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

Yakima Training Center

Yakima, Washington

Joint Base Lewis-McChord Public Works – Environmental Division

IMLM-PWE

MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433

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

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SITE
JOINT BASE LEWIS-MCCHORD YAKIMA TRAINING CENTER
PIERCE COUNTY, WASHINGTON

PREPARED FOR:
U. S. ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT AND PUBLIC WORKS – ENVIRONMENTAL DIVISION, JOINT BASE LEWIS MCCHORD, WASHINGTON

PREPARED BY:

ARCADIS U.S., INC.
7550 TEAGUE ROAD, SUITE 210
HANOVER, MARYLAND 21076

Prepared by: _____
Hoa Voscott, P.E., Site Inspection Project Manager, Arcadis U.S., Inc.

Reviewed by: _____
Rhonda Stone, PMP, Project Manager, Arcadis U.S., Inc.

Reviewed by: _____
Joseph Quinnan, P.G., P.E., Technical Lead, Arcadis U.S., Inc.

CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

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

YTC (originally known as the Yakima Firing Center) is a satellite installation of Joint Base Lewis-McChord (JBLM) and is located approximately 100 miles east of JBLM and about 5 miles northeast of the city of Yakima. It encompasses 327,231 acres in central Washington state. The YTC 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 and/or groundwater at all seven AOPIs; six of the seven AOPIs had PFOS, PFOA, and/or PFBS present at concentrations greater than the risk-based screening levels. The YTC 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 YTC, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?				Recommendation
	GW	SO	SW	SE	
Former Fire Training Pit (YFCR-53)	Yes	NS	NS	NS	Future study in a remedial investigation
Bird Bath Wash Rack	Yes	NS	NS	NS	Future study in a remedial investigation
Refractometer Solutions Testing Area	Yes	Yes	NS	No	Future study in a remedial investigation
Fire Station 29 (Building 346) and AFFF Storage Area (Building 321)	Yes	No	NS	NS	Future study in a remedial investigation
AFFF Storage Area (Building 821)	Yes	No	NS	NS	Future study in a remedial investigation

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?				Recommendation
	GW	SO	SW	SE	
AFFF Storage Area (Vehicle Maintenance Shop, Building 751)	NS	No	NS	NS	No action at this time
Selah Airstrip	Yes (2019 data)	No	NA	No	Future study in a remedial investigation

Notes:
Light gray shading – detection greater than the OSD risk screening level
Sediment data are compared to the OSD risk screening levels for soil since the features sampled were a typically-dry streambed and drainageway, and the exposure scenario is therefore the same as soil.

Acronyms:
GW – groundwater
NA – not applicable (i.e., PFOS, PFOA, or PFBS detected, but comparison to OSD risk screening levels is not applicable for the surface water feature sampled because it is not an expression of groundwater [e.g., a seep, spring, or gaining stream] and is not used as a source of drinking water)
ND – not detected
NS – not sampled (i.e., with respect to soil, samples were not collected if the ground has been significantly reworked in the area; with respect to surface water/sediment, no relevant surface water feature in the area to sample)
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 Yakima Training Center, Washington (YTC, which has historically been abbreviated as YFCR for Yakima Firing Center), 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 (as discussed in **Section 1.1** and further defined in **Section 6.5**) to determine whether further investigation is warranted. This report provides the PA/SI for YTC 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 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 (and 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 YTC, PA/SI development followed a similar process as described in **Sections 1.3.1** through **1.3.5** below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for YTC. The PA and SI processes are documented in the PA/SI Quality Control Checklist included as **Appendix B**.

1.3.1 Pre-Site Visit

First, 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), YTC, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 02 May 2018, seven weeks before the site visit to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

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

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

- The Installation Management Command (IMCOM) operation order
- The Army PA 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 26 and 27 June 2018. An in-brief meeting was held to provide installation staff with the objectives of the site visit and team introductions. **Section 3** includes information regarding personnel interviewed.

Personnel interviews were conducted with individuals having significant historical knowledge at YTC. The interviews focused on confirming information discussed in historical documents, collecting information that may have not been in historical documents, and corroborating other interviewees' information.

Site reconnaissance 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 installation declined a formal exit briefing; an informal meeting was held on 26 June 2018 with the installation at the end of the first day of the site visit 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. Map document files and associated geographic information system (GIS) data are provided as **Appendix D** (included in the final electronic deliverable only). GIS data layers created for the project are included in a Spatial Data Standards for Facilities, Infrastructure, and Environment-compliant geodatabase.

1.3.4 Site Inspection Planning and Field Work

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

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

- discuss the AOPIs selected for sampling and the proposed sampling plan for each AOPI
- discuss the technical approach and obtain concurrence on the SI sampling plan
- gauge regulatory involvement, requirements, or preferences
- identify overlapping unexploded ordnance or cultural resource areas
- confirm the plan for investigation-derived waste (IDW) handling and disposal
- identify specific installation access requirements and potential schedule conflicts
- 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 was developed to define the DQOs, present the sampling design and rationale, and provide qualifications for project personnel. The SI field work was completed in accordance with the PQAPP (Arcadis 2019) and the approved installation-specific QAPP Addendum. A Site Safety and Health Plan (SSHP) was also developed as an attachment to the QAPP Addendum to identify specific health and safety hazards that may be encountered at the 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 YTC (Arcadis 2020) 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 (LC/MS/MS) and compliant with the DoD Quality Systems Manual (QSM) 5.3 (DoD and Department of Energy 2019). 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 YTC, 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. Information in the following sub-sections is excerpted from the documents cited within.

2.1 Site Location

YTC (originally known as the Yakima Firing Center) is a satellite installation of Joint Base Lewis-McChord (JBLM) and is located approximately 100 miles east of JBLM and about 5 miles northeast of the city of Yakima (population 75,000; **Figure 2-1**). It encompasses 327,231 acres within Yakima and Kittitas Counties in central Washington state. The eastern border of the facility is the Columbia River. The YTC population is predominantly transient soldiers performing maneuvers with a few permanent adult residents and on-site workers. Less than 500 military and civilians are permanently stationed at YTC, including active-duty service members, the Washington National Guard, the Army Reserves, and Marine Reserves members; transient units can swell the YTC population into the thousands for short periods. The most significant adjacent population center is Selah, to the west of the Yakima River from the installation (population 6,300) (YTC 2017); other sparsely populated areas adjacent to the installation (i.e., between the installation and the Yakima River) include the Pomona, Pomona Heights, and East Selah neighborhoods. The installation layout is shown on **Figure 2-2**.

2.2 Mission and Brief Site History

The mission of the YTC is to provide military training facilities, maneuver areas, and ranges for the U.S. and allied nations. Since 1941 the YTC has been used for training artillery, infantry, and engineering units. It is primarily used by the Army, Army Reserve, and Washington National Guard. Prior to 1941, the facility area was privately owned and used for ranching and mining operations (USACE 2012b).

Historical environmental investigations and cleanup programs have been conducted at YTC. The JBLM Environmental Restoration Program is the lead executing agency for YTC; YTC is not on the National Priorities List (YTC 2017). Historical environmental investigations have been completed by YTC and the Army. Cleanup programs have been completed or are in progress for the following primary constituents of concern in soil and groundwater at YTC: munitions and explosives of concern; petroleum, oil, and lubricants; and volatile organic compounds (YTC 2017). YTC is being remediated by the Army under its CERCLA lead agency authority.

2.3 Current and Projected Land Use

YTC is divided into the cantonment area (approximately 1,000 acres in the southwest corner of the installation bounds) with administrative and maintenance buildings, and the down-range areas (the bulk of the lands), which are a series of undeveloped ridges used as maneuver training areas (**Figure 2-2**). The cantonment area is largely covered with asphalt and administrative buildings. One heliport (Vagabond Army Heliport) is located in the cantonment area, and an airstrip (Selah Airstrip) is located in the range area. Open areas include fields of vegetation dominated by shrubs. While most environmental sites historically investigated were closed with no further action decisions, land use controls and/or long-term management remedies remain in place at six Installation Restoration Program (IRP) sites for various constituents of concern.

The land use controls are in place at YTC to prohibit residential land use, excavation, and drinking water well installation to prevent exposure to impacted soil and groundwater at the previously investigated environmental sites. They will remain in-place until cleanup goals are attained. Additionally, ongoing operations at training ranges prohibit residential land development. Military munitions response program sites identified in historical environmental assessments have all been closed (YTC 2017). Outside of the cantonment area, there are several areas that have been used in the past to treat or dispose of wastes. Past waste management practices at most of these areas is not well documented (Science Applications International Corporation [SAIC] 1995).

YTC houses a public juvenile fishing pond open to youth 15 years and younger and does not require a recreation card with YTC; the pond is stocked by the Washington State Fisheries Department. Civilian hunters and recreationalists can obtain recreation cards with YTC to access the public lands with a successful background check and registration of weapons. The public can also access the Palouse to Cascades Trail without recreation cards; mountain biking or horseback riding is not permitted in the down-range areas. Land use in the areas around YTC is primarily agricultural or undeveloped grazing lands. The areas around Selah, Moxee and Black Rock Valleys, and Badger Pocket are host to either irrigated orchards and farmland, or dry land wheat farming (SAIC 1995). Additionally, some on-post areas, including near the Selah Airstrip, may be used by the Yakama Nation for subsistence activities.

2.4 Climate

Information in this section is excerpted from the PA (Shapiro and Associates 1991) and Periodic Review Report (USACE 2012b) for YTC. YTC is located within the semiarid Columbia Basin, which is characterized by sagebrush/wheatgrass steppe and grasslands (SAIC 1995). Precipitation is generally limited to the winter months in the form of snow and averages 8.8 inches; winters are cool, and summers are hot and dry. Mean annual temperature is 51 degrees Fahrenheit (ºF). The average January temperature is 28 ºF and the average July temperature is 72 ºF. Prevailing winds are from the west-northwest in both seasons and are controlled by valley trends (Shapiro and Associates 1991). Average annual potential evapotranspiration is estimated to be between 25 and 37 inches which significantly limits local recharge to aquifers at the site from precipitation (USACE 2012b).

2.5 Topography

Information in this section is excerpted from the PA (Shapiro and Associates 1991) and a facility assessment report (SAIC 1995) for YTC. YTC is located within the Walla Walla Plateau, a sub-province of the Columbia Plateau physiographic province. The area constitutes a transitional zone between the Cascade Mountains to the west and the main part of the Columbia Plateau to the east. The Walla Walla Plateau consists of a series of southeast-trending ridges and intervening valleys; this topography is a result of folding and uplifting of basalts and interbedded sediments of the Columbia Basalt Group (Shapiro and Associates 1991). Landforms in the Columbia Basin are characterized by irregular plains and table lands with moderate to high relief. Elevations on YTC vary from approximately 440 feet above mean sea level along the eastern border with the Columbia River to over 4,000 feet above mean sea level along some of the major east-west trending anticlinal and synclinal ridges (**Figure 2-3**; SAIC 1995). Continued uplift of the plateau has allowed streams and rivers to cut deeply into the basalts, resulting in steep-sided ravines. North-south trending drainages dissect the ridges and flow parallel toward the Columbia River to the east or the Yakima River to the west. In general, the western part of the installation is rolling to hilly, and the topography becomes increasingly rugged to the east in transition down to the Columbia River (Shapiro and Associates 1991).

2.6 Geology

Information in this section is excerpted from the Periodic Review Report for YTC (USACE 2012b) and the Groundwater Monitoring Report for the Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (Tetra Tech 2017). The YTC and surrounding region is underlain by a thick sequence of basalt lava flows with interbedded, weakly consolidated sediments. The lava flows, known collectively as the Columbia River Basalt Group, underlie much of eastern Washington, and have a total thickness of greater than 10,000 feet in parts of the region. Individual flows range from a few feet to more than 100 feet thick. Each flow typically consists of a vesicular or rubbly flow top, a relatively thick internal zone that has a hackly texture of random cooling joints, and lower zone that is characterized by columnar jointing perpendicular to the base of the flow (USACE 2012b). Overlying the basalt sequence in the YTC vicinity is a sequence of sedimentary strata known as the Ellensburg Formation. This formation is composed of partially consolidated sand and gravel, and sediments ranging from unconsolidated sand, silt, and clay to weakly indurated sandstone, siltstone, and claystone. These sediments range from a few feet to several hundred feet thick and are generally thickest in lowland areas. Younger deposits that locally overlie the Ellensburg Formation and the Columbia River Basalt in the YTC area include unconsolidated quaternary alluvial sand and gravel along the stream channels and floodplains, alluvial fan deposits of silty sand and gravel along the flanks of the ridges, and windblown silt (loess) deposits (USACE 2012b).

Within the Yakima Fold Belt, the Columbia River Basalt and Ellensburg Formation have been deformed into a series of east-northeast-trending anticlines and synclines. Owing to the relatively young age of this deformation, the anticlines are expressed as ridges and intervening synclines form valleys. The YTC cantonment area is mostly located within the synclinal valley between the anticlinal Yakima Ridge to the south and Umtanum Ridge to the north (Tetra Tech 2017).

2.7 Hydrogeology

Information in this section is excerpted from the Periodic Review Report for YTC (USACE 2012b) and the Groundwater Monitoring Report for the Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/MATES; Tetra Tech 2017). Extensive folding of the sedimentary and Columbia River basalt strata in the area has created a complex groundwater system with highly variable hydraulic properties, depths to water, and flow directions at any given location at YTC. Groundwater in the region occurs principally within the following principal aquifers (not all are present everywhere across YTC): surficial unconsolidated alluvial deposits, sedimentary units (principally the sand and gravels) of the Ellensburg Formation, the Saddle Mountains Basalt, the Wanapum Basalt, and the Grande Ronde Basalt (Tetra Tech 2017).

The alluvial deposits are typically moderately to highly permeable, and groundwater within them generally is unconfined. The water table in these deposits is typically at or near the elevation of the nearby streams. In the Ellensburg Formation, groundwater is found in the gravel layers within the surficial sedimentary formations and can be either unconfined or confined (creating artesian conditions) by overlying finer-grained materials, depending on the thickness and composition of the formation. Within the sequences of basalt, groundwater is predominantly found within the weathered, more fractured contact zones and within sedimentary interflow zones (Tetra Tech 2017 and USACE 2012b). The basalt flows and associated sedimentary interbeds form the most productive aquifer system in the region. Groundwater within this system occurs principally within fracture and rubble zones of the basalt flows and in the sand and gravel layers that occur between some of the flows. The water-yielding zones within this

sequence range from a few feet to over 50 feet thick. Their lateral extent ranges from short distances or up to several miles, depending on the stratigraphic continuity of the water-bearing unit (USACE 2012b).

Reported depths to groundwater range from 20 feet below ground surface (bgs) in stream valleys to more than 200 feet bgs at higher elevations at YTC. Groundwater springs occur where incised stream valleys intercept aquifers; even though annual precipitation is low in the region, approximately 200 springs are present at YTC (**Section 2.8**; Tetra Tech 2017). In the cantonment area of YTC, the uppermost groundwater occurs in shallow, perched zones (Selah Interbed Aquifer) in the vesiculated fractured basalt near the top or bottom of the Pomona Flow of the Saddle Mountain Basalt, depending on the area. Depth to groundwater can range from 10 to 100 feet bgs in the cantonment area, and the flow direction of the perched water is generally to the west and southwest off-post toward the Yakima River (**Figure 2-2**; Tetra Tech 2017, 2018). The Selah Interbed Aquifer is underlain by a thick sequence of basalt flows within the Columbia River Basalt Group (Tetra Tech 2017).

A highly productive regional basalt aquifer underlies the cantonment area at depth. The installation potable wells which serve as the primary drinking water supply are installed in this aquifer with screen depths greater than 350 feet bgs. The groundwater at depth in this area occurs in basalt fractures and interbedded sediments. This flow system is presumably recharged from a considerably higher area farther up slope and is confined under pressure beneath less permeable strata consisting of basalt or fine-grained sediment (USACE 2012b). Groundwater in the basalt aquifers generally flows westward toward the Yakima River with a more northwesterly flow component closer to the river (Ecology and Environment, Inc. 1993, SAIC 1995).

2.8 Surface Water Hydrology

Information in this section is excerpted from the PA for the YTC (Shapiro and Associates, Inc. 1991), an initial facility assessment report (SAIC 1995), and the Fort Lewis Grow the Army Final Environmental Impact Statement: Chapter 5 Affected Environment - YTC (DoD 2010). The dominant surface water bodies in the region around YTC are the Columbia River to the east and the Yakima River to the west. Both rivers flow from north to south in the vicinity of YTC. The Yakima River flows into the Columbia River approximately 120 miles downstream from YTC. The Columbia River's flow (more than 120,000 cubic feet per second) is regulated by a series of dams. Two major hydroelectric dams (Wanapum and Priest Rapids) are located on the Columbia River near the eastern border of YTC (SAIC 1995). The Columbia River receives runoff from several streams draining from the eastern side of YTC, including Hanson, Alkali Canyon, Corral Canyon, Sourdough Canyon, and Cold Creeks. The Yakima River's flow (average of approximately 2,500 cubic feet per second) is regulated by the Roza Dam in the vicinity of YTC. The Yakima River receives runoff from several streams draining from the western side of YTC, including Squaw, Burbank, and Selah Creeks. Selah Creek receives flow from several on-post ephemeral drainages and springs (e.g., Selah Springs). High evapotranspiration and low precipitation limit surface runoff from YTC. Only Alkali, Cold, and Squaw Creeks are perennial; most other creeks and drainages are ephemeral though a few are intermittent following a large storm event (Shapiro and Associates, Inc. 1991). Though some flash runoff events may occur at YTC if rain falls on snow or frozen ground, flooding is not an issue within the YTC boundaries (DoD 2010).

Several springs (ranging from seasonal to perennial) and seeps also feed some streams. Approximately 148 springs have been developed at YTC to provide water for agriculture and livestock. Three surface water impoundments or ponds (Kiddies, Taylor, and Eaton's Ponds) are located at YTC, supported by earthen dams to hold water year-round. Taylor Pond has historically been used primarily in support of fire suppression activities; Kiddies Pond is a fishing pond for juvenile use. Two irrigation canals divert water from the Yakima River in the vicinity of YTC to

supplement irrigation water. Peak surface water runoff occurs during the winter-spring snowmelt period (Shapiro and Associates, Inc. 1991).

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 YTC.

2.9.1 Stormwater Management System Description

YTC's geographic location with arid climate conditions and high evapotranspiration rates limits runoff from precipitation events; the stormwater season is considered to generally fall from mid-October through April. Stormwater from the cantonment area is managed through a series of structural control devices (e.g., ditches, swales, oil/water separators) which are designed to collect runoff and direct it to natural and man-made drainage systems. These drainages then discharge off-post; the main discharge from the cantonment area exits through Outfall 1, and consists of comingled industrial, non-industrial, and open land discharges. The YTC stormwater drainage systems ultimately or potentially discharge to the Yakima River (YTC 2015).

Pavement wash waters from permitted external building wash-downs are treated through oil/water separators, including from the North 300 Motor Pool/Training Units (i.e., where the refractometer testing solutions area is located outside of Building 323; YTC 2015). Wash rack water waste from other wash rack facilities is plumbed either to a closed-loop/recycle/cleaning system, the wastewater treatment plant (WWTP), a vault for containerization and sent to One Stop Yard (who handles all hazardous waste generated by YTC with the exception of those generated by the Army National Guard), or to a retention basin for infiltration/evaporation. The retention basins are plumbed to oil/water separators prior to discharge (none of which discharges directly to a water body; YTC 2015).

2.9.2 Sewer System Description

The WWTP is operated by the Directorate of Public Works (DPW) staff, and its activities are covered by the National Pollutant Discharge Elimination System wastewater permit for the facility. The treatment process includes a gravity grit channel, primary and secondary sedimentation tanks, trickling filters, primary and secondary digesters, a final sedimentary tank, and ultraviolet disinfection. Sludge generated by the WWTP is dried and transported to off-post landfills. The WWTP has a permitted effluent discharge to the Yakima River (YTC 2015).

2.10 Potable Water Supply and Drinking Water Receptors

The drinking water supply for YTC is provided entirely from groundwater sources. Wells provide water for three permitted drinking water distribution systems located in the cantonment area, at the Yakima Research Station and the Multi-Purpose Range Complex (MPRC; DoD 2010). Prior to distribution and use, this water is treated, typically at the wellhead, by chlorination. Water for the permitted drinking water distribution system in the cantonment area is stored in two tanks with a combined storage capacity of 1,130,000 gallons. Available well construction details for the installation's on-post potable water supply wells are provided in **Table 2-1**. Additional information about the wells that provide water for the three permitted drinking water distribution systems is noted below:

- The Pomona well along with the Jordan and Bowers wells (located in the cantonment area) supply the cantonment area drinking water distribution system.
    - The Pomona drinking water well reportedly flows at 250 gallons per minute and is the primary drinking water supply well for the installation. The well is located at Building 829 and is artesian. The high artesian pressure in this well is interpreted to indicate that groundwater flow to this well is due largely to the structural downwarp in which the YTC is located. The well is completed in the Wanapum and/or Grande Ronde Formation with open borehole completion between depths of approximately 353 and 407 feet bgs; historical surveys indicate that water enters the Pomona well at approximately 401 feet bgs, apparently along a sedimentary interbed or fracture zone (Tetra Tech 2017). Water is pumped to the entry point of the distribution system at Building 550 for chlorination and then pumped to Reservoir #590. The Pomona well is pumped 11 months of the year and is the primary production source for the cantonment area drinking water distribution system (Tetra Tech 2018).
    - The Jordan well is located at Building 550. Jordan well is pumped one month a year, treated and also sent to Reservoir #590. The well is completed to 617 feet bgs with casing open from 365 feet bgs. Static water level is reportedly around 50 feet bgs (YTC 2003).
    - The Bowers well is located at Building 860 and has a storage capacity of 500,000 gallons. The well is completed to 541 feet bgs with casing open from 493 feet bgs. No other information was provided for this well regarding pumping frequency.
- The Yakima Research Station well is located at Building 1901 where it is chlorinated, and then pumped to a reservoir with a storage capacity of 375,000 gallons. It is completed to 602 feet bgs with casing open from 307 feet bgs; static water level is reportedly around 325 feet bgs (YTC 2003).
- The Badger Gap well is located at Building 2110. Water is pumped to a reservoir for chlorination (approximately one gallon of bleach added to the reservoir every three months). The well is government-owned and contractor-operated.
- The MPRC well is located between Buildings 84H (main MPRC building) and 84B (treatment building); water is pumped to Building 84B for chlorination and then to a reservoir. The MPRC has one well with a storage capacity of 1,200 gallons (DoD 2010). The well is government-owned and contractor-operated.

Additional potable wells are located within the range/training areas (**Figure 2-2, Table 2-1**) and have a combined storage capacity of 415,300 gallons (DoD 2010). Water from these remaining wells located throughout the range/training areas is treated as needed (i.e., to supply troops during training) and is not part of the primary drinking water system (DoD 2010). The supply well located at the Selah Airstrip is currently in no-use status; detected PFAS concentrations have been observed in the well and are discussed in **Section 2.12**.

YTC currently has sufficient water resources to meet and surpass the existing maximum water demand. Deep aquifer water supplies are adequate for foreseeable needs at YTC. Non-potable water for fire suppression is obtained from both ground and surface water sources. There are 17 fast-fill wells, three spring-fed fast-fill wells, two fast-fill tanks (which are kept filled through water delivery by the YTC fire department), five earthen ponds and two heli-wells installed in the range areas around YTC for use in fire suppression activities. Surface water from the Columbia River represents one of the primary sources of water for aerial firefighting (the fire season does not overlap the occurrence of juvenile salmon in the river). Water used by troops during training would either be drawn from the cantonment area system and hauled to the field or drawn from one of the training area wells.

Additionally, approximately 100 feet from the Pomona well, the Pomona Artesian Irrigation Company (PAIC) well is installed in the same aquifer as the Pomona well. The PAIC well is the production well for the PAIC water system which serves about 60 homes and businesses west of YTC (off post). This well is also referred to as the Pomona Heights well (USACE 2012b) and is artesian. Flow rate information for the PAIC well is not known.

In addition, several residential drinking water wells have been installed just northwest of the YTC cantonment area boundary (i.e., less than 3,000 feet; Tetra Tech 2017). The locations of these residential wells are shown on **Figure 2-4a**. The State of Washington Department of Ecology Well Report Viewer online database and GIS data from YTC indicate several more supply wells in the area with water well use designations at residential addresses; these wells are installed with total depths ranging from 70 to 467 feet bgs. Some specific locations of the wells are shown for individual residences for the wells immediately northwest of the cantonment area; for wells for which exact coordinates of wells were not available, only the grid centers are depicted on **Figure 2-4a**. Hundreds of additional wells exist within 5-miles of the installation boundary, with use designations often not reported in the State database.

An Environmental Data Resources, Inc. (EDR) report generated for YTC, providing well search results within 5-miles of the installation, is provided as **Appendix E**. An EDR report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. The EDR report along with state and county GIS provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary. The locations of these public and state wells returned in the EDR search are depicted on **Figure 2-4b**, as per the data provided in **Appendix E**; however, it should be noted that the EDR report may include wells that have use designations other than potable water supply (i.e., exploratory wells, piezometers or monitoring wells, agricultural use wells) which are not specified in the report. State supply wells are likely to largely be piezometers and monitoring wells.

Previous investigations have demonstrated that the deeper aquifer used for drinking water on-post is not connected to the shallow aquifer beneath YTC (i.e., where contamination is found from IRP sites). For example, tetrachloroethene was found in a plume at depths of up to 80 feet bgs at the TVR/MATES; (shown on **Figure 2-2**) but has not been observed during the YTC 5-year reviews just south of the site in the Pomona drinking water supply well or the PAIC well (DoD 2010).

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. Information in this section is excerpted from the Fort Lewis Grow the Army Final Environmental Impact Statement: Chapter 5 Affected Environment - YTC (DoD 2010).

YTC is characterized by shrub-steppe vegetation, dominated by species of big sagebrush and bunchgrasses such as bluebunch wheatgrass and Sandberg’s bluegrass. Noxious weeds control in the training areas includes measures to manage knapweed, kochia, and various thistles in uplands, and purple loosestrife in wetland and riparian areas. No plant species known to occur on YTC are federally listed under the Endangered Species Act. Protective measures (i.e., stakes) are in place for populations of sensitive plant species that have the potential to be damaged by military training activities at YTC (DoD 2010).

The tributaries to the Columbia River which flow across YTC are intermittent and have been observed to be used by Chinook salmon fry during early rearing but the tributaries are too small for their spawning. Several other fish species are found in streams on the installation including the threespine stickleback, largescale sucker, mountain

sucker, longnose dace, chiselmouth, prickly sculpin, redside shiner, and the non-native eastern brook trout. No federally listed fish species are known to use rivers and streams on YTC (DoD 2010).

Wildlife at YTC uses three predominant habitat types: shrub-steppe uplands (95 percent [%] of land coverage at YTC), cliffs and talus slopes, and riparian and permanently wet areas. A total of 246 wildlife species occur or are likely to occur at YTC: eight amphibians, 14 reptiles, 174 birds, and 50 mammals. Deer mice, sagebrush voles, Great Basin pocket mice, least chipmunks, and northern pocket gophers account for 98% of the mammals at YTC; other small and mid-sized animals on the installation include black-tailed jackrabbits, Townsend's ground squirrels, Merriam's shrews, racoons, minks, muskrats, beavers, badgers, porcupines, harvest mice, long-tailed voles, and bats. Large mammals found at YTC include cougars, coyotes, mule deer, bighorn sheep, and elk (DoD 2010). No federally listed species are known to inhabit YTC, though some species (Columbia spotted frog, American white pelican, and sandhill cranes) have endangered status with the Washington state list.

2.12 Previous PFAS Investigations

Previous (i.e., pre-PA) PFAS evaluations relative to YTC have been conducted by the Army. The data collected during these investigations are summarized to provide full context of available PFAS data for YTC; in some cases, data recently collected by the Army as part of other PFAS evaluations may be used to supplement the data collected during this SI to make recommendations for further investigation. However, data not collected by the Army will not be used to make recommendations for further investigation.

In May 2016, the USEPA issued a lifetime health advisory for PFOS and PFOA of 70 ng/L (USEPA 2016); subsequently, in 2016, the Army issued a guidance publication for PFAS assessments (Army 2016a, 2016b, 2016c). In response to these actions, the third Unregulated Contaminant Monitoring Rule (UCMR3), and IMCOM Operations Order 16-088, Army installations began initial PFAS sampling in 2016 at water supply wells.

The Pomona well was sampled for 23 PFAS (including PFOS and PFOA) in April 2016 in response to the UCMR3. PFAS were detected at low concentrations (less than 10 ng/L combined, and less than the lifetime health advisory); however, the laboratory experienced severe QC issues, and the data are considered unreliable. These data are excluded from **Table 2-2**. Follow-up sampling was therefore conducted in October 2016 at six drinking water and potable water supply wells: the Pomona, Bowers, Jordan, MPRC, Badger Gap, and Yakima Research Station wells. The samples collected were analyzed for six PFAS via USEPA Method 537 (Eurofins Eaton Analytical 2016); results were non-detect at all six wells for all six constituents analyzed, including PFOS, PFOA, and PFBS (**Table 2-2**). The laboratory that analyzed samples under the UCMR3 met the USEPA's UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

In August 2019, 11 of the potable wells on-post were sampled for 14 PFAS (**Table 2-2**); the samples were analyzed as drinking water via USEPA Method 537 Version 1.1 (Eurofins Lancaster Laboratories Environmental 2019). All results were non-detect except at the Selah Airstrip well (which is installed in the perched aquifer to a total depth of 91 feet bgs and has a static water level of approximately 47 feet bgs). At the water standpipe which is used to fast-fill vehicles and is supplied water via piping from the Selah Airstrip well, detections included PFOS (4.2 ng/L), PFOA (96 ng/L, greater than the OSD risk screening levels of 40 ng/L [**Appendix A**]), and PFBS (11 ng/L). To evaluate PFAS in groundwater at its withdrawal point, follow-up samples were collected at the Selah Airstrip well house in November 2019; the well house samples yielded similar PFAS concentrations (**Table 2-2**). Water supplied from the Selah Airstrip production well (and water stand) has also been piped to buildings at the airstrip. Currently,

however, the well pump has been turned off and is in no-use status due to the PFAS concentrations in groundwater at this well.

The historical documents reviewed during the PA did not specify if the off-post, shallow residential wells were sampled as part of the IRP investigations; these wells are not known to have been sampled for PFAS either.

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 YTC, data was collected from three principal sources of information:

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

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

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various IRP administrative record, compliance, YTC fire department, and YTC DPW 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 YTC during the PA is provided in **Appendix F**.

3.2 Personnel Interviews

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

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

- IRP Manager (JBLM/YTC)
- Fire Chief
- Assistant Fire Chief
- Spill Prevention, Control, and Countermeasures Staff
- Airfield Safety Manager for Vagabond Army Heliport
- Stormwater Pollution Prevention Planner
- Natural Resource Manager
- Pesticide Application Manager
- GIS Coordinator
- WWTP Operator
- Fire Chief (Kittitas Valley Fire and Rescue)

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

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at YTC 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.

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 YTC is presented in **Section 4**. Further discussion regarding rationale for not retaining areas for further investigation is presented in **Section 5.1**, and further discussion regarding categorizing areas as AOPIs is presented in **Section 5.2**.

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

YTC 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/or Disposal Areas

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

At the time of the PA site visit, approximately 40 gallons of Ansulite 3% AFFF remained in each of three fire trucks (E-29, E-229, and E-329), and a total of 30 gallons of Ansulite 3% AFFF was stored in 5-gallon containers in Building 321 according to an inventory provided by the Army (IMCOM 2016). Fire Station 29 (Building 346) housed pumper trucks E-29 and E-229, while its associated Building 321 storage warehouse housed pumper truck E-329 and AFFF concentrate containers. The fire department personnel indicated that since the containers of AFFF concentrate were stored at Building 321 and not at Fire Station 29, the pumper trucks would have been filled at Building 321. Fire Station 29 (Building 346) is scheduled for demolition by the end of 2022.

In Spring 2020, the fire department personnel indicated that this older AFFF was scheduled for disposal through coordination with the Defense Logistics Agency. In Summer 2020, AFFF in the fire trucks tanks was emptied using a submersible pump, the tanks were triple rinsed, and all wastewater generated was containerized and transported off-post to JBLM for disposal (along with other AFFF concentrate that was on-hand at YTC in containers). The draining and rinsing of the tanks were completed in a secondary containment at the hazardous waste storage yard with no reported spills. It was reported that approximately 180 gallons of the newer replacement of approved military-specification AFFF remains on hand at the installation in containers (i.e., not in trucks or other apparatuses).

During the PA site visit, photographs of at least five blue 5-gallon containers of 6% AFFF were provided to Arcadis by DPW personnel. The photographs were reportedly taken at the Armed Forces Reserve Center (however, the building number could not be provided), and the containers have since been removed from storage at the location. Historically, the YTC fire department reportedly stored pallets of AFFF onsite at two locations, in the Conex storage area south of Vehicle Maintenance Shop Building 751 (outdoor storage between two Conex containers beneath a cover made of a truck bed) and at DPW Building 821 (indoor storage at the northeast corner of the building). No leaks or spills were reported at the current or former storage facilities (**Appendix G**).

Two former firefighting training areas were identified at YTC: the Former Fire Training Pit (FTP; YFCR-53) and what is now the Bird Bath Wash Rack (**Appendices F** and **G**). These areas are adjacent to one another (separated by an access road) to the northeast of the cantonment area. Firefighting training activities were conducted two to three times per year until 1987 and once in 1990 at the Former FTP (YFCR-53). Given the period of operation, AFFF was likely used during firefighting training activities at this area. The period of use of the Bird Bath Wash Rack area (prior to the construction of current Building 868) as a firefighting training area is unknown. The YTC fire department indicated that if AFFF was used here during the historical training exercises, AFFF would have also been used during nozzle testing and tank flushing at the sites. Nozzle testing with AFFF is performed to ensure optimal flow of AFFF mixture in case of emergency use and involves spraying AFFF through fire equipment which could result in a release to the environment if the mixture was not fully contained. Additionally, from 1997 to 2004, the parking lot east of Building 323 was utilized by the YTC fire department for quarterly refractometer AFFF solution testing, with some solution discharged to the ground. This parking lot reportedly may have also been used as a tank flushing area (**Appendix G**).

Additionally, the YTC fire department indicated that about 50 gallons of mixed AFFF solution would have been used around 2008 in response to a UH-60 helicopter crash in Range 5 (**Appendix G**); an exact crash location could not be provided. YTC has a limited capacity for aircraft traffic, so crash response was not common. However, the YTC fire department did historically operate an aircraft rescue and firefighting vehicle, which was disposed in 2000. The fire department reportedly kept 1.5 times the amount of AFFF on hand needed to reservice the vehicle but did not recall it ever being fully reserviced due to its infrequency of use.

Finally, a crash truck station was formerly located at the Selah Airstrip (former Building 2065), prior to runway expansion. The former crash truck station building was demolished in 2016. In follow-up email and telephone conversations with the installation as part of the PA, it was indicated that a fire truck containing AFFF was stored at the former crash truck station; however, no AFFF use, spills, or leaks were reported for the area.

An additional fire station (Doris Fire Station) is located at the northeast corner of the installation. However, personnel interviews indicated that this station was never occupied, and fire trucks were only parked there temporarily during training missions; it was not known if these trucks were equipped with AFFF.

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

Following document research, personnel interviews, and site reconnaissance at YTC, other potential PFAS source types (i.e., metal plating operations, pesticide use, prescribed burn areas, automobile maintenance shops, photo-processing facilities, laundry/water-proofing facilities, car washes, stormwater or sanitary sewer components [including WWTPs], landfills, or remediated soil application areas) were either not identified at the installation or did not prompt further research or constitute categorization as AOPIs.

It was noted during a discussion with a USAEC Pest Management Consultant (who provided a list of potentially PFAS-containing pesticides to the PA team; USAEC 2019) that the larger group of pesticides are generally not of PFAS concern. Specifically, this list indicated that products containing Sulfluramid (i.e., associated with insecticides) may have contained PFAS and were phased out in 1996. The USAEC Pest Management Consultant has records of pesticides used and stored at IMCOM installations, including YTC, and records review did not identify YTC as an installation having used or stored PFAS-containing pesticides/insecticides. Additionally, the PA team interviewed the YTC Pesticide Applications Manager and reviewed available pesticide use inventory documentation

provided by the installation for fiscal years 2004 to 2017 and did not identify PFAS-containing pesticides use, storage, or disposal.

Further discussion regarding areas not retained for further investigation is presented in **Section 5.1**.

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 YTC) 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.

YTC's fire department is actively involved in fighting regional brush fires which frequently start during training operations, and the department backs up local emergency service agencies during wildfire response in the surrounding areas (i.e., Kittitas Valley, Selah, Yakima). However, wildfires are not typically responded to with AFFF.

YTC fire department personnel recalled an off-post fire response to a semi-truck crash in the Burbank Creek area west of Range 12; AFFF was used during the response, but the volume of AFFF used and the exact location of the response was not provided. The Kittitas Valley fire department also reported responding to truck fires off-post along Interstate 82 (i.e., west of the installation, downgradient of the installation potable water wells) with Class B foams; frequency of the responses and estimated volume of AFFF used was not provided.

Several municipal fire departments are located within 5 miles of YTC to serve Selah, East Selah, Pomona, Yakima, Naches Heights, Terrace Heights, and Moxee. Several other operations which may use PFAS-containing materials occur in these municipalities (more frequent in Yakima), such as metal fabricating and plating shops, paint shops, automobile maintenance shops, laundering facilities, car washes, and pest management services.

5 SUMMARY AND DISCUSSION OF PA RESULTS

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

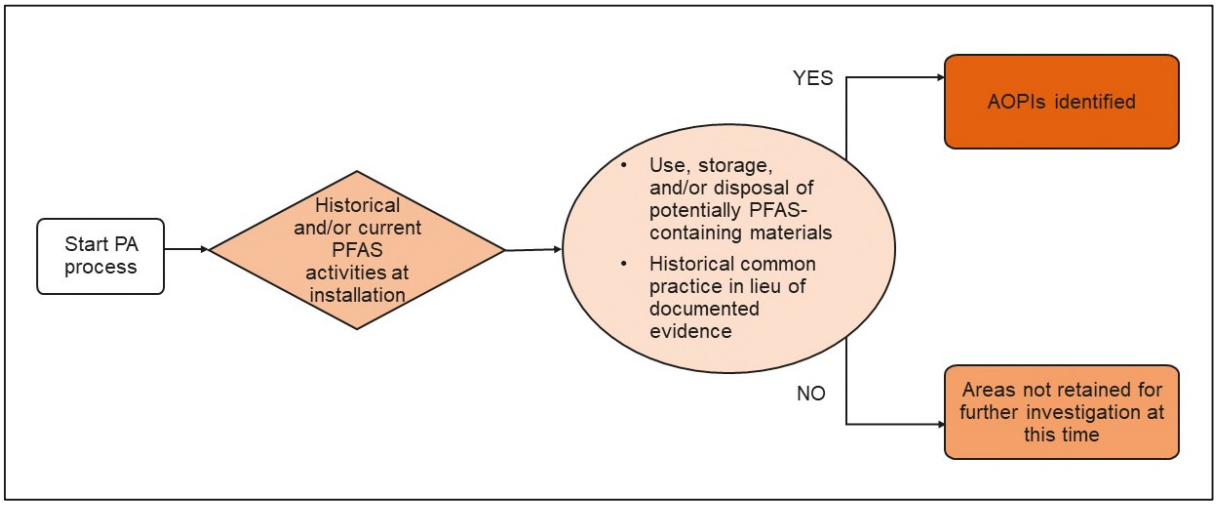

Figure 5-1: AOPI Decision Flowchart

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 YTC 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 is presented in **Table 5-1**, below.

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

Area Description	Dates of Operation	Relevant Site History	Reason Eliminated
Building 650 – WWTP	Unknown to current	YTC operates on a closed-loop system for wastewater and some stormwater runoff from the installation. Sludge generated by the plant is dried and transported to off-post landfills. The WWTP effluent discharges to the Yakima River.	No evidence of receipt of PFAS-containing material based on information obtained during the PA.
Building 396 – Vagabond Army Heliport	Unknown to current	No crash responses or AFFF use or storage reported at the heliport during personnel interviews. Surface water runoff from the area is directed to the WWTP.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing material based on information obtained during the PA.
Building 296 – Hangar	2017 to present	This building is a newly constructed hangar at Selah Airstrip. The building is equipped with a water-only deluge fire suppression system.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing material based on information obtained during the PA.
Doris Fire Station	Not applicable	Station was never occupied; according to personnel interviews, fire trucks were sometimes temporarily parked at the station during training missions only.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing material based on information obtained during the PA.
Building 809 – Pesticide Area	Unknown to current	Mixing and storage of various pesticides in a no-outlet concrete containment structure.	No evidence of use, storage, and/or disposal of PFAS-containing material based on information obtained during the PA.
Range 5 – UH60 Crash Site	Approximately 2008	Approximately 50 gallons of AFFF mixture was used during a helicopter crash response in this area.	The exact location of the response with AFFF could not be provided based on information obtained during the PA.

Area Description	Dates of Operation	Relevant Site History	Reason Eliminated
Landfills	Unknown to current	Mixed use landfills for on-post waste disposal.	No evidence of receipt of PFAS-containing material based on information obtained during the PA.
Various Wildfire Responses	Unknown to current	On- and off-post brush fires are responded to by the YTC fire department and other local emergency service agencies. The locations of each response were not provided, and brush fires are not typically responded to with AFFF.	No evidence of use, storage, and/or disposal of AFFF or other PFAS-containing materials, and exact locations of responses could not be provided based on information obtained during the PA.
Various Vehicle Fire Responses	Unknown	The YTC fire department responded to a semi-truck crash in the Burbank Creek area west of Range 12 with AFFF. The Kittitas Valley fire department also reported responding to various truck fires off-post along Interstate 82 (i.e., west of the installation, downgradient of the installation potable water wells) with AFFF.	Exact locations of responses with AFFF could not be provided based on information obtained during the PA; responses occurred off-post by multiple agencies.

5.2 AOPIs

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

The AOPI locations are shown on **Figure 5-2** (i.e., for the cantonment area) and on **Figure 5-3** (i.e., for the Selah Airstrip area). Aerial photographs of each AOPI that also show the approximate extent of AFFF use (if applicable) are presented on **Figures 5-2** and **5-3** and include active monitoring wells and water supply wells in the vicinity of each AOPI.

5.2.1 Former Fire Training Pit (YFCR-53; 1214A.1050)

The Former FTP (YFCR-53) was identified as an AOPI following document research, personnel interviews, and site reconnaissance based on reported historical firefighting training activities, during which AFFF was likely used given the time period of operation of the site. Installation fire department staff indicated that the pit area would have likely

also been used for nozzle and flow testing with AFFF when the pit was in operation. **Figure 5-2** shows the likely areal extent of AFFF use for this AOPI.

The Former FTP (YFCR-53) site is located in the northeast portion of the cantonment area and was identified as SWMU 59 during a 1995 environmental investigation. The site was used to practice extinguishing fires two or three times per year from an unknown start date until 1987, with a single training event in 1990. Practice events consisted of saturating an open, unlined earthen pit with water, adding and igniting 500 to 1,000 gallons of waste fuel, and then extinguishing the fire. During the 1990s, the site was used for storing stockpiles of waste sand filter material and sediments from the adjacent vehicle wash rack treatment system (i.e., Building 868 – Bird Bath Vehicle Wash Rack) as well as storing fuel bladders. An environmental investigation was conducted in 2001 to determine the extent of petroleum impacts in soil, and based on the results, a removal action of approximately 1,350 tons of petroleum-impacted soil was completed in three separate events in 2003 (USACE 2012b). The off-site disposal location of the soil is not known; however, it has been documented that some of the excavated material was used as the excavation's own backfill. The site is currently undeveloped and is expected to remain zoned for industrial/commercial use; land use controls are in place. It consists of vegetative cover (grasses and shrubs) with ephemeral surface water features nearby.

Five operable monitoring wells (FTP-1 and FTP-13 through FTP-16) are located downgradient of the area which was impacted by petroleum, oil, and lubricants constituents; groundwater and soil samples historically collected at the Former FTP were not analyzed for PFAS. Shallow groundwater (i.e., encountered at 10 to 25 feet bgs where historical petroleum, oil, and lubricants impacts were observed) in this area flows southwest; the next deepest groundwater bearing unit is at approximately 150 feet bgs. The Pomona and PAIC drinking water supply wells (screened at depths greater than approximately 350 feet bgs) are approximately 1 mile southwest of the AOPI (Tetra Tech 2017).

5.2.2 Bird Bath Wash Rack

The Bird Bath Wash Rack (located at current Building 868) was identified as an AOPI following personnel interviews and site reconnaissance indicating the area as a former firefighting training area. Retired installation personnel noted historical firefighting training activities (and therefore likely AFFF use) in the area prior to construction of the current wash rack facility. The area is adjacent to the Former FTP (YFCR-53) AOPI and therefore may have also likely been used as a firefighting training area (**Figure 5-2**). Google Earth aerial imagery indicates that the wash rack facility was installed sometime between 1996 and 2003; the imagery indicates a rectangular depression in 1996 in the area of the current wash rack that may have been a bermed pit. The land use for this area is currently industrial/commercial and is expected to remain so for the foreseeable future.

Groundwater conditions at this site are expected to be similar to those observed at Former FTP (YFCR-53): shallow groundwater (i.e., encountered at 10 to 25 feet bgs) in this area flows southwest, and the next deepest groundwater bearing unit is at approximately 150 feet bgs. The Pomona and PAIC drinking water supply wells are approximately 1 mile southwest of the AOPI.

5.2.3 Refractometer Solutions Testing Area

The Refractometer Solutions Testing Area (near Building 323; **Figure 5-2**) was identified as an AOPI following personnel interviews and site reconnaissance due to the reported AFFF mixing and testing of the crash trucks' nozzles conducted by the YTC fire department.

East of Building 323, the large asphalt parking lot was reportedly used for refractometer testing of mixed AFFF solutions from at least 1997 to 2004 (quarterly testing). The AFFF and water were mixed at this location, and some of the solution was discharged to the asphalt. Most of the solution reportedly dried on the asphalt before it could flow to the ditch to the north of the parking lot; however, residual AFFF may have run off during precipitation events to the ditch (which flows to an oil/water separator that eventually leads to an outfall off-post). The area was also reportedly used for cleaning out fire truck tanks. The AOPI is not associated with a previous IRP site. The land use for this area is currently industrial/commercial and is expected to remain so for the foreseeable future.

Shallow groundwater in this area flows southwest. Based on its proximity to the old TVR/MATES site, groundwater may be expected to be encountered at 10 to 45 feet bgs near this AOPI. The next encountered groundwater aquifer in the TVR/MATES site was at the Selah interbed of the Ellensburg Formation, beneath the Pomona basalt flow with depths to water ranging 60 to 100 feet bgs; this deeper groundwater flows west toward the Yakima River. The Pomona and PAIC drinking water supply wells (whose water intakes are around 400 feet bgs) are approximately 1,000 feet northeast of the AOPI.

5.2.4 Fire Station 29 (Building 346) and AFFF Storage Area (Building 321)

The Fire Station 29 (Building 346) and AFFF Storage Area (Building 321) was identified as an AOPI following personnel interviews and site reconnaissance due to storage of AFFF at the facility. Fire Station 29 is the primary fire station for the installation and houses two pumper trucks formerly equipped with AFFF. The storage area, Building 321, houses one pumper truck formerly equipped with AFFF. Additionally, two racks of firefighting agents including Class A foams and Class B foams remained in storage at Building 321 (**Figure 5-2**) at the time of the PA site visit. Some empty Class B AFFF containers have been repurposed to store Class A foams that have been drained from other equipment and scheduled for disposal. The fire department noted that these Class A foams stored in Class B containers were not used elsewhere due to cross-contamination concerns. Pumper trucks that were formerly equipped with AFFF and stored at Station 29 would have reportedly been filled at Building 321. A drain exists in the building that directs wastewater to the on-post WWTP. Outside of the building, a large asphalt pad slopes to stormwater ditches to the west. Personnel interviews did not indicate any spill incidents of AFFF at this building. The land use for this area is expected to remain zoned for industrial/commercial use.

5.2.5 AFFF Storage Area (Building 821)

The AFFF Storage Area at Building 821 (**Figure 5-2**) was identified as an AOPI following personnel interviews. YTC personnel indicated that the building was formerly utilized as an AFFF storage area by the YTC fire department. Approximately one pallet of AFFF (consisting of 27 to 36, 5-gallon containers) was historically stored here at the north end of the building near the loading dock, which is positioned over a gravel pad. Site personnel indicated that no drains exist in the building. Interviewed personnel did not indicate any spill incidents of AFFF at this building, and it was indicated that AFFF was no longer in storage at this location. The land use for this area is expected to remain zoned for industrial/commercial use.

5.2.6 AFFF Storage Area (Vehicle Maintenance Shop – Building 751)

The AFFF Storage Area south of the Vehicle Maintenance Shop (Building 751; **Figure 5-2**) was identified as an AOPI following personnel interviews. The area south of the Building 751 (**Figure 5-2**) was formerly utilized by the YTC fire department to store AFFF. Two pallets of AFFF were reportedly stored outside, adjacent to Conex containers under a metal cover; no AFFF containers were present at this location at the time of the PA site visit.

Personnel interviews did not indicate a release of AFFF at this storage location; however, cold storage of the material could have resulted in containers cracking and leaking. The period of storage of AFFF at this location was not indicated. The ground surface is gravel and slopes gently to the south. The land use for this area is expected to remain zoned for industrial/commercial use.

5.2.7 Selah Airstrip

The Selah Airstrip was identified as an AOPI following document research and review of historical analytical data. PFAS constituents, including PFOS, PFOA, and PFBS were detected in groundwater at the Selah Airstrip water stand and well house (non-potable water) in August and November 2019 (**Table 2-2**). Detections of PFOS, PFOA, and PFBS in the groundwater are suspected to be due to the use and storage of AFFF; however, the area of AFFF use and storage at the airstrip is uncertain. The former crash truck station (former Building 2065; **Figure 5-3**) was reportedly used in the 1980s and 1990s (U.S. Army Public Health Command 2010), and follow-up personnel interviews indicated that an AFFF crash truck was parked outside. However, there were no reports of AFFF use, leaks, or spills. The former crash truck station building was demolished in 2016. The ground surface has been reworked in many areas at this AOPI for construction of the airstrips and other facilities. The new hangar constructed at the airstrip contains a water-only deluge fire suppression system. The land use for this area is expected to remain zoned for industrial/commercial use. However, the on-post area around the AOPI may be used by the Yakama Nation for subsistence activities.

A groundwater well designated for potable use exists southwest of the airstrip and is connected to a water stand for fast-filling of vehicles. This well is screened from approximately 73 to 91 feet bgs (**Table 2-1**); this screened interval is assumed to be in the perched aquifer, though little data is available regarding the groundwater conditions at this AOPI (U.S. Army Public Health Command 2010). The water well and stand were turned off and put in no-use status following the detections of PFAS constituents observed at the well and water stand in 2019 (**Section 2.12**). According to YTC personnel, groundwater originating at the Selah Airstrip may have a connection with Selah Creek and may discharge at springs which flow to the creek (i.e., Selah Springs) or to the creek itself.

6 SUMMARY OF SI ACTIVITIES

Based on the results of the PA at YTC, an SI for PFOS, PFOA, and PFBS was conducted in accordance with CERCLA. SI sampling was completed at YTC at all seven AOPIs to evaluate presence or absence of PFOS, PFOA, and PFBS in comparison with the OSD risk screening levels. As such, an installation-specific QAPP Addendum (Arcadis 2020) 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 2012a). The preliminary CSMs identified potential human receptors and chemical exposure pathways based on current and/or reasonably anticipated future land uses. The preliminary CSMs identified soil, groundwater, surface water, and/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 September 2020 through the collection of field data and analytical samples.

The SI field work was completed in accordance with the standard operating procedures (SOPs), technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addendum (Arcadis 2020) 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 YTC. Non-conformances to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.3**. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

As identified during the DQO process and outlined in the site-specific QAPP Addendum (Arcadis 2020; Worksheet #11), 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/or sediment for PFOS, PFOA, or PFBS presence or absence at each of the sampled AOPIs and at other boundary evaluation locations.

6.2 Sampling Design and Rationale

The rationale used to determine whether sampling should be conducted at each AOPI during the SI is illustrated on **Figure 6-1** below.

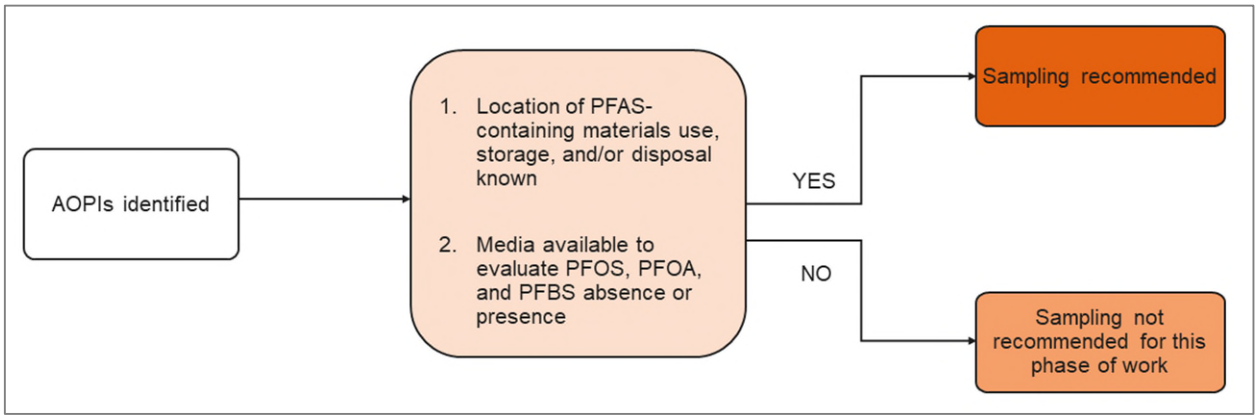

Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at YTC is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2020) and includes analysis of groundwater, soil, surface water, and sediment samples for PFOS, PFOA, and PFBS. Groundwater and surface water samples were also analyzed for field parameters (temperature, pH, dissolved oxygen, oxidation-reduction potential, and specific conductivity). Sediment samples were collected and analyzed for PFOS, PFOA, and PFBS, if the proposed surface water sampling locations were dry during the SI sampling event. Surface water and sediment samples were not collected in association with AOPIs where there were no pertinent surface water or storm drainage features in the area. At one soil sampling location per AOPI planned for soil sampling, one sample was also collected and analyzed for total organic carbon (TOC), pH, and grain size analysis at. TOC, pH, and grain size data were collected as they may be useful in future fate and transport studies.

At the Former FTP (YFCR-53), five existing groundwater monitoring wells were sampled within the footprint of and downgradient of the AOPI. At the Bird Bath Wash Rack, three boreholes were advanced via sonic drilling methods and groundwater was sampled at the first encountered groundwater (which was in basalt bedrock). Three existing groundwater monitoring wells (screened in the perched aquifer) were sampled in association with the Refractometer Solutions Testing Area: two of the wells are downgradient of where surface water runoff from the area would flow to stormwater ditches, and the third well (TVR-5) is located near the oil/water separator to which surface runoff from the AOPI may have been directed. The TVR-5 monitoring well was also sampled as a boundary monitoring well. Additionally, two other boundary monitoring wells (MRC-2 and 815-2) were sampled along the western boundary of the cantonment area to evaluate PFOS, PFOA, and PFBS concentrations in groundwater potentially flowing off-post. The Selah Airstrip well was not resampled due to availability of recent (2019) analytical data for PFOS, PFOA, and PFBS.

Soil samples were not collected at the Former FTP or Bird Bath Wash Rack as the ground had been significantly reworked at both AOPIs (during other IRP activities at the Former FTP and during the vehicle wash rack construction at the Bird Bath Wash Rack); therefore, encountering native shallow soil (i.e., at 0 to 2 feet bgs) was unlikely and shallow soil sampling was not proposed there. Shallow soil samples were collected via hand auger from the 0 to 2 feet interval at the remaining five AOPIs to evaluate PFOS, PFOA, and PFBS presence or absence and to evaluate the potential for those areas to be sources to surface water and groundwater as an influence to drinking water.

At the Refractometer Solutions Testing Area, one soil sample was collected beneath the asphalt of the indicated AFFF use area, and one soil sample was collected at the unlined stormwater ditch northeast of the AOPI to which surface water runoff would have flowed. Additionally, a composite sediment sample was collected at this AOPI along the shotcrete-lined stretch of ditch north of the parking lot to which surface water runoff would have flowed. At the AFFF Storage Area (Building 821) AOPI, one soil sample was collected near the loading dock and one soil sample was collected near the loading ramp at the northeast end of the warehouse where it was indicated that AFFF was stored. The TVR-5 well sampled in association with the Refractometer Solutions Testing Area is also downgradient of the AFFF Storage Area (Building 821) AOPI. At the AFFF Storage Area (Vehicle Maintenance Shop, Building 751) AOPI, one soil sample was collected from beneath where AFFF was stored on pallets in cold storage, and one soil sample was collected just downgradient of the storage area near the gravel pad. At the Fire Station 29 (Building 346) and AFFF Storage Area (Building 321) AOPI, two soil samples were collected outside of Building 321, one on either side of the driveway leading out of the bay to D Street. Soil samples were not collected outside of Fire Station 29 (Building 346) as no AFFF tank filling activities or spills were reported at that location. Two wells (MMP-1 and MMP-2) that were sampled in association with the Refractometer Solutions Testing Area

may also be impacted by surface water runoff from the Fire Station 29 (Building 346) and AFFF Storage Area (Building 321) AOPI. At the Selah Airstrip AOPI, five soil samples were collected within and downgradient of the area of the suspected AFFF use associated with the former crash truck station building: three of the samples were collected near the former building, and two of the samples were collected inside the runways where former surface water diversion features have been noted on historical aerial photographs.

Surface water samples were collected to inform the presence or absence of PFOS, PFOA, and PFBS downgradient of potential source areas associated with the Selah Airstrip AOPI. Grab surface water samples were collected from the following locations: downgradient of Selah Springs (which discharges to Selah Creek) in Selah Creek since Selah Springs was dry at the time of the SI field event, and at Selah Creek before the creek flows off-post. The intermittent stream west of the Selah Airstrip was dry during the field sampling event; therefore, a sediment sample was collected from the dry stream bed instead of a surface water sample at that location.

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), the SOPs and TGIs included as Appendix A to the PQAPP, the QA/QC requirements identified in Worksheet #20 of the PQAPP, the approved scope and sampling methods outlined in the site-specific QAPP Addendum (Arcadis 2020), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Attachment 4 of the QAPP Addendum; Arcadis 2020). 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 during SI field work 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 2020). 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. Photographs of the sampling activities are included in the daily field notes and sample collection logs.

6.3.1 Field Methods

Groundwater samples were collected using low-flow purging methods (using a peristaltic or decontaminated, portable bladder pump and purged through high-density polyethylene [HDPE] tubing) from approximately the center of the saturated screened interval at existing monitoring wells. At sampling locations where boreholes were advanced via rotary sonic methods, a grab groundwater sample was collected using low-flow purging methods through a new pre-packed screen within 5 feet of first encountered groundwater using a peristaltic pump. The construction details for the existing monitoring wells sampled during the SI are included in **Table 6-1**. The sampling depths (i.e., within 5 feet of first encountered groundwater) at the temporary boreholes advanced at the Bird Bath Wash Rack are also included on **Table 6-1**.

In eight of the 10 existing wells sampled, passive diffusion bags or bailers were found downhole upon accessing the wells (i.e., in all existing wells except at FTP-13 and MMP-2; see **Appendix K**). YTC personnel verified that the

brands and models of the devices were PFAS-free. The devices were removed from the wells prior to purging and sampling, and they were replaced after sample collection.

Soil samples were collected as composites from approximately 0 to 2 feet bgs intervals at each sampling location using a decontaminated stainless-steel hand auger.

Surface water samples were collected using direct-fill methods just below the water surface. The sediment sample collected at Selah Airstrip was collected from the upper 10 centimeters using a stainless-steel trowel. The sediment sample at the Refractometer Solutions Testing Area (YTC-RSTA-1-SE) was collected as a composite from the shotcrete lined drainage downgradient from the parking lot by collecting a small aliquot with a decontaminated stainless-steel trowel approximately every 30 feet along the stretch and homogenizing the material before bottling for laboratory analysis.

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

6.3.2 Quality Assurance/Quality Control

Worksheets #20 of the PQAPP and QAPP Addendum provide QA/QC requirements for field duplicates, matrix spike/matrix spike duplicates, equipment blanks (EBs), 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 2020), 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 2020). The decontaminated reusable equipment from which EBs were collected include bladder pump, water level meter, hand auger, stainless-steel trowel, drill bit and casing, and from a polyvinyl chloride riser that was used to recover a pump lost downhole at well MMP-2, as applicable to the sampled media. An EB was also collected on the HDPE tubing and Aqualine string used to collect the groundwater samples. One source blank was collected from the drillers' water tote filled at YTC's Pomona well and used to pressure-wash drill tooling. Field blanks were collected using laboratory-supplied PFAS-free deionized water. Analytical results for blank samples are discussed in **Section 7.11**.

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, USAEC, and YTC) were encountered during the YTC 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 included as **Appendix L** and are summarized below:

- The soil sample planned at the YTC-RSTA-1-SO location was collected instead as a composite sediment sample since the stormwater ditch was found to be lined with shotcrete. Sediments accumulated along the stretch of ditch north of the Refractometer Solutions Testing Area parking lot were collected in aliquots at

approximately every 30 feet, and the material was homogenized before bottling for laboratory analysis. The sample identification was changed to YTC-RSTA-1-SE to denote sediment medium.

- Selah Spring was dry during the SI field event; reconnaissance was conducted in the area to note topographic drainage, and a surface water sample was collected in Selah Creek downgradient of where the spring (when flowing) would flow to the creek. The sample retains the original identification of YTC-SELAHSP-SW.
- One soil sampling location (YTC-B821-2-SO) at Building 821 was moved from north of the loading dock to off the ramp at the northeast corner of the building due to suspected loading activities at the loading ramp in addition to the loading dock, which could represent an additional spill or release area.
- The Selah Creek surface water sampling location (YTC-SELAHCR-SW) was moved approximately 0.5 miles upstream due to a fence hindering access further downgradient and limited water observed in the creek.
- The sediment sample, YTC-SELAH-1-SE, collected at Selah Airstrip (since no surface water was present) was moved to a location parallel to the YTC-SELAH-5-SO sample. The rationale for selecting this location was that the original alternative location was in an area where there was evidence of heavily reworked soil (presumably to regrade the former retention pond in the area), and the original surface water sampling location (YTC-SELAH-1-SW) was located in an area heavily traveled by troops in training.
- A screen-point sampler was not utilized for sample collection; therefore, an EB on this device was not collected as proposed in the QAPP Addendum (Arcadis 2020). The EB identified as YTC-EB-5 (i.e., previously designated for the screen point sampler) was instead collected on a polyvinyl chloride riser casing that was utilized to recover a pump in well MMP-2.

6.3.4 Decontamination

Non-dedicated reusable sampling equipment (e.g., bladder pump, water level meter, hand auger, screen drill bit and casing, and stainless-steel trowel) 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 (Appendix A of the PQAPP [Arcadis 2019]).

6.3.5 Investigation-Derived Waste

IDW, including soil cuttings, excess sediment, groundwater, surface water, decontamination fluids, and disposable equipment were collected and disposed as directed by YTC. Soil cuttings were returned to the ground at the point of collection. Liquid IDW (i.e., purge water and decontamination water) was temporarily containerized; a composite liquid IDW sample was collected and analyzed for PFOS, PFOA, and PFBS to determine the disposal plan. The IDW was placed in Department of Transportation-approved 55-gallon drums, labeled as non-hazardous, and staged at the Hazardous Waste Storage Yard (Building 450) pending the analysis. The Hazardous Waste Storage Yard manager provided a label for the drum with identification “Arcadis, 20-0264, 034-001-001.” Analytical results for IDW samples collected during the SI are discussed in **Section 7.9**.

Equipment IDW was collected in bags and disposed in waste receptacles on post. Equipment IDW includes personal protective equipment and other disposable materials (e.g., gloves, plastic sheeting, and HDPE and silicon tubing) that may contact sampled media.

6.4 Data Analysis

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

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Pace South Carolina (formerly Shealy Environmental Services, Inc.), an ELAP-accredited laboratory for PFAS analysis, including PFOS, PFOA, and PFBS, by LC/MS/MS. 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 constituents, 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 5.3, Table B-15 (DoD and Department of Energy 2019).

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 2020) by the analytical method noted:

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

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

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

6.4.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with SI sampling at YTC. 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 the DUSR.

Based on the final data usability assessment, the environmental data collected at YTC during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUSR and its associated data validation reports (**Appendix 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 YTC QAPP Addendum (Arcadis 2020). Data qualifiers applied to laboratory analytical results for samples collected during the SI at YTC are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

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

Table 6-2 OSD Risk Screening Levels Calculated for PFOS, PFOA, and PFBS in Tap Water and Soil Using USEPA's Regional Screening Level Calculator

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

Notes:

1. Risk screening levels for tap water and soil provided by the OSD. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October 15 (**Appendix A**). The risk screening levels for PFBS in tap water and soil were updated in April 2021 based on the updated toxicity values published by the USEPA (USEPA 2021).
2. All soil data will be screened against both the residential scenario and industrial/commercial risk screening levels (since samples were 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 compared to groundwater data for this Army PFAS PA/SI. Surface water data are not compared to the OSD residential tap water risk screening level as the surface water features sampled (i.e., losing streams/creeks) are not expressions of groundwater (i.e., as springs/seeps or gaining streams/creeks would be) and surface water is not used as a drinking water source nearby. The surface water data are collected only to determine presence or absence and to support re-evaluation of the CSMs. While the current and most likely future land uses of the AOPIs at YTC are industrial/commercial, both residential and industrial/commercial soil risk screening levels for PFOS, PFOA, and PFBS will be used to evaluate detected soil and sediment concentrations (if sediment comparisons are appropriate, e.g., if the sediment was collected from a typically-dry streambed or drainageway and therefore exposure scenarios would be similar to that of soil). The data from the SI sampling event are compared to the relevant 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 YTC (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 2020). 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** below 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 YTC with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** through **7-7** show the PFOS, PFOA, and PFBS analytical results for groundwater, soil, and surface water and/or sediment for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, and/or PFBS greater than the 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 **Appendix M**) 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)
Former Fire Training Pit (YFCR-53)	Yes
Bird Bath Wash Rack	Yes
Refractometer Solutions Testing Area	Yes
Fire Station 29 (Building 346) and AFFF Storage Area (Building 321)	Yes
AFFF Storage Area (Building 821)	Yes
AFFF Storage Area (Vehicle Maintenance Shop, Building 751)	No
Selah Airstrip	Yes

7.1 Former Fire Training Pit (YFCR-53)

Five existing groundwater monitoring wells were sampled at this AOPI: FTP-1 and FTP-13 through FTP-16. Groundwater was generally encountered at 12 to 14 feet bgs within the footprint of the AOPI and approximately 25 feet bgs at the most downgradient monitoring well, FTP-16. Soil was not sampled at this AOPI because the ground has been significantly reworked during previous IRP actions. Surface water and sediment were not sampled at this AOPI as there are no pertinent surface water features in the area.

Exceedances of the OSD risk screening levels were observed for PFOS and PFOA in groundwater samples collected at all five monitoring wells at this AOPI. PFBS was also detected in each sample, with exceedances of the OSD risk screening levels at three of the five monitoring wells (i.e., excluding FTP-14 and FTP-15). The maximum concentrations of PFOS (45,000 DJ ng/L), PFOA (5,200 DJ ng/L), and PFBS (5,900 DJ ng/L) were observed at well FTP-1, located at the center of this AOPI (**Figure 7-2**, **Table 7-1**); these concentrations represent the maximum PFOS, PFOA, and PFBS concentrations observed in groundwater across the installation. The qualifier "DJ" indicates that the analytes were analyzed at dilution (D) and the results are estimated quantities (J). At the downgradient monitoring well associated with this AOPI (FTP-16), concentrations of PFOS, PFOA, and PFBS were 10,000 DJ ng/L, 3,900 DJ ng/L, and 5,200 DJ ng/L, respectively. The monitoring wells are screened in the perched aquifer groundwater zone; groundwater flow direction of this zone in the vicinity of this AOPI is to the southwest. Impacts observed at well FTP-16 may be due to a combination of sources from the Former FTP and the Bird Bath Wash Rack AOPI.

7.2 Bird Bath Wash Rack

Three grab groundwater samples were collected at this AOPI via sonic drilling methods around the downgradient corner of the suspected AFFF use area at this AOPI. Soil was not sampled at this AOPI because the ground has been significantly reworked for construction of the wash rack. Surface water and sediment were not sampled at this AOPI as there are no pertinent surface water features in the area. Groundwater flow direction in this area is to the southwest (towards monitoring well FTP-16).

Weathered, vesicular basalt bedrock was encountered at approximately 5 to 7 feet bgs at this AOPI. Groundwater was generally encountered at 11.5 to 15.5 feet bgs during drilling. Exceedances of the OSD risk screening levels were observed for PFOS, PFOA, and PFBS in all three groundwater samples collected at temporary groundwater sampling locations at this AOPI. At the Bird Bath Wash Rack, the maximum concentrations of PFOS (6,600 DJ ng/L), PFOA (820 ng/L), and PFBS (2,200 DJ ng/L) were observed at the southeast and downgradient corner of the suspected use area (YTC-BBWR-1-GW; **Figure 7-2**, **Table 7-1**).

7.3 Refractometer Solutions Testing Area

The subsections below summarize the groundwater and soil PFOS, PFOA, and PFBS analytical results collected in association with the Refractometer Solutions Testing Area east of Building 323 (**Figure 7-3**). Groundwater flow direction in this area is to the west-southwest (Tetra Tech 2018). Surface water was not sampled at this AOPI as there are no pertinent surface water features in the area.

7.3.1 Groundwater

Two existing monitoring wells were sampled at this AOPI, downgradient of the drainage ditch to which runoff from this AOPI would have flowed: MMP-1 and MMP-2.

Exceedances of the OSD risk screening levels were observed for PFOS and PFOA in groundwater samples collected at both MMP-1 and MMP-2 monitoring wells at this AOPI. While PFBS was detected in each sample, no detected concentrations of PFBS in groundwater exceeded the OSD risk screening levels at this AOPI. Between these two wells, the maximum PFOS, PFOA, and PFBS concentrations observed were 5,300 DJ ng/L (at MMP-1), 170 ng/L (at MMP-2), and 100 ng/L (at MMP-2), respectively. These wells are located within 50 feet of the installation boundary. Impacts observed at these wells could be, in part, attributed to other upgradient sources (i.e., the Former

FTP and Bird Bath Wash Rack AOPIs). or adjacent sources (i.e., the Fire Station 29 [Building 346] and AFFF Storage Area [Building 321] AOPI, where surface runoff could have flowed north and infiltrated the ground surface near the wells).

Additionally, monitoring well TVR-5 was sampled northeast of this AOPI based on indications from the installation that an oil/water separator existing in the vicinity of the well and may have received runoff water from the area. TVR-5 may also be cross-gradient or downgradient from the AFFF Storage Area (Building 821) AOPI at which PFAS were detected in soil, and impacts observed at the well could be, in part, attributed to the AFFF Storage Area (Building 821). The PFOS concentration observed in well TVR-5 (180 ng/L) exceeded the OSD risk screening level (**Figure 7-3**, **Table 7-1**). PFOA and PFBS concentrations (18 ng/L and 47 ng/L, respectively) at this well were less than the OSD risk screening levels. Monitoring well TVR-5 also serves as a boundary monitoring well for the installation.

7.3.2 Soil and Sediment

Two shallow soil samples were collected from 0 to 2 feet bgs at this AOPI: one along the unlined portion of the stormwater ditch northeast and downgradient of the testing area (YTC-RSTA-2-SO), where runoff would have flowed, and one beneath the asphalt in the center of the testing area (YTC-RSTA-3-SO). A third solid sample was collected as a composite sediment sample (YTC-RSTA-1-SE) along the shotcrete lined ditch due north of the testing area, where runoff would have flowed.

PFOS was detected in both soil samples and the sediment sample; the greatest PFOS concentration at this AOPI (0.76 mg/kg, greater than the residential OSD risk screening level) was observed at the YTC-RSTA-3-SO location (soil collected beneath the asphalt). Detected concentrations of PFOS at the other solid media sampling locations YTC-RSTA-1-SE (0.10 mg/kg) and YTC-RSTA-2-SO (0.0035 mg/kg) were less than the OSD risk screening levels (**Figure 7-3**, **Table 7-2**). PFOA was detected in one of the soil samples (YTC-RSTA-3-SO, 0.0027 mg/kg) and in the sediment sample (YTC-RSTA-1-SE, 0.0013 mg/kg), less than the OSD risk screening levels. The sediment sample data are compared to the OSD risk screening levels for soil as the sample was collected from a dry drainageway where the potential exposure scenario is similar to that for soil. Of the solid samples collected at this AOPI, PFBS was only detected in the YTC-RSTA-3-SO soil sample beneath the asphalt (0.0025 mg/kg, less than the OSD risk screening levels).

7.4 Fire Station 29 (Building 346) and AFFF Storage Area (Building 321)

Two shallow soil samples were collected from 0 to 2 feet bgs at this AOPI along the stormwater ditch (running parallel to C Street) west of the Building 321 AFFF storage area to evaluate PFOS, PFOA, and PFBS presence or absence in an area where nozzle testing is suspected to have occurred outside of the fire truck parking bay. One sample was collected north of the gated driveway (YTC-B321-1-SO), and one sample was collected south of the gated driveway (YTC-B321-2-SO). PFOS was detected in both samples (0.0031 mg/kg at YTC-B321-1-SO and 0.015 mg/kg at YTC-B321-2-SO). PFOA and PFBS were also detected in sample YTC-B321-2-SO (0.00090 J mg/kg and 0.00065 J mg/kg, respectively), but they were not detected in sample YTC-B321-1-SO (**Figure 7-3**, **Table 7-2**). The qualifiers for these analytes (J) indicate that the analyte was detected at a concentration between the LOD and LOQ, and the result is an estimated quantity. No exceedances of the OSD risk screening levels were observed for PFOS, PFOA, or PFBS in these samples.

Soil samples were not collected outside of Fire Station 29 (Building 346) as no AFFF tank filling activities or spills were reported at that location. Surface water and sediment were not sampled at this AOPI as there are no pertinent surface water features in the area. However, surface runoff (overland flow and in stormwater drainages) from the AOPI flows to the north, and may infiltrate the ground surface, and, in part, contribute to the impacts observed in groundwater at wells MMP-1 and MMP-2 (i.e., wells sampled in association with the Refractometer Solutions Testing Area). PFOS and PFOA exceedances of the OSD risk screening levels were observed in these wells, and the source(s) contributing to the PFAS concentrations at the wells should be determined during a future investigation.

7.5 AFFF Storage Area (Building 821)

Two shallow soil samples were collected from 0 to 2 feet bgs at this AOPI: one near a loading dock (YTC-B821-SO) and one at the end of a loading ramp (YTC-B821-2-SO) on the northeast side of the building where AFFF would be brought into the storage building. PFOS was detected less than the OSD risk screening levels in both samples (0.0027 mg/kg at YTC-B821-1-SO and 0.0017 mg/kg at YTC-B821-2-SO). PFOA and PFBS were not detected in either sample (**Figure 7-4**, **Table 7-2**).

Surface water and sediment were not sampled at this AOPI as there are no pertinent surface water features in the area. However, monitoring well TVR-5, which exhibited a PFOS concentration (180 ng/L) in exceedance of the OSD screening level, is located cross-gradient or downgradient of this AOPI. As discussed in **Section 7.3.1**, TVR-5 was sampled in association with potential receipt of AFFF runoff from the Refractometer Solutions Testing Area at the nearby oil/water separator.

7.6 AFFF Storage Area (Vehicle Maintenance Shop – Building 751)

Two shallow soil samples were collected from 0 to 2 feet bgs at this AOPI: one within the footprint of the AFFF storage area (YTC-VMS-1-SO) and one just downslope from the gravel pad where the AFFF was stored (YTC-VMS-2-SO). PFOS was detected at a concentration less than the OSD risk screening levels in the YTC-VMS-2-SO sample (0.0018 mg/kg) but was not detected in the YTC-VMS-1-SO sample. PFOA and PFBS were not detected in either sample (**Figure 7-5**, **Table 7-2**).

Surface water and sediment were not sampled at this AOPI as there are no pertinent surface water features in the area. Groundwater was not sampled at this AOPI during the SI given no reported spills or leaks of AFFF at the location; no monitoring wells exist downgradient of the AOPI, and soil sampling was conducted to first evaluate PFAS presence or absence in the potential source medium at the AOPI.

7.7 Selah Airstrip

The subsections below summarize the soil, sediment, and surface water PFOS, PFOA, and PFBS analytical results associated with the Selah Airstrip. As discussed in **Section 2.12**, a November 2019 PFAS sampling event at YTC indicated a detected concentration of PFOA (100 ng/L; **Figure 7-6** and **Table 2-1**) in the Selah Airstrip well that exceeded the OSD risk screening level. PFOS and PFBS were also detected in the Selah Airstrip well during the historical November 2019 sampling event (3.4 ng/L and 11 ng/L, respectively). Groundwater was therefore not resampled at this AOPI given the recent data was considered usable and sufficient to identify PFOS, PFOA, and PFBS presence in groundwater at the AOPI. The Selah Airstrip well is screened from approximately 73 to 91 feet bgs (assumed to be in the perched aquifer, though little data is available regarding the groundwater conditions at this AOPI; U.S. Army Public Health Command 2010).

7.7.1 Soil and Sediment

Five shallow soil samples were collected from 0 to 2 feet bgs at this AOPI: three around the footprint of the former crash truck station (YTC-SELAH-1-SO through YTC-SELAH-3-SO), one at the apex of the new and old runways (YTC-SELAH-4-SO), and one in a low-lying area downgradient of the apex where stormwater runoff from upgradient areas would flow (YTC-SELAH-5-SO). PFOS was detected in all three samples collected near the former crash truck station; the greatest PFOS concentration observed (0.12 mg/kg at YTC-SELAH-1-SO) was just less than the 0.13 mg/kg OSD risk screening level. PFOA was also detected in the YTC-SELAH-1-SO sample (0.0020 mg/kg) at a concentration less than the risk screening level. PFOA and PFBS were not detected in either the YTC-SELAH-2-SO or the YTC-SELAH-3-SO sample. PFOS, PFOA, and PFBS were not detected in either YTC-SELAH-4-SO or YTC-SELAH-5-SO (**Figure 7-6**, **Table 7-2**).

Additionally, one sediment sample was collected along the intermittent stream southwest of the airstrip; the surface water sample proposed at this location could not be collected as the location was dry. This location was sampled for sediment rather than in the southwest corner of the runways due to evidence of rework of soil in the area which filled in the former stormwater retention pond feature in the area. PFOS, PFOA, and PFBS were not detected in the sediment sample (**Figure 7-6**, **Table 7-4**).

7.7.2 Surface Water

One surface water sample (YTC-SELAHSP-1-SW) was collected along Selah Creek, downgradient of where Selah Springs would flow into the creek since the spring was dry upon access. PFOS, PFOA, and/or PFBS were not detected in the sample (**Figure 7-6**, **Table 7-3**).

7.8 Boundary Monitoring Samples

This section summarizes the PFOS, PFOA, and PFBS analytical results from the three groundwater samples collected at existing monitoring wells and one surface water sample collected at the installation boundary to evaluate potential PFAS concentrations in the media flowing off-post (**Figure 7-7**, **Tables 7-1** and **7-3**).

To the northwest of the cantonment area and potentially downgradient[1] of the Former FTP and Bird Bath Wash Rack at existing well MRC-2 (screened at approximately 101 to 111 feet bgs), concentrations of PFOS (1,200 DJ ng/L) and PFOA (49 ng/L) exceeded the OSD risk screening levels. Further south along the installation border at existing well 815-2 (screened at approximately 115 to 130 feet bgs), concentrations of PFOS (260 ng/L) and PFOA (51 ng/L) exceeded the OSD risk screening levels. Finally, at existing well TVR-5 (screened from 132 to 142 feet bgs), the concentration of PFOS (180 ng/L) exceeded the OSD risk screening level while the concentration of PFOA (18 ng/L) was less than the OSD risk screening level. PFBS was also detected in all three of these wells at concentrations ranging from 47 ng/L to 130 ng/L, all less than the OSD risk screening level (**Figure 7-7**). Additionally, it should be noted that the MMP-1 and MMP-2 wells (screened from approximately 88 to 98 feet bgs and 64 to 74 feet bgs, respectively) which were sampled as part of the evaluation for the Refractometer Solutions Testing Area are located within 50 to 100 feet of the installation boundary; these wells exhibited exceedances of the OSD risk screening levels for PFOS and PFOA (as discussed in **Section 7.3** and shown on **Figure 7-3**).

[1] The groundwater flow gradients are not well defined between the Former FTP and monitoring well MRC-2 and are only estimated in areas outside of the Old TVR/MATES site (i.e., where the highest density of monitoring wells exists in the cantonment area near the AOPIs).

PFOS, PFOA, and PFBS were not detected in the surface water sampled along Selah Creek approximately 0.5 mile upstream of the installation boundary (**Figure 7-7**, **Table 7-3**).

7.9 Investigation Derived Waste

A composite sample of the purge and decontamination wastewater was collected from the 55-gallon drum (which contained approximately 30 gallons of liquid) placed in temporary in storage at the Hazardous Waste Storage Yard (Building 450). The results indicated the following concentrations in the wastewater: 7,500 ng/L PFOS, 1,200 ng/L PFOA, and 2,000 ng/L PFBS (**Appendix N**). The PFOS, PFOA, and PFBS concentrations observed exceed the OSD risk screening levels. The IDW water drum was transported off-post by Advanced Chemical Transport Enviro on 26 July 2021 for disposal at an off-post Subtitle C landfill that accepts PFAS-containing waste, as agreed upon by the installation.

7.10 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. These data are provided in **Appendix N**. The TOC concentration in soil samples collected just below the ground surface where fill material was encountered generally ranged from 553 mg/kg (YTC-VMS-1-SO) to 5,620 mg/kg (YTC-SELAH-1-SO); one outlying TOC concentration was observed in soil below the asphalt at the Refractometer Solutions Testing Area (56,300 mg/kg). The TOC content in soil at this installation was generally typical of organic content in desert soil (approximately 5,000 mg/kg) at the Selah Airstrip and particularly for fill material at the AFFF storage AOPIs (Building 323, 751, and 821). TOC content in soil beneath the Refractometer Solutions Testing Area (which is also likely non-native fill material) was slightly greater than a typical topsoil (5,000 to 30,000 mg/kg), particularly for a desert climate.

The percentage of fines (i.e., silt and clay) in soils at YTC were as follows: 4.8% at the Refractometer Solutions Testing Area, 6.2% at the Building 751 – Vehicle Maintenance Shop AFFF storage area, 7.5% at the Building 321 AFFF storage area (adjacent to Fire Station 29, Building 346), 16.9% at the Building 821 AFFF storage area, and 40.4% at the Selah Airstrip AOPI. 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, which ranged from 2.5% to 5.7% between all 13 soil samples collected, was typical for a sandy soil (0 to 10%) or fill, particularly in the arid climate characteristic of YTC. The pH of the soil, which ranged from 7.7 to 8.9 standard units, was slightly alkaline (7 to 9).

Based on the geochemical and geotechnical data obtained during the SI at YTC, PFAS constituents may be relatively more mobile than in soils with more fines and greater TOC content; however, the arid climate may slow vertical transport.

7.11 Blank Samples

EBs were collected on the following types of non-dedicated equipment used to collect environmental samples: bladder pump, HDPE tubing and Aqualine string, water level meter, hand auger, stainless-steel trowel, drill bit and casing, and a section of polyvinyl chloride riser that was used to recover a pump at well MMP-2. Additionally, two field blanks were collected to satisfy the collection frequency of 1 per 20 normal samples (independent of media type). One source blank was also collected to evaluate the PFOS, PFOA, and PFBS concentrations in water used to

fill the drillers tote for use in the decontamination of tooling via a pressure washer. The full analytical results for blank samples collected during the SI are included in **Appendix N**.

PFOS, PFOA, and PFBS were not detected in any EBs or in the source blank. However, PFOS was detected at a concentration of 2.7 J ng/L in one field blank (YTC-FB-2-092220); the result was qualified (J) as an estimated concentration between the LOD and the LOQ.

7.12 Conceptual Site Models

The preliminary CSMs presented in the QAPP Addendum (Arcadis 2020) were re-evaluated and updated, if necessary, based on the SI sampling results. The CSMs presented on **Figures 7-8** through **7-10** 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 are surfactants (which do not volatilize) and are found in a charged or ionic state at environmentally-relevant pH (i.e., pH 5 to 9 standard units). PFOS, PFOA, and PFBS are each negatively charged at environmentally-relevant pH. The media potentially affected by PFOS, PFOA, PFBS releases at Army installations are soil, groundwater, surface water, and sediment. Once released to the environment, a primary factor that inhibits the movement of PFAS constituents is the presence of organic matter and organic co-constituents in soils and sediments. Generally, PFAS constituents are mobile in the potentially affected media, and they are not known to be fully broken down by natural processes.

Based on the use, storage, and/or disposal at 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). Additionally, a subsistence user was selectively added to the CSM for Selah Airstrip due to the known use of the on-post area around the airstrip by the Yakama Nation for subsistence activities. 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”. The CSMs prepared for the PA/SI consider only soil, groundwater, surface water, and sediment exposure pathways. Human exposure via consumption of locally gathered plants, which may be a relevant pathway for subsistence users at the Selah Airstrip, is not considered. The plant consumption exposure pathway could be evaluated during a human health risk assessment as part of a remedial investigation conducted under CERCLA. However, given the depth to groundwater in the area (i.e., not near-surface and estimated to be approximately 70 feet bgs given the depth of

installation of the Selah Airstrip well), plants which may be consumed by the subsistence users are not likely to uptake groundwater. 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.

CSMs were developed for each individual AOPI and are combined where source media, potential migration pathways and exposure media, and human exposure pathway determinations are congruent. The following exposure pathway determinations apply to all CSMs:

- The AOPIs are not residential or recreational sites and are wholly located within the installation boundaries. Therefore, the soil exposure pathways for on-installation residents and recreational users and for off-installation receptors are incomplete.
- PFOS, PFOA, and/or PFBS were detected in groundwater at all AOPIs where groundwater samples were collected (including at the Selah Airstrip water stand and well house, where historical samples were collected). The Pomona and Jordan wells, which supply drinking water to the cantonment area, are screened in the deeper aquifer which is not hydraulically connected to the shallow aquifer beneath YTC. However, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents at all seven AOPIs are potentially complete to account for potential future use of the shallow aquifer groundwater downgradient of the AOPIs and to consider the potential for the Selah Airstrip well to be turned back on for potable supply or other industrial activities.
- Recreational users are not likely to contact groundwater during outdoor recreational activities, therefore, the groundwater exposure pathway for on-installation recreational users is incomplete.
- Groundwater originating at the AOPIs has the potential to flow off-post. The groundwater contained in the shallow aquifer above the confining layer may be used by off-post receptors. Therefore, the groundwater exposure pathway for off-installation drinking water receptors is considered potentially complete.

Additional exposure pathway descriptions for each CSM are listed below by figure.

Figure 7-8 shows the CSM for the Former Fire Training Pit (YFCR-53) and Bird Bath Vehicle Wash Rack Building 868 AOPIs where AFFF was likely used during historical firefighter training activities.

- Soil was not sampled at these two AOPIs since the ground had been significantly reworked at both AOPIs and obtaining a representative shallow soil (i.e., at 0 to 2 feet bgs) was unlikely (while some native soil was used as backfill at the Former Fire Training Pit [YFCR-53]). However, AFFF releases to soil and/or paved surfaces have been confirmed or suspected at these AOPIs, and PFOS, PFOA, and PFBS was detected in groundwater at the AOPIs, indicating a potential PFAS source. 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 potentially complete.
- Surface water bodies on-post are intermittent (i.e., only flowing after heavy precipitation events) downgradient of the AOPIs and are not used for drinking water or recreation. Residents and recreational users are not likely to otherwise contact surface water and sediment downgradient of these AOPIs; therefore, these exposure pathways are incomplete. However, on-installation site workers could contact constituents in surface water and sediment following heavy precipitation events; therefore, the surface water and sediment exposure pathways are potentially complete.

- Despite YTC's arid climate and the intermittent nature of surface water features on-post, constituents could migrate from soil and shallow groundwater to off-post surface water bodies. Therefore, surface water and sediment exposure pathways for off-installation receptors are considered potentially complete.

Figure 7-9 shows the CSM for the Refractometer Solutions Testing Area and the three AFFF Storage Areas (Fire Station 29 [Building 346] and AFFF Storage Area [Building 321], Building 821, and Building 751) AOPIs. AFFF releases to soil and/or paved surfaces have been confirmed or suspected at these AOPIs.

- PFOS, PFOA, and/or PFBS were detected in soil at each of these AOPIs. 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.
- Surface water bodies on-post are intermittent (i.e., only flowing after heavy precipitation events) downgradient of the AOPIs and are not used for drinking water or recreation. Residents and recreational users are not likely to otherwise contact surface water and sediment; therefore, these exposure pathways are incomplete. However, on-installation site workers could contact constituents in surface water and sediment following heavy precipitation events; therefore, the surface water and sediment exposure pathways are potentially complete.
- Despite YTC's arid climate and the intermittent nature of surface water features on-post, constituents could migrate from soil and shallow groundwater to off-post surface water bodies. Therefore, surface water and sediment exposure pathways for off-installation receptors are considered potentially complete.

Figure 7-10 shows the CSM for the Selah Airstrip AOPI. Based on personnel interviews and the PFAS detections, it is likely that AFFF was historically released to soil and/or paved surfaces at this AOPI, although no leaks or spills were reported.

- PFOS, PFOA, and/or PFBS were detected in soil at the former crash truck station area at the Selah Airstrip AOPI. 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.
- A subsistence user was selectively added to the CSM for Selah Airstrip due to the known use of the on-post area around the airstrip by the Yakama Nation for subsistence activities. Subsistence users could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust; therefore, the soil exposure pathway for on-installation subsistence users is considered complete.
- Subsistence users are not likely to contact groundwater during outdoor activities. Therefore, the groundwater exposure pathway for on-installation subsistence users is considered incomplete.
- Surface water bodies on-post are intermittent (i.e., only flowing after heavy precipitation events) and are not used for drinking water. Residents and recreational users are not likely to otherwise contact surface water and sediment; therefore, these exposure pathways are incomplete. However, PFOS, PFOA, and/or PFBS were detected in soil and on-installation site workers and subsistence users could contact constituents in surface water runoff and sediment following heavy precipitation events; therefore, the surface water and sediment exposure pathways for these receptors are potentially complete.
- Surface water runoff from this AOPI drains to Selah Creek, which then flows a distance greater than 5 stream miles to the installation boundary before flowing off-post. Due to this distance, off-post surface water bodies are not likely to be impacted by the AOPI. Additionally, PFOS, PFOA, and PFBS were non-detect in Selah Creek

approximately 0.5 miles upgradient of the installation boundary. Therefore, surface water and sediment exposure pathways for off-installation receptors are incomplete.

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 6-2**).

8 OFF-POST PRIVATE POTABLE WELL INVESTIGATION

Based on SI sampling results, off-post private wells were identified for sampling as part of the PA/SI investigation at YTC to determine whether there are off-post impacts to drinking water due to Army operations. The off-post wells were identified for sampling because of their location within 1 mile downgradient of the installation boundary at which PFOS and/or PFOA were detected in on-post groundwater at concentrations greater than the USEPA LHA. An off-post well survey was completed for an area specified by the Army using readily available information from the online Washington State well database. County records were also reviewed to identify wells that may not be included in the state database, and relevant parcels were reviewed to compile a list of property owners. After reviewing available groundwater modeling reports (i.e., United States Geological Survey reports), numerous off-post private potable wells were identified for possible sampling based on the understanding of the relationship between on- and off-post hydrogeological conditions.

Community outreach and notification was coordinated between the Army PA/SI team, YTC, and Headquarters of the Department of the Army, who agreed that all property owners included in the specified investigation area would be contacted by YTC personnel via the United States Postal Service (USPS) mail to ensure that the drinking water wells are included for sampling during this investigation. YTC personnel notified the property owners of this sampling event by letter delivered by the USPS in July 2021. The letter included a questionnaire regarding the presence of a drinking water well on the property, whether the owner would allow access to the property for sampling, and, if access is allowed, requested the owner determine an available date for their well to be sampled. Property access and permission to sample the wells on the properties was obtained by YTC personnel prior to or during the sampling event.

Sampling protocols followed those outlined in this PA/SI report, the YTC PA/SI QAPP Addendum (Arcadis 2021), and the YTC Off-Post Sampling QAPP Addendum (Seres-Arcadis Joint Venture 2021). Off-post private potable well sampling was completed at 22 locations from 07 to 09 September 2021. Based on the results of the initial off-post sampling event, the Army identified eight locations (i.e., eight wells, serving 12 households) where drinking water exceeded the USEPA LHA of 70 ng/L for PFOS or PFOA, individually or combined. The Army began providing bottled water to the affected locations on 08 October 2021. Additional off-post sampling will be completed in an expanded investigation area. A letter report summarizing the results of the initial and expanded off-post potable well investigation and the associated laboratory reports will be provided as a separate addendum to this report when the results are available.

9 CONCLUSIONS AND RECOMMENDATIONS

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

The 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/or PFBS use, storage, and/or disposal at YTC. Following the evaluation, seven AOPIs were identified.

Table 2-1 includes historical data collected at the installation's potable supply wells. PFOS, PFOA, and PFBS were not detected in the primary wells which supply drinking water for the YTC cantonment area; these wells are screened in the deep, confined aquifer and the confining layer appears to be intact. However, PFOS, PFOA, and PFBS were detected at the Selah Airstrip supply well (which is currently out-of-service following the August and November 2019 sampling events for PFAS at the well and it is not connected to the main cantonment drinking water supply system); the PFOA concentration in the well is greater than the OSD risk screening level.

All AOPIs were sampled during the SI at YTC 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 YTC QAPP Addendum (Arcadis 2020). PFOS, PFOA, and PFBS presence was identified at all seven of the AOPIs at YTC based on the data collected from 21 to 25 September 2020 during the SI field work; results from sampling media at six of the seven AOPIs exceeded the OSD risk screening levels. Below is a summary of the SI sampling results.

- Groundwater: PFOS, PFOA, and/or PFBS were detected in all 13 groundwater samples collected. PFOS and/or PFOA concentrations exceeded the 40 ng/L OSD risk screening levels in all 13 samples, including at existing wells MMP-1, MMP-2, 815-2, TVR-5, and MRC-2, which are located within 50 to 500 feet of the installation boundary and in the path of groundwater flow moving from the AOPIs toward the installation boundary. PFBS concentrations exceeded the 600 ng/L OSD risk screening level in six of the 13 samples. Maximum concentrations were observed at existing well FTP-1 at the Former FTP (YFCR-53): 45,000 ng/L PFOS, 5,200 ng/L PFOA, and 5,900 ng/L PFBS. The data indicate that the Former FTP is the AOPI with the greatest residual mass of PFAS. Historical groundwater samples collected at the Selah Airstrip well (collected in August and November 2019) exhibited exceedances of the OSD risk screening levels for PFOA (96 to 100 ng/L). The source(s) contributing to the PFAS concentrations observed in wells that may be impacted from multiple AOPIs (e.g., TVR-5, MMP-1, MMP-2) should be determined during a future investigation.
- Soil: PFOS, PFOA, and/or PFBS were detected in 10 of the 13 samples collected; the PFOS concentration in one sample collected at the Refractometer Solutions Testing Area exceeded the residential OSD risk screening level of 0.13 mg/kg. The maximum concentrations were observed at sampling location YTC-RSTA-3-SO beneath the asphalt: 0.76 mg/kg PFOS, 0.0027 mg/L PFOA, and 0.0025 mg/kg PFBS.
- Surface water: PFOS, PFOA, and PFBS were not detected in either surface water sample collected (i.e., one along Selah Creek just downstream of where Selah Springs would flow into the creek and one further downgradient near the installation boundary to the west).

- Sediment: PFOS and PFOA were detected in one of the two sediment samples collected (YTC-RSTA-1-SE, collected as a composite along the ditch downgradient of the Refractometer Solutions Testing Area): 0.10 mg/kg PFOS and 0.0013 mg/kg PFOA, both less than the 0.13 mg/kg OSD risk screening level for soil. PFBS was not detected in the sample. PFAS were not detected in the sediment sample collected along the intermittent stream west of Selah Airstrip.

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

- Complete exposure pathways include:
  - Soil exposure pathways for site workers at five AOPIs: the Refractometer Solutions Testing Area, the three AFFF Storage Areas (Fire Station 29 [Building 346] and AFFF Storage Area [Building 321], Building 821, and Building 751), and Selah Airstrip.
  - The soil exposure pathway for subsistence users at the Selah Airstrip AOPI.
- Potentially complete exposure pathways include:
  - Soil exposure pathways for site workers at the Former FTP and Bird Bath Wash Rack AOPIs.
  - Groundwater exposure pathways for on-installation site workers and residents at all seven AOPIs to account for potential future use of the downgradient on-post groundwater (including the shallow aquifer). The groundwater exposure pathway is also potentially complete for site workers at the Selah Airstrip AOPI to account for the potential exposure scenario if the supply well at the airstrip is turned on for use again.
  - Groundwater exposure pathways for off-installation receptors from all seven AOPIs due to lack of land use controls off-installation and downgradient of YTC.
  - Surface water and sediment exposure pathways for site workers at all seven AOPIs.

Although the CSMs indicate complete or potentially complete exposure pathways may exist, the recommendation for future study in a remedial investigation or no action at this time is based on the comparison of the SI analytical results for PFOS, PFOA, and PFBS to the OSD risk screening levels (**Table 6-2**). **Table 9-1** below summarizes the AOPIs identified at YTC, the PFOS, PFOA, and PFBS sampling, and recommendations for each AOPI; further investigation is warranted at YTC. 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 YTC, and Recommendations

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?				Recommendation
	GW	SO	SW	SE	
Former Fire Training Pit (YFCR-53)	Yes	NS	NS	NS	Future study in a remedial investigation
Bird Bath Wash Rack	Yes	NS	NS	NS	Future study in a remedial investigation

AOPI Name	PFOS, PFOA, and/or PFBS detected greater than OSD Risk Screening Levels?				Recommendation
	GW	SO	SW	SE	
Refractometer Solutions Testing Area	Yes	Yes	NS	No	Future study in a remedial investigation
Fire Station 29 (Building 346) and AFFF Storage Area (Building 321)	Yes	No	NS	NS	Future study in a remedial investigation
AFFF Storage Area (Building 821)	Yes	No	NS	NS	Future study in a remedial investigation
AFFF Storage Area (Vehicle Maintenance Shop, Building 751)	NS	No	NS	NS	No action at this time
Selah Airstrip	Yes (2019 data)	No	NA	No	Future study in a remedial investigation

Notes:
Light gray shading – detection greater than the OSD risk screening level
Sediment data are compared to the OSD risk screening levels for soil since the features sampled were a typically-dry streambed and drainageway, and the exposure scenario is therefore the same as soil.

Acronyms:
GW – groundwater
NA – (i.e., PFOS, PFOA, or PFBS detected, but comparison to OSD risk screening levels is not applicable for the surface water feature sampled because it is not an expression of groundwater [e.g., a seep, spring, or gaining stream] and is not used as a source of drinking water)
ND – not detected
NS – not sampled (i.e., with respect to soil, samples were not collected if the ground has been significantly reworked in the area; with respect to surface water/sediment, no relevant surface water feature in the area to sample)
SE – sediment
SO – soil
SW – surface water

Data collected during the PA (**Section 3**, **Section 4**, and **Section 5**) and SI (**Section 6** and **Section 7**) were sufficient to draw the conclusions summarized above. The data limitations relevant to the development of this PA/SI for PFOS, PFOA, and PFBS at YTC 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.

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 EDR well search results (**Appendix E**), historical site documents (Tetra Tech 2017), and online databases (Department of Ecology 2020). These sources were referenced when identifying potential off-post drinking water receptors. The EDR report and online State of Washington well viewer does not include well use designation (i.e., domestic, agricultural, livestock watering, industrial) for all wells surrounding the installation.

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. 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.

Finally, the available PFOS, PFOA, and PFBS analytical data is limited to that historically collected at the installation potable supply wells (**Table 2-1**) and that collected in September 2020 during the SI sampling event (**Tables 7-1** through **7-4** and **Appendix N**). Soil samples were not collected outside of Fire Station 29 (Building 346) as no AFFF tank filling activities or spills were reported at that location; this AOPI was evaluated through soil samples collected at the AFFF Storage Area (Building 321) at which fire department activities were conducted in association with the fire station. Groundwater data are not available at the AFFF Storage Area at the Vehicle Maintenance Shop (Building 751); soil was evaluated at this storage area AOPI to identify presence or absence of PFOS, PFOA, and/or PFBS. Some existing wells (i.e., TVR-5, MMP-1, and MMP-2) sampled during the SI may receive impacts from upgradient or cross-gradient AOPIs or from adjacent AOPIs where surface water runoff converges from multiple AOPIs. Additionally, the groundwater samples associated with the Refractometer Solutions Testing Area were collected downgradient of where surface runoff from the AOPI would have flowed (i.e., not directly downgradient of the AFFF use area); impacts observed at these groundwater wells may be, in part, attributed to upgradient AOPIs. PFOS, PFOA, and PFBS concentrations in groundwater and surface water may experience seasonal fluctuations. Off-post sampling will be conducted under a separate contract and scope of work. Available data, including PFOS, PFOA, and/or PFBS, listed in **Appendix N** were analyzed per the selected analytical method. The approved sampling scope of the SI focused on identifying presence or absence of PFOS, PFOA, and PFBS at the AOPIs. SI sampling at locations at or in close proximity of the AOPIs did not delineate the extent of PFOS, PFOA, and/or PFBS impacts or identify the primary migration pathways for the chemicals. Groundwater flow direction in some areas (i.e., near well MRC-2 and the Selah Airstrip well) are estimated based on the current understanding of the hydrogeological CSM. Impacts observed at the wells sampled during the SI may be attributed to multiple sources.

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

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ACRONYMS

°F	degrees Fahrenheit
%	percent
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	conceptual site model
DoD	Department of Defense
DPW	Directorate of Public Works
DQO	data quality objective
DUSR	Data Usability Summary Report
EB	equipment blank
EDR	Environmental Data Resources, Inc.
ELAP	Environmental Laboratory Accreditation Program
FTP	fire training pit
GIS	geographic information system
GW	groundwater
HDPE	high-density polyethylene
IDW	investigation-derived waste
IMCOM	Installation Management Command
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
JBLM	Joint Base Lewis-McChord
LC/MS/MS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram (parts per million)

MPRC	Multi-Purpose Range Complex
NA	not applicable
ND	not detected
ng/L	nanograms per liter (parts per trillion)
NS	not sampled
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PAIC	Pomona Artesian Irrigation Company
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
SAIC	Science Applications International Corporation
SE	sediment
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SW	surface water
SWMU	solid waste management unit
TGI	technical guidance instruction
TOC	total organic carbon

TVR/MATES	Tracked Vehicle Repair/Old Mobilization and Training Equipment Site
U.S.	United States
UCMR3	third Unregulated Contaminant Monitoring Rule
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
WWTP	wastewater treatment plant
YFCR	Army Environmental Database-Restoration's abbreviation for Yakima Firing Center
YTC	Yakima Training Center

TABLES

Table 2-1 - On-Post Potable Water Wells Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

Well Identification	Building Location	Basin	Easting	Northing	Casing Depth (ft bgs)	Total Depth (ft bgs)	Approximate Static Water Level (ft bgs)	Notes
Pomona	P-0829	Yakima	694871.100	5172244.385	353	407	Artesian	Wells provide water for the cantonment area drinking water distribution system.
Jordan	P-0551 (P-0550)	Yakima	695149.848	5171842.619	365	617	53	
Bowers	P-0860	Yakima	696344.716	5173298.451	241	541	162	
YRS	P-1721	Yakima	701889.543	5172927.999	307	602	324	Well provides water for YRS drinking water distribution system.
MPRC	P-U084B	Columbia	717131.375	5185002.500	1300	1311	1005	Well provides water for MPRC drinking water distribution system.
Badger Pocket/ Badger Gap	P-U084E	Yakima	708607.6875 707116.5087	5192417.0000 5192944.1759	490	510	175	No additional notes.
Dead Truck Farm	P-0020	Yakima	707154.000	5203249.000	40	150	53	Wells are pumped and treated as needed (i.e., to supply troops during training exercises); wells are not connected to main cantonment drinking water distribution system.
Doris	P-3002	Columbia	728443.700	5194962.138	580	580	435	
Exit 11	P-2239	Yakima	701394.563	5188940.000	200	580	289	
North Filey Road	P-0010	Columbia	730923.289	5167831.916	40	950	533	
Range 19	P-2229	Yakima	706162.688	5184387.000	135	425	93	
Range 55	P-2555	Yakima	718105.777	5168615.085	105	135	72	
Hester	NA	Yakima	703211.045	5172606.547	315	585	244	
Range Control	P-1804	Yakima	703217.679	5172521.393	281	302	266	
Selah Airstrip	P-2060	Yakima	704259.750	5176188.000	73	91	47	
PAIC	P-0840	Yakima	694859.3956	5172220.3995	(NA - similar to Pomona well*)			Well supplies drinking water for approximately 60 residences and businesses off-post.

Table 2-1 - On-Post Potable Water Wells Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

Acronyms:
bgs – below ground surface
ft – feet
MPRC – Multi-Purpose Range Complex
NA - not analyzed
PAIC – Pamona Artesian Irrigation Company
YRS – Yakima Research Station

Sources:
Data table: Yakima Training Center. 2003. Yakima Training Center Well Data. June.
*Construction details not provided on source table noted above. Additional information regarding PAIC well construction is as provided by the United States Army Corps of Engineers in the 2012 Periodic Review Report, Yakima Training Center, Yakima, Washington.

Table 2-2 - Historical PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

		Well ID	Pomona (Bldg 829)	Pomona (Bldg 829)	Bowers (Bldg 860)	Bowers (Bldg 860)	Jordan (Bldg 550)	Jordan (Bldg 550)	MPRC (Bldg 84B)	MPRC (Bldg 84B)	Badger Gap (Bldg 2110)
		Sample ID	YTC_GW_991042PomonaWell_FW	YTC_GW_991042 PAMONA_RW Drinking Water	YTC_GW_991042BowersWell_FW	YTC_GW_991042 BOWERSWELL_RW Drinking Water	YTC_GW_991042JordanWell_FW	YTC_GW_991042 JordanWell_RW	YTC_GW_07035T MPRCWell_FW	YTC_GW_07035T_ MPRC_S01_FW	YTC_GW_070349BadgerGap_FW
		Laboratory	EEA	ELLE	EEA	ELLE	EEA	ELLE	EEA	ELLE	EEA
		Sample Date	10/26/2016	8/19/2019	10/25/2016	8/19/2019	10/26/2016	8/20/2019	10/25/2016	8/20/2019	10/25/2016
PFAS (ng/L)	**LHA**	**OSD Tapwater**									
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorobutanesulfonic acid (PFBS)		600	< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorodecanoic acid (PFDA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorododecanoic acid (PFDoA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluoroheptanoic acid (PFHpA)			< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorohexanesulfonic acid (PFHxS)			< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorohexanoic acid (PFHxA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorononanoic acid (PFNA)			< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorooctanesulfonic acid (PFOS)	70	40	< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorooctanoic acid (PFOA)	70	40	< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorotetradecanoic acid (PFTeDA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorotridecanoic acid (PFTrDA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluoroundecanoic acid (PFUnA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA

Table 2-2 - Historical PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

		Well ID	Badger Gap (Bldg U084E)	YRS (Bldg 1901)	YRS (Bldg 1901)	Hester (Bldg unavailable)	Range 55 (Bldg 2555)	Selah Airstrip (Water stand)	Selah Airstrip (Well House, Bldg 2060)	Exit 11 (Bldg 2239)	New Doris Well (Bldg unavailable)
		Sample ID	YTC_GW_70349 BadgerGAP_S01_ FW	YTC_GW_07029L YRSBLDG1901_F W	YTC_GW_07029L YRS_RW	YTC_GW_07029L HESTER_RW	YTC_GW_70307_ RANGE55_S01_F W	YTC_GW_SELAH _FW	YTC_GW_SELAH _RW	YTC_GW_070328 _Exit11S01_FW	YTC_NEWDORIS WELL_FW
		Laboratory	ELLE	EEA	ELLE	ELLE	ELLE	ELLE	ELLE	ELLE	ELLE
		Sample Date	8/20/2019	10/26/2016	8/19/2019	8/20/2019	8/20/2019	8/20/2019	11/14/2019	8/20/2019	8/21/2019
PFAS (ng/L)	**LHA**	**OSD Tapwater**									
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorobutanesulfonic acid (PFBS)		600	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**11**	**11**	< 1.8	< 1.8
Perfluorodecanoic acid (PFDA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorododecanoic acid (PFDoA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluoroheptanoic acid (PFHpA)			< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**24**	**20**	< 1.8	< 1.8
Perfluorohexanesulfonic acid (PFHxS)			< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**330**	**300**	< 1.8	< 1.8
Perfluorohexanoic acid (PFHxA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	**95**	**100**	< 1.8	< 1.8
Perfluorononanoic acid (PFNA)			< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorooctanesulfonic acid (PFOS)	70	40	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**4.2**	**3.4**	< 1.8	< 1.8
Perfluorooctanoic acid (PFOA)	70	40	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**96**	**100**	< 1.8	< 1.8
Perfluorotetradecanoic acid (PFTeDA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorotridecanoic acid (PFTrDA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluoroundecanoic acid (PFUnA)			< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8

Table 2-2 - Historical PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

		Well ID	Dead Truck Farm (Bldg 0020)
		Sample ID	YTC_DEADTRUCKFARM
		Laboratory	ELLE
		Sample Date	8/21/2019
PFAS (ng/L)	LHA	OSD Tapwater	
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)			< 1.8
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)			< 1.8
Perfluorobutanesulfonic acid (PFBS)		600	< 1.8
Perfluorodecanoic acid (PFDA)			< 1.8
Perfluorododecanoic acid (PFDoA)			< 1.8
Perfluoroheptanoic acid (PFHpA)			< 1.8
Perfluorohexanesulfonic acid (PFHxS)			< 1.8
Perfluorohexanoic acid (PFHxA)			< 1.8
Perfluorononanoic acid (PFNA)			< 1.8
Perfluorooctanesulfonic acid (PFOS)	70	40	< 1.8
Perfluorooctanoic acid (PFOA)	70	40	< 1.8
Perfluorotetradecanoic acid (PFTeDA)			< 1.8
Perfluorotridecanoic acid (PFTrDA)			< 1.8
Perfluoroundecanoic acid (PFUnA)			< 1.8

Notes and Acronyms:

1. All data and qualifier definitions are as provided in laboratory analytical reports. The samples were analyzed as drinking water via USEPA Method 537.
2. Bolded data indiate concentrations detected greater than the method reporting limit (MRL).
3. 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 15.).
4. Underlined values indicate the result was detected greater than the USEPA LHA. Results are compared to the LHA because the samples were analyzed as drinking water.

< - concentration not detected greater than the MRL; result is reported as less than the MRL
Bldg - building
EEA - Eurofins Eaton Analytical
ELLE - Eurofins Lancaster Laboratories Environmental
ID - identification
LHA - United States Environmental Protection Agency Life Health Advisory
MPRC - Multi-purpose Range Complex
NA - not analyzed
ng/L - nanograms per liter
OSD - Office of the Secretary of Defense
PFAS - per- and polyfluoroalkyl substances
RSL - risk screening level
USEPA - United States Environmental Protection Agency
YRS - Yakima Research Station

Table 6-1 - Monitoring Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

Well Identification	Elevation at TOC (ft amsl)	Ground Surface Elevation (ft amsl)	Total Depth (ft bgs)	September 2020 Depth to Water (ft bmp)	September 2020 Groundwater Elevation (ft amsl)	Screen Interval (ft bgs)	Well Diameter (inches)	Screened Lithologic Unit
Fire Training Pit Monitoring Wells								
FTP-1	1467.72	1464.59	21.0	13.70	1450.9	8 – 18	2	Fractured Basalt
FTP-13	1473.07	1470.96	25.0	15.18	1455.8	10 – 20	2	
FTP-14	1457.48	1455.35	22.0	18.68	1436.7	12 – 22	2	
FTP-15	1460.88	1458.72	20.0	16.98	1441.7	10 – 20	2	
FTP-16	1444.81	1442.68	30.0	26.95	1415.7	20 – 30	4	
Tracked Vehicle Repair/Old Mobilization and Training Equipment Site Monitoring Wells								
MMP-1	1301.37	1298.39	100.5	49.99	1248.4	88 – 98	4	Fractured Basalt
MMP-2	1301.31	1298.55	75.5	51.56	1247.0	64 – 74	4	
TVR-5	1302.04	1299.42	142.0	47.41	1252.0	132 – 142	2	Sand/Silt beneath Basalt
Installation Boundary Monitoring Wells								
MRC-2	1312.11	1309.64	113.5	68.20	1241.4	101 – 111	4	Fractured Basalt with Sand Interbeds
815-2	1304.28	1301.86	127.0	49.18	1252.7	115 – 130	2	Sand/Silt beneath Basalt
Temporary Boreholes for Grab Groundwater Sampling[1]								
BBWR-1-GW	NS	NS	20.0	12.70	NC	15 – 20	2	Fractured Basalt
BBWR-2-GW	NS	NS	20.0	11.52	NC	15 – 20		
BBWR-3-GW	NS	NS	20.0	15.38	NC	15 – 20		

Table 6-1 - Monitoring Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

Notes and Acronyms:

1. Temporary boreholes were advanced for grab groundwater sample collection at the BBWR area of potential interest. Groundwater was sampled at first encountered groundwater, and the boreholes were abandoned in accordance with state requirements after sample collection.

amsl – above mean sea level
BBWR – Bird Bath Wash Rack
bgs – below ground surface
bmp – below measuring point (i.e., top of casing for existing wells, ground surface for temporary boreholes)
ft – feet
NC – not calculated
NS – not surveyed
TOC – top of casing

Source:

Tetra Tech, Inc. 2017. 2016 Annual Groundwater Monitoring Report: Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site, Joint Base Lewis-McChord and Yakima Training Center, Yakima, WA. June.

Table 7-1 Groundwater PFOS, PFOA, PFBS, Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

AOPI	Location Type	Location	Sample ID	Analyte		PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
				OSD Tapwater		40		40		600	
				Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
BIRD BATH WASH RACK	Temporary Well	YTC-BBWR-1	YTC-BBWR-1-GW-092420	09/24/2020	N	**6,600**	DJ	**820**		**2,200**	DJ
	Temporary Well	YTC-BBWR-2	YTC-BBWR-2-GW-092320	09/23/2020	N	**3,100**	DJ	**380**		**1,400**	DJ
	Temporary Well	YTC-BBWR-3	YTC-BBWR-3-GW-092420	09/24/2020	N	**2,400**	DJ	**220**		**1,800**	DJ
BOUNDARY MONITORING LOCATION	Monitoring Well	YTC-815-2	YTC-815-2-092520	09/25/2020	N	**260**		**51**		**75**	
	Monitoring Well	YTC-MRC-2	YTC-MRC-2-092520	09/25/2020	N	**1,200**	DJ	**49**		**130**	
FORMER FIRE TRAINING PIT (YFCR-53)	Monitoring Well	YTC-FTP-1	YTC-FTP-1-092320	09/23/2020	N	**45,000**	DJ	**5,200**	DJ	**5,900**	DJ
	Monitoring Well	YTC-FTP-13	YTC-FTP-13-092120	09/21/2020	N	**410**		**150**		**1,100**	DJ
			YTC-FD-1-GW-092120	09/21/2020	FD	**440**		**160**		**1,100**	DJ
	Monitoring Well	YTC-FTP-14	YTC-FTP-14-092220	09/22/2020	N	**1,900**	DJ	**490**		**570**	
	Monitoring Well	YTC-FTP-15	YTC-FTP-15-092220	09/22/2020	N	**1,700**	DJ	**180**		**320**	
	Monitoring Well	YTC-FTP-16	YTC-FTP-16-092420	09/24/2020	N	**10,000**	DJ	**3,900**	DJ	**5,200**	DJ
REFRACTOMETER SOLUTIONS TESTING AREA	Monitoring Well	YTC-MMP-1	YTC-MMP-1-092420	09/24/2020	N	**5,300**	DJ	**150**		**46**	
	Monitoring Well	YTC-MMP-2	YTC-MMP-2-092520	09/25/2020	N	**2,600**	DJ	**170**		**100**	
	Monitoring Well	YTC-TVR-5	YTC-TVR-5-092520	09/25/2020	N	**180**		**18**		**47**	

Notes:
1. Bolded values indicate the result was detected greater than the limit of detection.
2. Gray shaded value indicates the detected concentration is greater than or equal to the Office of the Secretary of Defense (OSD) risk screening level for the residential tapwater exposure scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.).

Acronyms/Abbreviations:
-- - not applicable
AOPI - area of potential nterest
FD - field duplicate sample
GW - groundwater
ID - identification
N - primary sample
ng/L - nanograms per liter (parts per trillion)
PFBS - perfluorobutanesulfonic acid
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
Qual - qualifier
YTC - Yakima Training Center

Qualifier:
DJ - The analyte was analyzed at dilution and the result is an estimated quantity.

Table 7-2 - Soil PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

			Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
			OSD Industrial/Commercial	1.6		1.6		25	
			OSD Residential	0.13		0.13		1.9	
AOPI	Location	Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
FIRE STATION 29 (BUILDING 346) AND AFFF STORAGE AREA (BUILDING 321)	YTC-B321-1	YTC-B321-1-SO-092320	09/23/2020	N	**0.0031**		0.00093	U	0.00093	U
	YTC-B321-2	YTC-B321-2-SO-092320	09/23/2020	N	**0.015**		**0.0009**	J	**0.00065**	J
AFFF STORAGE AREA (BUILDING 821)	YTC-B821-1	YTC-B821-1-SO-092320	09/23/2020	N	**0.0027**		0.00085	U	0.00085	U
	YTC-B821-2	YTC-B821-2-SO-092320	09/23/2020	N	**0.0017**		0.00093	U	0.00093	U
REFRACTOMETER SOLUTIONS TESTING AREA	YTC-RSTA-2	YTC-RSTA-2-SO-092520	09/25/2020	N	**0.0035**		0.0011	U	0.0011	U
	YTC-RSTA-3	YTC-RSTA-3-SO-092420	09/24/2020	N	**0.76**	DJ	**0.0027**		**0.0025**	
SELAH AIRSTRIP	YTC-SELAH-1	YTC-SELAH-1-SO-092220	09/22/2020	N	**0.12**		**0.002**		0.0011	U
	YTC-SELAH-2	YTC-SELAH-2-SO-092220	09/22/2020	N	**0.071**		0.00097	U	0.00097	U
	YTC-SELAH-3	YTC-SELAH-3-SO-092220	09/22/2020	N	**0.0038**		0.00087	U	0.00087	U
	YTC-SELAH-4	YTC-SELAH-4-SO-092220	09/22/2020	N	0.0010	U	0.0010	U	0.0010	U
	YTC-SELAH-5	YTC-SELAH-5-SO-092220	09/22/2020	N	0.00095	U	0.00095	U	0.00095	U
AFFF STORAGE AREA (VEHICLE MAINTENANCE SHOP, BUILDING 751)	YTC-VMS-1	YTC-VMS-1-SO-092320	09/23/2020	N	0.0011	U	0.0011	U	0.0011	U
	YTC-VMS-2	YTC-VMS-2-SO-092320	09/23/2020	N	**0.0018**		0.00090	U	0.00090	U
		YTC-FD-1-SO-092320	09/23/2020	FD	**0.0018**		0.0011	U	0.0011	U

Notes:
1. Bolded values indicate the result was detected greater than the limit of detection
2. Gray shaded value indicates the detected concentration is greater than or equal to the Office of the Secretary of Defense (OSD) risk screening level for the residential exposure scenario (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.).

Acronyms/Abbreviations:
AOPI - area of potential interest
AFFF - aqueous film-forming foam
FD - field duplicate sample
ID - identification
mg/kg - milligrams per kilogram (parts per million)
N - primary sample
PFBS - perfluorobutanesulfonic acid
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
Qual - qualifier
SO - soil
YTC - Yakima Training Center

Qualifiers:
DJ - The analyte was analyzed at dilution and the result is an estimated quantity.
J - The analyte was positively identified; however the associated numerical value is an estimated concentration c
U - The analyte was analyzed for but the result was not detected above the limit of quantitation (LOQ).

Table 7-3 - Surface Water PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

					Analyte	PFOS (ng/L)		PFOA (ng/L)		PFBS (ng/L)	
AOPI	Location Type	Location	Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
SELAH AIRSTRIP	Surface Water/Seep	YTC-SELAHCR-1	YTC-SELAHCR-SW-092220	09/22/2020	N	3.9	U	3.9	U	3.9	U
	Surface Water/Seep	YTC-SELAHSP-1	YTC-SELAHSP-SW-092220	09/22/2020	N	3.4	U	3.4	U	3.4	U
			YTC-FD-1-SW-092220	09/22/2020	FD	3.4	U	3.4	U	3.4	U

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 - perfluorobutanesulfonic acid
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
Qual - qualifier
SW - surface water
YTC - Yakima Training Center

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

Table 7-4 - Sediment PFOS, PFOA, and PFBS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, Washington

				Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFBS (mg/kg)	
				OSD Industrial/Commercial	1.6		1.6		25	
				OSD Residential	0.13		0.13		1.9	
AOPI	Location	Sample ID	Sample Date	Sample Type	Result	Qual	Result	Qual	Result	Qual
REFRACTOMETER SOLUTIONS TESTING AREA	YTC-RSTA-1	YTC-RSTA-1-SE-092520	09/25/2020	N	**0.10**		**0.0013**		0.0011	U
SELAH AIRSTRIP	YTC-SELAH-1	YTC-SELAH-1-SE-092220	09/22/2020	N	0.0010	U	0.0010	U	0.0010	U
		YTC-FD-1-SE-092220	09/22/2020	FD	0.00094	U	0.00094	U	0.00094	U

Notes:
1. Bolded values indicate the result was detected greater than the limit of detection.
2. Sediment data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for soil for the residential and industrial/commercial receptor scenarios (OSD. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.), as the potential exposure scenario for sediment collected along typically-dry drainages is the same for that of soil.

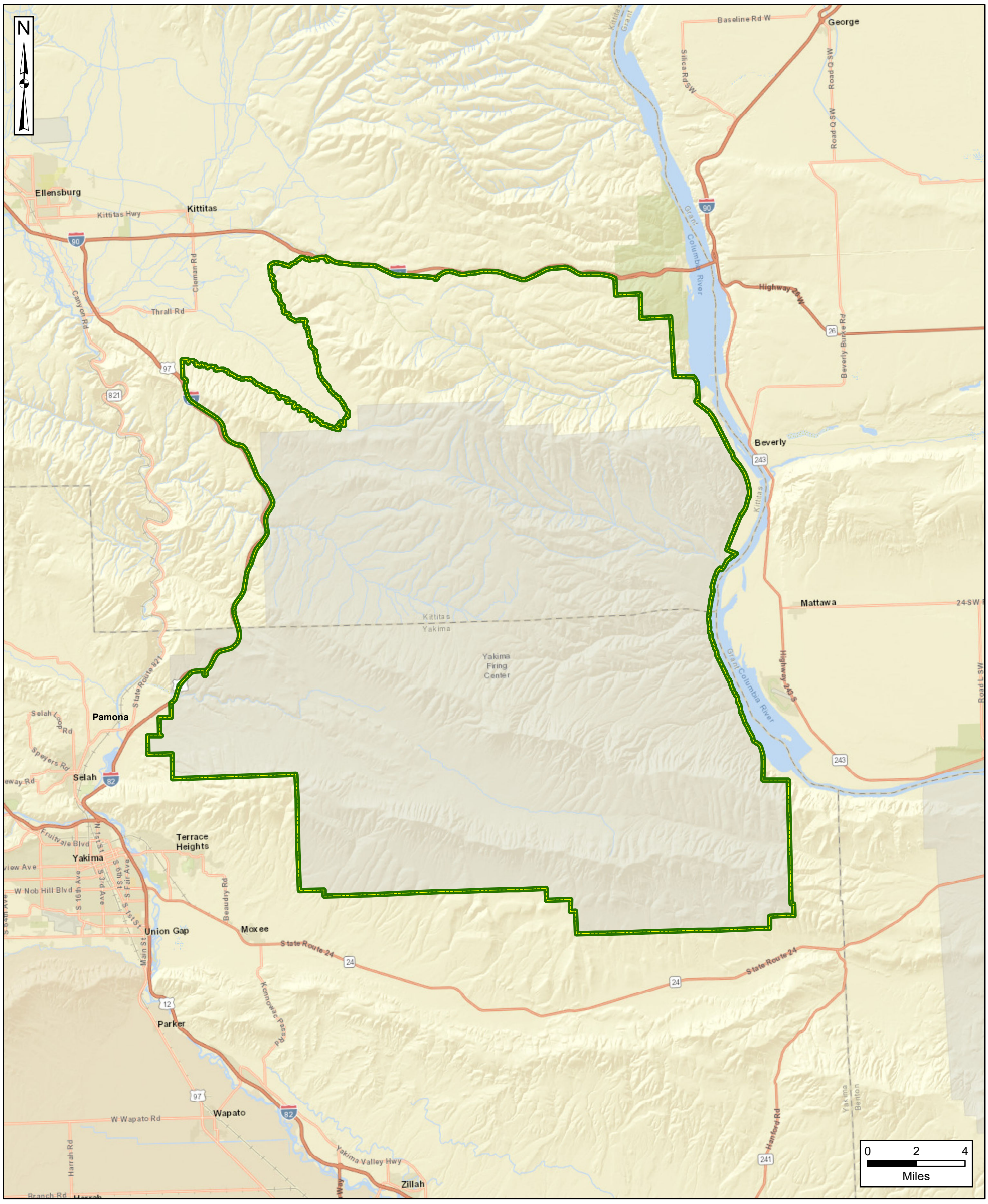
Acronyms/Abbreviations:
AOPI - area of potential interest
FD - field duplicate sample
ID - identification
mg/kg - milligrams per kilogram (parts per million)
N - primary sample
PFBS - perfluorobutanesulfonic acid
PFOA - perfluorooctanoic acid
PFOS - perfluorooctane sulfonate
Qual - qualifier
SE - sediment
YTC - Yakima Training Center

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

FIGURES

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 2-1
Site Location



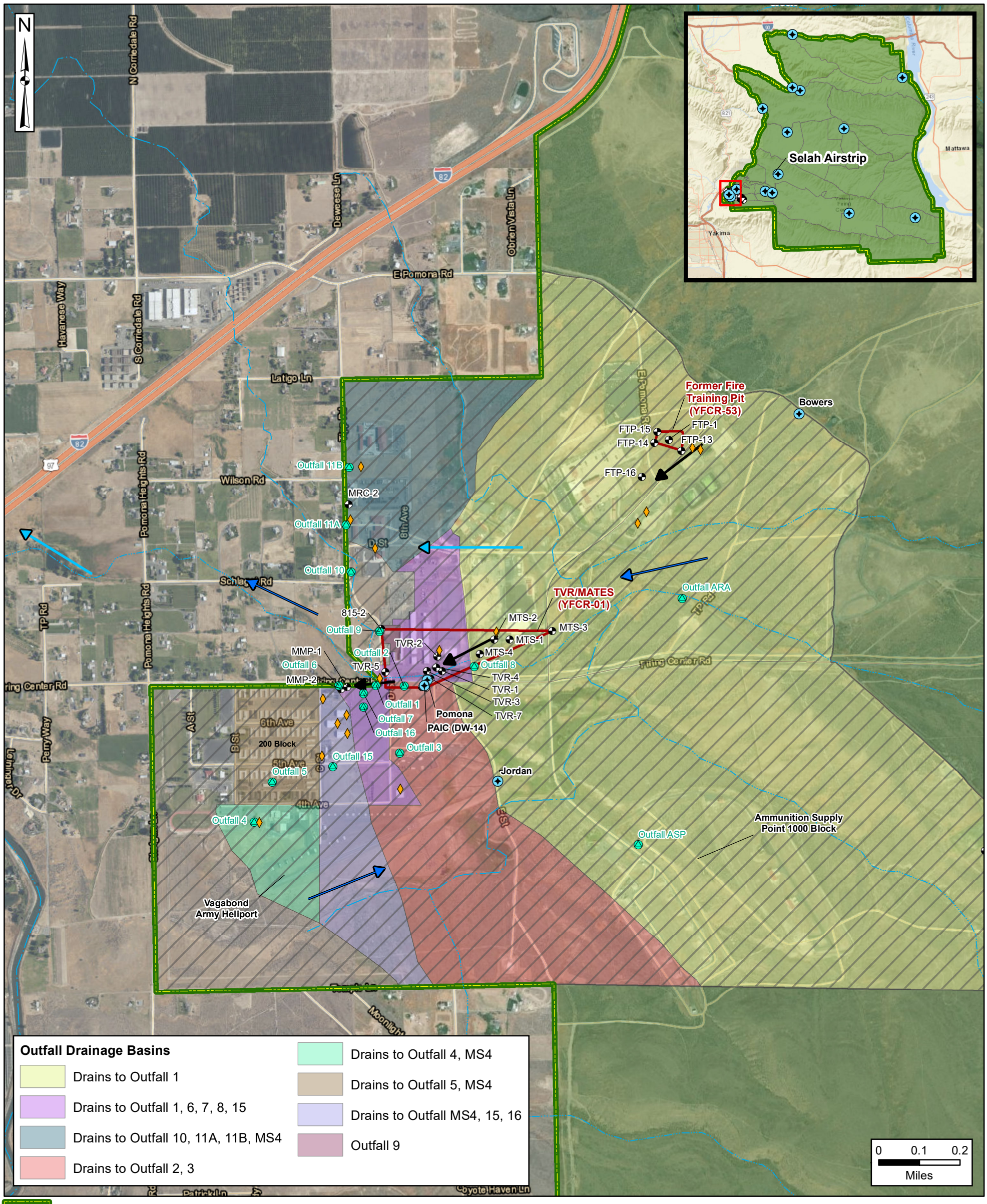
Installation Boundary

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Street Map Data

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 2-2
Site Layout



Installation Boundary
Cantonment Area
Range/Training Area
IRP Site
Potable Water Well
Monitoring Well
River/Stream (Perennial)
River/Stream (Intermittent)
Canal/Ditch
Surface Water Flow Direction
Deep Groundwater (i.e., Used for Installation Potable Supply) Flow Direction
Perched Groundwater Flow Direction
Outfall
Oil/Water Separator

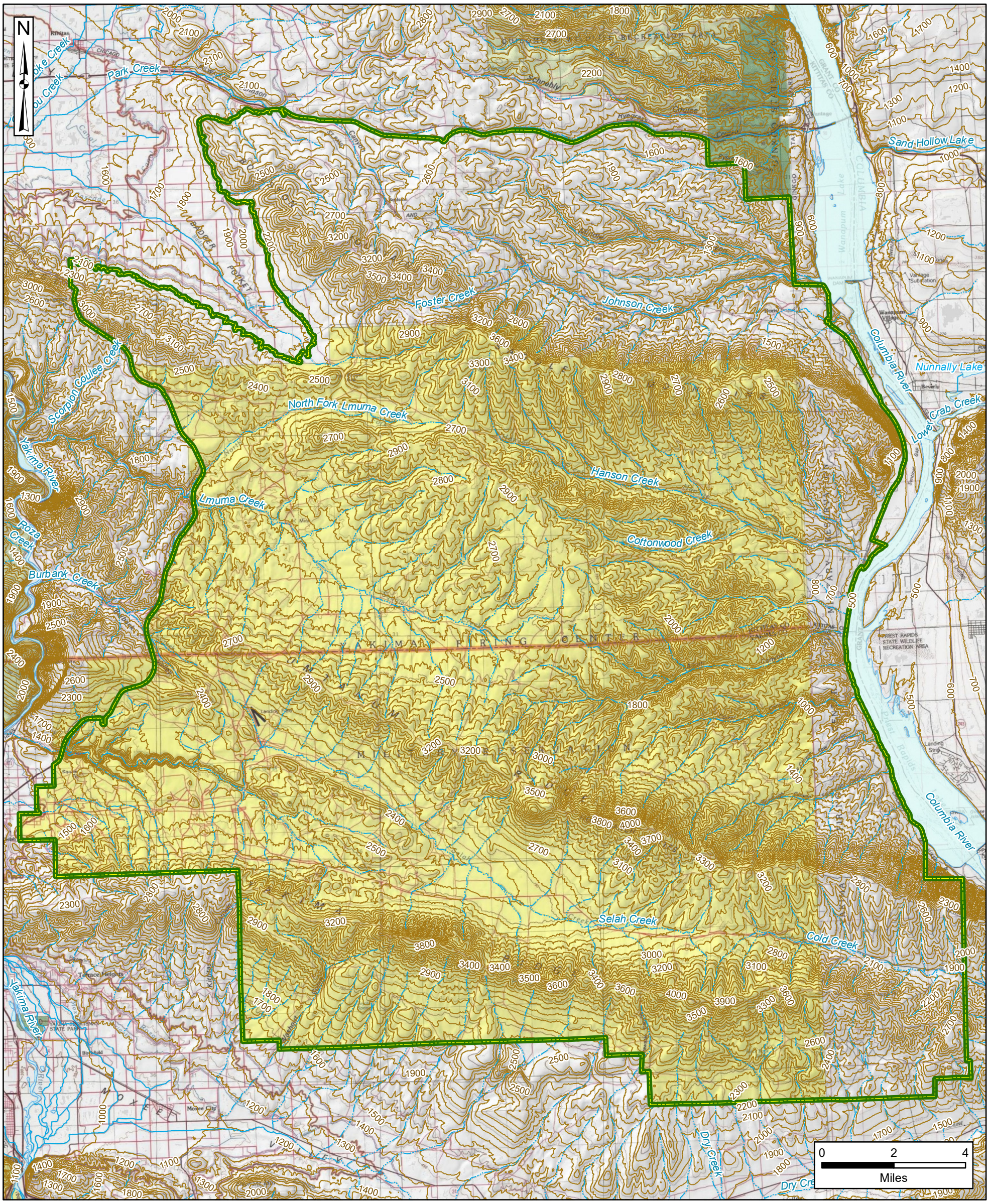
IRP = Installation Restoration Program
TVR/MATES = tracked vehicle repair/mobilization and training equipment site
YFCR = Yakima Training Center (formerly Yakima Firing Center; denotes Installation Restoration Program site)

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

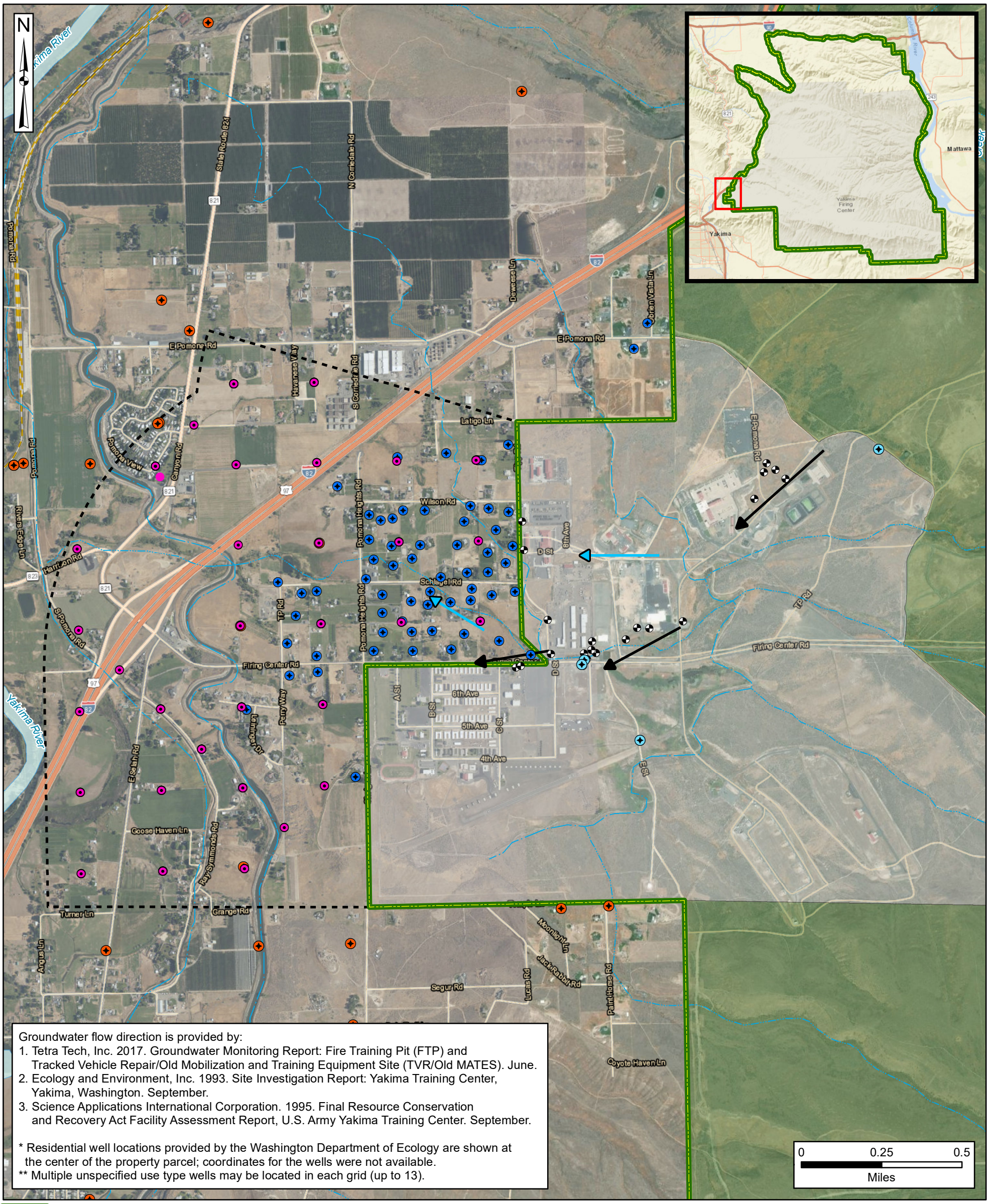
Figure 2-3
Topography Map



Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Topo Map

Coordinate System:
WGS 1984, UTM Zone 10 North

Figure 2-4a
Off-site Potable Wells within One Mile of Cantonment Area

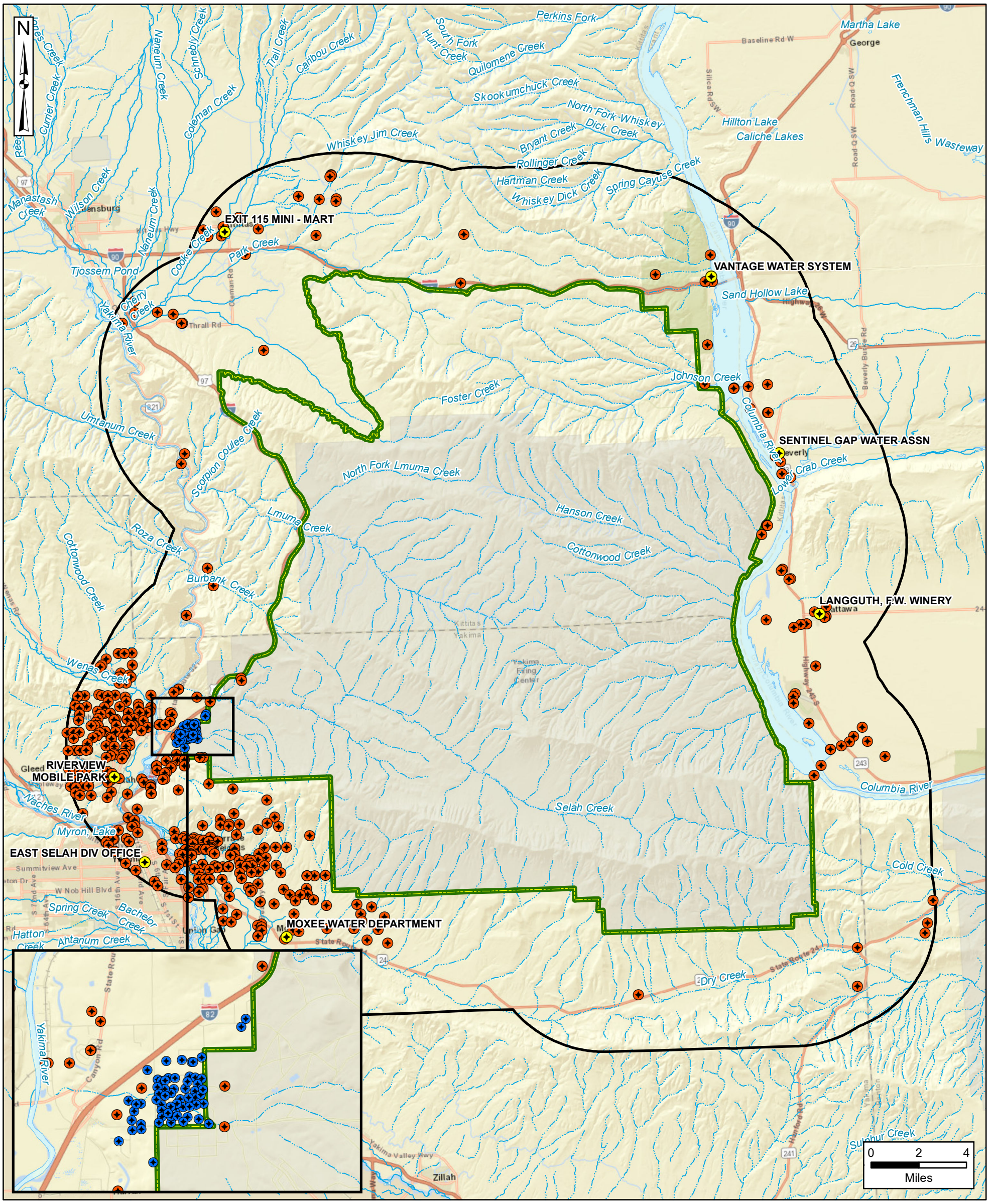


Data Sources:
EDR Well Data, 2018
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 2-4b
Off-site Potable Well Locations



- Installation Boundary
- 5-Mile Radius
- River/Stream (Perennial)
- River/Stream (Intermittent)
- Water Body
- Public Water Supply System Well (Data Source: EDR)
- Supply Well (Use Designation Unknown; Data Source: EDR)
- Off-Post Potable Water Well (Data Source: YTC, Tetra Tech 2017, Washington Department of Ecology 2021*)

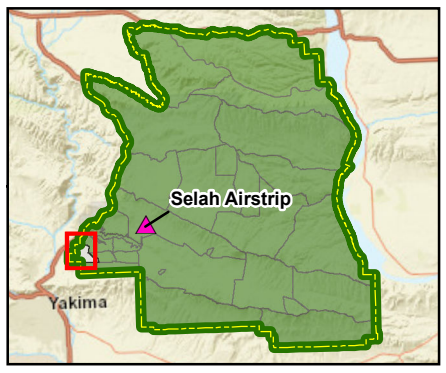
* Residential well locations provided by the Washington Department of Ecology are shown at the center of the property parcel; coordinates for the wells were not available.

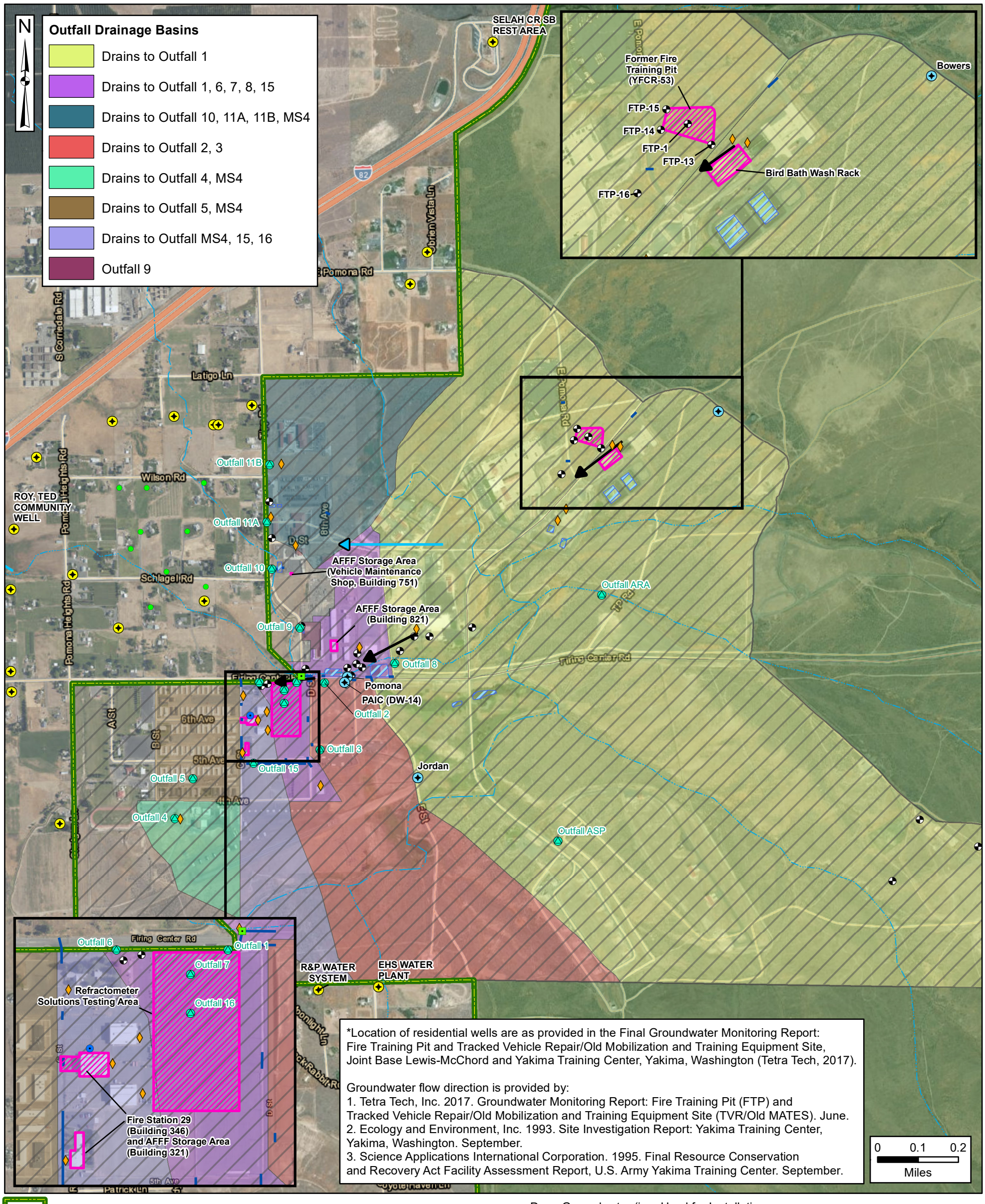
Data Sources:
EDR Well Data, 2018
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Street Map Data

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 5-2
Cantonment AOPI Locations and Extent of AFFF Use





USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

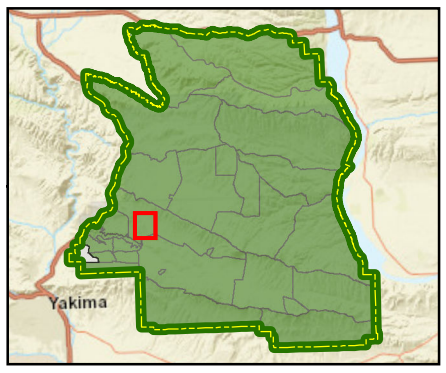
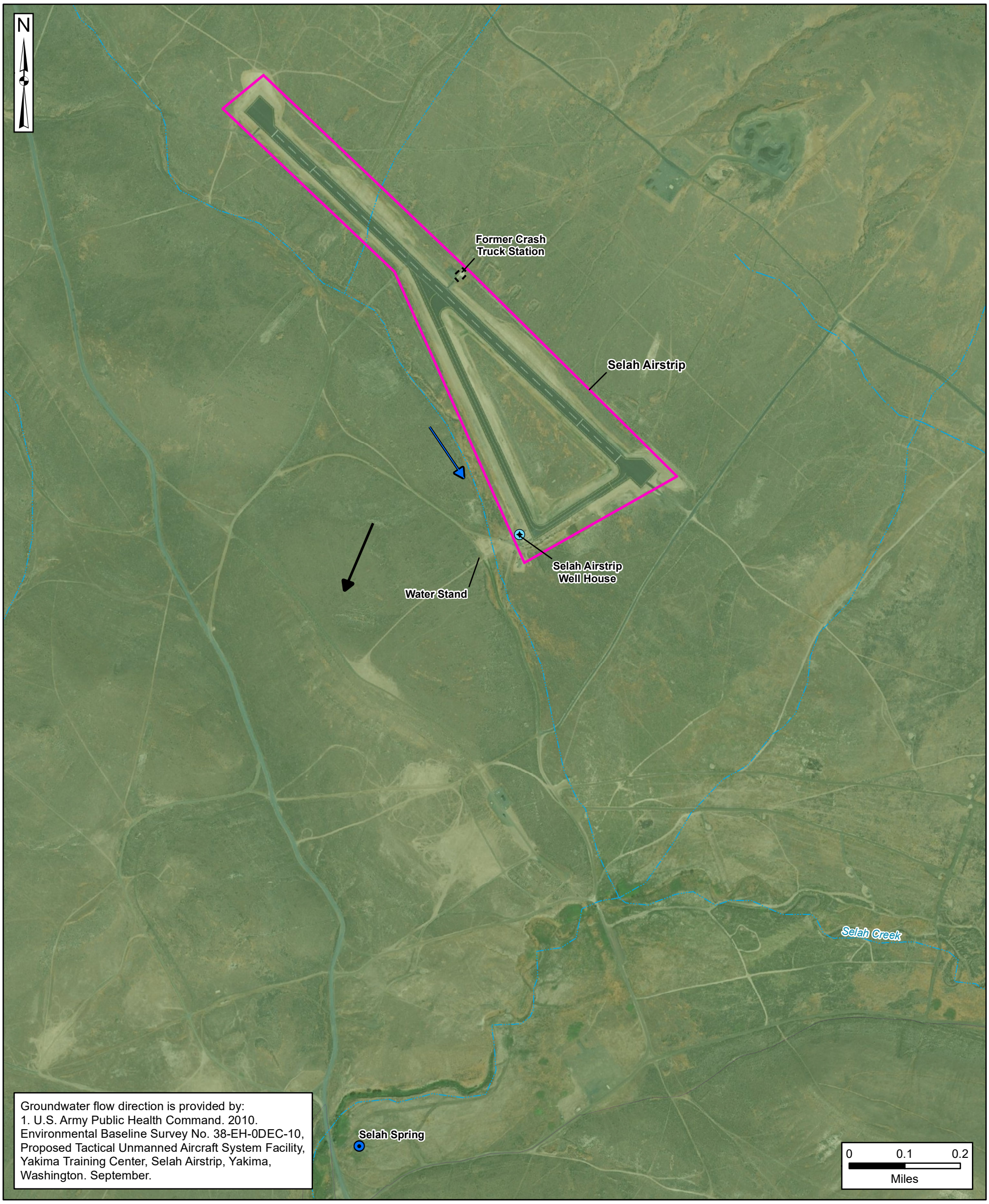


Figure 5-3
Selah Airstrip AOPI



Groundwater flow direction is provided by:
1. U.S. Army Public Health Command. 2010. Environmental Baseline Survey No. 38-EH-0DEC-10, Proposed Tactical Unmanned Aircraft System Facility, Yakima Training Center, Selah Airstrip, Yakima, Washington. September.

- Installation Boundary
- Cantonment Area
- Range/Training Area
- AOPI
- River/Stream (Intermittent)
- Canal/Ditch
- Perched Groundwater Flow Direction
- Surface Water Flow Direction
- Potable Water Well (On-Installation)
- Spring
- Former Building

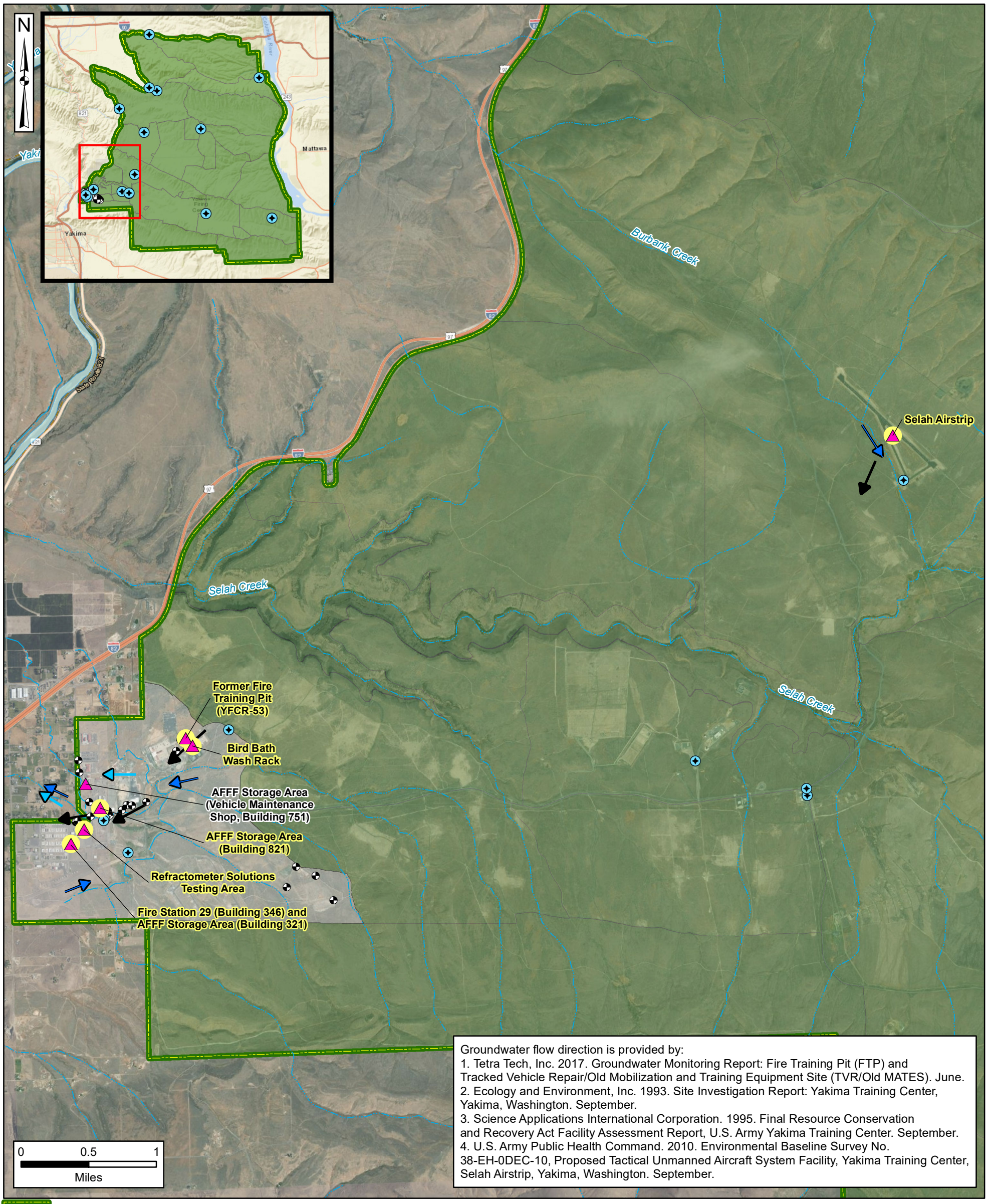
AOPI = area of potential interest

Data Sources:
EDR Well Data, 2018
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

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



Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.
4. U.S. Army Public Health Command. 2010. Environmental Baseline Survey No. 38-EH-0DEC-10, Proposed Tactical Unmanned Aircraft System Facility, Yakima Training Center, Selah Airstrip, Yakima, Washington. September.

- Installation Boundary
- Cantonment Area
- Range/Training Area
- River/Stream (Intermittent)
- Canal/Ditch
- Surface Water Flow Direction
- Deep Groundwater (i.e., Used for Installation Potable Supply) Flow Direction
- Perched Groundwater Flow Direction
- Potable Water Well
- Monitoring Well
- AOPI
- AOPI with OSD Risk Screening Level Exceedance

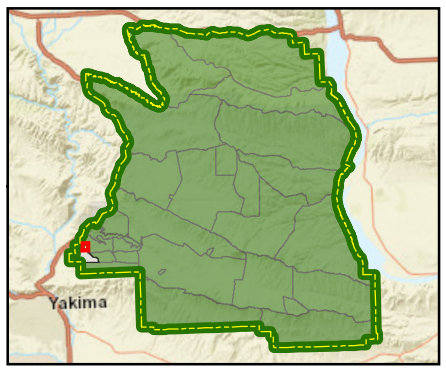
AFFF = aqueous film-forming foam
AOPI = area of potential interest
OSD = Office of the Secretary of Defense
YFCR = Yakima Training Center (formerly Yakima Firing Center; denotes Installation Restoration Program site)

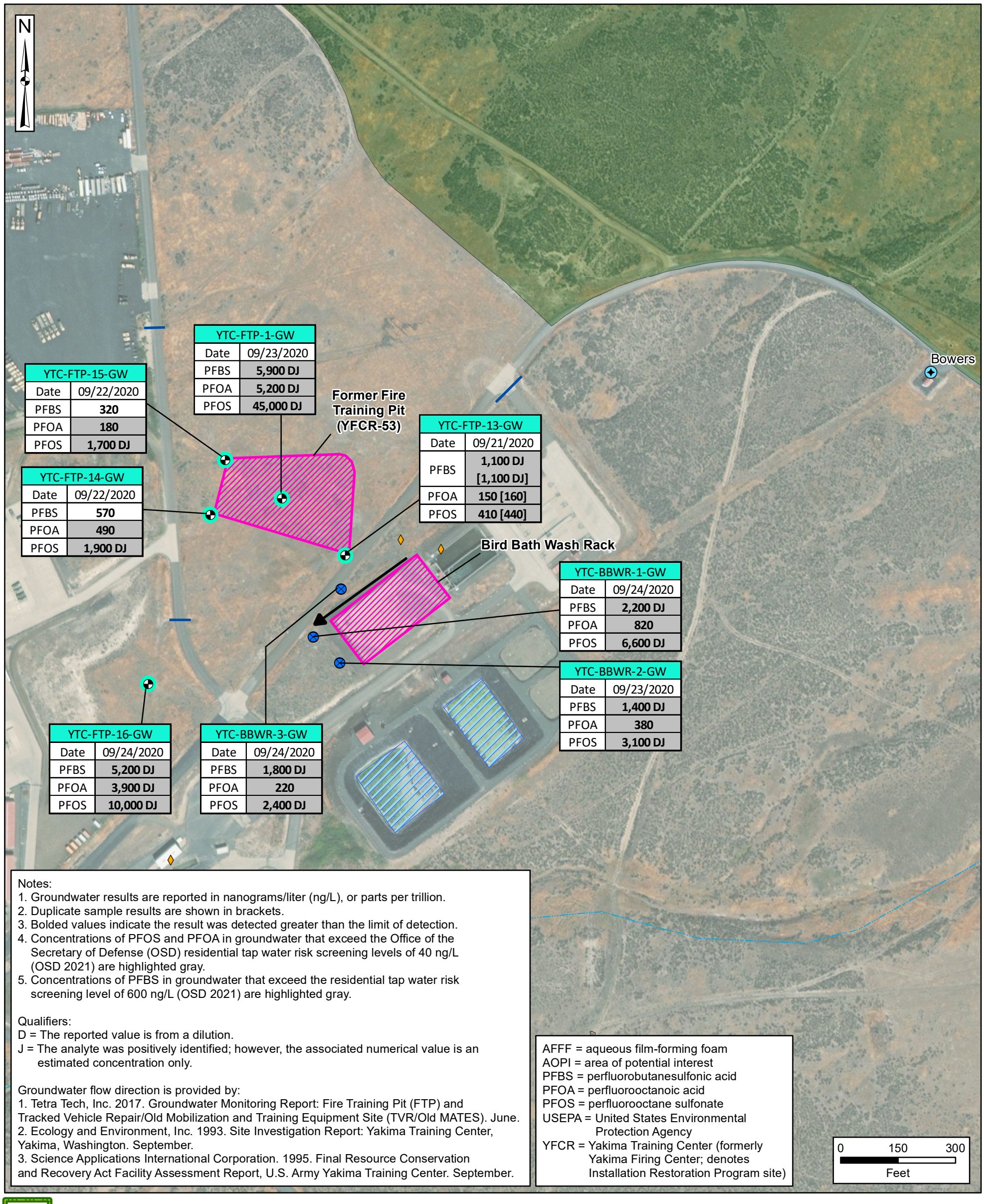
Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 7-2
Former Fire Training Pit (YFCR-53) and Bird Bath Wash Rack AOPIs
PFOS, PFOA, and PFBS Analytical Results





Notes:
1. Groundwater results are reported in nanograms/liter (ng/L), or parts per trillion.
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate the result was detected greater than the limit of detection.
4. Concentrations of PFOS and PFOA in groundwater that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening levels of 40 ng/L (OSD 2021) are highlighted gray.
5. Concentrations of PFBS in groundwater that exceed the 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.

Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

AFFF = aqueous film-forming foam
AOPI = area of potential interest
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
USEPA = United States Environmental Protection Agency
YFCR = Yakima Training Center (formerly Yakima Firing Center; denotes Installation Restoration Program site)

0 150 300
Feet

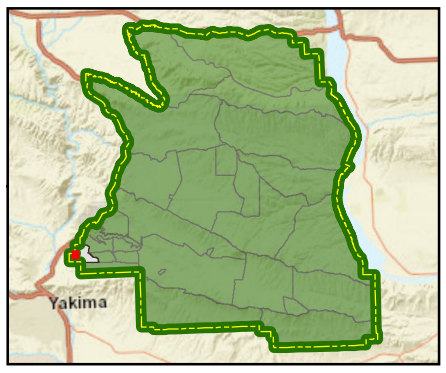
- Installation Boundary
- Cantonment Area
- Range/Training Area
- AOPI
- Approximate AFFF Use Area
- River/Stream (Intermittent)
- Perched Groundwater Flow Direction
- Potable Water Well (On-Installation)
- Monitoring Well
- Groundwater Sampling Location - Existing Well
- Grab Groundwater Sampling Location at First Encountered - Sonic Drilling Methods
- Oil/Water Separator
- Culvert
- Retention/Detention Pond

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 7-3
Refractometer Solutions Testing Area and Fire Station 29 (Building 346) and AFFF Storage Area (Building 321) AOPIs PFOS, PFOA, and PFBS Analytical Results



YTC-TVR-5-GW	
Date	09/25/2020
PFBS	**47**
PFOA	**18**
PFOS	**180**

YTC-RSTA-1-SE*	
Date	9/25/2020
PFBS	0.0011 U
PFOA	**0.0013**
PFOS	**0.10**

YTC-MMP-1-GW	
Date	09/24/2020
PFBS	**46**
PFOA	**150**
PFOS	**5,300 DJ**

YTC-MMP-2-GW	
Date	09/25/2020
PFBS	**100**
PFOA	**170**
PFOS	**2,600 DJ**

YTC-RSTA-2-SO	
Date	09/25/2020
PFBS	0.0011 U
PFOA	0.0011 U
PFOS	**0.0035**

YTC-B321-1-SO	
Date	09/23/2020
PFBS	0.00093 U
PFOA	0.00093 U
PFOS	**0.0031**

YTC-RSTA-3-SO	
Date	09/24/2020
PFBS	**0.0025**
PFOA	**0.0027**
PFOS	**0.76**

YTC-B321-2-SO	
Date	09/23/2020
PFBS	**0.00065 J**
PFOA	**0.00090 J**
PFOS	**0.015**

Refractometer Solutions Testing Area

Fire Station 29 (Building 346) and AFFF Storage Area (Building 321)

Outfall 1
Outfall 2
Outfall 3
Outfall 6
Outfall 7
Outfall 15
Outfall 16

Pomona
PAIC (DW-14)

Firing Center Rd
D St
6th Ave
5th Ave

0 100 200
Feet

Notes:
1. Groundwater results are reported in nanograms/liter (ng/L), or parts per trillion.
2. Soil and sediment results are reported in milligrams per kilogram (mg/kg), or parts per million.
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA in groundwater that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening levels of 40 ng/L (OSD 2021) are highlighted gray.
5. Concentrations of PFOS and PFOA that exceed the OSD residential soil risk screening level of 0.13 mg/kg (OSD 2021) are highlighted gray.

Qualifers:
D = The reported value is from a dilution.
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).

Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

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

*The sediment sample was collected as a multi-point composite of loose sediment along the ditch and shallow accumulations of soil at the edge of the asphalt pad.

- Installation Boundary
- Cantonment Area
- Range/Training Area
- AOPI
- Approximate AFFF Use Area
- River/Stream (Intermittent)
- Canal/Ditch
- Surface Runoff Flow Direction
- Perched Groundwater Flow Direction
- Potable Water Well (On-Installation)
- Monitoring Well
- Groundwater Sampling Location - Existing Well
- Soil Sampling Location (0-2 feet)
- Sediment Sampling Location
- Oil/Water Separator
- Outfall
- Stormwater Drain
- Sedimentation Junction Box
- Culvert
- Retention/Detention Pond

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

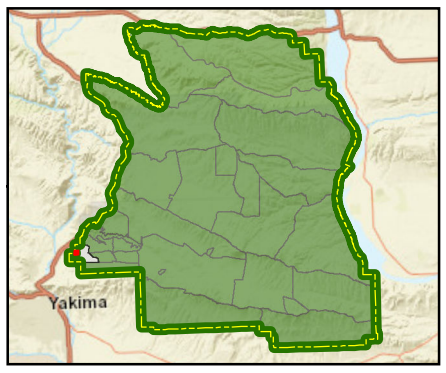


Figure 7-4
AFFF Storage Area (Building 821) AOPI
PFOS, PFOA, and PFBS Analytical Results

Notes:
1. Groundwater results are reported in nanograms/liter (ng/L), or parts per trillion.
2. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
3. Bolded values indicate the result was detected greater than the limit of detection.
4. Concentrations of PFOS and PFOA in groundwater that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening levels of 40 ng/L (OSD 2021) are highlighted gray.

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

Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

YTC-815-2-GW	
Date	09/25/2020
PFBS	**75**
PFOA	**51**
PFOS	**260**

YTC-B821-1-SO	
Date	09/23/2020
PFBS	0.00085 U
PFOA	0.00085 U
PFOS	**0.0027**

YTC-B821-2-SO	
Date	09/23/2020
PFBS	0.00093 U
PFOA	0.00093 U
PFOS	**0.0017**

YTC-TVR-5-GW	
Date	09/25/2020
PFBS	**47**
PFOA	**18**
PFOS	**180**

AFFF Storage Area (Building 821)

Outfall 9
Outfall 2
Pomona
PAIC (DW-14)
D St
1044
1100
1146
Firing Center Rd

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

0 50 100
Feet

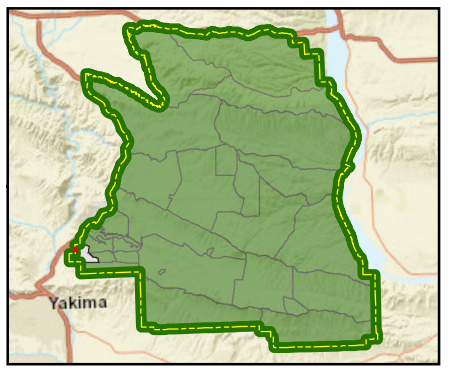
Installation Boundary
Cantonment Area
Range/Training Area
AOPI
River/Stream (Intermittent)
Perched Groundwater Flow Direction
Monitoring Well
Potable Water Well (On-Installation)
Soil Sampling Location (0-2 feet)
Groundwater Sampling Location - Existing Well
Oil/Water Separator
Outfall
Sedimentation Junction Box
Culvert
Retention/Detention Pond

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 7-5
AFFF Storage Area
(Vehicle Maintenance Shop, Building 751) AOPI
PFOS, PFOA, and PFBS Analytical Results



Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg), or parts per million.
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Groundwater flow direction in this area is not well known; groundwater flow in the cantonment area is generally west and southwest (Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June).

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

N

Vehicle Maintenance Shop, Building 751

YTC-VMS-1-SO	
Date	09/23/2020
PFBS	0.0011 U
PFOA	0.0011 U
PFOS	0.0011 U

AFFF Storage Area

YTC-VMS-2-SO	
Date	09/23/2020
PFBS	0.00090 U [0.0011 U]
PFOA	0.00090 U [0.0011 U]
PFOS	**0.0018 [0.0018]**

0 25 50
Feet

Installation Boundary
AOPI
Canal/Ditch
Soil Sampling Location (0-2 feet)
Oil/Water Separator
Culvert
Retention/Detention Pond

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

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

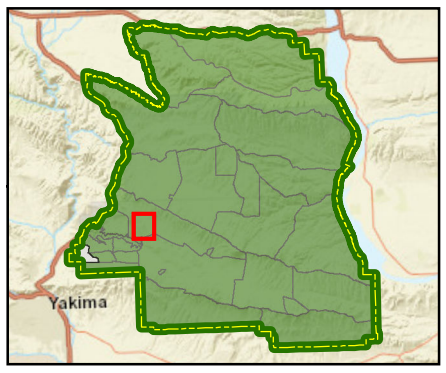


Figure 7-6
Selah Airstrip AOPI
PFOS, PFOA, and PFBS Analytical Results

N

YTC-SELAH-3-SO	
Date	09/22/2020
PFBS	0.00087 U
PFOA	0.00087 U
PFOS	**0.0038**

YTC-SELAH-2-SO	
Date	09/22/2020
PFBS	0.00097 U
PFOA	0.00097 U
PFOS	**0.071**

Former Crash Truck Station

YTC-SELAH-1-SO	
Date	09/22/2020
PFBS	0.0011 U
PFOA	**0.0020**
PFOS	**0.12**

YTC-SELAH-4-SO	
Date	09/22/2020
PFBS	0.0010 U
PFOA	0.0010 U
PFOS	0.0010 U

YTC-SELAH-1-SE	
Date	9/22/2020
PFBS	0.0010 U [0.00094 U]
PFOA	0.0010 U [0.00094 U]
PFOS	0.0010 U [0.00094 U]

Selah Airstrip

YTC-SELAH-5-SO	
Date	09/22/2020
PFBS	0.00095 U
PFOA	0.00095 U
PFOS	0.00095 U

SELAH AIRSTRIP WELL HOUSE	
Date*	11/14/2019
PFBS	**11**
PFOA	**100**
PFOS	**3.4**

SELAH AIRSTRIP WATER STAND	
Date*	8/20/2019
PFBS	**11**
PFOA	**96**
PFOS	**4.2**

Selah Creek

Selah Spring

YTC-SELAHSP-SW	
Date	9/22/2020
PFBS	3.4 U [3.4 U]
PFOA	3.4 U [3.4 U]
PFOS	3.4 U [3.4 U]

0 0.1 0.2
Miles

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

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

Groundwater flow direction is provided by:
1. U.S. Army Public Health Command. 2010. Environmental Baseline Survey No. 38-EH-0DEC-10, Proposed Tactical Unmanned Aircraft System Facility, Yakima Training Center, Selah Airstrip, Yakima, Washington. September.

- Installation Boundary
- Cantonment Area
- Range/Training Area
- AOPI
- Historical Building Footprint
- River/Stream (Intermittent)
- Canal/Ditch
- Perched Groundwater Flow Direction
- Surface Water Flow Direction
- Potable Water Well (On-Installation)
- Selah Spring
- Soil Sampling Location (0-2 feet)
- Sediment Sampling Location
- Water Stand
- Surface Water Sampling Location

AOPI = Area of Potential Interest
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

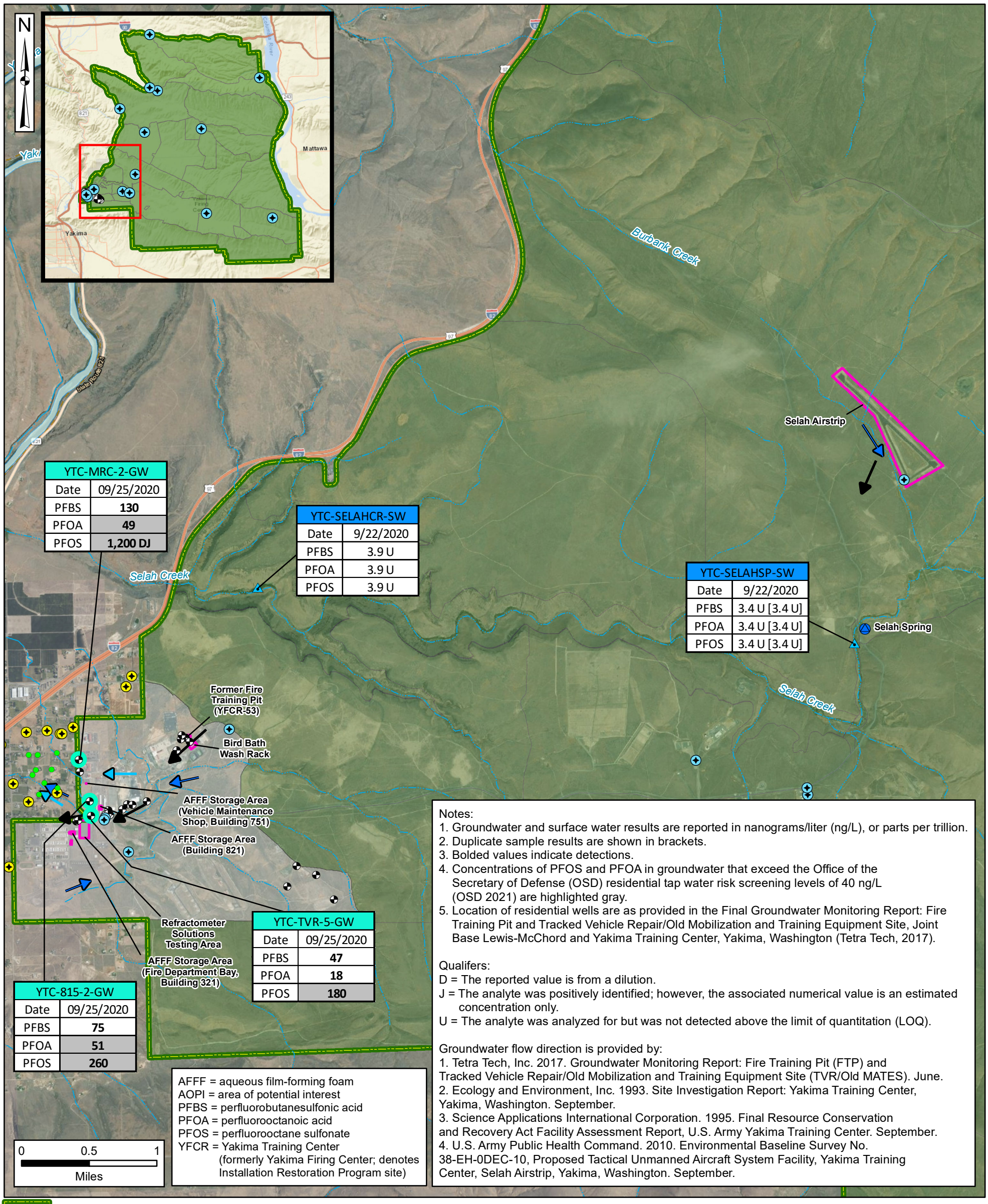
* historical data

Data Sources:
EDR Well Data, 2018
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 7-7
Other Sampling Locations
PFOS, PFOA, and PFBS Analytical Results



YTC-MRC-2-GW	
Date	09/25/2020
PFBS	**130**
PFOA	**49**
PFOS	**1,200 DJ**

YTC-SELAHCR-SW	
Date	9/22/2020
PFBS	3.9 U
PFOA	3.9 U
PFOS	3.9 U

YTC-SELAHSP-SW	
Date	9/22/2020
PFBS	3.4 U [3.4 U]
PFOA	3.4 U [3.4 U]
PFOS	3.4 U [3.4 U]

YTC-TVR-5-GW	
Date	09/25/2020
PFBS	**47**
PFOA	**18**
PFOS	**180**

YTC-815-2-GW	
Date	09/25/2020
PFBS	**75**
PFOA	**51**
PFOS	**260**

AFFF = aqueous film-forming foam
AOPI = area of potential interest
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
YFCR = Yakima Training Center (formerly Yakima Firing Center; denotes Installation Restoration Program site)

Notes:
1. Groundwater and surface water results are reported in nanograms/liter (ng/L), or parts per trillion.
2. Duplicate sample results are shown in brackets.
3. Bolded values indicate detections.
4. Concentrations of PFOS and PFOA in groundwater that exceed the Office of the Secretary of Defense (OSD) residential tap water risk screening levels of 40 ng/L (OSD 2021) are highlighted gray.
5. Location of residential wells are as provided in the Final Groundwater Monitoring Report: Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site, Joint Base Lewis-McChord and Yakima Training Center, Yakima, Washington (Tetra Tech, 2017).

Qualifers:
D = The reported value is from a dilution.
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).

Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.
4. U.S. Army Public Health Command. 2010. Environmental Baseline Survey No. 38-EH-0DEC-10, Proposed Tactical Unmanned Aircraft System Facility, Yakima Training Center, Selah Airstrip, Yakima, Washington. September.

- Installation Boundary
- Cantonment Area
- Range/Training Area
- AOPI
- River/Stream (Intermittent)
- Canal/Ditch
- Surface Water Flow Direction
- Deep Groundwater (i.e., Used for Installation Potable Supply) Flow Direction
- Perched Groundwater Flow Direction
- Potable Water Well (On-Installation)
- Water Supply Well (Off-Installation)
- Residential Supply Well[5]
- Selah Spring
- Monitoring Well
- Groundwater Sampling Location - Existing Well
- Surface Water Sampling Location

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

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]
Aqueous Film-Forming Foam (AFFF) Releases to Soil and/or Paved Surfaces				Soil	Ingestion	◐	○	○	○
					Dermal Contact	◐	○	○	○
					Inhalation (dust)	◐	○	○	○
	Desorption / Dissolution	Groundwater		Groundwater	Ingestion	◐	◐	○	◐
					Dermal Contact	◐	◐	○	◐
			Discharge/Recharge						
	Surface Runoff / Dissolution / Adsorption	Surface Water		Surface Water [1]	Ingestion	◐	○	○	◐
					Dermal Contact	◐	○	○	◐
			Adsorption / Desorption	Sediment	Ingestion	◐	○	○	◐
					Dermal Contact	◐	○	○	◐

Legend:

● = Complete Exposure Pathway

◐ = Potentially Complete Exposure Pathway

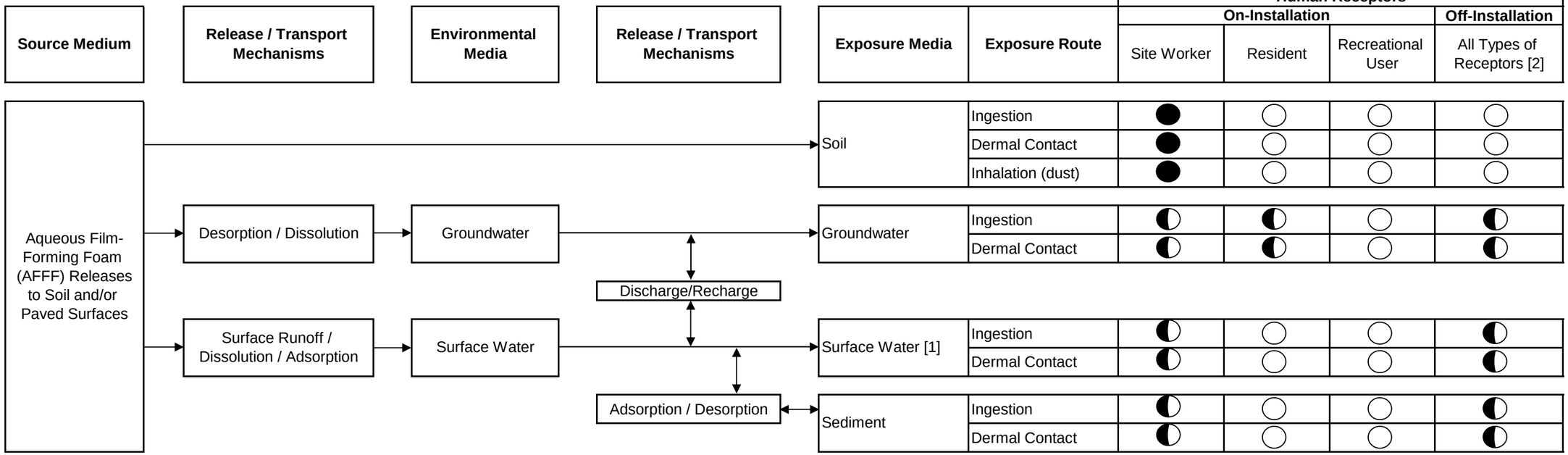
○ = Incomplete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during outdoor activities.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - Former Fire Training Pit (YFCR-53) and Bird Bath Wash Rack Areas of Potential Interest
USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 7-8



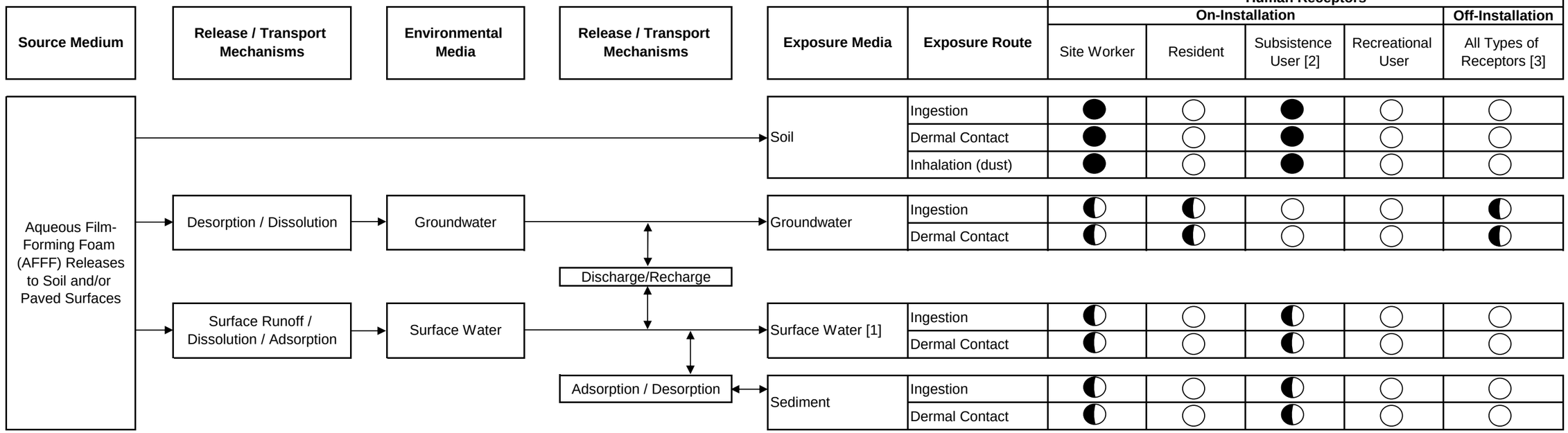
Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during outdoor activities.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

Conceptual Site Model - Refractometer Solutions Testing Area and AFFF Storage Areas (Fire Station 29 [Building 346] and AFFF Storage Area [Building 321], Building 821, and Building 751) Areas of Potential Interest
USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 7-9



Legend:

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

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Subsistence Users and Recreational Users describes incidental ingestion and dermal contact during outdoor activities.
[2] A subsistence user was selectively added to the conceptual site model for Selah Airstrip due to the known use of the on-post area around the airstrip by the Yakama Nation for subsistence activities.
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model - Selah Airstrip Area of Potential Interest
USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 7-10

APPENDIX A

Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.

APPENDIX B

Preliminary Assessment/Site Inspection Quality Control Checklist

APPENDIX C

Antiterrorism/Operations Security Review Cover Sheet

APPENDIX D

GIS Deliverable CD (included in final electronic deliverable only)

APPENDIX E

Installation EDR Survey Reports

APPENDIX F

Research Log

APPENDIX G

Compiled Interview Logs

APPENDIX H

Site Reconnaissance Photo Log

APPENDIX I

Compiled Site Reconnaissance Logs

APPENDIX J

Site Inspection Field Notes

APPENDIX K

Site Inspection Field Forms

APPENDIX L

Field Change Reports

APPENDIX M

Data Usability Summary Report

APPENDIX N

Site Inspection Laboratory Analytical Results