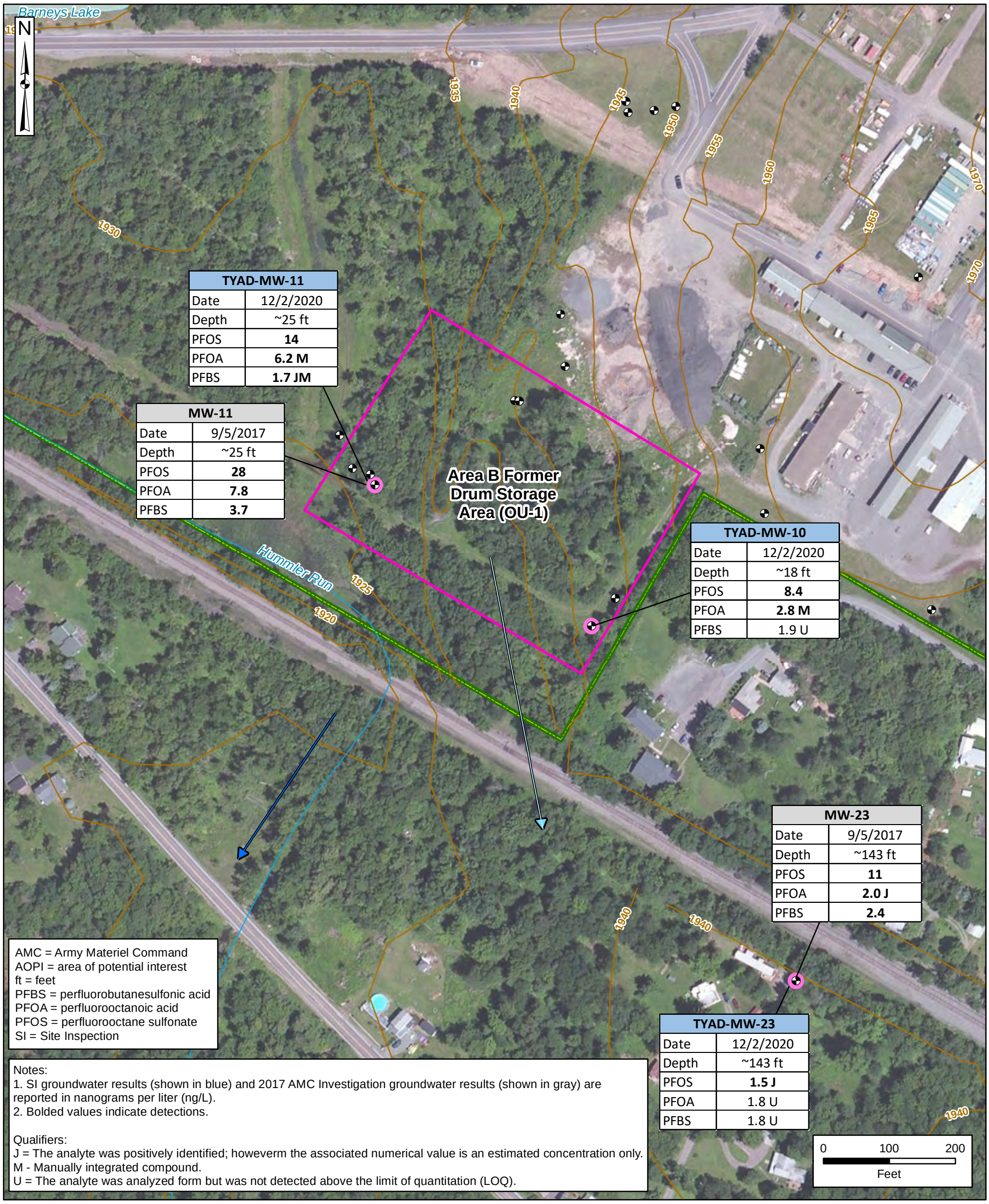
Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 7-7
Area B Former Drum Storage Area (OU-1)
PFOS, PFOA, and PFBS Analytical Results





AMC = Army Materiel Command
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
SI = Site Inspection

Notes:
1. SI groundwater results (shown in blue) and 2017 AMC Investigation groundwater results (shown in gray) are reported in nanograms per liter (ng/L).
2. Bolded values indicate detections.

Qualifiers:
J = The analyte was positively identified; howeverm the associated numerical value is an estimated concentration only.
M - Manually integrated compound.
U = The analyte was analyzed form but was not detected above the limit of quantitation (LOQ).

Installation Boundary
AOPI
River/Stream (Perennial)
Elevation Contour (feet)
Surface Water Flow Direction
Groundwater Flow Direction (Shallow Bedrock)
Monitoring Well
Groundwater Sampling Location (Existing Well) *

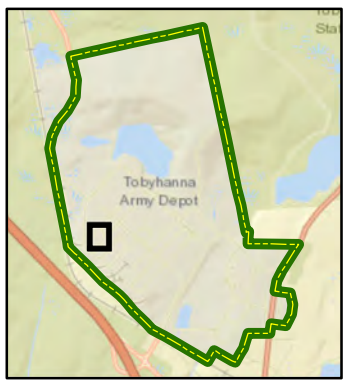
* MW-11 and MW-23 were also previously sampled

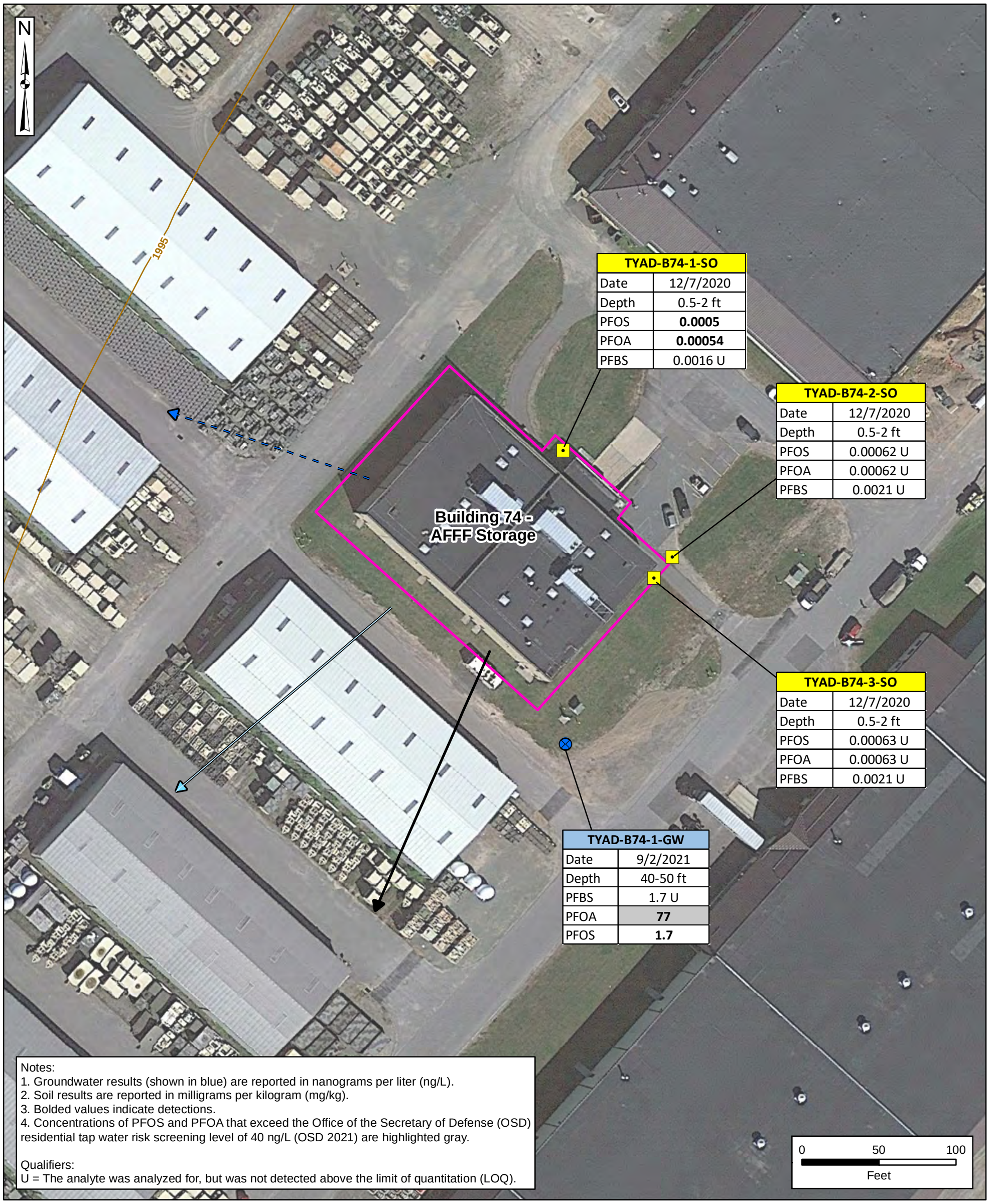
Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 7-8
Building 74 - AFFF Storage
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater results (shown in blue) are reported in nanograms per liter (ng/L).
2. Soil results are reported in milligrams per kilogram (mg/kg).
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening level of 40 ng/L (OSD 2021) are highlighted gray.

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

- Installation Boundary
- AOPI
- Elevation Contour (feet)
- Surface Runoff Flow Direction
- Groundwater Flow Direction (Overburden)
- Groundwater Flow Direction (Shallow Bedrock)
- Surface Soil Sampling Location
- Groundwater Sampling Location (New Well)

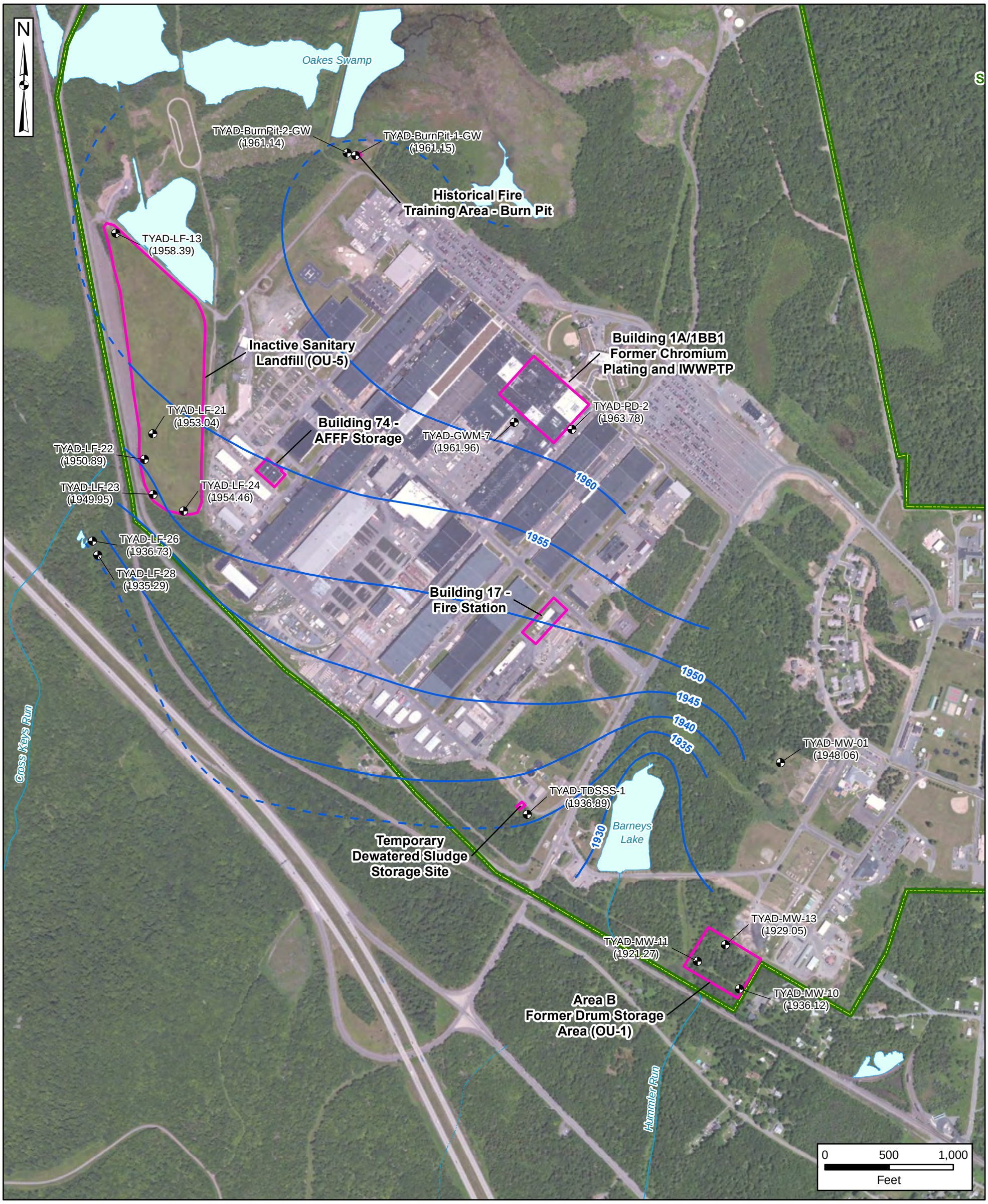
AFFF = aqueous film-forming foam
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
Google Earth, Aerial Imagery, 2020

Coordinate System:
WGS 1984, UTM Zone 18 North

USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, PA

Figure 7-9
Overburden Groundwater Contours – January 2021



Installation Boundary
AOPI
River/Stream (Perennial)
Stream (Intermittent)
Monitoring Well
Groundwater Elevation Contour (feet)
(dashed where inferred)

AFFF = aqueous film-forming foam
AOPI = Area of Potential Interest
IWWPTP = Industrial Wastewater Pretreatment Plant

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North

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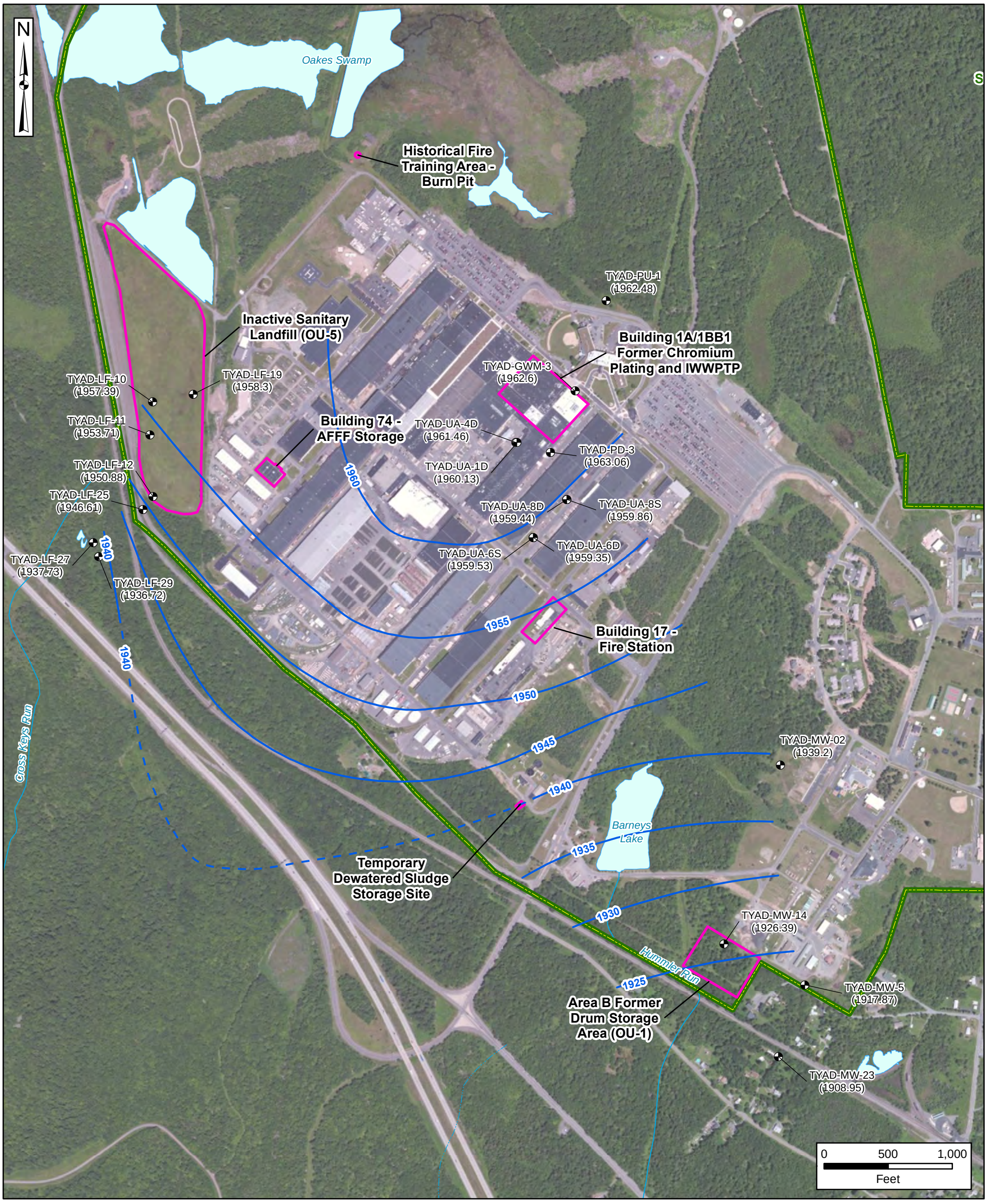
Tobyhanna Army Depot, PA

Figure 7-10
Bedrock Groundwater Contours – January 2021

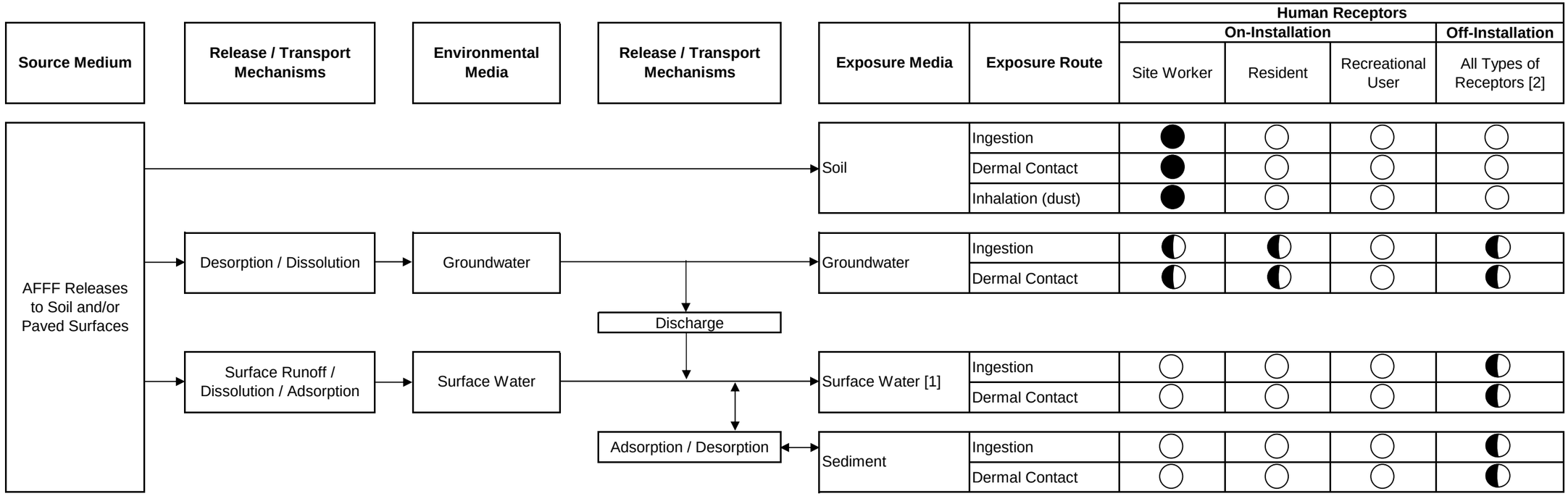


Installation Boundary
AOPI
River/Stream (Perennial)
Stream (Intermittent)
Monitoring Well
Groundwater Elevation Contour (feet) (dashed where inferred)

AFFF = aqueous film-forming foam
AOPI = Area of Potential Interest
IWWPTP = Industrial Wastewater Pretreatment Plant

Data Sources:
Tobyhanna Army Depot, GIS Data, 2019
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 18 North



Legend:

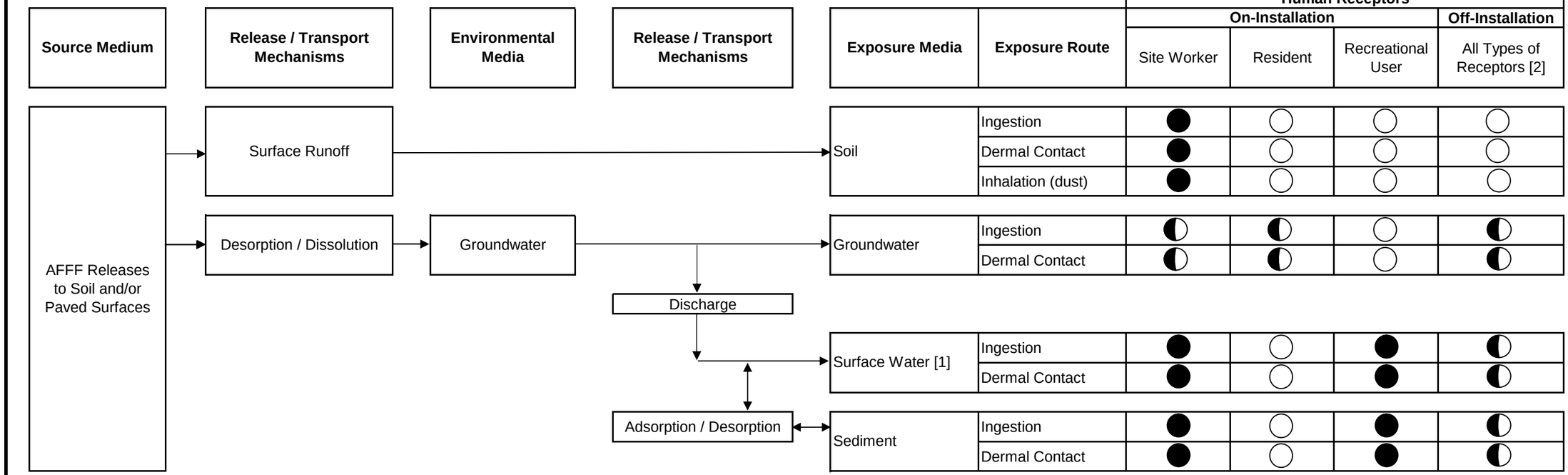
- ● = Complete Exposure Pathway
- ◐ = Potentially Complete Exposure Pathway
- ○ = Incomplete Exposure Pathway

Notes:
[1] Surface water and sediment exposure pathways describe incidental ingestion and dermal contact during either outdoor work activities (for Site Worker) or outdoor recreational activities (for Recreational User).
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF - aqueous film forming foam

ARCADIS

Conceptual Site Model - Historical Fire Training Area- Burn Pit
USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, Pennsylvania

Figure 7-11



Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] Surface water and sediment exposure pathways describe incidental ingestion and dermal contact during either outdoor work activities (for Site Worker) or outdoor recreational activities (for Recreational User).
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF - aqueous film forming foam

ARCADIS

Conceptual Site Model - Building 17- Fire Station
USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, Pennsylvania

Figure 7-12

Source Medium	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	On-Installation: Resident	On-Installation: Recreational User	Off-Installation: All Types of Receptors [2]
PFAS- containing wastes released to Subsurface Soil				Subsurface Soil	Ingestion	◐	○	○	○
					Dermal Contact	◐	○	○	○
					Inhalation (dust)	◐	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◐	◐	○	◐
					Dermal Contact	◐	◐	○	◐
			Discharge						
				Surface Water [1]	Ingestion	●	○	●	◐
					Dermal Contact	●	○	●	◐
			Adsorption / Desorption	Sediment	Ingestion	●	○	●	◐
					Dermal Contact	●	○	●	◐

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

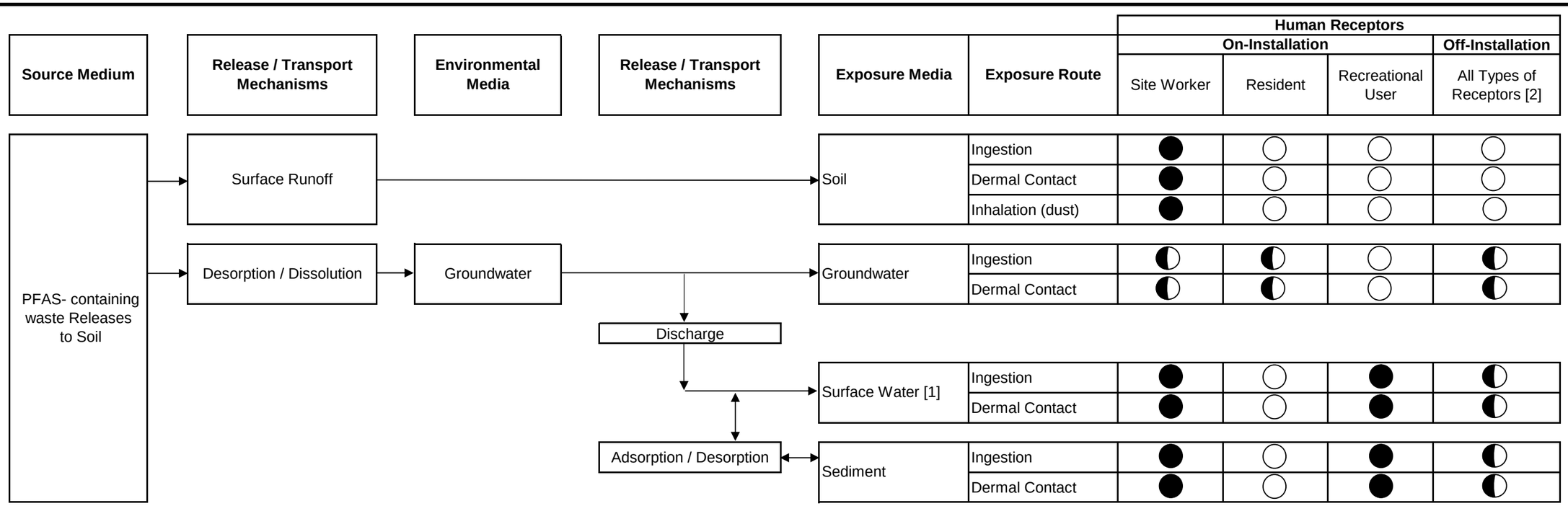
○ = Incomplete Exposure Pathway

Notes:
[1] Surface water and sediment exposure pathways describe incidental ingestion and dermal contact during either outdoor work activities (for Site Worker) or outdoor recreational activities (for Recreational User).
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
IWWPTP - industrial wastewater pretreatment plant
PFAS - per and polyfluoroalkyl substances

ARCADIS

Conceptual Site Model - Building 1A/1BB1 Former Chromium Plating and IWWPTP
USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, Pennsylvania

Figure 7-13



Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] Surface water and sediment exposure pathways describe incidental ingestion and dermal contact during either outdoor work activities (for Site Worker) or outdoor recreational activities (for Recreational User).
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
PFAS - per and polyfluoroalkyl substances

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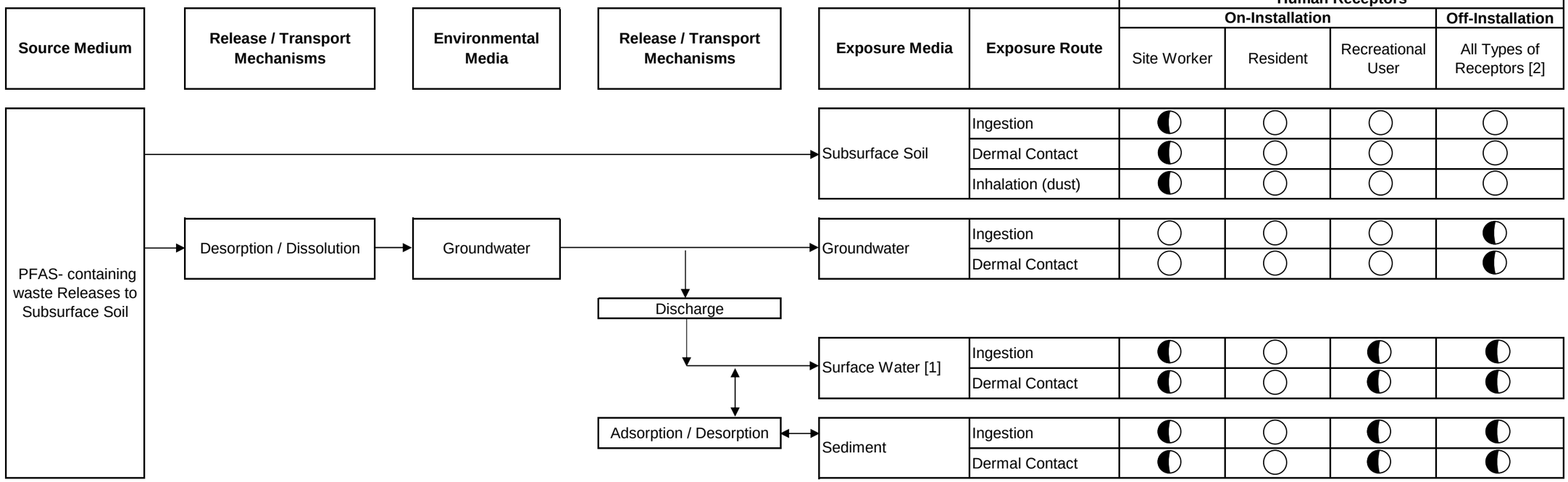
Conceptual Site Model - Temporary Dewatered Sludge Storage Site
USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, Pennsylvania

Figure 7-14



Legend:

◐ = Potentially Complete Exposure Pathway

◯ = Incomplete Exposure Pathway

Notes:
[1] Surface water and sediment exposure pathways describe incidental ingestion and dermal contact during either outdoor work activities (for Site Worker) or outdoor recreational activities (for Recreational User).
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
PFAS - per and polyfluoroalkyl substances

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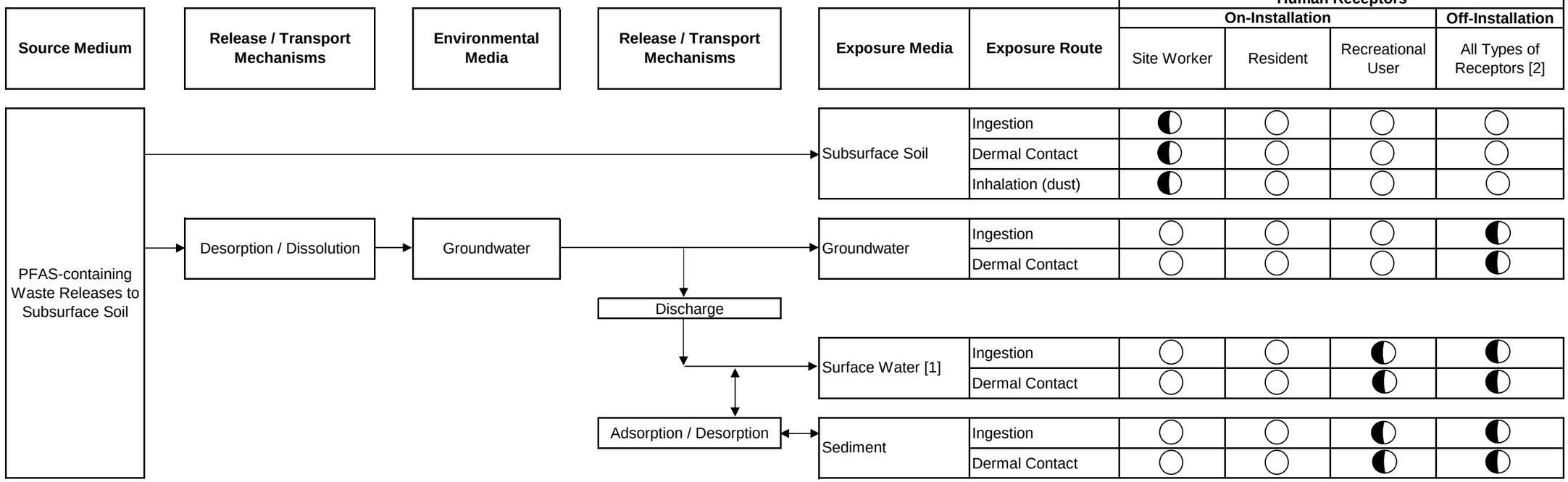
Conceptual Site Model - OU-5 Inactive Sanitary Landfill
USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, Pennsylvania

Figure 7-15



Legend:

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

Notes:
[1] Surface water and sediment exposure pathways describe incidental ingestion and dermal contact during either outdoor work activities (for Site Worker) or outdoor recreational activities (for Recreational User).
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
PFAS - per and polyfluoroalkyl substances

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Conceptual Site Model - OU-1 Area B Former Drum Storage Area
USAEC PFAS Preliminary Assessment / Site Inspection
Tobyhanna Army Depot, Pennsylvania

Figure 7-16

Source Medium	Release / Transport Mechanisms	Environmental Media	Release / Transport Mechanisms	Exposure Media	Exposure Route	Human Receptors: On-Installation: Site Worker	On-Installation: Resident	On-Installation: Recreational User	Off-Installation: All Types of Receptors [2]
AFFF Releases to Soil and/or Paved Surfaces				Soil	Ingestion	●	○	○	○
					Dermal Contact	●	○	○	○
					Inhalation (dust)	●	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◐	◐	○	◐
					Dermal Contact	◐	◐	○	◐
			Discharge						
	Surface Runoff to Stormwater System/ Dissolution / Adsorption	Surface Water		Surface Water [1]	Ingestion	○	○	○	◐
					Dermal Contact	○	○	○	◐
			Adsorption / Desorption	Sediment	Ingestion	○	○	○	◐
					Dermal Contact	○	○	○	◐

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

○ = Incomplete Exposure Pathway

Notes:
[1] Surface water and sediment exposure pathways describe incidental ingestion and dermal contact during either outdoor work activities (for Site Worker) or outdoor recreational activities (for Recreational User).
[2] All types of off-installation human receptors include drinking water receptors and recreational users.
AFFF - aqueous film forming foam

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Conceptual Site Model - Building 74 - AFFF Storage
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Tobyhanna Army Depot, Pennsylvania

Figure 7-17

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