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

Wheeler Army Airfield, Hawaii

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

June 2023

Preliminary Assessment and Site Inspection of Per- and Polyfluoroalkyl Substances

Wheeler Army Airfield, Hawaii

Nick Wood, PE
Site Inspection Project Manager, Arcadis U.S., Inc.

Rhonda Stone, PMP
Project Manager, Arcadis U.S., Inc.

Johnsie Lang, PhD, EIT
Technical Expert, Arcadis U.S., Inc.

Prepared for:

U.S. Army Corps of Engineers

Contract No.: W912DR-18-D-0004

Delivery Order No.: W912DR1818F0685

Prepared by:

Arcadis U.S., Inc.

7550 Teague Road

Suite 210

Hanover

Maryland 21076

Arcadis Ref.:

30001994

Date:

June 2023

CONTENTS

Executive Summary ES-1
1 Introduction 1
1.1 Project Background 1
1.2 PA/SI Objectives 2
1.2.1 PA Objectives 2
1.2.2 SI Objectives 2
1.3 PA/SI Process Description 2
1.3.1 Pre-Site Visit 3
1.3.2 Preliminary Assessment Site Visit 3
1.3.3 Post-Site Visit 4
1.3.4 Site Inspection Planning and Field Work 4
1.3.5 Data Analysis, Validation, and Reporting 5
2 Installation Overview 6
2.1 Site Location 6
2.2 Mission and Brief Site History 6
2.3 Current and Projected Land Use 6
2.4 Climate 7
2.5 Topography 7
2.6 Geology 7
2.7 Hydrogeology 7
2.8 Surface Water Hydrology 8
2.9 Relevant Utility Infrastructure 8
2.9.1 Stormwater Management System Description 8
2.9.2 Sewer System Description 8
2.10 Potable Water Supply and Drinking Water Receptors 9
2.11 Ecological Receptors 9
2.12 Previous PFAS Investigations 10
3 Summary of PA Activities 11
3.1 Records Review 11

3.2 Personnel Interviews 11
3.3 Site Reconnaissance 12
4 Potential PFAS Use, Storage, and/or Disposal Areas 13
4.1 AFFF Use, Storage, and Disposal Areas 13
4.2 Other PFAS Use, Storage, and/or Disposal Areas 14
4.3 Readily Identifiable Off-Post PFAS Sources 15
5 Summary and Discussion of PA Results 16
5.1 Areas Not Retained for Further Investigation 16
5.2 AOPIs 18
5.2.1 Building 200: Fire Station #14 18
5.2.2 Fire Truck Water Tank Drainage Area 19
5.2.3 Building 100: Car Fire 19
5.2.4 Runway AFFF Training Area 19
5.2.5 Helicopter Crash 20
5.2.6 Wheeler Gulch 20
5.2.7 Building 251: Civil Air Patrol Hangar 21
6 Summary of SI Activities 22
6.1 Data Quality Objectives 22
6.2 Sampling Design and Rationale 22
6.3 Sampling Methods and Procedures 24
6.3.1 Field Methods 24
6.3.2 Quality Assurance/Quality Control 25
6.3.3 Dedicated Equipment Background 25
6.3.4 Field Change Reports 25
6.3.5 Decontamination 26
6.3.6 Investigation-Derived Waste 26
6.4 Data Analysis 26
6.4.1 Laboratory Analytical Methods 26
6.4.2 Data Validation 27
6.4.3 Data Usability Assessment and Summary 27
6.5 Office of the Secretary of Defense Risk Screening Levels 28

7 Summary and Discussion of SI Results 30
7.1 Building 200: Fire Station #14 31
7.1.1 Groundwater 31
7.1.2 Soil 32
7.2 Building 251: Civil Air Patrol Hangar 33
7.2.1 Groundwater 33
7.3 Fire Truck Water Tank Drainage Area 33
7.3.1 Soil 33
7.4 Building 100: Car Fire 34
7.4.1 Soil 34
7.5 Runway AFFF Training Area 35
7.5.1 Soil 35
7.6 Helicopter Crash 36
7.6.1 Soil 36
7.7 Wheeler Gulch 37
7.7.1 Soil 37
7.8 Dedicated Equipment Background Sample 38
7.9 TOC, pH, and Grain Size 38
7.10 Blank Samples 39
7.11 Conceptual Site Models 39
8 Conclusions and Recommendations 42
9 References 46
Acronyms 48

TABLES

Table ES-1 Summary of AOPIs Identified during the PA, PFOS, PFOA, PFBS, PFNA, and PFHxS Sampling at Wheeler Army Airfield, and Recommendations (in text)

Table 5-1 Installation Areas Not Retained for Further Investigation (in text)

Table 6-1 Monitoring Well Construction Details

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

Table 7-1 Groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Table 7-2 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Table 7-3 AOPIs and OSD Risk Screening Level Exceedances (in text)

Table 8-1 Summary of AOPIs Identified during the PA, PFOS, PFOA, PFBS, PFNA, and PFHxS Sampling at WAAF, and Recommendations (in text)

FIGURES

Figure 2-1 Site Location

Figure 2-2 Site Layout

Figure 2-3 Topographic Map

Figure 2-4 Off-Post Potable Supply Wells

Figure 5-1 AOPI Decision Flowchart (in text)

Figure 5-2 AOPI Locations

Figure 5-3 Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar

Figure 5-4 Fire Truck Water Tank Drainage Area

Figure 5-5 Building 100: Car Fire

Figure 5-6 Runway AFFF Training Area

Figure 5-7 Helicopter Crash

Figure 5-8 Wheeler Gulch

Figure 6-1 AOPI Sampling Decision Tree (in text)

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

Figure 7-2 Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Figure 7-3 Fire Truck Water Tank Drainage Area PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Figure 7-4 Building 100: Car Fire PFOS, PFOA, PFBS, PFNA, and PFHxS, Analytical Results

Figure 7-5 Runway AFFF Training Area PFOS, PFOA, PFBS, PFNA, and PFHxS, Analytical Results

Figure 7-6 Helicopter Crash PFOS, PFOA, PFBS, PFNA, and PFHxS, Analytical Results

Figure 7-7 Wheeler Gulch PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Figure 7-8 Conceptual Site Model for Building 200: Fire Station #14, Fire Truck Water Tank Drainage Area, Building 100: Car Fire, Runway AFFF Training Area, Helicopter Crash, and Wheeler Gulch AOPIs

Figure 7-9 Conceptual Site Model for Building 251: Civil Air Patrol Hangar AOPI

APPENDICES

Appendix A Office of the Secretary of Defense. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July 06.

Appendix B Preliminary Assessment/Site Inspection Quality Control Checklist

Appendix C Not Used

Appendix D Installation EDR Survey Reports

Appendix E Research Log

Appendix F Compiled Interview Logs

Appendix G Site Reconnaissance Photo Log

Appendix H Compiled Site Reconnaissance Logs

Appendix I Site Inspection Field Notes

Appendix J Site Inspection Field Forms

Appendix K Site Inspection Photo Log

Appendix L Field Change Reports

Appendix M Data Usability Summary Report (Level IV analytical reports included in final electronic deliverable only)

Appendix N Site Inspection Laboratory Analytical Results

EXECUTIVE SUMMARY

The United States Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) at Army installations nationwide because the Office of the Secretary of Defense (OSD) has developed risk-based screening levels for these chemicals. 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 Wheeler Army Airfield (WAAF) PA/SI was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), National Oil and Hazardous Substances Pollution Contingency Plan, and Army/Department of Defense policy and guidance.

WAAF is a 1,430-acre installation located on the island of Oahu, Hawaii, approximately 20 miles northwest of Honolulu between the Waianae and Koolau Mountain Ranges. The surrounding area consists of another installation, Schofield Barracks (SCHBR), and the municipality of Wahiawa to the north, agricultural land and SCHBR to the west, Waipio Acres (a census-designated place) and the town of Mililani to the east, and agricultural land and the town of Mililani to the south. Wahiawa is composed of residential, commercial, and light industrial properties, and Mililani is composed primarily of residential and commercial properties.

The WAAF 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 OSD for PFOS, PFOA, PFBS, PFNA, and PFHxS. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at WAAF because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of HFPO-DA, it is generally not a component of other products the military used. In addition, it is unlikely that HFPO-DA would be an individual chemical of concern in the absence of other PFAS. Therefore, there are no HFPO-DA SI analytical results to screen against the 2022 OSD risk screening levels. PFOS, PFOA, PFBS, PFNA and/or PFHxS were detected in soil and/or groundwater at all seven AOPIs; four of the seven AOPIs had PFOS, PFOA, PFBS, PFNA, and/or PFHxS present at concentrations greater than the risk-based screening levels. The WAAF PA/SI identified the need for further study in a CERCLA remedial investigation. **Table ES-1** summarizes the PA/SI sampling results and provides recommendations for further study in a remedial investigation or additional supplemental groundwater sampling at each AOPI.

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

AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/NS)		Recommendation
	GW	SO	
Building 200: Fire Station #14	Yes[2]	Yes	Further study in a remedial investigation
Fire Truck Water Tank Drainage Area	NS	No	Further evaluation [1]
Building 100: Car Fire	NS	No	Further evaluation[1]
Runway AFFF Training Area	NS	No	Further evaluation[1]
Helicopter Crash	NS	Yes	Further study in a remedial investigation
Wheeler Gulch	NS	Yes	Further study in a remedial investigation
Building 251: Civil Air Patrol Hangar	Yes[2]	NS	Further study in a remedial investigation

Notes:
1 = Soil analytical data indicates PFOS, PFOA, PFBS, PFNA, and/or PFHxS presence below OSD risk screening levels, but because there is a potential for migration to groundwater, further evaluation is recommended.
2 = The existing monitoring well sampled during the SI was in close proximity to both Building 200: Fire Station #14 AOPI and Building 251: Civil Air Patrol Hangar AOPI. Therefore, the groundwater results were used to evaluate and recommend both AOPIs for further study in a remedial investigation.
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
NS – not sampled
SO – soil

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) and site inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA) at Army installations nationwide because the Office of the Secretary of Defense (OSD) has developed risk-based screening levels for these chemicals. 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 Wheeler Army Airfield (WAAF) based on the use, storage and/or disposal of PFAS-containing materials, in accordance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018). The SI included multi-media sampling at AOPIs to determine whether or not a release has occurred, and the analytical results were compared to the Office of the Secretary of Defense (OSD) PFOS, PFOA, PFBS, PFNA, and PFHxS risk screening levels to determine whether further investigation is warranted. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at WAAF because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of HFPO-DA, it is generally not a component of other products the military used. In addition, it is unlikely that HFPO-DA would be an individual chemical of concern in the absence of other PFAS. Therefore, there are no HFPO-DA SI analytical results to screen against the OSD risk screening levels. This report provides the PA/SI for WAAF 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 2016a). On 15 October 2019, the OSD provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water and

soil, calculated using the USEPA's Regional Screening Level (RSL) calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 08 April 2021, USEPA published an updated toxicity assessment for PFBS (USEPA 2021). Based on the updated toxicity assessment for PFBS, the OSD issued a memorandum on 15 September 2021 to include updated PFBS risk screening levels (OSD 2021). On 18 May 2022, the USEPA published an update to the RSLs table. The May 2022 RSL table included six PFAS constituents: PFOS, PFOA, PFBS, PFNA, PFHxS, and HFPO-DA (USEPA 2022). On 06 July 2022, the OSD issued a memorandum to include revised risk screening levels based on the May 2022 USEPA RSLs (OSD 2022). The July 2022 Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program is provided for reference as **Appendix A**. These screening criteria are discussed further in **Section 6.5**.

1.2 PA/SI Objectives

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

1.2.1 PA Objectives

During the PA, investigators collect readily available information and conduct site reconnaissance. This PA evaluates and documents areas throughout WAAF 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

A 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 WAAF, PA/SI development followed the process as described below. **Section 3** provides a summary of the PA activities completed, and **Section 6** provides a summary of the SI activities completed for WAAF. 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), WAAF, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 07 January 2019, approximately 8 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 WAAF.

A read-ahead package was prepared and submitted to the appropriate POCs 2 weeks before the site visit. The read-ahead package contains the following information:

- The Installation Management Command operation order
- 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 in conjunction with visits to multiple other Hawaii installations between 05 and 22 March 2019. 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 WAAF. 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. An informal exit briefing was conducted on 21 March 2019 with U.S. Army Garrison, Hawaii (USAG-HI) to discuss preliminary findings of the PA site visits.

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 CSMs for each AOPI, which serve as the basis for developing the SI scope of work presented in an installation-specific Quality Assurance Project Plan (QAPP) Addendum.

1.3.4 Site Inspection Planning and Field Work

The SI process was initiated at the installation to evaluate PFOS, PFOA, PFBS, PFNA, and PFHxS presence or absence at each AOPI and determine whether further investigation is warranted. First, an SI kickoff and scoping teleconference was held between the Army PA team, USAG-HI, USAEC, and USACE.[1]

The objectives of the SI kickoff and scoping teleconference were to obtain concurrence on the SI sampling plan from USAEC, USACE, and the installation POCs, as well as a discussion of the following topics:

- AOPIs selected for sampling and the proposed sampling plan for each AOPI
- Identify overlapping unexploded ordnance areas at Wheeler Gulch AOPI
- Specific installation access requirements and potential schedule conflicts
- General SI deliverable and field work schedule information and logistics
- Health and safety considerations

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

[1] The SI kickoff teleconference covered the six original installations on Oahu within USAG-HI's purview: Schofield Barracks, Wheeler Army Airfield, Helemano Military Reservation, Fort Shafter, Tripler Army Medical Center, and Aliamanu Military Reservation.

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 WAAF (Arcadis 2022) 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-accredited for PFOS, PFOA, PFBS, PFNA, and PFHxS analysis by liquid chromatography with tandem mass spectrometry and compliant with the DoD Quality Systems Manual (QSM) 5.3 (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 WAAF, including the location and layout, the installation mission(s) over time, a brief site history, current and projected land use, climate, topography, geology, hydrogeology, surface water hydrology, potable wells within a 5-mile radius of the installation, and applicable ecological receptors.

2.1 Site Location

WAAF is a 1,430-acre installation located on the island of Oahu, Hawaii, approximately 20 miles northwest of Honolulu between the Waianae and Koolau Mountain Ranges (**Figure 2-1**). The surrounding area consists of another installation, Schofield Barracks (SCHBR), and the municipality of Wahiawa to the north, agricultural land and SCHBR to the west, Waipio Acres (a census-designated place) and the town of Mililani to the east, and agricultural land and the town of Mililani to the south. Wahiawa is composed of residential, commercial, and light industrial properties, and Mililani is composed primarily of residential and commercial properties. **Figure 2-2** details the layout of WAAF.

2.2 Mission and Brief Site History

The mission of WAAF is to train, equip, and sustain Army forces in the Pacific Theater. Additionally, the mission is to provide aviation support to the Hawaii Army Air National Guard and a number of DoD activities, including the Defense Communications Agency, the Air Force's 6010th Aerospace Defense Group, the Hawaii Army National Guard's Aviation Support Facility, and the 25th Infantry Division Combat Aviation Brigade (Army 2016).

WAAF was bombed during the attack on Pearl Harbor and, during World War II, ammunition storage structures, bunkers, a new hangar, family housing, and support structures were constructed. Several small arms ranges were also established around that time; all have been subsequently closed and are undergoing cleanup under the Military Munitions Response Program (MMRP). The installation was deactivated and placed in caretaker status in 1949 and reactivated in 1952 during the Korean War. In the 1960s, the U.S. Air Force, Army, U.S. Navy, and Hawaii National Guard shared the installation's facilities. There were no heavy maintenance shops, such as engine rebuilding or metal plating, at the facility; therefore, shop-generated wastes were not extensive. The Army assumed control of the installation's administration, maintenance, and operations in 1977 and, thereafter, the installation became the center for all Army aviation activities in the Pacific (primarily helicopters) (Army 2016).

2.3 Current and Projected Land Use

WAAF is an active U.S. Army installation that is primarily used as a helicopter base and a training area (OHM 1998). Minor vehicle and aircraft maintenance activities take place at WAAF, and major equipment maintenance is performed at Hickam Air Force Base. Additionally, firefighting training, ground maintenance, and fuel management activities take place on the installation. Although information regarding the population of WAAF was not readily available at the time of this PA/SI, other land uses at WAAF include residential housing and recreational facilities used for baseball, softball, football, and paintball (**Figure 2-2**; CH2M Hill 2011). There are no foreseeable future land use changes for WAAF.

2.4 Climate

The island of Oahu, located in the tropics, is part of the Hawaiian Volcanic Island chain and as a result sees only two seasons, winter, and summer. Winter is slightly cooler and wetter, but conditions are fairly similar year-round. Oahu is characterized by mild temperatures, persistent northeastern trade winds, moderate humidity, and variation in rainfall over short distances. Greater weather variations occur between elevations and coastal exposures (windward or leeward) than between seasons. According to the Western Regional Climate Center (WRCC), the annual average total precipitation at Upper Wahiawa Station 874.3, Hawaii (518838), located near WAAF, from April 1971 to November 2015 was 67.48 inches per year (WRCC 2023). Annual temperatures at Upper Wahiawa Station 874.3, Hawaii (518838), from April 1971 to November 2015 ranged from an average minimum of 64.4 degrees Fahrenheit to an average maximum of 79.2 degrees Fahrenheit for the period of May 1940 to June 2016 (WRCC 2023).

2.5 Topography

WAAF is situated between the Waianae Mountain Range to the west and the Koolau Mountain Range to the east. Land elevations range from approximately 800 to 900 feet above mean sea level along the northern installation boundary and from approximately 500 to 700 feet above mean sea level along the southern boundaries **(Figure 2-3)** (CH2M Hill 2011).

2.6 Geology

The Island of Oahu consists of the eroded remnants of two large shield volcanoes, Waianae and Koolau. The main post at WAAF is underlain by the Koolau Basalt member of the Koolau Volcanic series, which butts up against the older eroded surface of the Kamaileunu and Lualualei (lower and middle) members of the Waianae Volcanic series. The Koolau Basalt flowed in thin, nearly horizontal layers on which soils developed and alluvial sediments were deposited between flows during the eruptive history of the Koolau Volcano. The Koolau volcanics are overlain by recent alluvial sediments eroded from the Waianae Range, which accounts for the surficial deposits that cover most of WAAF (CH2M Hill 2011).

The installation is underlain by an approximately 10-foot layer of clay-rich soil over a 100-foot or greater sequence of saprolite. Saprolite is silty clay formed from the decomposition of the original lava and contains features of the original rock texture and structure. Bedrock basalt begins between 100 and 150 feet below ground surface (bgs) throughout the region. Most of the flatlands at WAAF are underlain by soils of the Wahiawa Series. The steep slopes of Waikele Gulch, located along the western installation boundary, are underlain by erosion prone soils of the Helemano series and soft saprolite deposits that are vulnerable to slope failure (CH2M Hill 2011).

2.7 Hydrogeology

The aquifer beneath the northern portion of WAAF is part of the Wahiawa Aquifer System in the Central Aquifer Sector, and the aquifer beneath the southern portion of WAAF is part of the Waipahu Aquifer System in the Pearl Harbor Aquifer Sector (Mink and Lau 1990). The northern aquifer is a high level, unconfined dike aquifer and the southern aquifer is a basal, unconfined flank aquifer. Both aquifers are classified as currently developed for drinking water use by municipal and private users, having a salinity

of less than 250 milligrams per liter of chloride, being irreplaceable, and highly vulnerable to contamination (Mink and Lau 1990). On Oahu, because of the limited resources, interconnection among groundwater sources, and the relatively rapid time of groundwater travel, most unconfined aquifers are vulnerable to contamination (Mink and Lau 1990). The aquifer classifications (e.g., high, moderate, low, or no vulnerability to contaminants) are based on familiarity with environmental conditions (Mink and Lau 1990). The direction of groundwater flow beneath the installation is undetermined from readily available documents; however, groundwater in the area generally flows toward the east and south. Depth-to-groundwater ranges from approximately 600 feet bgs on the north side of WAAF to approximately 845 feet bgs on the south side of WAAF (CH2M Hill 2011).

2.8 Surface Water Hydrology

On-installation surface water features include Waikele Stream, which runs along the western installation boundary, and two tributaries of Waikele Stream located near the eastern/southeastern installation boundaries (**Figure 2-2)**. The majority of WAAF drains to Waikele Stream, which flows southward through the town of Mililani and eventually drains to the West Loch of Pearl Harbor. The portion of the Waikele Stream on WAAF is considered ephemeral and is likely to only contain water after heavy rainfall. On-installation surface water features are not used as drinking water sources. Surface water features in the surrounding area include several streams and Wahiawa Reservoir, located adjacent to the northern installation boundary. Wahiawa Reservoir is used for recreational activities and to irrigate 3,000 acres of pineapple fields. Off-installation surface water features in proximity to WAAF are likely not used for drinking water (Arcadis 2022).

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 WAAF.

2.9.1 Stormwater Management System Description

Surface runoff at WAAF drains to Waikele Stream, which is listed on the Clean Water Act Section 303(d) list as an impaired water body based on nutrients and turbidity, and as such, is subject to Waikele watershed total maximum daily load requirements for nutrients, sediments, and turbidity. The Waikele Stream watershed drains toward Pearl Harbor, which is also listed as an impaired water body (CH2M Hill 2011).

2.9.2 Sewer System Description

Wastewater at WAAF flows via the sanitary sewer to the on-site wastewater treatment plant (Schofield Barracks Wastewater Treatment Plant) located south of the airfield. It was originally constructed and became operational in approximately 1978 (Harding Lawson Associates, 1993). It was privatized by the Army in 2004 and Aqua Engineers, Inc. currently operates the plant (City and County of Honolulu Department of Design and Construction 2008). According to USAG-HI personnel, wastewater treatment plant sludge and biosolids are hauled offsite for incineration at the Honolulu Program of Waste Energy

Recovery (H-Power) facility in Kapolei; additionally, when H-Power is intermittently unable to accept waste, it is either hauled offsite to Waimanalo Gulch Sanitary Landfill in Kapolei, or temporarily stored in roll-off containers at the WWTP for later disposal at H-Power. One cesspool, which is an underground container/pit for the temporary storage and infiltration of liquid waste and sewage, has been closed, and two others have been replaced with approved wastewater treatment systems (USEPA 2016c). The exact location of the cesspools was undetermined upon review of readily available documents.

2.10 Potable Water Supply and Drinking Water Receptors

Drinking water at WAAF is obtained from four SCHBR water supply wells. The wells are located adjacent to WAAF's northeast installation boundary and are owned by the USAG-HI Directorate of Public Works (DPW). Groundwater beneath WAAF, SCHBR, and the surrounding region is used as a drinking water source for WAAF, SCHBR, nearby military facilities, and public water supply systems in Wahiawa, Kunia, and Mililani (**Figure 2-4**). As stated in **Section 2.7**, groundwater flow beneath the installation is undetermined and groundwater flow directions in the region vary. Therefore, it is undetermined whether or not off-post wells in the area surrounding WAAF are hydraulically downgradient of an AOPI.

An Environmental Data Resources, Inc. (EDR) report includes search results from a variety of environmental, state, city, and other publicly available databases for a referenced property. An EDR report was generated for WAAF, which along with state and county geographic information systems (GIS) provided by the installation identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-4**). However, army owned-wells/water sources and on-post installation wells/water sources, if present, are not shown or identified on figures in this PA/SI report due to operational security guidance/requirements. The EDR report providing well search results provided as **Appendix D**.

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.

Several rare and endangered plants, animals, and natural communities are located within a 4-mile radius of WAAF; however, none have been identified on the installation. The Waikele Stream is considered habitat for the federally endangered Hawaiian Duck and Hawaiian Coot. It is also a plant sanctuary recovery habitat for rare flora. There are a number of endemic fish known to inhabit the Waikele Stream, including the *'o'opu nakea, 'o'opu naniha, 'o'opu hi'ukole, 'o'op 'okuhe, aholehole,* and *'ama'ama*. A number of nonnative fish species are also known to inhabit the Waikele Stream, including the mangrove goby, liberty mollies, shortfin mollie, bristle-nose, tilapia, guppies, Chinese catfish, loach, mosquito fish, and sword tail. There are no native terrestrial amphibians, reptiles, or mammals known to inhabit the installation. The portion of the Waikele Stream on WAAF is considered ephemeral and is not likely a suitable habitat for endangered aquatic species (CH2M Hill 2011).

2.12 Previous PFAS Investigations

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

The USEPA conducted the third Unregulated Contaminant Monitoring Rule (UCMR3) monitoring between 2013 and 2015. UCMR3 is a national program that collects data for contaminants that are suspected to be present in drinking water and do not have health-based standards set under the Safe Drinking Water Act (USEPA 2016b). The UCMR3 included the analysis of PFOS, PFOA, PFBS, PFNA, and PFHxS in public water systems serving more than 10,000 people between 2013 to 2015. During monitoring events conducted in 2013 (January, March, June, and July), 2014 (January, February, March, June, July, and September), and 2015 (January) samples were collected from 10 to 20 public supply wells within a 5-mile radius of WAAF (the locations of sampled wells were undetermined from readily available documents). Results indicated that PFOS, PFOA, PFBS, PNFA, and PFHxS were not detected in any of the samples collected from the public supply wells. The minimum reporting levels at the time of UCMR3 sampling were 40 ng/L for PFOS, 20 ng/L for PFOA, 90 ng/L for PFBS, 20 ng/L for PFNA, and 30 ng/L for PFHxS. The laboratory that analyzed the samples under UCMR3 met the USEPA's UCMR3 Laboratory Approval Program application and Proficiency Testing criteria for USEPA Method 537 Version 1.1.

Drinking water samples were collected from SCHBR on 19 March and 09 September 2014, and 16 October 2017 for PFAS analysis (including PFOS, PFOA, and PFBS) using USEPA Method 537 (Naval Facilities Engineering Command [NAVFAC] 2014a; NAVFAC 2014b; Army 2017). Based on chain of custody records included with the laboratory reports, the water samples were collected from a post chlorination facility. The samples from March and September 2014 were collected/relinquished by the USAG-HI DPW. Although the signature of the person who relinquished the sample from October 2017 is provided on that chain of custody record, the organization with which that person is affiliated is not identified. Analytical results for samples collected on 19 March and 09 September 2014 indicate PFBS was not detected above the method reporting limit of 90 ng/L, PFOS was not detected above the method reporting limit of 40 ng/L, and PFOA was not detected above the method reporting limit of 20 ng/L (NAVFAC 2014a; NAVFAC 2014b). Analytical results for the sample collected on 16 October 2017 indicate none of the analyzed constituents were detected above the method reporting limit of 2.0 ng/L (Army 2017).

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 WAAF, data was collected from three principal sources of information and are described in the subsections below:

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

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

3.1 Records Review

The records reviewed for this PA included, but were not limited to, the EDR report, various Installation Restoration Program (IRP) administrative record documents, compliance documents, federal fire department documents, USAG-HI DPW documents, and geographic information system files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for WAAF is provided in **Appendix E**.

3.2 Personnel Interviews

Interviews were mostly conducted during the site visit. A total of 18 interviews were conducted, including 22 different people (some interviews included multiple people). Two of the 18 interviews were conducted via phone call prior to the site visit period (05 to 22 March 2019), and one interview was conducted via phone call after the site visit. The list of roles for the installation personnel interviewed during the PA process for WAAF is presented below (affiliation is with WAAF unless otherwise noted).

- IRP/MMRP/Underground Storage Tanks Manager
- Colorado State University Employee
- Federal Fire Department Fire Fighter
- Hazardous Waste Program Manager
- Federal Fire Department Engineer
- Federal Fire Department Chief of Operations

- Firefighting Captain
- Firefighting Lieutenant
- Compliance Manager
- Safe Drinking Water and Clean Air Program Manager
- Airfield Operations Manager
- DPW Supply Branch Chief
- DPW Operations and Maintenance Division Chief
- Director of DPW
- DPW Building Manager

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

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at WAAF 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 G**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix H**.

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

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

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

4.1 AFFF Use, Storage, and Disposal Areas

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

As identified during site visit interviews with the Federal Fire Department staff, AFFF has been stored at Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar. AFFF was stored in a shed on the west side of Building 200: Fire Station #14 and 5-gallon buckets of AFFF were also stacked on a containment pallet in the engine bay. As-built drawings of Building 251: Civil Air Patrol Hangar show a foam fire-suppression system. The foam onsite was likely Aer-O-Foam XL-3% (which contains PFAS) and was stored in a 400-gallon fluoro-protein foam tank. There is no indication the foam system has ever been deployed and there have been no known leaks. The foam tank was found to contain an unidentified black liquid substance during the PA site visit. This substance may be expired foam concentrate from when the system was installed.

For emergency preparedness, installation/fire department personnel were trained to perform nozzle testing with AFFF to ensure optimal flow and use of the AFFF mixture. Nozzle testing involved spraying AFFF through fire equipment. Fire equipment training also included arc training to maximize the arc, reach, and distance covered by AFFF in an emergency response. A review of readily available documents and interviews confirmed the Runway AFFF Training Area and Wheeler Gulch are the only known locations of AFFF training at WAAF.

In 1989 personnel observed a training session at the Runway AFFF Training Area where AFFF was sprayed approximately 100 feet from the runway's edge. The Federal Fire Department has also been observed spraying what appeared to be water in that area multiple times. Therefore, it is possible that AFFF training could have occurred in the area more than once. AFFF training is not known to have occurred at the Building 200: Fire Station #14. However, Federal Fire Department personnel noted that releases have likely been occurring at the station since the late 1960s. Valves and gauges on old trucks

were known to cause leakages and spills of AFFF on the front apron. Fire trucks were also washed on the front apron. The leaking trucks were replaced circa 2002 to 2004 to resolve the leakage/spill issue. Five-gallon buckets of AFFF were historically stored in an exterior shed attached to the west wall of Building 200: Fire Station #14 until 2018. Additionally, approximately five 10-gallon buckets of AFFF were stacked on a containment pallet in the engine bay and removed prior to the PA site visit (exact removal date is undetermined from readily available documents). In March 2019 at the time of the PA site visit, AFFF was stored in tank reservoirs in the fire trucks (including an engine, brush truck, and pumper) located onsite at the Building 200: Fire Station #14 AOPI.

During site visit interviews, Federal Fire Department personnel noted that fire truck water tank reservoirs were emptied onto a grassy field located near the northern installation boundary, just north of Building 200: Fire Station #14, when the water reservoirs became contaminated with AFFF. It was standard procedure to flush out the system and refill the foam and water reservoirs following any AFFF use. This likely occurred on multiple occasions from the late 1960s through approximately 2004. Following records research, personnel interviews, and site reconnaissance, Wheeler Gulch was identified as a place used to flush fire truck systems, clear nozzles, practice/train, and test AFFF on multiple occasions (likely since the late 1960s),

There are two known crash/fire responses at WAAF in which AFFF was utilized. Circa 2005, a car fire occurred in the asphalt parking lot adjacent to Building 100. AFFF was used for approximately 20 seconds during emergency response efforts. The fire truck was parked west of the car fire, adjacent to a grass curb feature. AFFF overspray likely occurred in the grass curb feature. In May 2009, a helicopter crashed on the east side of the WAAF runway. Initial emergency response efforts included the use of dry chemicals. Thereafter, two Federal Fire Department fire trucks discharged a full tank of water mixed with AFFF concentrate (1,500 gallons each). At the time of the crash, the asphalt runway was cracked; however, it has since been repaved.

Site personnel interviews, reconnaissance trips, and historical documents identified the Former Fire-Fighter Training Area in the southeast area of WAAF near Airdrome Road used by firefighters when WAAF was an Air Force installation from the 1950s until 1980 (**Figure 5-2**). Training activities were relocated to Hickam Air Force Base in 1980 and included igniting waste oils, diesel, or jet fuel which were placed over a water layer and extinguishing them with a combination of water and AFFF (OHM 1998). In 1980, the contaminated soil at this site was excavated and taken to a landfill at SCHBR, and replacement soil was subsequently brought in to fill the excavation. The volume of soil excavated, the volume of replacement soil brought in, and the lateral and vertical extent of the excavation were not provided in readily available documents. Additionally, aerial images indicate there has been extensive soil disturbance (e.g., excavating and regrading) in that area over the past two decades.

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

Following document research, personnel interviews, and site reconnaissance at WAAF, no other PFAS source types (i.e., metal plating facilities, landfills, and photo-processing areas) were identified as preliminary locations for use, storage, and/or disposal of PFAS-containing materials on the installation. Specific discussion regarding areas not retained for further investigation is presented in **Section 5.1** and specific discussion regarding areas retained as AOPIs is presented in **Section 5.2**.

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at WAAF) 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 in **Table 4-1**. A comprehensive list of potential off-post sources can be found in the EDR report (**Appendix D**). Although these sources are within a 5-mile radius of the WAAF installation, several of these off-post sources are hydraulically (north/north-northwest) upgradient of WAAF.

Table 4-1. Readily Identifiable Off-Post PFAS Sources

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation[1]
Honolulu Fire Department	5-269 Kipapa Drive, Mililani, Hawaii 96789	Fire Station	0.51, East
Wahiawa Fire Station	640 California Avenue, Wahiawa, Hawaii 96786	Fire Station	0.55, North
Fire Station 41 Mililani Mauka	95-1990 Meheula Parkway, Mililani, Hawaii 96789	Fire Station	1.62, East
Fire Station 42 Waikele	94-840 Lumiaina Place, Waipahu, Hawaii 96797	Fire Station	3.75, Southeast
Fire Station 12 Waipahu (Historical)	94891 Waipahu Street Ext, Waipahu, Hawaii 96797	Fire Station	4.75, South
Firestone Complete Auto Care	Road A Building 80, Schofield Barracks, Hawaii 96857	Automotive Maintenance	0.06, North
Ohana Automotive Repair & Service LLC	136 Wilikina Drive, Wahiawa, Hawaii 96786	Automotive Maintenance	0.16, North
US Alterations and Cleaners	176 S Kamehameha Highway, Wahiawa, Hawaii 96786	Laundry	0.18, North
Wahiawa Laundromat	34 Maalo Street, Wahiawa, Hawaii 96786	Laundry	0.56, North
Wahiawa General Hospital	128 Lehua Street, Wahiawa, Hawaii 96786	Hospital	0.70, North
The Queen's Health Care Center – Mililani	95-1249 Meheula Parkway, Mililani, Hawaii 96789	Hospital	1.12, East
Walgreens Photo	135 S Kamehameha Highway, Wahiawa, Hawaii 96786	Photo-Processing	0.35, North
CVS Photo	95 1249 Meheula Parkway, Suite D, Mililani, Hawaii 96789	Photo-Processing	0.70, South
Pioneer Ace Hardware	930 Kilani Avenue, Wahiawa, Hawaii 96786	Paint Facility/Manufacturer	0.82, North
Pristine Painting & Coatings LLC	401 N Cane Street, Suite A7, Wahiawa, Hawaii 96786	Paint Facility/Manufacturer	0.9, North
Forest Farms	25 Kamananui Road, Wahiawa, Hawaii 96786	Farm	1.28, Northwest

Notes:
1 = Distance in miles from the installation to the off-post PFAS source.

5 SUMMARY AND DISCUSSION OF PA RESULTS

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

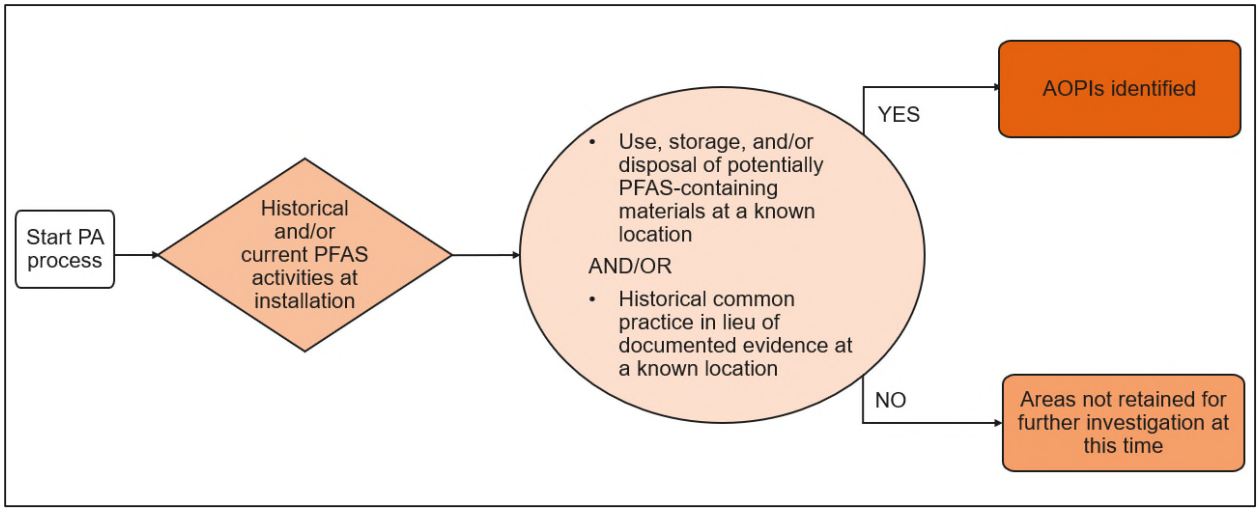


Figure 5-1: AOPI Decision Flowchart

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 WAAF are presented in **Section 8**.

5.1 Areas Not Retained for Further Investigation

Through the evaluation of information obtained during records review, personnel interviews, and/or site reconnaissance, the areas described in **Table 5-1**were categorized as areas not retained for further investigation at this time.

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

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

Area Description	Dates of Operation	Relevant Site History	Rationale
Fuselage Fire-Fighting Training Prop	Approximately 2009 to present	A propane-fueled fuselage prop is used for fire-fighter training. According to an interview with the Federal Fire Department Captain, they have had the prop for approximately 10 years, and only water has been used in training with the prop, never AFFF.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at this location.

Area Description	Dates of Operation	Relevant Site History	Rationale
Hangar Fire Suppression	Date undetermined from readily available documents to present	There are no fire-suppression systems utilizing AFFF in any of the Army or Army National Guard hangars.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at these locations.
Schofield Barracks Wastewater Treatment Plant	Approximately 1978 to present	Facility receives wastewater from Helemano Military Reservation, SCHBR, and WAAF. Waste fluid from X-ray development disposed of via sanitary sewer (does not go to wastewater treatment plant). Sludge disposed off-site by the Navy.	No confirmed receipt or known release and/or observed storage/spill of PFAS-containing material.
Gulch Runway Dump	Undetermined from readily available documents	Historical records and photographs provide evidence of burial/soil disturbance, indicating the use of this area as a waste landfill (OHM 1998). Access roads entering the site from the west and south were also identified in historical records. The Gulch Runway Dump, DP02, has a record of surface and sub-surface contamination with petroleum products, solvents, PCBs, and lead. Remediation efforts at the Gulch Runway Dump included excavating and removing waste drums, identifying the horizontal and vertical boundaries of the buried drums expanse, and removing contaminated surface and subsurface soil to the extent necessary to meet cleanup criteria (OHM 1998).	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at this location.
Kunia Gate Dump	1950s to 1974	Kunia Gate Dump was the primary base landfill operating from the 1950s until its closure in 1974 (OHM 1998). Stage 1 and 2 investigations resulted in a site cleanup and removal action performed in 1995. As of 1998, the only activity at the Kunia Gate Dump was military vehicle fueling in a fenced fueling station located centrally within the Kunia Gate Dump site.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposed of at this location.
Former Fire-Fighter Training Area	1950s to 1980	The Former Fire-Fighter Training Area in the southeast area of WAAF was used by firefighters when WAAF was an Air Force installation from the 1950s until 1980 (**Figure 5-2**). In 1980, the contaminated soil at this site was excavated and taken to a landfill at SCHBR, and replacement soil was subsequently brought in to fill the excavation. The volume of soil excavated, the volume of replacement soil brought in, and the lateral and vertical extent of the excavation were not provided in readily available documents. Additionally, aerial images indicate there has been extensive soil disturbance (e.g., excavating and regrading) in that area over the past two decades. Therefore, it is unlikely that soil at the Former Fire-Fighter Training Area would reflect conditions attributable to native soil present when firefighting training activities were conducted in the area and, if potentially impacted native soil remained at the AOPI, its location would be unidentifiable.	Soil sampling location could not be determined because the lateral and vertical extent of the excavation is not provided by readily available documents.

5.2 AOPIs

Overviews for each AOPI identified during the PA process are presented in this section. The Wheeler Gulch AOPI overlaps with or is within the proximity of several WAAF MMRP sites and/or Headquarters Army Environmental System (HQAES) sites. The MMRP site identifiers, HQAES numbers, and current site status are discussed within the Wheeler Gulch AOPI subsection presented below. At the time of this PA, none of the WAAF IRP sites have historically been investigated or are currently being investigated for the possible presence of PFAS. UCMR3 data indicates that two public supply wells within a 5-mile radius upgradient of WAAF were analyzed for PFOS, PFOA, PFBS, PFNA, and PFHxS during monitoring events conducted on 19 March and 09 September 2014. However, results indicated that PFOS, PFOA, PFBS, PNFA, and PFHxS were not detected above the then-current method detection limits in any of the samples collected from the public supply wells.

The AOPI locations are shown on **Figure 5-2**. Detailed views of each AOPI showing the approximate extent of AFFF use (if applicable) are presented on **Figures 5-3** through **5-8** and include active monitoring wells in the vicinity of each AOPI.

5.2.1 Building 200: Fire Station #14

Building 200: Fire Station #14 is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to leakage of AFFF from firefighting equipment since the 1960s (**Figure 5-3**).

Fire Station #14, which fronts Santos Dumont Avenue, was built prior to World War II. Although AFFF training is not known to have occurred onsite, Federal Fire Department personnel noted that AFFF releases have likely been occurring at the station since the late 1960s. Valves and gauges on old trucks were known to cause leakages and spills of AFFF on the front apron. Fire trucks were also washed on the front apron. Surface runoff from the front apron would have flowed to a grassy area that borders the east side of the front apron, toward Santos Dumont Avenue, and possibly to a grassy area across Santos Dumont Avenue. The leaking trucks were replaced circa 2002 to 2004 to resolve the leakage/spill issue. Five-gallon buckets of AFFF were historically stored in an exterior shed attached to the west wall of Building 200: Fire Station #14 until 2018. Additionally, approximately five 10-gallon buckets of AFFF were stacked on a containment pallet in the engine bay and removed prior to the PA site visit (exact removal date is undetermined from readily available documents). In March 2019 at the time of the PA site visit, AFFF was stored in tank reservoirs in the fire trucks (including an engine, brush truck, and pumper) located onsite at the Building 200: Fire Station #14 AOPI. It is possible personnel would have exited through the back-bay doors to access/transport AFFF from the engine bay. Surface runoff near the back-bay door closest to where the pallet of AFFF was stored flows toward a patch of dirt at the back of the building. Additionally, fire truck water reservoirs impacted with AFFF were emptied onto a grassy area behind and immediately adjacent to the fire station. Adjacent to that grassy area is an open grassy field formerly occupied by Building 218, a gasoline service station that ceased all operations in 1999. Four underground storage tanks, two sumps, a dry well, associated pipelines, and petroleum impacted soil were excavated and removed from the service station site. The top 21 feet of the former dry well excavation area, which was located approximately 20 feet northwest of Building 200, was filled with thermally treated soil from a non-related remedial action; however, residual impacted soil remained in the vicinity of the dry well.

5.2.2 Fire Truck Water Tank Drainage Area

The Fire Truck Water Tank Drainage Area is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to known/suspected PFAS-containing material was disposed at this location (**Figure 5-4**).

The AOPI is a grassy field located approximately 700 feet northwest of AOPI Building 200: Fire Station #14. Federal Fire Department personnel noted that on multiple occasions (likely from the late 1960s through approximately 2004), the fire truck water tank reservoirs were emptied onto the grassy field when the reservoirs became impacted with AFFF. The fire trucks were driven to the Fire Truck Water Tank Drainage Area AOPI and would likely have been parked in a parking lot area near the intersection of Elleman Road and Strieber Avenue. The parking lot area is paved with asphalt and concrete and is surrounded by a curb. In general, surface runoff at the AOPI flows toward Strieber Avenue; however, surface water on the west side of the AOPI (i.e., west of Elleman Road) flows toward a low point near the center of that section of the field. Additionally, there is a break in the curb near the southeast corner of the parking lot that allows surface runoff to flow to the adjacent grass. Surface runoff near the break in the curb flows toward the intersection of Elleman Road and Strieber Avenue.

5.2.3 Building 100: Car Fire

Building 100: Car Fire is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to use of a known/suspected PFAS containing material at this location (**Figure 5-5**).

Circa 2005, a car fire occurred in the asphalt parking lot adjacent to Building 100. AFFF was used for approximately 20 seconds during emergency response efforts. The fire truck was parked west of the car fire, adjacent to a grass curb feature. AFFF overspray likely occurred in the grass curb feature. The parking lot consists of multiple parking areas at different elevations that slope toward Santos Dumont Avenue. Surface runoff in the area where the car fire occurred flows to a lower-level parking area via storm drains that pass through a concrete curb, then to Santos Dumont Avenue via storm drains that pass through a sidewalk abutting the street, and to a storm sewer inlet located at the intersection of Santos Dumont Avenue and Whiteman Road. However, due to the limited amount of AFFF used during emergency response efforts, it is unlikely that AFFF would have reached far beyond the immediate vicinity of the car fire to the storm drain west of the AOPI.

5.2.4 Runway AFFF Training Area

The Runway AFFF Training Area is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to use of known/suspected PFAS containing material at this location (**Figure 5-6**).

The AOPI is a grassy area that abuts the west end of the WAAF runway. In 1989, personnel observed a training session where AFFF was sprayed approximately 100 feet from the runway's edge. The Federal Fire Department has also been observed spraying what appeared to be water in that area multiple times. Therefore, it is possible that AFFF training could have occurred in the area more than once.

5.2.5 Helicopter Crash

The Helicopter Crash is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to use of a known/suspected PFAS containing material at this location (**Figure 5-7**).

In May 2009, a helicopter crashed on the east side of the WAAF runway. Initial emergency response efforts included the use of dry chemicals. Thereafter, two Federal Fire Department fire trucks discharged a full tank of water mixed with AFFF concentrate (1,500 gallons each). At the time of the crash, the asphalt runway was cracked; however, it has since been repaved. Surface runoff from the runway flows to a trench-drain on the north side of the runway and/or to a grassy swale on the south side of the runway. The trench-drain spans the length of the runway and likely discharges to a vegetated area more than 5,000 feet southwest of the crash site; however, stormwater sewer conveyance information (e.g., stormwater sewer route and discharge location) for the trench-drain was not provided in readily available documents reviewed. Aerial images indicate the grassy area south of the crash site has been regraded since 2009; however, the grassy area along the edge of the runway appears to have remained undisturbed.

5.2.6 Wheeler Gulch

The Wheeler Gulch is identified as an AOPI following records research, personnel interviews, and site reconnaissance due to disposal of multiple known/suspected PFAS-containing materials at this location (**Figure 5-8**).

On multiple occasions (likely since the late 1960s), the AOPI was used as a place to flush fire truck systems, clear nozzles, practice/train, and test AFFF. Whereas the gulch itself is steep and heavily vegetated, land near the adjacent roadways, Denny Road to the north and Welch Road to the south, are relatively flat and covered in soil and/or grass. AFFF would have been sprayed from the roadway into the gulch. Surface runoff at the AOPI flows toward the gulch, which is transected by Waikele Stream. The stream is not visible from the roadway due to the heavy vegetation and steepness of the gulch; therefore, the condition of the stream (e.g., the presence of water at any given time) was not determined at the time of the PA site visit.

The following MMRP sites were identified at or near AOPI Wheeler Gulch: Gulch Runway Dump (DP02/HQAES-ID 2221A.1038) located approximately 1,000 feet east of the AOPI, Small Arms Range 1 (WAAF-001-R-01/HQAES-ID 2221A.1017) overlapping with the northern portion of the AOPI, and Archery Range North (WAAF-005-R-01/HQAES-ID 2221A.1021) located adjacent to the southern AOPI boundary. Contaminated soil was removed to the extent necessary to meet cleanup criteria at Gulch Runway Dump (DP02/HQAES-ID 2221A.1038). No further action was recommended for both munitions and explosives of concern and munitions constituents at Small Arms Range 1 (WAAF-001-R-01/HQAES-ID 2221A.1017). Land use controls are in place at Archery Range North (WAAF-005-R-01/HQAES-ID 2221A.1021) including, but not limited to, coordination and approval requirements for intrusive activities (i.e., residual lead impacts and munitions debris could potentially be encountered). Given that MMRP sites were identified at or near Wheeler Gulch, the possibility exists for munitions and explosives of concern to be present within the AOPI.

5.2.7 Building 251: Civil Air Patrol Hangar

Although the Building 251: Civil Air Patrol Hangar was not initially identified as an AOPI following records research, personnel interviews, and site reconnaissance, it was identified as an AOPI following the completion of the initial SI sampling due to the presence of a known/suspected PFAS containing material at this location (**Figure 5-9**).

Built to defuel OB-10s (small twin-engine Air Force aircraft). The hangar was constructed with a sprinkler and foam fire-suppression system (with 400-gallon fluoro-protein foam storage tank). The hangar was never used for its intended purpose and was transferred to the Civil Air Patrol upon completion. Airfield staff believe the foam (Aer-O-Foam XL-3%) component of the fire-suppression system was deactivated sometime prior to or when the Civil Air Patrol moved into the hangar sometime between 1994 and 1997. DPW confirmed that the fire-suppression system, including the pumps, are “old and unused” and the conveyance piping is disconnected. There is no indication the foam system has ever been deployed and there have been no known leaks. The foam tank was found to contain an unidentifiable black liquid substance during the PA site visit. This substance may be expired foam concentrate from when the system was installed. This area likely drains through a trench drain to Wheeler Gulch and eventually to the West Loch of Pearl Harbor.

6 SUMMARY OF SI ACTIVITIES

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

The SI field work was completed in accordance with the standard operating procedures, technical guidance instructions (TGIs), sampling design, and QA/QC requirements as detailed in the QAPP Addendum (Arcadis 2022) and PQAPP (Arcadis 2019). The subsections below summarize the DQOs, sampling design and rationale, sampling activities and methods, and data analyses procedures for the SI phase at WAAF. Non-conformances to the prescribed procedures in the PQAPP and QAPP Addendum are described in **Section 6.3.4**. Analytical results obtained through SI field activities are summarized in **Section 7**.

6.1 Data Quality Objectives

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

6.2 Sampling Design and Rationale

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

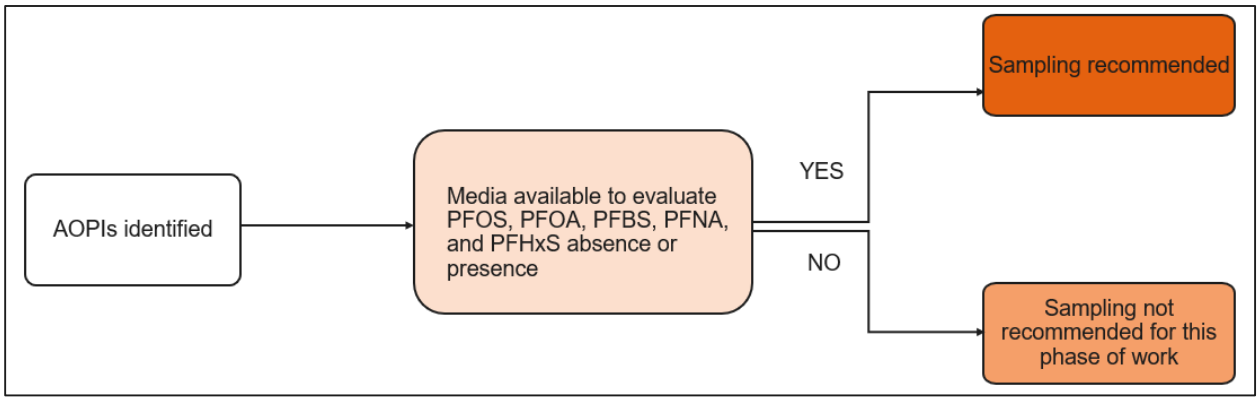


Figure 6-1: AOPI Sampling Decision Tree

The sampling design for SI sampling activities at WAAF is detailed in Worksheet #17 of the QAPP Addendum (Arcadis 2022). Briefly, soil and/or groundwater samples were collected at locations of known or suspected use, storage, and/or disposal of PFAS-containing materials, locations of surface runoff collection, and downgradient locations if exact use, storage, or disposal locations are unknown. Sample locations were selected based on site-specific historical evidence and surface runoff / surface conditions observed in the field at each sampled AOPI. Sample media types collected for each AOPI were based on media most likely to confirm the presence or absence of PFOS, PFOA, PFBS, PFNA, and PFHxS.

Soil samples were collected from six of the seven AOPIs to assess the presence of PFOS, PFOA, PFBS, PFNA, and PFHxS. Soil samples were not collected from the Building 251: Civil Air Patrol Hangar AOPI because this location was identified as an AOPI after the initial SI sampling was completed. The focus of the soil sampling at the AOPIs was the upper 2 feet of native soil. One soil sample per AOPI was also analyzed for total organic carbon (TOC), pH, and grain size. These data are collected as they may be useful in future fate and transport studies. The targeted soil sampling areas at each AOPI are believed to have the potential for the greatest PFAS (including PFOS, PFOA, PFBS, PFNA, and PFHxS) concentrations closest to known or suspected use, storage, and/or disposal of PFAS-containing materials.

Groundwater sampling was not included as part of the sampling design for five of the AOPIs (Fire Truck Water Tank Drainage Area, Building 100: Car Fire, Runway AFFF Training Area, Helicopter Crash, and Wheeler Gulch) due to the significant depth-to-groundwater (i.e., approximately 600 feet bgs) on the north side of WAAF. Only one groundwater sample was collected from existing monitoring well 3-2902-003 (MW2-3) approximately equidistant from the Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar AOPIs, located on the east side of WAAF with an approximate depth to groundwater of 560 feet bgs. The sampling depth at well MW2-3 was from approximately the center of the saturated screened interval at 620 feet bgs. **Table 6-1** attached to the end of this report includes the monitoring well construction details for MW2-3.

Although there is an existing monitoring well southwest of Wheeler Gulch AOPI, heavy irrigation of the adjacent farmland likely creates a localized northeast hydraulic gradient in the area (i.e., the well is likely up-gradient of the AOPI); therefore, a sample was not proposed to be collected from this existing monitoring well. Additionally, although stormwater sewer conveyances near the AOPIs likely discharge to

areas that drain towards Waikele Stream, media within the stream are likely impacted by other upgradient conditions (e.g., activities originating in the surrounding area), not necessarily by the AOPIs. Therefore, instead of collecting surface water and co-located sediment samples that could potentially be influenced by upgradient conditions, soil and/or groundwater samples were collected directly from the AOPIs to more accurately evaluate PFOS, PFOA, PFBS, PFNA, and PFHxS presence (i.e., PFAS associated with each respective AOPI).

6.3 Sampling Methods and Procedures

Environmental data were collected and analyzed in accordance with the PQAPP (Arcadis 2019), the standard operating procedures 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 20222), and the safety procedures specified in the Accident Prevention Plan (Arcadis 2018) and SSHP (Arcadis 2022). The sampling methods described in the standard operating procedures 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 cross-contamination does not occur during collection, and transport. In general, sampling techniques used in the SI were consistent with conventional sampling techniques used in the environmental industry, but special considerations were made regarding PFAS-containing materials and equipment and cross-contamination potential.

The sampling methods employed during the SI are detailed in the PQAPP (Arcadis 2019) and QAPP Addendum (Arcadis 2022). The subsections below provide a summary of the field methods and procedures utilized to complete the SI scope of work. Field notes and field forms (i.e., soil boring logs, groundwater purging logs, water quality meter calibration log, utility and structures checklist, and tailgate health and safety forms) documenting the SI sampling activities are included in **Appendices I** and **J**, respectively. Photographs of the sampling activities are included in **Appendix K**.

6.3.1 Field Methods

Composite soil samples were collected from 0 to 2 feet bgs using a 3.25-inch diameter nickel plated alloy steel hand auger. Most of the samples were homogenized over the entirety of the top 2-foot interval. However, in some instances, samples were collected from a shallower soil interval (e.g., 0 to 0.5, 0 to 1 feet bgs) due to encountering refusal or difficult auger conditions. In general, sampling points were positioned in the center, downgradient, and/or cross gradient of the suspected release area. Soil collected with the hand auger and trowel was transferred to a stainless-steel bowl where it was mixed for homogenization. A portion of the homogenized soil was then placed in the sample container and packed with ice in a cooler to meet the preservation temperature requirements. Nitrile gloves and sleeves made of un-coated flash spun high density polyethylene fibers were worn during sample collection to prevent PFAS contamination. Soil lithological descriptions were continuously logged and documented on field forms and coordinates for each sampling location were recorded using a handheld global positioning system.

The groundwater sample was collected from existing monitoring well 3-2902-003 (MW2-3) at the Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar AOPIs. Groundwater was purged until water quality meter parameters stabilized using a dedicated pump installed on 12 May 1995

approximately at the center of the saturated screened interval. Although a low-flow sampling method was not possible when using the dedicated pump, PFAS sampling precautions were followed. Following the well purge, the groundwater sample was collected. Any known PFAS-containing components at the well head, including the polyvinyl chloride adapter pipe used to redirect groundwater flow for purging and sampling, were replaced with PFAS-free components. Groundwater samples were packed with ice in a cooler to meet the preservation temperature requirements.

Decontamination procedures for non-dedicated equipment used during sampling are described in **Section 6.3.5**.

6.3.2 Quality Assurance/Quality Control

Worksheet #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 during decontamination activities, and field blanks for laboratory-supplied water used in the final decontamination step.

QA/QC samples were collected at the frequencies specified in the QAPP Addendum (Arcadis 2022), typically at a rate of 1 per 20 parent samples. One field duplicate, one matrix spike, and one matrix spike duplicate sample were collected for media sampled for PFOS, PFOA, PFBS, PFNA, and PFHxS only. Two EBs were collected for media sampled for PFOS, PFOA, PFBS, PFNA, and PFHxS, for each piece of relevant equipment (hand auger and stainless steel bowl) for each sampling event, as specified in the QAPP Addendum (Arcadis 2022). The decontaminated reusable equipment from which EBs were collected include the hand auger, stainless-steel bowl, and polyvinyl chloride adapter pipe as applicable to the sampled media. Analytical results for blank samples are discussed in **Section 7.10**.

6.3.3 Dedicated Equipment Background

One dedicated equipment background (DEB) sample was collected from existing monitoring well 3-2902-003 (MW2-3) at the Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar AOPIs. This well has dedicated, down-hole equipment, and it is undetermined from readily available documents if the equipment has PFAS-containing components. The DEB was collected from the well when water was first produced during the initial purging of the equipment (i.e., before one equipment [pump and tubing] volume had been purged). PFOS, PFOA, PFBS, PFNA, and/or PFHxS concentrations in the DEBs reflect concentrations of stagnant groundwater, and they may be biased high by contributions from equipment that contains PFOS, PFOA, PFBS, PFNA, and/or PFHxS. The parent sample was collected after the well was purged and three rounds of field parameters were collected.

The DEB is not collected like an EB and therefore is not used to qualify data during the data validation process. However, DEB results (discussed in **Section 7.8**) may be used in a weight-of-evidence discussion regarding data conclusions.

6.3.4 Field Change Reports

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

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

- FCR-WAAF-01: At the Wheeler Gulch AOPI, samples WAAF-WG-1-SO and WAAF-WG-4-SO were moved approximately 10 feet southwest of the originally planned boring locations into the vegetation. Sample WAAF-WG-2-SO was moved approximately 20 feet southwest of the originally planned boring location into the vegetation. These samples were moved due to asphalt obstructions that were encountered at less than 1-inch bgs; therefore, there was insufficient soil volume for sample collection at the original boring locations. Additionally, samples for grain size, pH, and TOC analyses were collected from location WAAF-WG-3-SO instead of WAAF-WG-1-SO due to insufficient soil volume at WAAF-WG-1-SO.
- FCR-WAAF-02: At the Helicopter Crash AOPI, the WAAF-HC-3-SO soil boring was re-located approximately 20 feet south of the original boring location. Asphalt was encountered at 2 inches bgs at the original boring location; therefore, there was insufficient soil volume for sample collection.

6.3.5 Decontamination

Non-dedicated reusable sampling equipment (e.g., hand auger, stainless-steel bowl, polyvinyl chloride pipes/connectors, water quality meter, and water-level meter) that came into direct contact with sampling media was decontaminated before first use, between sampling locations/intervals, and before demobilization in accordance with P-09, TGI - Groundwater and Soil Sampling Equipment Decontamination (Arcadis 2019, Appendix A).

6.3.6 Investigation-Derived Waste

Investigation-derived waste (IDW) generated during the SI included soil cuttings and decontamination fluids. In accordance with the PQAPP, the soil cuttings were backfilled in the original soil boring location and the decontamination fluids were disposed on the ground at the point of sample collection. Disposable equipment IDW that was in contact with sampling media (e.g., nitrile gloves, paper towels, garbage bags, and sleeves made of un-coated flash spun high density polyethylene fibers) was collected in bags and disposed in municipal waste receptacles.

6.4 Data Analysis

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

6.4.1 Laboratory Analytical Methods

Analytical samples collected during the SI were submitted to Eurofins Lancaster Laboratories Environmental, an Environmental Laboratory Accreditation Program-accredited laboratory for PFAS analysis, including PFOS, PFOA, PFBS, PFNA, and PFHxS, by liquid chromatography with tandem mass

spectrometry using USEPA Method 537 (Modified). Laboratory analyses associated with the SI were completed in accordance with Worksheets #12.1 through #12.5 in the PQAPP (Arcadis 2019). Eighteen PFAS-related compounds, including PFOS, PFOA, PFBS, PFNA, and PFHxS, were analyzed for in groundwater and soil samples using an analytical method that is Environmental Laboratory Accreditation Program-accredited and compliant with QSM 5.3 (DoD and Department of Energy 2019), Table B-15. The soil samples were packed with ice in a cooler to meet preservation temperature requirements to cool samples to less than 6 degrees Celsius, and to prevent sample temperatures from exceeding 10 degrees Celsius during the first 48 hours after collection. The hold times for the samples were 14 days for preparation and 28 days after extraction for analysis.

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

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

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

The laboratory limit of detection (LOD) is defined as “the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific matrix with a specific method at 99 percent confidence” (DoD 2017). The lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias is known as the limit of quantitation (LOQ; DoD 2017). Concentrations detected between the laboratory 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 laboratory limits of detection 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 data, were verified and validated in accordance with the data verification procedures described in Worksheets #34 through #36 of the PQAPP (Arcadis 2019). Each laboratory data package/sample delivery group underwent Stage 3 data validation in accordance with DoD QSM 5.3 (DoD and Department of Energy 2019). Additionally, 10% of the data underwent Stage 4 data validation. Copies of the data validation reports for each sample delivery group are included as attachments to the DUSR in **Appendix M**. The Level IV analytical reports are included within **Appendix M** in the final electronic deliverable only.

6.4.3 Data Usability Assessment and Summary

A data usability assessment was completed for all analytical data associated with SI sampling at WAAF. 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 WAAF 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 WAAF QAPP Addendum (Arcadis 2022). Data qualifiers applied to laboratory analytical results for samples collected during the SI at WAAF are provided in the data tables, data validation reports, and the Data Usability Summary Table located at the end of DUSR. Qualifiers for data shown on figures are defined in the notes of figures.

6.5 Office of the Secretary of Defense Risk Screening Levels

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

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

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

Notes:
1. Risk screening levels for tap water and soil provided by the OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July 06 (**Appendix A**).
2. All soil data will be screened against both the Residential Scenario and Industrial/Commercial risk screening levels (if collected from less than 2 feet bgs), regardless of the current and projected land use of the AOPI.
3. Of the six PFAS compounds presented in the 06 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the CSM developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at WAAF because HFPO-DA is generally not a component of MIL-SPEC AFFF and based

on its history including distribution limitations that restricted use of HFPO-DA, it is generally not a component of other products the military used. In addition, it is unlikely that HFPO-DA would be an individual chemical of concern in the absence of other PFAS.
mg/kg = milligram per kilogram
ng/L = nanograms per liter
ppm = parts per million
ppt = parts per trillion

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

7 SUMMARY AND DISCUSSION OF SI RESULTS

This section summarizes the analytical results obtained from samples collected during the SI at WAAF (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 2022). The sample results discussion below focuses on the PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results because they have OSD risk screening levels. The Army will make subsequent investigation decisions based on these constituents' concentrations relative to the OSD risk screening levels.

Tables 7-1 and **7-2** attached to the end of the report provides a summary of the groundwater and soil analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS. **Table 7-3** summarizes AOPIs and whether their SI results exceed the OSD risk screening levels. **Appendix N** includes the full suite of analytical results for these media, as well as for the QA/QC samples. An overview of AOPIs at WAAF with OSD risk screening level exceedances is depicted on **Figure 7-1**. **Figures 7-2** through **7-7** show the PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results in groundwater and soil for each AOPI. Non-detected results are reported as less than the LOQ. Detections of PFOS, PFOA, PFBS, PFNA, and/or PFHxS greater than the applicable OSD risk screening levels are highlighted in summary tables and on figures. Final qualifiers applied to the data by the laboratory and the project chemist (as defined in **Section 6.4.3**) are presented on the analytical tables. Groundwater data collected during the SI are reported in ng/L, or ppt, and soil data are reported in mg/kg, or ppm.

Field parameters measured for groundwater during purging are provided on the field forms in **Appendix J**. Groundwater was first encountered at 557.97 feet below top of sounding tube during groundwater sampling at monitoring well MW2-3. In general, depth-to-groundwater ranges from approximately 600 feet bgs on the north side of WAAF to approximately 845 feet bgs on the south side of WAAF (CH2M Hill 2011). Soil descriptions are provided on the field forms in **Appendix J**. The results of the SI are grouped by AOPI and discussed for each medium as applicable.

Soil samples were not collected from the Building 251: Civil Air Patrol Hangar AOPI because this location was not recognized as an AOPI until after the initial SI sampling was completed. Groundwater sampling only took place at the Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar AOPIs, where there was an existing monitoring well present, due to the significant depth-to groundwater (i.e., approximately 600 feet bgs) on the northside of WAAF. Additionally, the existing monitoring well southwest of the Wheeler Gulch AOPI is influenced by heavy irrigation from the adjacent farmland likely resulting in a localized northeast hydraulic gradient in the area (i.e., groundwater likely flows from the well toward the AOPI); therefore, if PFAS (including PFOS, PFOA, and PFBS) were present in groundwater, it would likely not migrate from the AOPI toward the well (**Figure 5-8**).

Additionally, although stormwater sewer conveyances near the AOPIs likely discharge to areas that drain towards Waikele Stream, media within the stream are likely impacted by other upgradient conditions (e.g., activities originating in the surrounding area), not necessarily by the AOPIs. Therefore, instead of collecting surface water and co-located sediment samples that could potentially be influenced by upgradient conditions, soil and/or groundwater samples were collected from the AOPIs to more accurately evaluate PFOS, PFOA, and PFBS presence (i.e., PFAS associated with each respective AOPI).

Additionally, given that off-installation media would likely be impacted by activities/sources originating from the surrounding community (i.e., not necessarily by the AOPIs) and because sampling of on-installation media would most accurately evaluate PFAS presence (including PFOS, PFOA, and PFBS) associated with each AOPI, sampling of off-installation media was not included as part of the current sampling design.

Table 7-3 AOPIs and OSD Risk Screening Level Exceedances

AOPI Name	OSD Exceedances (Yes/No)
Building 200: Fire Station #14	Yes
Fire Truck Water Tank Drainage Area	No
Building 100: Car Fire	No
Runway AFFF Training Area	No
Helicopter Crash	Yes
Wheeler Gulch	Yes
Building 251: Civil Air Patrol Hangar	Yes

7.1 Building 200: Fire Station #14

The groundwater subsection below summarizes the groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 200: Fire Station #14. Please note that the groundwater results listed in Section 7.1.1 are the same as the groundwater results listed in Section 7.2.1 associated with Building 251: Civil Air Patrol Hangar. The soil subsection summarizes the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 200: Fire Station #14.

7.1.1 Groundwater

One grab groundwater sample (WAAF-MW2-3-102022) and a duplicate sample were collected from an existing monitoring well (MW2-3) located southwest and cross gradient of the AOPI following purging with a portable submersible pump (**Figure 7-2**, **Table 7-1)**. The depth to static groundwater was 557.97 feet below top of sounding tube (**Appendix J**). Analytical results are as follows (duplicate results are shown in brackets):

- PFOS was detected in the groundwater sample at a concentration of 48 J- (estimated quantity; may be biased low) [49 J-] ng/L. The detected concentration exceeds the OSD tap water risk screening level (4 ng/L).
- PFOA was detected in the groundwater sample at a concentration of 44 J- [43 J-] ng/L. The detected concentration exceeds the OSD tap water risk screening level (6 ng/L).
- PFBS was detected in the groundwater sample at a concentration of 7.9 J- [7.1 J-] ng/L. The detected concentration does not exceed the OSD tap water risk screening level (601 ng/L).
- PFNA was not detected in the groundwater sample. Therefore, there were no exceedances of the OSD tap water risk screening level (6 ng/L).

- PFHxS was detected in the groundwater sample at a concentration of 73 J- [73 J-] ng/L. The detected concentration exceeds the OSD tap water risk screening level (39 ng/L).

7.1.2 Soil

Five surface soil samples were collected via hand auger at the Building 200: Fire Station #14 AOPI on 18 October 2022 (**Figure 7-2**, **Table 7-2**) Soil samples WAAF-FS14-1-SO-101822 (0 to 2 feet bgs), WAAF-FS14-2-SO-101822 (0 to 2 feet bgs), WAAF-FS14-3-SO-101822 (0 to 2 feet bgs), WAAF-FS14-4-SO-101822 (0 to 2 feet bgs), and WAAF-FS14-5-SO-101822 (0 to 2 feet bgs) were located to the west, northwest, north, southeast, and south of the fire station building, respectively. A duplicate soil sample was collected at location WAAF-FS14-4-SO-101822. Analytical results are as follows (duplicate results are shown in brackets):

- PFOS was detected in samples WAAF-FS14-1-SO-101822, WAAF-FS14-2-SO-101822, WAAF-FS14-3-SO-101822, WAAF-FS14-4-SO-101822, and WAAF-FS14-5-SO-101822 at concentrations of 0.045 mg/kg, 0.016 mg/kg, 0.2 mg/kg, 0.29 [0.41] mg/kg, and 0.28 mg/kg, respectively. All the detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg), but only the detected concentrations at WAAF-FS14-3-SO-101822, WAAF-FS14-4-SO-101822, and WAAF-FS14-5-SO-101822 exceed the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in samples WAAF-FS14-1-SO-101822, WAAF-FS14-2-SO-101822, WAAF-FS14-3-SO-101822, WAAF-FS14-4-SO-101822, and WAAF-FS14-5-SO-101822 at concentrations of 0.0078 mg/kg, 0.00053 mg/kg, 0.0050 mg/kg, 0.0089 J+ (estimated quantity; may be biased high) [0.0084] mg/kg, and 0.0086 mg/kg, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was detected in samples WAAF-FS14-1-SO-101822, WAAF-FS14-3-SO-101822, WAAF-FS14-4-SO-101822, and WAAF-FS14-5-SO-101822 at concentrations of 0.000089 J (estimated quantity) mg/kg, 0.00071 mg/kg, 0.0026 [0.0025] mg/kg, 0.00039 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in samples WAAF-FS14-1-SO-101822, WAAF-FS14-2-SO-101822, WAAF-FS14-3-SO-101822, WAAF-FS14-4-SO-101822, and WAAF-FS14-5-SO-101822 at concentrations of 0.015 mg/kg, 0.00087 mg/kg, 0.01 mg/kg, 0.0089 J+ [0.0088] mg/kg, and 0.012 J+ mg/kg, respectively. The detected concentrations do not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in samples WAAF-FS14-1-SO-101822, WAAF-FS14-2-SO-101822, WAAF-FS14-3-SO-101822, WAAF-FS14-4-SO-101822, and WAAF-FS14-5-SO-101822 at concentrations of 0.00096 mg/kg, 0.00066 mg/kg, 0.037 mg/kg, 0.032 [0.032] mg/kg, and 0.012 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.2 Building 251: Civil Air Patrol Hangar

The groundwater subsection below summarizes the groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 251: Civil Air Patrol Hangar. Please note that the groundwater results listed in Section 7.2.1 are the same as the groundwater results listed in Section 7.1.1 associated with Building 200: Fire Station #14.

7.2.1 Groundwater

One grab groundwater sample (WAAF-MW2-3-102022) and a duplicate sample were collected from an existing monitoring well (MW2-3) located northwest and cross gradient of the AOPI following purging with a portable submersible pump (**Figure 7-2**, **Table 7-1**). The depth to static groundwater was 557.97 feet below top of sounding tube (**Appendix J**). Analytical results are as follows (duplicate results are shown in brackets):

- PFOS was detected in the groundwater sample at a concentration of 48 J- (estimated quantity; may be biased low) [49 J-] ng/L. The detected concentration exceeds the OSD tap water risk screening level (4 ng/L).
- PFOA was detected in the groundwater sample at a concentration of 44 J- [43 J-] ng/L. The detected concentration exceeds the OSD tap water risk screening level (6 ng/L).
- PFBS was detected in the groundwater sample at a concentration of 7.9 J- [7.1 J-] ng/L. The detected concentration does not exceed the OSD tap water risk screening level (601 ng/L).
- PFNA was not detected in the groundwater sample. Therefore, there were no exceedances of the OSD tap water risk screening level (6 ng/L).
- PFHxS was detected in the groundwater sample at a concentration of 73 J- [73 J-] ng/L. The detected concentration exceeds the OSD tap water risk screening level (39 ng/L).

7.3 Fire Truck Water Tank Drainage Area

The subsections below summarize the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Fire Truck Water Tank Drainage Area.

7.3.1 Soil

Four surface soil samples were collected via hand auger at the Fire Truck Water Tank Drainage Area AOPI on 17 and 18 October 2022 (**Figure 7-3** and **Table 7-2**). Soil samples WAAF-FTDA-1-SO-101722 (0 to 1.4 feet bgs), WAAF-FTDA-2-SO-101722 (0 to 0.67 feet bgs), and WAAF-FTDA-3-SO-101822 (0 to 2 feet bgs) were located in the grass near the center of the AOPI, and WAAF-FTDA-4-SO-101822 (0 to 2 feet bgs) was located in the grass directly adjacent to the curb at the intersection of Elleman Road and Strieber Ave. A duplicate soil sample was collected at location WAAF-FTDA-3-SO-101822. Analytical results are as follows (duplicate results are shown in brackets):

- PFOS was detected in samples WAAF-FTDA-1-SO-101722, WAAF-FTDA-2-SO-101722, WAAF-FTDA-3-SO-101822, and WAAF-FTDA-4-SO-101822 at concentrations of 0.0046 mg/kg, 0.0015 mg/kg, 0.00055 J [0.0097 J+] mg/kg, and 0.0014 mg/kg, respectively. None of the detected

concentrations exceed the OSD residential risk screening level (0.013 mg/kg) or the OSD industrial/commercial risk screening level (0.16 mg/kg).

- PFOA was detected in samples WAAF-FTDA-1-SO-101722, WAAF-FTDA-2-SO-101722, WAAF-FTDA-3-SO-101822, and WAAF-FTDA-4-SO-101822 at concentrations of 0.00049 mg/kg, 0.000098 J mg/kg, 0.00071 [0.00042 J+] mg/kg, and 0.00059 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was detected in samples WAAF-FTDA-2-SO-101722 and WAAF-FTDA-3-SO-101822 (duplicate sample) at concentrations of 0.000039 J mg/kg and 0.00012 U (not detected above the LOQ) [0.000091 J+] mg/kg, respectively. The detected concentrations do not exceed the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in samples WAAF-FTDA-1-SO-101722, WAAF-FTDA-2-SO-101722, WAAF-FTDA-3-SO-101822, and WAAF-FTDA-4-SO-101822 at concentrations of 0.00053 mg/kg, 0.00012 J mg/kg, 0.00016 J+ [0.00023 J+] mg/kg, and 0.0001 J mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in samples WAAF-FTDA-1-SO-101722, WAAF-FTDA-2-SO-101722, WAAF-FTDA-3-SO-101822, and WAAF-FTDA-4-SO-101822 at concentrations of 0.00011 J mg/kg, 0.0001 J mg/kg, 0.00018 J [0.00095 J+] mg/kg, and 0.00027 mg/kg. None of the detected concentrations exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.4 Building 100: Car Fire

The subsections below summarize the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Building 100: Car Fire.

7.4.1 Soil

Two surface soil samples were collected via hand auger at the Building 100: Car Fire AOPI on 17 October 2022 (**Figure 7-4** and **Table 7-2**). Soil sample WAAF-CF-1-SO-101722 (0 to 2 feet bgs) was located approximately 30 feet west of the AOPI boundary in a grassy area. WAAF-CF-2-SO-101722 (0 to 2 feet bgs) was located in the middle of an asphalt parking space within the AOPI boundary. Analytical results are as follows:

- PFOS was detected in samples WAAF-CF-1-SO-101722 and WAAF-CF-2-SO-101722 at concentrations of 0.0024 mg/kg and 0.00019 J mg/kg, respectively. Neither of the detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg) or the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in samples WAAF-CF-1-SO-101722 and WAAF-CF-2-SO-101722 at concentrations of 0.00072 mg/kg and 0.00013 J mg/kg, respectively. Neither of the detected

concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).

- PFBS was not detected in either of the soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in sample WAAF-CF-1-SO-101722 at a concentration of 0.00014 J mg/kg. The detected concentration does not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in samples WAAF-CF-1-SO-101722 and WAAF-CF-2-SO-101722 at concentrations of 0.000043 J mg/kg and 0.000046 J mg/kg. Neither of the detected concentrations exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.5 Runway AFFF Training Area

The subsections below summarize the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Runway AFFF Training Area.

7.5.1 Soil

Four surface soil samples were collected via hand auger at the Runway AFFF Training Area AOPI on 21 October 2022 (**Figure 7-5** and **Table 7-2**). Soil samples WAAF-RAFFFTA-1-SO-102122 (0 to 1.4 feet bgs), WAAF-RAFFFTA-2-SO-102122 (0 to 1.2 feet bgs), WAAF-RAFFFTA-3-SO-102122 (0 to 1 foot bgs), and WAAF-RAFFFTA-4-SO-102122 (0 to 1.5 feet bgs) were located in the grass parallel to the west end of the runway. Analytical results are as follows:

- PFOS was detected in samples WAAF-RAFFFTA-1-SO-102122, WAAF-RAFFFTA-2-SO-102122, WAAF-RAFFFTA-3-SO-102122, and WAAF-RAFFFTA-4-SO-102122 at concentrations of 0.0033 mg/kg, 0.0067, mg/kg, 0.001 mg/kg, and 0.0014 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.013 mg/kg) or the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in samples WAAF-RAFFFTA-1-SO-102122, WAAF-RAFFFTA-2-SO-102122, WAAF-RAFFFTA-3-SO-102122, and WAAF-RAFFFTA-4-SO-102122 at concentrations of 0.0004 mg/kg, 0.00016 J mg/kg, 0.00018 J mg/kg, and 0.00023 J mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was not detected in any of the soil samples. Therefore, there were no exceedances of the OSD residential risk screening level (1.9 mg/kg) or the OSD industrial/commercial risk screening level (25 mg/kg).
- PFNA was detected in samples WAAF-RAFFFTA-1-SO-102122, WAAF-RAFFFTA-2-SO-102122, WAAF-RAFFFTA-3-SO-102122, and WAAF-RAFFFTA-4-SO-102122 at concentrations of 0.00033 mg/kg, 0.000094 J mg/kg, 0.0001 J mg/kg, and 0.00013 J mg/kg, respectively. None of the detected

concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).

- PFHxS was detected in samples WAAF-RAFFFTA-1-SO-102122, WAAF-RAFFFTA-2-SO-102122, WAAF-RAFFFTA-3-SO-102122, and WAAF-RAFFFTA-4-SO-102122 at concentrations of 0.00015 J mg/kg, 0.00006 J mg/kg, 0.000097 J mg/kg, and 0.0001 J mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.6 Helicopter Crash

The subsections below summarize the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Helicopter Crash.

7.6.1 Soil

Four surface soil samples were collected via hand auger at the Helicopter Crash AOPI on 21 October 2022 (**Figure 7-6** and **Table 7-2**). Soil samples WAAF-HC-1-SO-102122 (0-2 feet bgs), WAAF-HC-2-SO-102122 (0-2 feet bgs), WAAF-HC-3-SO-102122 (0-0.83 feet bgs), and WAAF-HC-4-SO-102122 (0-2 feet bgs) were located in the grass parallel and adjacent to the runway. Analytical results are as follows:

- PFOS was detected in samples WAAF-HC-1-SO-102122, WAAF-HC-2-SO-102122, WAAF-HC-3-SO-102122, and WAAF-HC-4-SO-102122 at concentrations of 0.0011 mg/kg, 0.00044 mg/kg, 0.055 mg/kg, and 0.0017 mg/kg, respectively. One of the four detected concentrations (WAAF-HC-3-SO) exceeds the OSD residential risk screening level (0.013 mg/kg) but not the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in samples WAAF-HC-1-SO-102122, WAAF-HC-2-SO-102122, WAAF-HC-3-SO-102122, and WAAF-HC-4-SO-102122 at concentrations of 0.0003 J mg/kg, 0.00013 J mg/kg, 0.00099 mg/kg, and 0.00059 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was detected in sample WAAF-HC-3-SO-102122 at a concentration of 0.000041 J mg/kg. The detected concentration does not exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFNA was detected in samples WAAF-HC-1-SO-102122, WAAF-HC-2-SO-102122, WAAF-HC-3-SO-102122, and WAAF-HC-4-SO-102122 at concentrations of 0.00019 J mg/kg, 0.000071 J mg/kg, 0.0015 mg/kg, and 0.00037 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in samples WAAF-HC-2-SO-102122, WAAF-HC-3-SO-102122, and WAAF-HC-4-SO-102122 at concentrations of 0.000074 J mg/kg, 0.00031 mg/kg, and 0.000057 J mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.7 Wheeler Gulch

The subsections below summarize the soil PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results associated with Wheeler Gulch.

7.7.1 Soil

Six surface soil samples were collected via hand auger at the Wheeler Gulch AOPI on 19 October 2022 (**Figure 7-7** and **Table 7-2**). Soil samples WAAF-WG-3-SO-101922 (0 to 2 feet bgs), WAAF-WG-5-SO-101922 (0 to 0.5 foot bgs), and WAAF-WG-6-SO-101922 (0 to 0.25 foot bgs) were located in the grass and directly adjacent to the densely vegetated area. WAAF-WG-1-SO-101922 (0 to 0.17 foot bgs), WAAF-WG-2-SO-101922 (0 to 0.83 foot bgs), and WAAF-WG-4-SO-101922 (0-0.042 foot bgs) were located approximately 20 feet into the densely vegetated area. Analytical results are as follows:

- PFOS was detected in samples WAAF-WG-1-SO-101922, WAAF-WG-2-SO-101922, WAAF-WG-3-SO-101922, WAAF-WG-4-SO-101922, WAAF-WG-5-SO-101922, and WAAF-WG-6-SO-101922 at concentrations of 0.016 mg/kg, 0.008 mg/kg, 0.011 mg/kg, 0.0023 mg/kg, 0.0082 mg/kg, and 0.0034 mg/kg, respectively. One of the six detected concentrations (WAAF-WG-1-SO-101922) exceeds the OSD residential risk screening level (0.013 mg/kg) but not the OSD industrial/commercial risk screening level (0.16 mg/kg).
- PFOA was detected in samples WAAF-WG-1-SO-101922, WAAF-WG-2-SO-101922, WAAF-WG-3-SO-101922, WAAF-WG-4-SO-101922, WAAF-WG-5-SO-101922, and WAAF-WG-6-SO-101922 at concentrations of 0.00063 mg/kg, 0.0003 J mg/kg, 0.00019 J mg/kg, 0.00017 J mg/kg, 0.00044 mg/kg, and 0.0015 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFBS was detected in samples WAAF-WG-1-SO-101922, WAAF-WG-2-SO-101922, and WAAF-WG-6-SO-101922 at concentrations of 0.000098 J mg/kg, 0.000047 J mg/kg, and 0.000046 J mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFNA was detected in samples WAAF-WG-1-SO-101922, WAAF-WG-2-SO-101922, WAAF-WG-3-SO-101922, WAAF-WG-4-SO-101922, WAAF-WG-5-SO-101922, and WAAF-WG-6-SO-101922 at concentrations of 0.00038 mg/kg, 0.0003 mg/kg, 0.00044 mg/kg, 0.0002 mg/kg, 0.00071 mg/kg, and 0.0016 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.019 mg/kg) or the OSD industrial/commercial risk screening level (0.25 mg/kg).
- PFHxS was detected in samples WAAF-WG-1-SO-101922, WAAF-WG-2-SO-101922, WAAF-WG-3-SO-101922, WAAF-WG-4-SO-101922, WAAF-WG-5-SO-101922, and WAAF-WG-6-SO-101922 at concentrations of 0.0013 mg/kg, 0.00063 mg/kg, 0.00013 J mg/kg, 0.000088 J mg/kg, 0.00017 J mg/kg, and 0.00033 mg/kg, respectively. None of the detected concentrations exceed the OSD residential risk screening level (0.13 mg/kg) or the OSD industrial/commercial risk screening level (1.6 mg/kg).

7.8 Dedicated Equipment Background Sample

One DEB was collected from MW2-3 associated with the Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar AOPIs. The WAAF-(MW2-3)-102022 (parent sample) and WAAF-FS14-DEB-1-102022 samples both had detections for PFOS, PFOA, PFBS, and PFHxS (**Appendix N**). As summarized below, no equipment influences on PFOS, PFOA, PFBS, and PFHxS concentrations were observable, as the reported concentrations of these analytes were similar in both the parent and companion DEB samples.

- PFOS was detected at a concentration of 48 J- ng/L in sample WAAF-(MW2-3)-102022 and 46 J- ng/L in sample WAAF-FS14-DEB-1-102022. Both detected concentrations exceed the OSD tap water risk screening level (4 ng/L). The DEB concentration is slightly less than the parent sample concentration, therefore the dedicated, down-hole sampling equipment did not have an impact on the PFOS concentrations in MW2-3.
- PFOA was detected at a concentration of 44 J- ng/L in sample WAAF-(MW2-3)-102022 and 36 J- ng/L in sample WAAF-FS14-DEB-1-102022. Both detected concentrations exceed the OSD tap water risk screening level (6 ng/L). The DEB concentration is slightly less than the parent sample concentration, therefore the dedicated, down-hole sampling equipment did not have an impact on the PFOA concentrations in MW2-3.
- PFBS was detected at a concentration of 7.9 J- ng/L in sample WAAF-(MW2-3)-102022 and 6.7 J- ng/L in sample WAAF-FS14-DEB-1-102022. Neither of the detected concentrations exceeded the OSD tap water risk screening level (601 ng/L). The DEB concentration is slightly less than the parent sample concentration, therefore the dedicated, down-hole sampling equipment did not have an impact on the PFBS concentrations in MW2-3.
- PFHxS was detected at a concentration of 73 J- ng/L in sample WAAF-(MW2-3)-102022 and 58 J- ng/L in sample WAAF-FS14-DEB-1-102022. Both detected concentrations exceed the OSD tap water risk screening level (39 ng/L). The DEB concentration is slightly less than the parent sample concentration, therefore the dedicated, down-hole sampling equipment did not have an impact on the PFHxS concentrations in MW2-3.

The parent sample and DEB pair had detections for PFOS, PFOA, PFBS, PFNA, and/or PFHxS constituents in both the parent and DEB sample (**Appendix N**). PFOS, PFOA, PFBS, PFNA, and/or PFHxS results between the paired DEB and parent sample had little variation, suggesting minor equipment influence, if any. The one DEB sample pair collected at WAAF suggests that sampling using the dedicated downhole sampling equipment did not bias sample results for PFOS, PFOA, PFBS, PFNA, and/or PFHxS.

7.9 TOC, pH, and Grain Size

In addition to sampling soil for PFOS, PFOA, PFBS, PFNA, PFHxS, and moisture content, one soil sample per each AOPI, except for Building 251: Civil Air Patrol Hangar where soil samples were not collected, was analyzed for TOC, pH, and grain size data as they may be useful in future fate and transport studies. The full analytical results from samples collected during the SI are included in **Appendix N**. The TOC in the soil samples ranged from 7,270 to 24,300 mg/kg with an average of 14,010

mg/kg. The TOC at this installation was, on average, within range of what is typically observed in topsoil (5,000 to 30,000 mg/kg). The combined percentage of fines (i.e., silt and clay) in soils at WAAF ranged from 44.1 to 89.3% with an average of 59.7%. 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 ranged from 5.4 to 25.7% with an average of 15.26% which is typical for clay soils (0 to 20%). The pH of the soil ranged from 7.2 J standard units to 7.5 J standard units with an average of 7.3 standard units which is approximately neutral. Based on these geochemical and physical soil characteristics, PFAS constituents are relatively less mobile in soils with high percentages of fines.

7.10 Blank Samples

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

7.11 Conceptual Site Models

The preliminary human health CSM presented in the QAPP Addendum (Arcadis 2022) was re-evaluated and updated based on the SI sampling results. The human health CSMs presented on **Figure 7-8** and **Figure 7-9** and in this section therefore represent the current understanding of the potential for human exposure. The source media, potential migration pathways and exposure media, and human exposure pathways are congruent for six of the seven AOPIs, therefore only two CSM figures were prepared.

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

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

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

The following exposure pathway determinations apply to both CSM figures:

- The AOPIs are not used for residential or recreational purposes and are wholly located within the installation. Therefore, the soil exposure pathways for on-installation residents and recreational users, and for off-installation receptors are incomplete.
- PFOS, PFOA, PFBS, PFNA, and PFHxS were detected in a groundwater sample collected at the Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar AOPIs. Groundwater samples were not collected at the remaining five AOPIs, but due to detections in soil, it was assumed constituents may be present in deep groundwater there as well. However, the most and the highest detections of PFOS, PFOA, PFBS, PFNA, and PFHxS in soil were observed at the Building 200: Fire Station #14 AOPI, therefore it is likely for deep groundwater concentrations to be lower at the remaining AOPIs. Drinking water at WAAF is obtained from four drinking water wells located on the SCHBR installation (i.e., off the WAAF installation). The direction of groundwater flow beneath the installation is undetermined from readily available documents; however, groundwater in the area generally flows toward the east and south (Oki 1998). In the absence of land use controls or site-specific hydrological conditions that prevent future potable well installations, the groundwater exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are potentially complete to account for the potential future use of on-post groundwater downgradient of the AOPIs.
- Recreational users are not likely to contact groundwater during outdoor recreational activities; therefore, the groundwater exposure pathway for on-installation recreational users is considered to be incomplete.
- Groundwater originating at the AOPIs likely flows off-post through the installation's eastern and southern boundaries. In the absence of land use controls preventing potable use of off-post groundwater, the groundwater exposure pathway for off-installation drinking water receptors is potentially complete.
- Constituents in soil could migrate to surface water via stormwater runoff and/or shallow groundwater discharge. Surface water features at WAAF are not used as drinking water sources. However, on-installation recreational users could potentially contact constituents in surface water features via incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for on-installation recreational users are considered to be potentially complete.
- Off-installation surface water features in proximity to WAAF are likely not used for drinking water. However, off-installation recreational users could potentially contact constituents in off-installation surface water features via incidental ingestion and dermal contact; therefore, the surface water and

sediment exposure pathways for off-installation recreational users are considered to be potentially complete.

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

Figure 7-8 shows the CSM for the Building 200: Fire Station #14, Fire Truck Water Tank Drainage Area, Building 100: Car Fire, Runway AFFF Training Area, Helicopter Crash, and Wheeler Gulch AOPIs. AFFF was historically released to soil and/or paved surfaces at these six AOPIs during fire-fighting operations (i.e., during standard fire station activities, emergency response efforts, fire-fighting training/practice, and/or fire truck system maintenance).

- PFOS, PFOA, PFBS, PFNA, and/or PFHxS were detected in soil, and site workers could contact constituents in soil via incidental ingestion, dermal contact, and inhalation of dust. Therefore, the soil exposure pathway for on-installation site workers is complete.

Figure 7-9 shows the CSM for the Building 251: Civil Air Patrol Hangar AOPI. This hangar was identified as an AOPI due to the presence of a foam fire suppression system. There is no indication the foam system has ever been deployed and there have been no known leaks.

- Soil samples were not collected at this AOPI because this location was not recognized as an AOPI until after the initial SI sampling. If PFOS, PFOA, PFBS, PFNA, and/or PFHxS are present in soil, site workers 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.

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, PFBS, PFNA, and PFHxS to the OSD risk screening levels (**Table 6-2**).

8 CONCLUSIONS AND RECOMMENDATIONS

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

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

Drinking water samples were collected from SCHBR on 19 March and 09 September 2014, and 16 October 2017 for PFAS analysis (including PFOS, PFOA, and PFBS) using USEPA Method 537 (NAVFAC 2014a; NAVFAC 2014b; Army 2017). Based on chain of custody records included with the laboratory reports, the water samples were collected from Building 1575 Post Chlorination. Analytical results for samples collected on 19 March and 09 September 2014 indicate PFBS was not detected above the method reporting limit of 90 ng/L, PFOS was not detected above the method reporting limit of 40 ng/L, and PFOA was not detected above the method reporting limit of 20 ng/L (NAVFAC 2014a; NAVFAC 2014b). Analytical results for the sample collected 16 October 2017 indicate none of the analyzed constituents were detected above the method reporting limit of 2.0 ng/L (Army 2017). The EDR report identified several off-post public and private wells within 5 miles of the installation boundary (**Figure 2-4**). However, army owned-wells/water sources and on-post installation wells/water sources, if present, are not shown or identified on figures in this PA/SI report due to operational security guidance/requirements. As stated in Section 2.7, groundwater flow beneath the installation is undetermined and groundwater flow directions in the region vary. Therefore, it is undetermined whether or not off-post wells in the area surrounding WAAF are hydraulically downgradient of an AOPI. The EDR report providing well search results is provided as **Appendix D**.

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

Six of the seven AOPIs had detections of PFOS, PFOA, PFBS, PFNA, and/or PFHxS in soil. PFOS concentrations exceeded the residential soil OSD risk screening level at three AOPIs and exceeded the industrial/commercial risk screening level at one AOPI. Detections of PFOA, PFBS, PFNA, and PFHxS

did not exceed OSD risk screening levels at any of the AOPIs. The PFOS, PFOA, PFBS, PFNA, and PFHxS analytical results are summarized below:

- PFOS was detected in soil samples collected at six of the seven AOPIs. The PFOS soil residential risk screening level (0.013 mg/kg) was exceeded all five soil samples at the Building 200: Fire Station #14 AOPI, one of the soil samples collected at the Helicopter Crash AOPI, and one the soil samples collected at the Wheeler Gulch AOPI. The PFOS soil industrial/commercial risk screening level (0.16 mg/kg) was exceeded at three of the soil samples collected at the Building 200: Fire Station #14 AOPI. The maximum detected concentration of PFOS was 0.41 mg/kg (Building 200: Fire Station #14 AOPI, WAAF-FS14-4-SO-101822).
- PFOA was detected in soil samples collected at six of the seven AOPIs. The PFOA soil residential risk screening level (0.019 mg/kg) was not exceeded in any of the soil samples. The maximum detected concentration of PFOA was 0.089 J+ mg/kg (Building 200: Fire Station #14 AOPI, WAAF-FS14-4-SO-101822).
- PFBS was detected in at least one soil sample at the Building 200: Fire Station #14, Fire Truck Water Tank Drainage Area, Helicopter Crash, and Wheeler Gulch AOPIs. The PFBS soil residential risk screening level (1.9 mg/kg) was not exceeded in any of the soil samples. The maximum detected concentration of PFBS was 0.0026 mg/kg (Building 200: Fire Station #14 AOPI, WAAF-FS14-4-SO-101822).
- PFNA was detected in detected in all of the soil samples except one (WAAF-CF-2-SO-101722) at six of the seven AOPIs. The PFNA soil residential risk screening level (0.019 mg/kg) was not exceeded in any of the soil samples. The maximum detected concentration of PFNA was 0.015 mg/kg (Building 200: Fire Station #14 AOPI, WAAF-FS14-1-SO-101822).
- PFHxS was detected in all of the soil samples except one (WAAF-HC-1-SO-102122) at six of the seven AOPIs. The PFHxS soil residential risk screening level (0.13 mg/kg) was not exceeded in any of the soil samples. The maximum detected concentration of PFHxS was 0.037 mg/kg (Building 200: Fire Station #14 AOPI, WAAF-FS14-4-SO-101822).

The one groundwater sample collected during the SI at the Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar AOPIs had detections of PFOS, PFOA, PFBS and PFHxS. The reported concentrations for PFOS, PFOA, and PFHxS exceeded their respective OSD risk screening levels.

Following the SI sampling, all seven AOPIs with confirmed PFOS, PFOA, PFBS, PFNA, and/or PFHxS presence were considered to have complete or potentially complete exposure pathways. Soil exposure pathways for on-installation site workers are complete at six AOPIs and potentially complete at one AOPI. The groundwater exposure pathways for on-post drinking water receptors are potentially complete to account for the potential future use of on-post groundwater downgradient of all seven AOPIs. Due to a lack of land use controls off-installation and downgradient of WAAF, the groundwater exposure pathways for off-installation drinking water receptors are also potentially complete. Surface water is not used for drinking water at WAAF; however, on-installation recreational users and off-installation receptors (e.g., workers or recreational users) could contact constituents in downgradient surface water and sediment via incidental ingestion and dermal contact. Therefore, the surface water and sediment exposure pathways are potentially complete.

Although the CSM indicates complete or potentially complete exposure pathways may exist, the recommendation for a future study in a remedial investigation or additional supplemental groundwater sampling is based on the comparison of the SI analytical results for PFOS, PFOA, PFBS, PFNA, and PFHxS to the OSD risk screening levels (**Table 6-2**). **Table 8-1** summarizes the AOPIs identified at WAAF, PFOS, PFOA, PFBS, PFNA, and PFHxS sampling and recommendations for each AOPI; further investigation is warranted at WAAF. In accordance with CERCLA, site-specific risk will be assessed during a future phase to evaluate whether remedial actions are required.

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

AOPI Name	PFOS, PFOA, PFBS, PFNA, and/or PFHxS detected greater than OSD Risk Screening Levels? (Yes/No/NS)		Recommendation
	GW	SO	
Building 200: Fire Station #14	Yes[2]	Yes	Further study in a remedial investigation
Fire Truck Water Tank Drainage Area	NS	No	Further evaluation[1]
Building 100: Car Fire	NS	No	Further evaluation[1]
Runway AFFF Training Area	NS	No	Further evaluation[1]
Helicopter Crash	NS	Yes	Further study in a remedial investigation
Wheeler Gulch	NS	Yes	Further study in a remedial investigation
Building 251: Civil Air Patrol Hangar AOPIs	Yes[2]	NS	Further study in a remedial investigation

Notes:
1 = Soil analytical data indicates PFOS, PFOA, PFBS, PFNA, and/or PFHxS presence below OSD risk screening levels, but because there is a potential for migration to groundwater, further evaluation is recommended.
2 = The existing monitoring well sampled during the SI was in close proximity to both Building 200: Fire Station #14 AOPI and Building 251: Civil Air Patrol Hangar AOPI. Therefore, the groundwater results were used to evaluate and recommend both AOPIs for further study in a remedial investigation.
Light gray shading – detection greater than the OSD risk screening level
GW – groundwater
NS – not sampled
SO – soil

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

Although soil analytical data indicates PFOS, PFOA, PFBS, PFNS, and/or PFHxS presence below OSD risk screening levels at the Fire Truck Water Tank Drainage Area, Building 100: Car Fire, and Runway AFFF Training Area AOPIs, groundwater pathways are potentially complete at these AOPIs. Groundwater

samples were not collected during the SI, therefore further evaluation is recommended to further investigate the groundwater exposure pathways.

It is our understanding that FFD personnel are generally stationed at a FFD fire station for approximately two years before rotating to another fire station. The WAAF fire station (Building 200: Fire Station #14 AOPI) was built prior to World War II. The PA site visit team was able to interview a FFD lieutenant currently stationed at Fire Station #14 (stationed at WAAF for approximately 5 years by the time of the PA site visit) and a FFD captain also currently stationed at Fire Station #14 (stationed at WAAF for approximately 4 years by the time of the PA site visit). The PA site team also was able to interview one other FFD fire fighter who had previously been stationed at Fire Station #14. There is the potential for other historical fire responses with AFFF on WAAF about which interviewees were unaware.

Records gathered for the use, storage and/or disposal of PFAS-containing materials were reviewed during the PA process. Documentation specific to AFFF may have been limited (e.g., each AFFF use; procurement records, documentation of AFFF used during crash responses or fire training activities) due to lack of recordkeeping requirements for the full timeline of common AFFF practices. Anecdotal accounts of AFFF use (and therefore likely PFOS, PFOA, PFBS, PFNA, and PFHxS use) were limited to available 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 off post well search results (**Appendix D**).

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

Finally, the available PFOS, PFOA, PFBS, PFNA, and PFHxS analytical data is limited to results from on-post soil and groundwater sampling locations. Available data, including PFOS, PFOA, PFBS, PFNA, and PFHxS, is listed in **Appendix N**, which were analyzed per the selected analytical method. HFPO-DA was not in the suite of PFAS compounds analyzed during the SI at WAAF because it was not considered a constituent of concern at the time; therefore, there are no HFPO-DA SI analytical results to screen against the 2022 OSD risk screening levels.

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

9 REFERENCES

Arcadis U.S., Inc. (Arcadis). 2018. Accident Prevention Plan: A-E Services, PFASs Contamination in the Cleanup/Restoration Programs at Active Army Installations – Nationwide. Prepared for USACE, Baltimore District. March.

Arcadis. 2019. Final Programmatic Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP), USAEC PFAS PA/SI, Active Army Installations, Nationwide, USA. October.

Arcadis. 2022. Final UFP QAPP Addendum, Revision 1, USAEC PFAS PA/SI, Wheeler Army Airfield, Hawaii. October.

Army. 2016. Wheeler Army Airfield, Army Defense Environmental Restoration Program, Installation Action Plan. December 27.

Army. 2017. (US Army Public Health Center) Memorandum for DPW, Environmental Division (947 Wright Avenue/Kimberly De Caprio), Wheeler Army Airfield, Schofield Barracks, HI 96857, Subject: Laboratory Sciences (LAB) Final Analytical Report (Project Site: Installation Management Command PFCs FY18 – USAG-HI). November 14

Army. 2018. Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances. September 4. Available online at: https://www.fedcenter.gov/admin/itemattachment.cfm?attachmentid=1150. CH2M Hill. 2011. Draft Remedial Investigation Report, Wheeler Army Airfield, Combat Aviation Brigade, Munitions Response Site (AEDB-R #WAAF-010-R-01). September.

City and County of Honolulu Department of Design and Construction. 2008. Final Environmental Impact Statement for the Central Oahu Wastewater Facilities Plan. June.

Department of Defense (DoD). 2017. Fact Sheet: Detection and Quantitation – What Project Managers and Data Users Need to Know. October. DoD. 2019. Environmental Data Quality Working Group: Final General Data Validation Guidelines. November 4.

DoD. 2020. Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15. May 1.

DoD and Department of Energy. 2019. Consolidated Quality Systems Manual for Environmental Laboratories, Version 5.3. May.

Harding Lawson Associates. 1993. Draft Final Preliminary Assessment Report and Sampling and Analysis Plan for Operable Unit 3, Schofield Army Barracks, Island of Oahu, Hawaii, Volume I of III - Text. February 2. Interstate Technology Regulatory Council. 2017. History and Use of Per-and Polyfluoroalkyl Substances (PFAS). November. Available online at: https://pfas-1.itrcweb.org/wp-content/uploads/2017/11/pfas_fact_sheet_history_and_use__11_13_17.pdf.

Interstate Technology Regulatory Council. 2020. Section 3.1 Firefighting Foams. Updated April 14. Available online at: https://pfas-1.itrcweb.org/3-firefighting-foams/#3_1

NAVFAC. 2014a. Memorandum (Packet No: 14-039410410): NAVFAC Hawaii, Environmental Services Laboratory, PRP411 to Michelle Lyman, USAG-HI DPW (Enclosed: Lab Number(s) 14-03941). April 10.

NAVFAC. 2014b. Memorandum (Packet No: 14-087371006): NAVFAC Hawaii, Environmental Services Laboratory, PRP411 to Liana Lee (Enclosed: Lab Number(s) 14-08737). October 6.

Office of the Secretary of Defense (OSD). 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October.

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

OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July.

OHM. 1998. Final Closure Report, Gulch Runway Dump, DP02; and PCB Sampling Results for Kunia Gate Dump, DP03; and Fire Training Area, FT04, Wheeler Army Airfield, Oahu, Hawaii, July 17.

Oki, Delwyn S. 1998. Geohydrology of the Central Oahu, Hawaii, Ground-Water Flow System and Numerical Simulation of the Effects of Additional Pumping (United States Geological Survey, Water-Resources Investigations Report 97-4276).

R. M. Towill Corporation. 1978. Schofield Barracks Analysis of Existing Facilities Environmental Assessment Report Master Plan Basic Information Maps. August.

USACE. 2005. Environmental Quality: Guidance for Evaluating Performance-Based Chemical Data, Engineer Manual 200-1-10, CEMP-RA/CECW-E, June 30.

USACE. 2012. Environmental Quality: Conceptual Site Models, Engineer Manual 200-1-12, CEMP-CE, December 28.

USEPA. 2016a. Lifetime Health Advisories and Health Effects Support Documents for Perfluorooctanoic Acid and Perfluorooctane Sulfonate. EPA-HQ-OW-2014-0138; FRL-9946-91-OW. Federal Register/ Vol. 81. No. 101. May 25. Available online at: https://www.govinfo.gov/content/pkg/FR-2016-05-25/pdf/2016-12361.pdf.

USEPA. 2016b. The Third Unregulated Contaminant Monitoring Rule Fact Sheet for Assessment Monitoring (List 1 Contaminants) (UCMR3). May.

USEPA. 2016c. EPA enforces ban on U.S. Army's cesspools on Oahu and Big Island. June 21. Available online at: https://www.epa.gov/archive/epa/newsreleases/epa-enforces-ban-us-armys-cesspools-oahu-and-big-island.html

USEPA. 2021. Human Health Toxicity Values for Perfluorobutane Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3). EPA/600/R-20/345F. Center for Public Health and Environmental Assessment, Office of Research and Development, Washington DC. April.

USEPA. 2022. Regional Screening Levels (RSLs) – Generic Tables. Tables as of May 2022. Access online: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables WRCC. 2023. WRCC Database. Available online at: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?hi8838. Retrieved January 18, 2023.

ACRONYMS

%	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
DEB	dedicated equipment background
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.
FCR	Field Change Report
HFPO-DA	hexafluoropropylene oxide dimer acid
HQAES	Headquarters Army Environmental System
IDW	investigation-derived waste
installation	United States Army or Reserve installation
IRP	Installation Restoration Program
LOD	limit of detection
LOQ	limit of quantitation
mg/kg	milligrams per kilogram (parts per million)
MMRP	Military Munitions Response Program
NAVFAC	Naval Facilities Engineering Command
ng/L	nanograms per liter (parts per trillion)
OSD	Office of the Secretary of Defense
PA	preliminary assessment

PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexane sulfonate
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	parts per million
ppt	parts per trillion
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RSL	Regional Screening Level
SCHBR	Schofield Barracks
SI	site inspection
SSHP	Site Safety and Health Plan
TGI	technical guidance instruction
TOC	total organic carbon
UCMR3	third Unregulated Contaminant Monitoring Rule
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USAG-HI	United States Army Garrison, Hawaii
USEPA	United States Environmental Protection Agency
WAAF	Wheeler Army Airfield
WRCC	Western Regional Climate Center

TABLES

Table 6-1 - Monitoring Well Construction Details
USAEC PFAS Preliminary Assessment/Site Inspection
Wheeler Army Airfield, Hawaii

Area of Potential Interest	Sampling Location ID[1]	Total Well Depth (Constructed)	Measuring Point Elevation	Measuring Point	October 2022 Depth to Groundwater from MP	October 2022 Groundwater Elevation	Screened Interval	Casing Diameter	Dedicated Submersible Pump
		(ft bgs)	(ft amsl)		(ft)	(ft amsl)	(ft bgs)	(inches)	(Y/N)
Building 200: Fire Station #14	MW2-3	693	828.81	TOST	557.97	270.84	543 - 693	6	Y

Notes:
1. Groundwater sample was collected from existing monitoring well.

Acronyms/Abreviations:
amsl = above mean sea level
bgs = below ground surface
ft = feet
ID = identification
MP = measuring point
N = No
TOST = top of sounding tube
Y = Yes

Sources:
Construction details for the wells associated with the Building 200: Fire Station #14 AOPI are from 1994 and were provided by Harding Lawson Associates (internal document or table extracted from a report).
HGRRC, Well Data, 2019
Groundwater sampling log from October 2022 SI sampling (Appendix J).

Table 7-1 - Groundwater PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Wheeler Army Air Field, Hawaii

Location	Sample/ Parent ID	Sample Date	Analyte	PFOS (ng/L)		PFOA (ng/L)		PFHxS (ng/L)		PFBS (ng/L)		PFNA (ng/L)	
			OSD Tapwater Risk Screening Level	4		6		39		601		6	
			Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
WAAF-MW2-3-GW	WAAF-(MW2-3)-102022/ WAAF-FD-1-GW-102022	10/20/2022	N	**48**	J-	**44**	J-	**73**	J-	**7.9**	J-	1.8	UJ
		10/20/2022	FD	**49**	J-	**43**	J-	**73**	J-	**7.1**	J-	1.8	UJ

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection.
2. Gray shaded values indicate the result was detected greater than the 2022 Office of the Secretary of Defense (OSD) risk screening levels, (OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).
3. The existing monitoring well (MW 2-3) sampled during the SI was in close proximity to both Building 200: Fire Station #14 AOPI and Building 251: Civil Air Patrol Hangar AOPI. The groundwater results were used to evaluate and recommend both AOPIs for further study in remedial investigation. Therefore, there are no analytical results shown in this table for Building 251: Civil Air Patrol Hangar AOPI.

Acronyms/Abbreviations:
FD = field duplicate sample
ID = identification
N = primary sample
ng/L = nanograms per liter (parts per trillion)
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier

Qualifier:
J- = The result is an estimated quantity; the result may be biased low.
UJ = The analyte was analized for but was not detected. The limit of quantitation (LOQ) Is approximate and may be inaccurate or imprecise.

Table 7-2 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Wheeler Army Airfield, Hawaii

Location	Sample/ Parent ID	Sample Date	Analyte	PFOS (mg/kg)		PFOA (mg/kg)		PFHxS (mg/kg)		PFBS (mg/kg)		PFNA (mg/kg)	
			OSD Industrial/Commercial Risk Screening Level	0.16		0.25		1.6		25		0.25	
			OSD Residential Risk Screening Level	0.013		0.019		0.13		1.9		0.019	
			Sample Type	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
WAAF-CF-1-SO	WAAF-CF-1-SO-101722	10/17/2022	N	**0.0024**		**0.00072**		**0.000043**	J	0.00024	U	**0.00014**	J
WAAF-CF-2-SO	WAAF-CF-2-SO-101722	10/17/2022	N	**0.00019**	J	**0.00013**	J	**0.000046**	J	0.00025	U	0.00025	U
WAAF-FS14-1-SO	WAAF-FS14-1-SO-101822	10/18/2022	N	**0.045**		**0.0078**		**0.00096**		**0.000089**	J	**0.015**	
WAAF-FS14-2-SO	WAAF-FS14-2-SO-101822	10/18/2022	N	**0.016**		**0.00053**		**0.00066**		0.00022	U	**0.00087**	
WAAF-FS14-3-SO	WAAF-FS14-3-SO-101822	10/18/2022	N	***0.2***		**0.005**		**0.037**		**0.00071**		**0.01**	
WAAF-FS14-4-SO	WAAF-FD-1-SO-101822 / WAAF-FS14-4-SO-101822	10/18/2022	N	***0.29***		**0.0089**	J+	**0.032**		**0.0026**		**0.0089**	J+
		10/18/2022	FD	***0.41***		**0.0084**		**0.032**		**0.0025**		**0.0088**	
WAAF-FS14-5-SO	WAAF-FS14-5-SO-101822	10/18/2022	N	***0.28***		**0.0086**		**0.012**		**0.00039**		**0.012**	J+
WAAF-FTDA-1-SO	WAAF-FTDA-1-SO-101722	10/17/2022	N	**0.0046**		**0.00049**		**0.00011**	J	0.00021	U	**0.00053**	
WAAF-FTDA-2-SO	WAAF-FTDA-2-SO-101722	10/17/2022	N	**0.0015**		**0.000098**	J	**0.0001**	J	**0.000039**	J	**0.00012**	J
WAAF-FTDA-3-SO	WAAF-FD-2-SO-101822 / WAAF-FTDA-3-SO-101822	10/18/2022	N	**0.00055**	J	**0.00071**		**0.00018**	J	0.00023	U	**0.00016**	J+
		10/18/2022	FD	**0.0097**	J+	**0.00042**	J+	**0.00095**	J+	**0.000091**	J+	**0.00023**	J+
WAAF-FTDA-4-SO	WAAF-FTDA-4-SO-101822	10/18/2022	N	**0.0014**		**0.00059**		**0.00027**		0.00023	U	**0.0001**	J
WAAF-HC-1-SO	WAAF-HC-1-SO-102122	10/21/2022	N	**0.0011**		**0.0003**	J	0.00024	U	0.00024	U	**0.00019**	J
WAAF-HC-2-SO	WAAF-HC-2-SO-102122	10/21/2022	N	**0.00044**		**0.00013**	J	**0.000074**	J	0.00023	U	**0.000071**	J
WAAF-HC-3-SO	WAAF-HC-3-SO-102122	10/21/2022	N	**0.055**		**0.00099**		**0.00031**		**0.000041**	J	**0.0015**	
WAAF-HC-4-SO	WAAF-HC-4-SO-102122	10/21/2022	N	**0.0017**		**0.00059**		**0.000057**	J	0.00024	U	**0.00037**	
WAAF-RAFFFTA-1-SO	WAAF-RAFFFTA-1-SO-102122	10/21/2022	N	**0.0033**		**0.0004**		**0.00015**	J	0.0002	U	**0.00033**	
WAAF-RAFFFTA-2-SO	WAAF-RAFFFTA-2-SO-102122	10/21/2022	N	**0.0067**		**0.00016**	J	**0.00006**	J	0.0002	U	**0.000094**	J
WAAF-RAFFFTA-3-SO	WAAF-RAFFFTA-3-SO-102122	10/21/2022	N	**0.001**		**0.00018**	J	**0.000097**	J	0.00022	U	**0.0001**	J
WAAF-RAFFFTA-4-SO	WAAF-RAFFFTA-4-SO-102122	10/21/2022	N	**0.0014**		**0.00023**	J	**0.0001**	J	0.00023	U	**0.00013**	J
WAAF-WG-1-SO	WAAF-WG-1-SO-101922	10/19/2022	N	**0.016**		**0.00063**		**0.0013**		**0.000098**	J	**0.00038**	
WAAF-WG-2-SO	WAAF-WG-2-SO-101922	10/19/2022	N	**0.008**		**0.0003**	J	**0.00063**		**0.000047**	J	**0.0003**	
WAAF-WG-3-SO	WAAF-WG-3-SO-101922	10/19/2022	N	**0.011**		**0.00019**	J	**0.00013**	J	0.00027	U	**0.00044**	
WAAF-WG-4-SO	WAAF-WG-4-SO-101922	10/19/2022	N	**0.0023**		**0.00017**	J	**0.000088**	J	0.0002	U	**0.0002**	
WAAF-WG-5-SO	WAAF-WG-5-SO-101922	10/19/2022	N	**0.0082**		**0.00044**		**0.00017**	J	0.00021	U	**0.00071**	
WAAF-WG-6-SO	WAAF-WG-6-SO-101922	10/19/2022	N	**0.0034**		**0.0015**		**0.00033**		**0.000046**	J	**0.0016**	

Table 7-2 Soil PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results
USAEC PFAS Preliminary Assessment/Site Inspection
Wheeler Army Airfield, Hawaii

Notes:
1. **Bolded** values indicate the result was detected greater than the limit of detection
2. Data are compared to the Office of the Secretary of Defense (OSD) risk screening levels for both the residential as well as the industrial/commercial scenarios (OSD. 2022. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. July).
3. Gray shaded values indicate the result was detected greater than the residential scenario risk screening levels (OSD 2022).
4. Gray shaded and italicized values indicate the result was detected greater than the industrial/commercial scenario (i.e., and therefore greater than the residential scenario) risk screening levels (OSD 2022).
5. Analytical results are not included in this table for Building 251: Civil Air Patrol Hangar AOPI. Soil samples were not collected at this AOPI because this location was not recognized as an AOPI until after the initial SI sampling was completed.

Acronyms/Abbreviations:
FD = field duplicate sample
ID = identification
mg/kg = milligrams per kilogram (parts per million)
N = primary sample
PFAS = per- and polyfluoroalkyl substances
PFBS = perfluorobutanesulfonic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
PFNA = perfluorononanoic acid
PFHxS = perfluorohexane sulfonate
Qual = qualifier

Qualifier:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
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
Wheeler Army Airfield, Hawaii

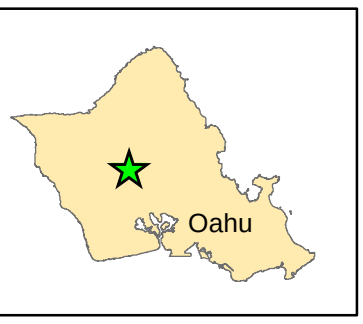


Figure 2-1
Site Location

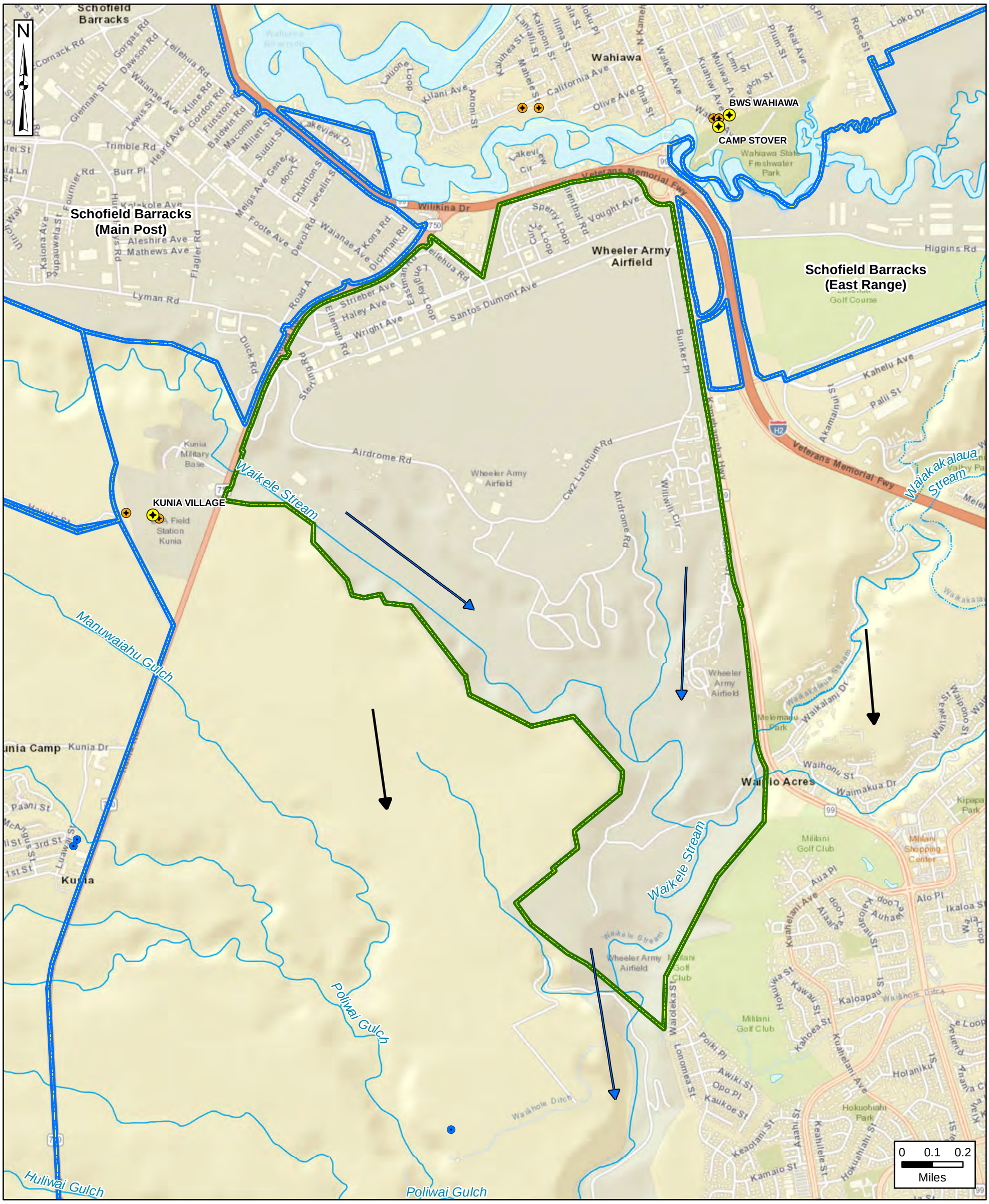
Installation Boundary
Adjacent Military Installation
Stream (Perennial)
Stream (Intermittent)
Water Body

Data Sources:
USAG-HI, GIS Data, 2018
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 2-2
Site Layout



- Installation Boundary
- Adjacent Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Public Water Supply System Well
- Other Public Supply Well
- Other Designated Use Water Well
- Surface Water Flow Direction
- Assumed Groundwater Flow Direction

Data Sources:
USAG-HI, GIS Data, 2018
EDR, Well, Data, 2018
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 2-3
Topographic Map

Installation Boundary
Adjacent Military Installation
Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Assumed Groundwater Flow Direction
Contour interval = 20 feet

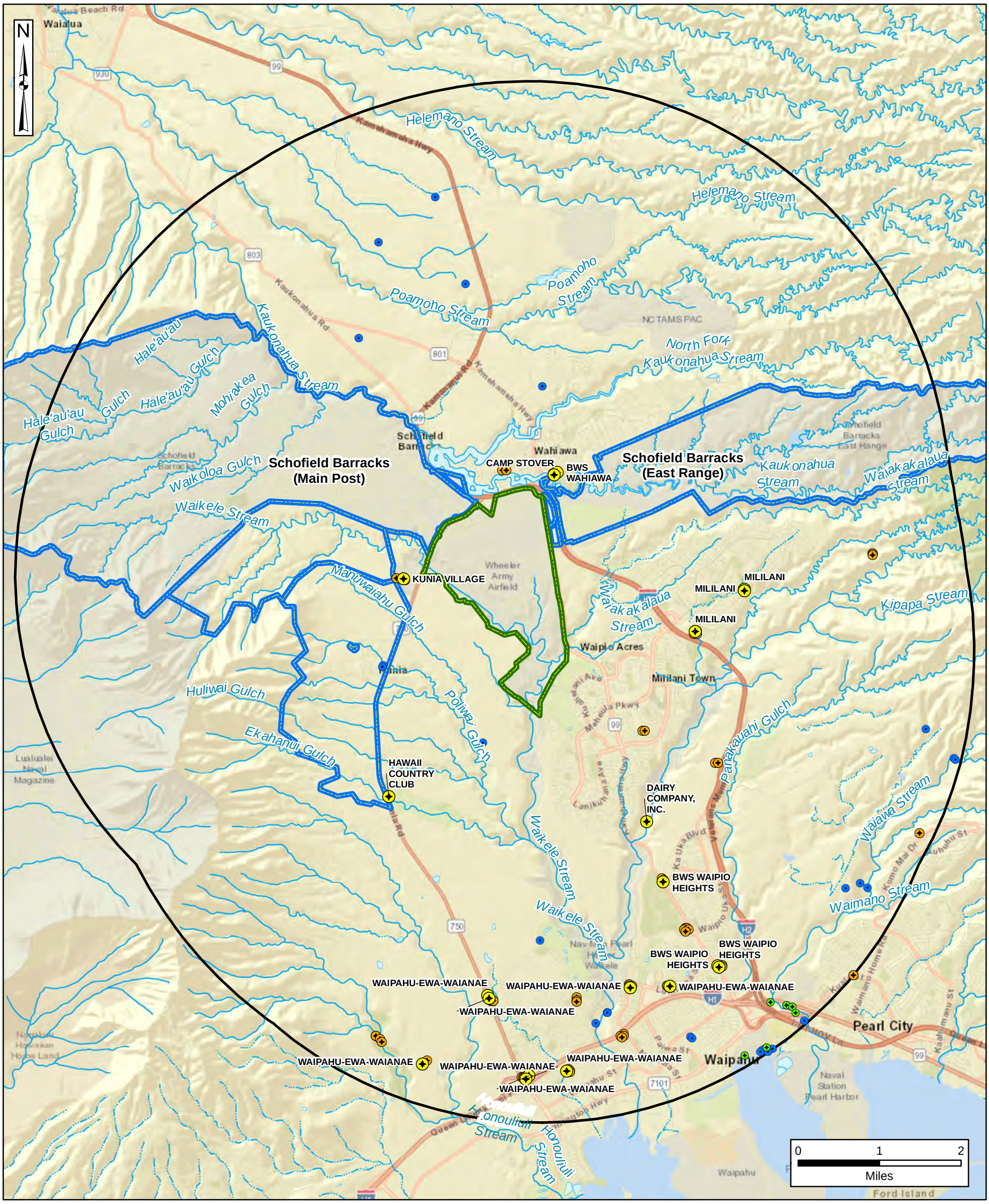
Notes:
1) The direction of groundwater flow beneath the installation is unknown; however, groundwater in the area generally flows towards the east and south.
2) Surface water flow direction is based on hydrology and topography.

Data Sources:
USAG-HI, GIS Data, 2018
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 2-4
Off-Post Potable Supply Wells



- Installation Boundary
- 5-Mile Radius
- Adjacent Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Public Water Supply System Well
- Other Public Supply Well
- Domestic Well
- Other Designated Use Water Well

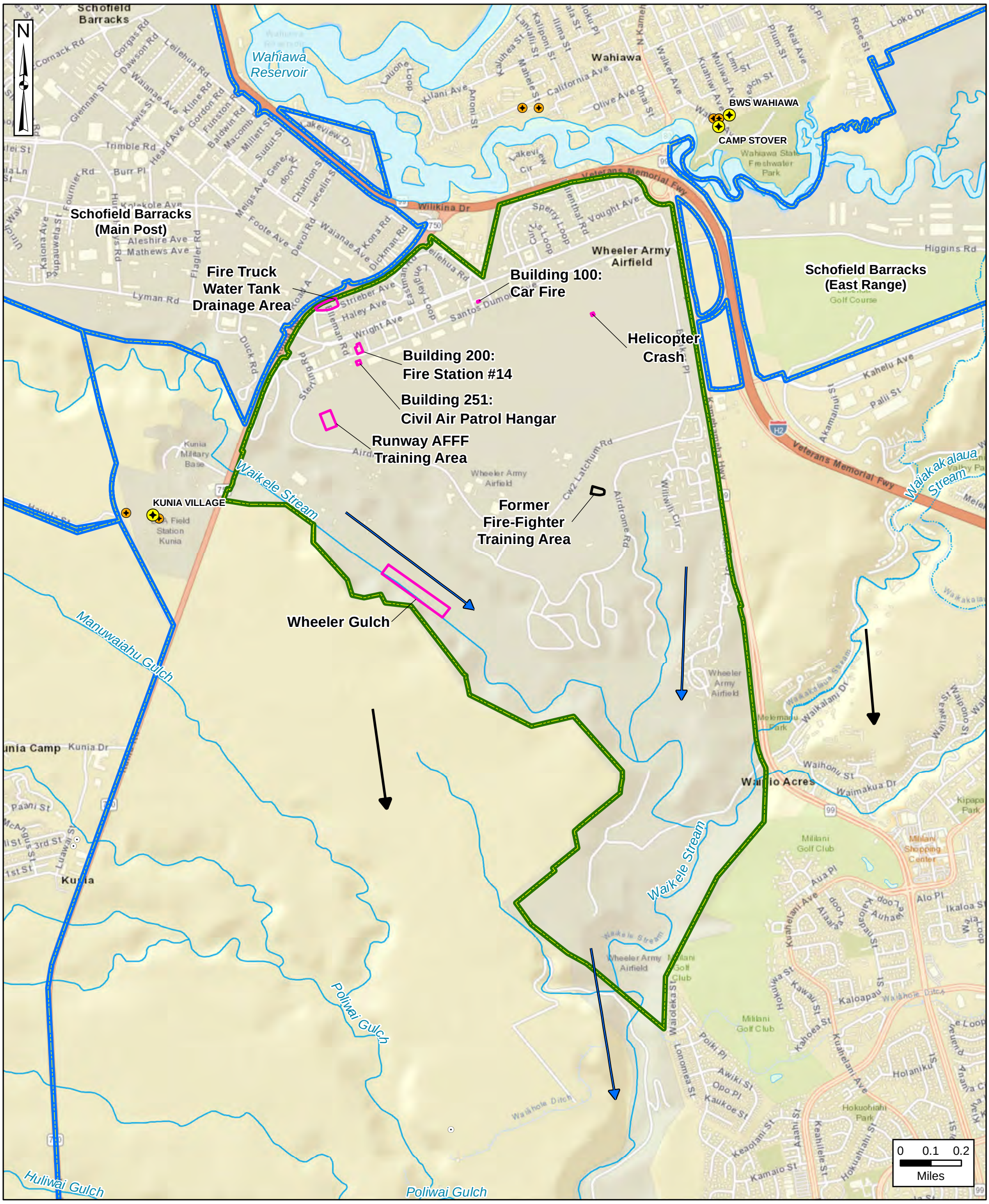
Note: Public Water Supply System Well data from the Federal Reporting Data System includes water systems that provide water to at least 25 people for at least 60 days annually. Other designated use wells includes agricultural wells, industrial wells, irrigation wells and wells of other or unknown use.

Data Sources:
USAG-HI, GIS Data, 2018
EDR, Well, Data, 2018
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 5-2
AOPI Locations



- Installation Boundary
- AOPI
- AOPI Not Included in Site Inspection Sampling Scope of Work
- Adjacent Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Assumed Groundwater Flow Direction

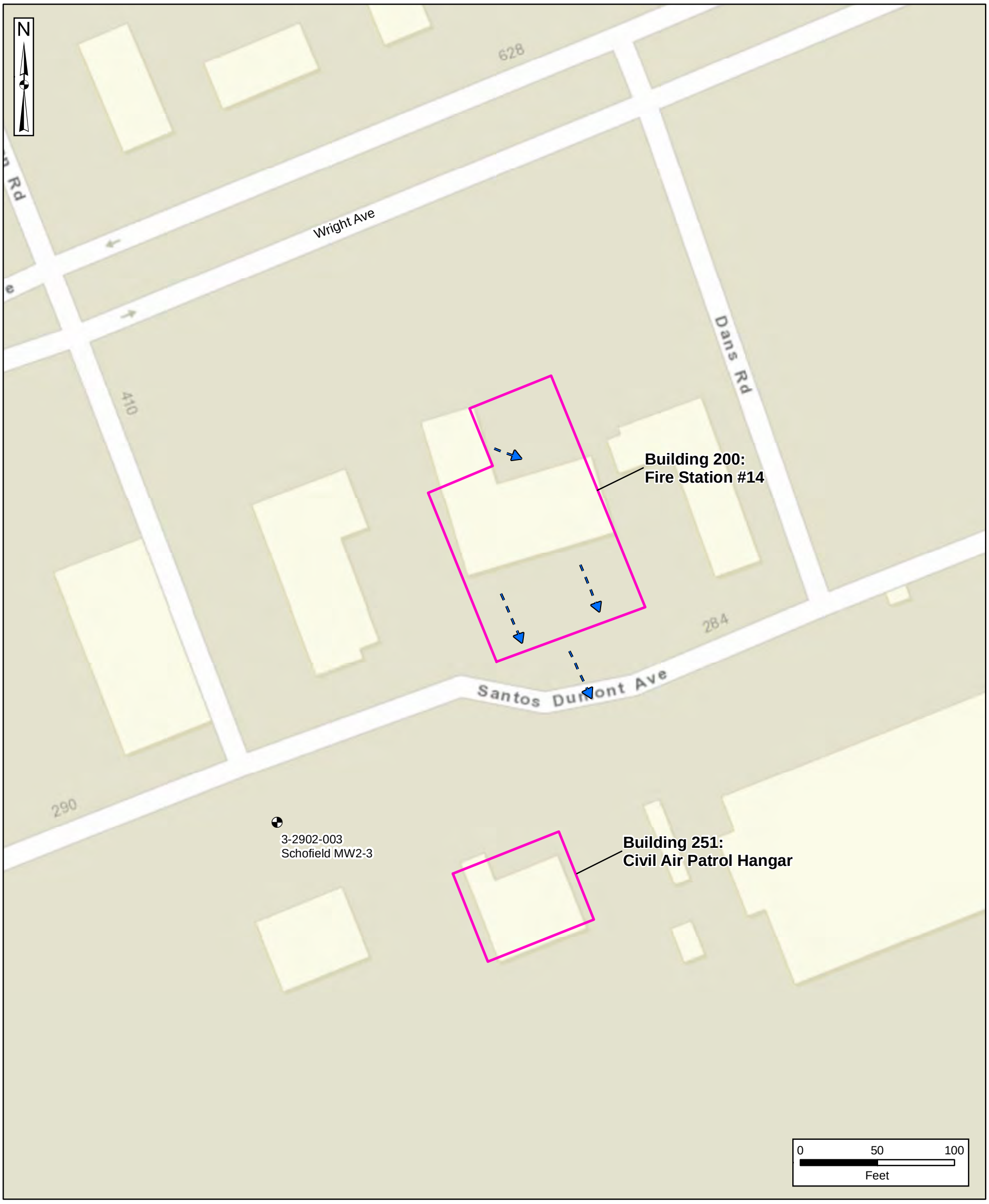
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
USAG-HI, GIS Data, 2018
HGGRC, Well Data, 2019
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 5-3
Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar



Installation Boundary

AOPI

Stormwater/Surface Runoff Flow Direction

Monitoring Well

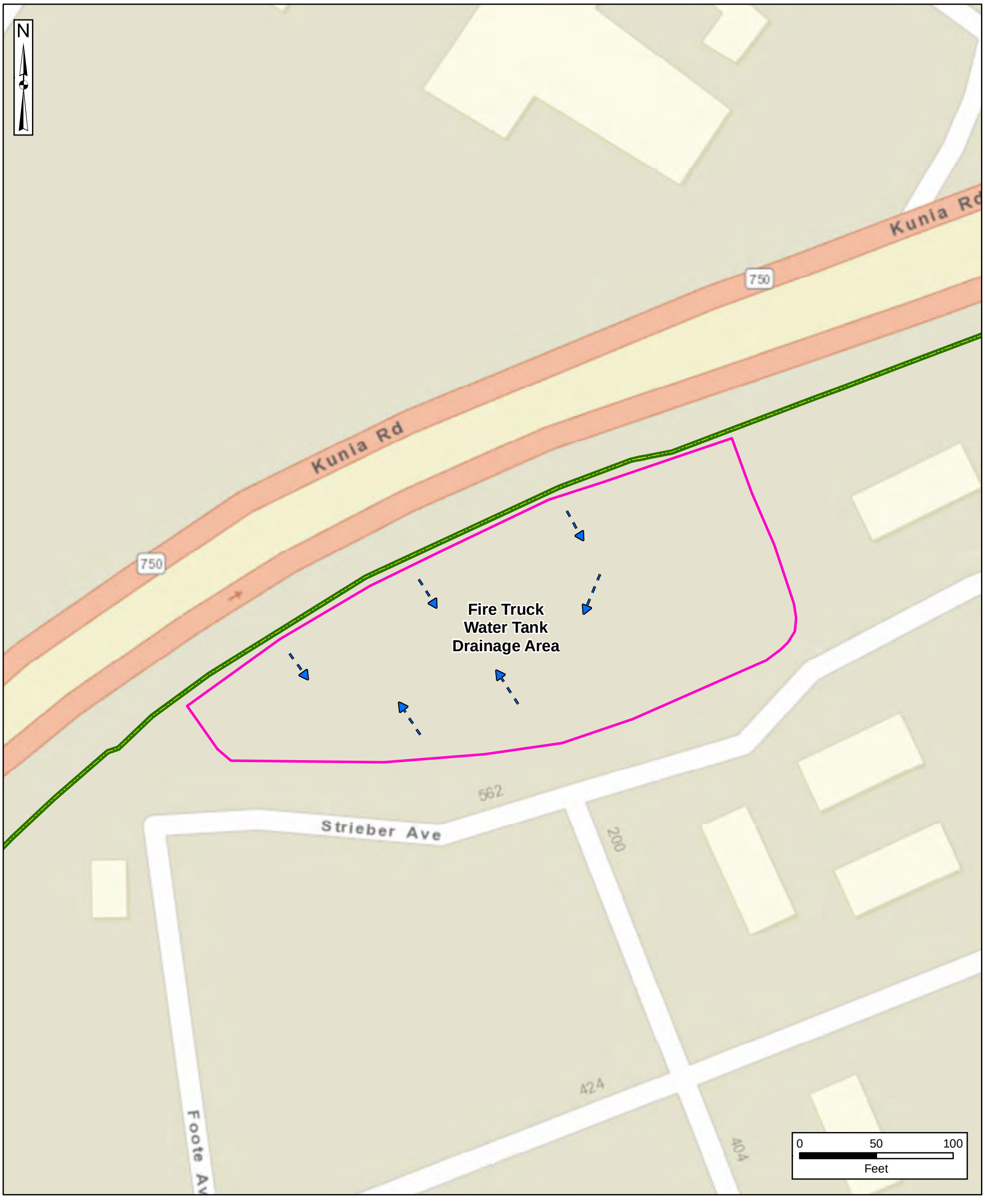
AOPI = area of potential interest

Data Sources:
USAG-HI, GIS Data, 2018
HGGRC, Well Data, 2019
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 5-4
Fire Truck Water Tank Drainage Area



Installation Boundary

AOPI

Stormwater/Surface Runoff Flow Direction

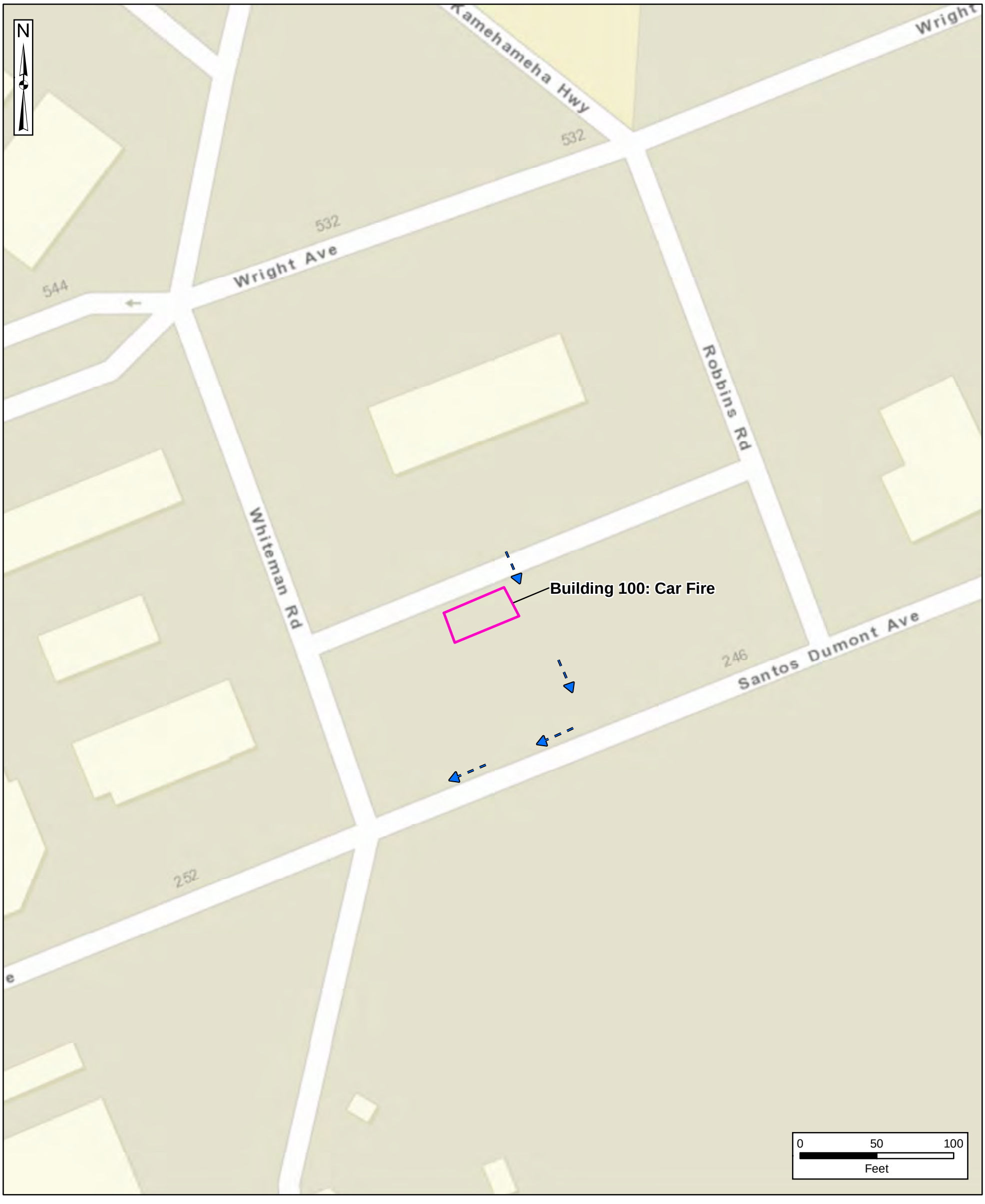
AOPI = area of potential interest

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 5-5
Building 100: Car Fire



Installation Boundary

AOPI

Stormwater/Surface Runoff Flow Direction

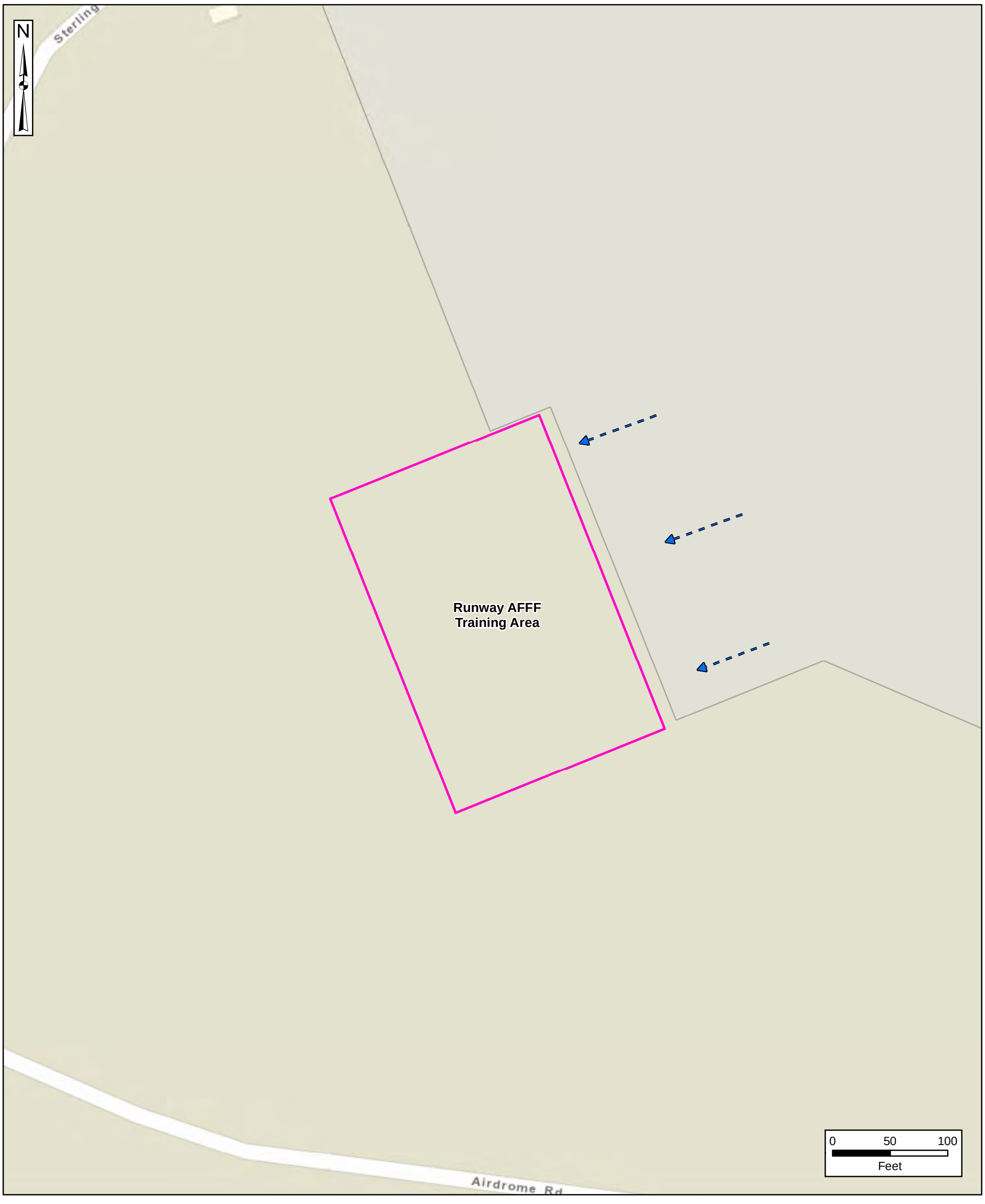
AOPI = area of potential interest

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 5-6
Runway AFFF Training Area



Installation Boundary

AOPI

Stormwater/Surface Runoff Flow Direction

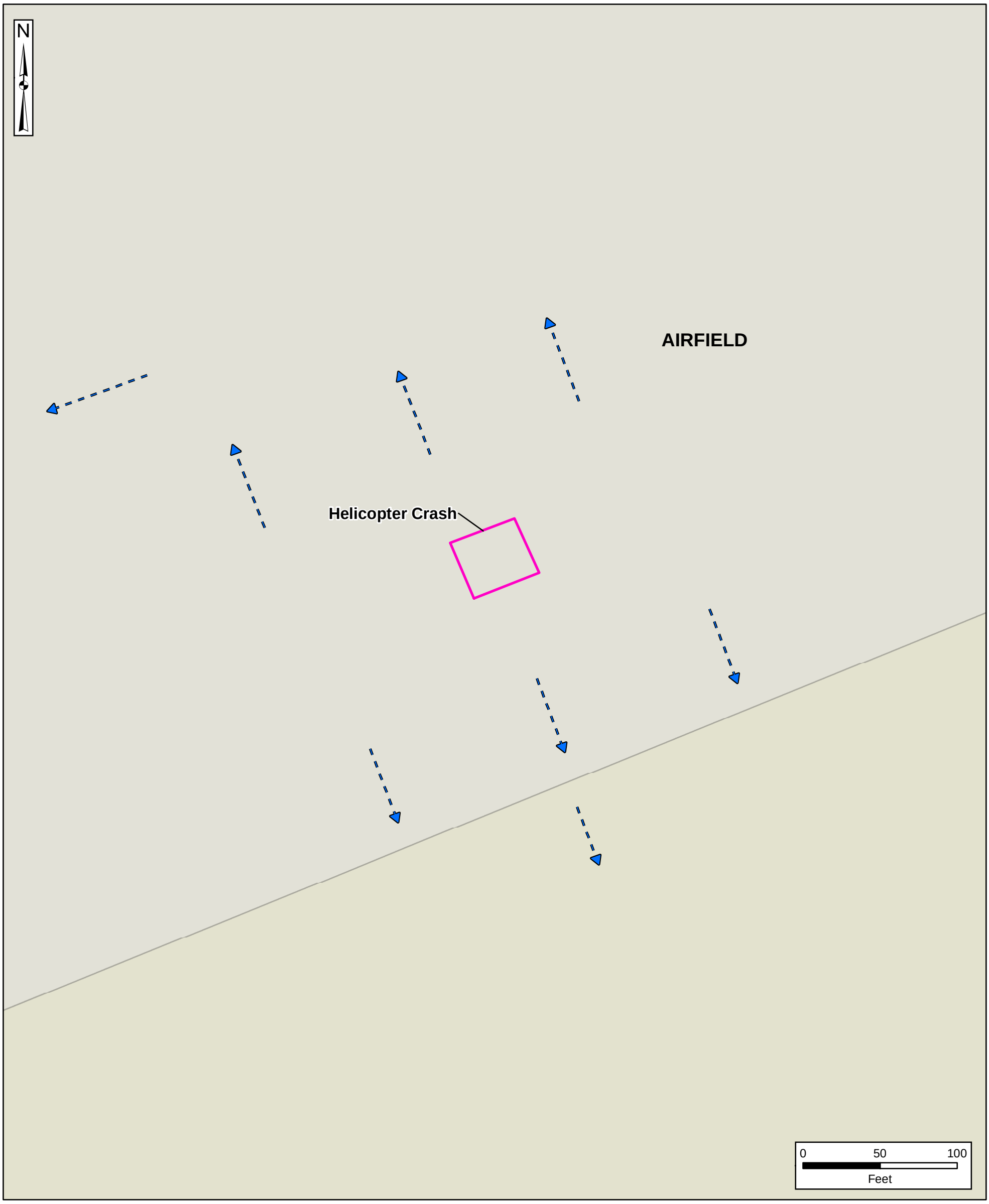
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 5-7
Helicopter Crash



Installation Boundary

AOPI

Stormwater/Surface Runoff Flow Direction

AOPI = area of potential interest

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 5-8
Wheeler Gulch

Installation Boundary
AOPI
Stream (Perennial)
Stormwater/Surface Runoff Flow Direction
Surface Water Flow Direction
Monitoring Well

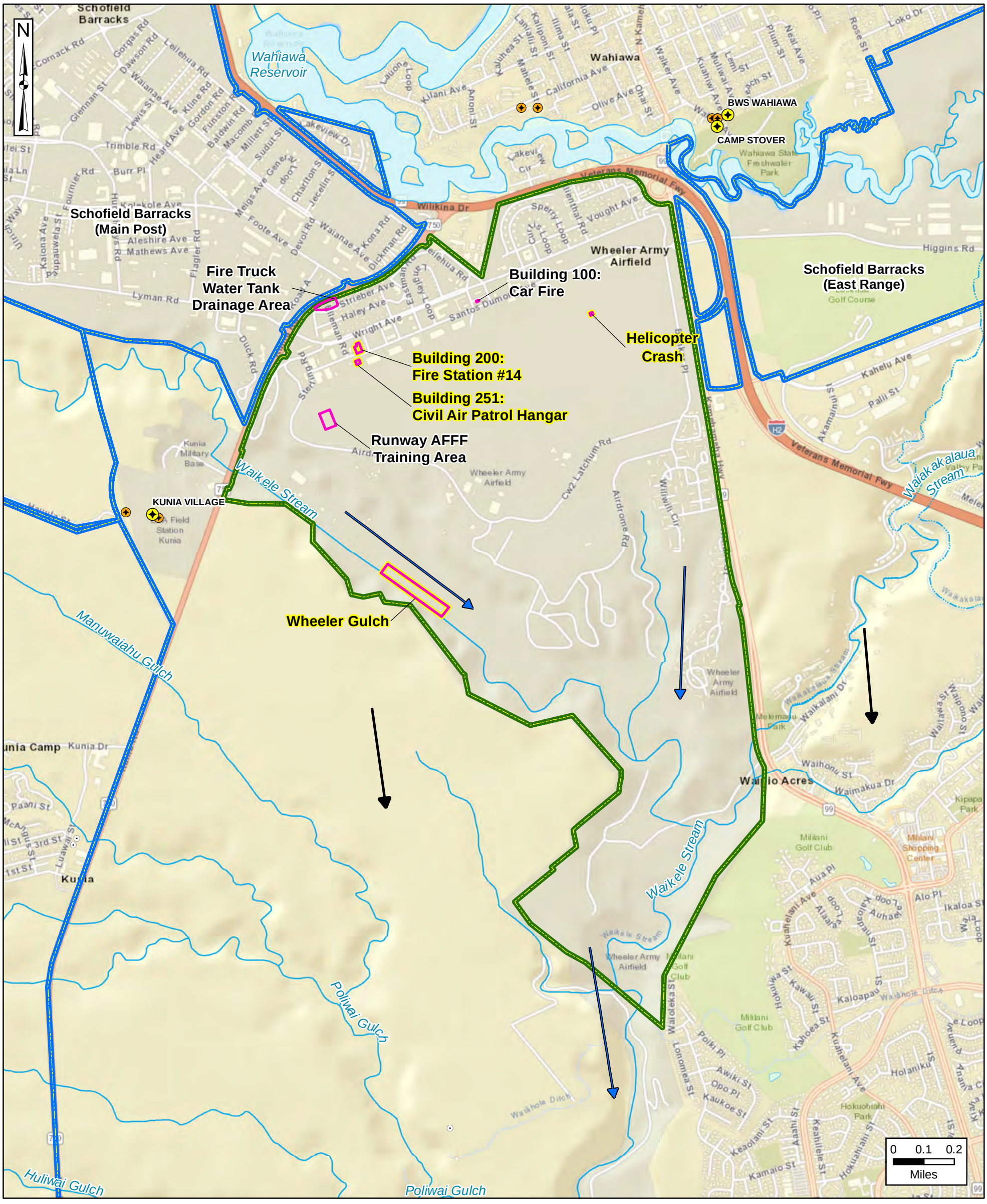
AOPI = area of potential interest

Data Sources:
USAG-HI, GIS Data, 2018
HGGRC, Well Data, 2019
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

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



Installation Boundary
AOPI
AOPI with OSD Risk Screening Level Exceedance
Adjacent Military Installation
Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Assumed Groundwater Flow Direction

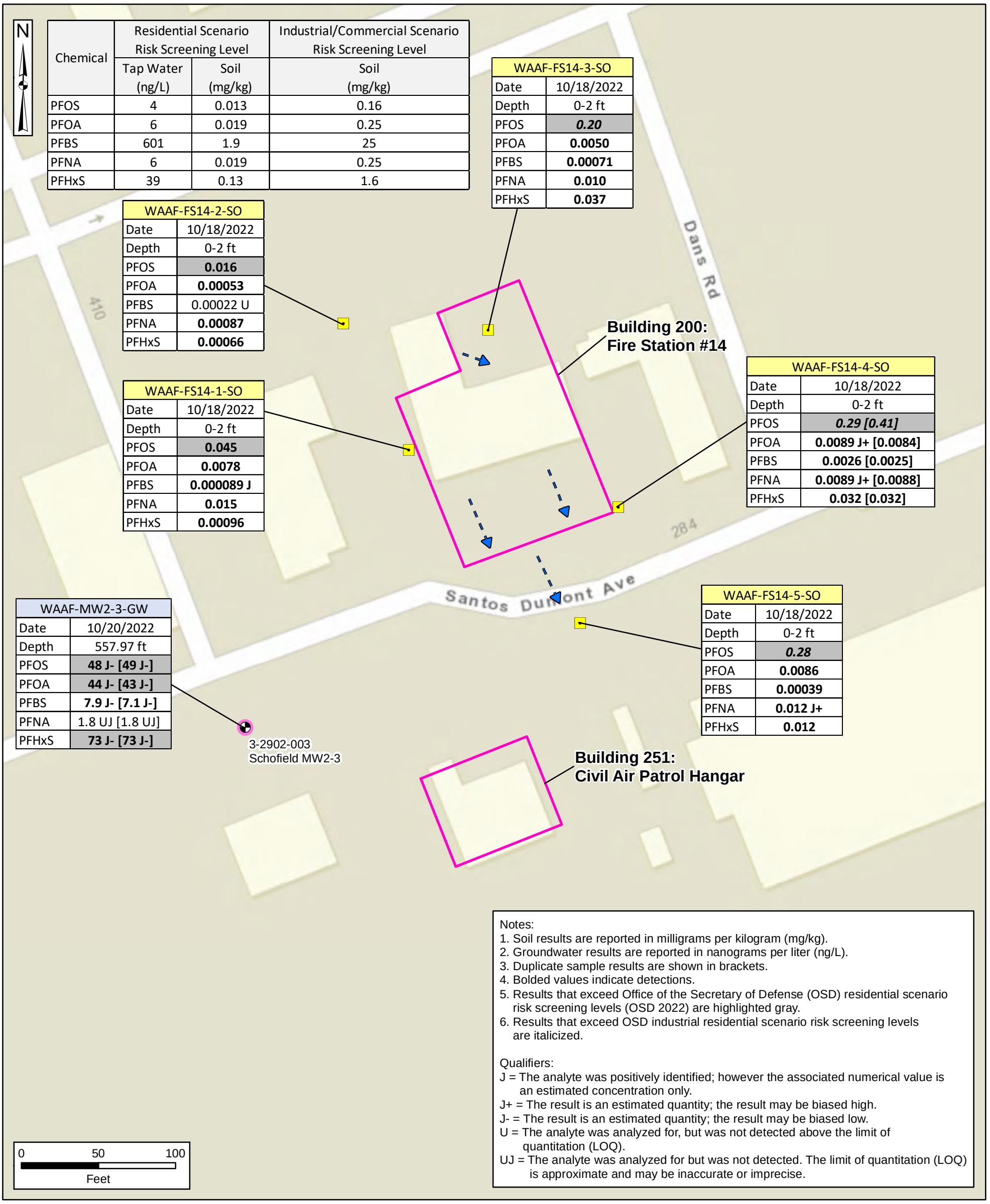
AFFF = aqueous film-forming foam
OSD = Office of the Secretary of Defense

Data Sources:
USAG-HI, GIS Data, 2018
HGGRC, Well Data, 2019
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 7-2
Building 200: Fire Station #14 and Building 251: Civil Air Patrol Hangar
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results



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

WAAF-FS14-3-SO	
Date	10/18/2022
Depth	0-2 ft
PFOS	***0.20***
PFOA	**0.0050**
PFBS	**0.00071**
PFNA	**0.010**
PFHxS	**0.037**

WAAF-FS14-2-SO	
Date	10/18/2022
Depth	0-2 ft
PFOS	**0.016**
PFOA	**0.00053**
PFBS	0.00022 U
PFNA	**0.00087**
PFHxS	**0.00066**

WAAF-FS14-1-SO	
Date	10/18/2022
Depth	0-2 ft
PFOS	**0.045**
PFOA	**0.0078**
PFBS	**0.000089 J**
PFNA	**0.015**
PFHxS	**0.00096**

WAAF-FS14-4-SO	
Date	10/18/2022
Depth	0-2 ft
PFOS	***0.29 [0.41]***
PFOA	**0.0089 J+ [0.0084]**
PFBS	**0.0026 [0.0025]**
PFNA	**0.0089 J+ [0.0088]**
PFHxS	**0.032 [0.032]**

WAAF-MW2-3-GW	
Date	10/20/2022
Depth	557.97 ft
PFOS	**48 J- [49 J-]**
PFOA	**44 J- [43 J-]**
PFBS	**7.9 J- [7.1 J-]**
PFNA	1.8 UJ [1.8 UJ]
PFHxS	**73 J- [73 J-]**

WAAF-FS14-5-SO	
Date	10/18/2022
Depth	0-2 ft
PFOS	***0.28***
PFOA	**0.0086**
PFBS	**0.00039**
PFNA	**0.012 J+**
PFHxS	**0.012**

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Groundwater results are reported in nanograms per liter (ng/L).
3. Duplicate sample results are shown in brackets.
4. Bolded values indicate detections.
5. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.
6. Results that exceed OSD industrial residential scenario risk screening levels are italicized.

Qualifiers:
J = The analyte was positively identified; however the associated numerical value is an estimated concentration only.
J+ = The result is an estimated quantity; the result may be biased high.
J- = The result is an estimated quantity; the result may be biased low.
U = The analyte was analyzed for, but was not detected above the limit of quantitation (LOQ).
UJ = The analyte was analyzed for but was not detected. The limit of quantitation (LOQ) is approximate and may be inaccurate or imprecise.

Installation Boundary
AOPI
Stormwater/Surface Runoff Flow Direction
Monitoring Well
Shallow Soil Sampling Location
Groundwater Sampling Location (Existing Well)

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

Data Sources:
USAG-HI, GIS Data, 2018
HGGRC, Well Data, 2019
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 7-3
Fire Truck Water Tank Drainage Area
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

N

Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

WAAF-FTDA-3-SO	
Date	10/18/2022
Depth	0-2 ft
PFOS	**0.00055 J [0.0097 J+]**
PFOA	**0.00071 [0.00042 J+]**
PFBS	0.00023 U **[0.000091 J+]**
PFNA	**0.00016 J+ [0.00023 J+]**
PFHxS	**0.00018 J [0.00095 J+]**

WAAF-FTDA-1-SO	
Date	10/17/2022
Depth	0-1.4 ft
PFOS	**0.0046**
PFOA	**0.00049**
PFBS	0.00021 U
PFNA	**0.00053**
PFHxS	**0.00011 J**

WAAF-FTDA-2-SO	
Date	10/17/2022
Depth	0-0.67 ft
PFOS	**0.0015**
PFOA	**0.000098 J**
PFBS	**0.000039 J**
PFNA	**0.00012 J**
PFHxS	**0.00010 J**

WAAF-FTDA-4-SO	
Date	10/18/2022
Depth	0-2 ft
PFOS	**0.0014**
PFOA	**0.00059**
PFBS	0.00023 U
PFNA	**0.00010 J**
PFHxS	**0.00027**

Fire Truck Water Tank Drainage Area

Kunia Rd
750
Strieber Ave
562
200
424
404

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.
3. Duplicate sample results are shown in brackets.

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

0 50 100
Feet

Installation Boundary
AOPI
Stormwater/Surface Runoff Flow Direction
Shallow Soil Sampling Location

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

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 7-4
Building 100: Car Fire
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

WAAF-CF-2-SO	
Date	10/17/2022
Depth	0-2 ft
PFOS	**0.00019 J**
PFOA	**0.00013 J**
PFBS	0.00025 U
PFNA	0.00025 U
PFHxS	**0.000046 J**

WAAF-CF-1-SO	
Date	10/17/2022
Depth	0-2 ft
PFOS	**0.0024**
PFOA	**0.00072**
PFBS	0.00024 U
PFNA	**0.00014 J**
PFHxS	**0.000043 J**

Building 100: Car Fire

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.

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

0 50 100
Feet

Installation Boundary
AOPI
Stormwater/Surface Runoff Flow Direction
Shallow Soil Sampling Location

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

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 7-5
Runway AFFF Training Area
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

N

Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

WAAF-RAFFFTA-1-SO	
Date	10/21/2022
Depth	0-1.4 ft
PFOS	**0.0033**
PFOA	**0.00040**
PFBS	0.00020 U
PFNA	**0.00033**
PFHxS	**0.00015 J**

WAAF-RAFFFTA-2-SO	
Date	10/21/2022
Depth	0-1.2 ft
PFOS	**0.0067**
PFOA	**0.00016 J**
PFBS	0.00020 U
PFNA	**0.000094 J**
PFHxS	**0.000060 J**

WAAF-RAFFFTA-3-SO	
Date	10/21/2022
Depth	0-1 ft
PFOS	**0.0010**
PFOA	**0.00018 J**
PFBS	0.00022 U
PFNA	**0.00010 J**
PFHxS	**0.000097 J**

WAAF-RAFFFTA-4-SO	
Date	10/21/2022
Depth	0-1.5 ft
PFOS	**0.0014**
PFOA	**0.00023 J**
PFBS	0.00023 U
PFNA	**0.00013 J**
PFHxS	**0.00010 J**

Runway AFFF Training Area

Airdrome Rd

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.

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

0 50 100
Feet

Installation Boundary
AOPI
Stormwater/Surface Runoff Flow Direction
Shallow Soil Sampling Location

AFFF = aqueous film-forming form
AOPI = area of potential interest
ft = feet
PFBS = perfluorobutanesulfonic acid
PFHxS = perfluorohexane sulfonate
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 7-6
Helicopter Crash
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

N

Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

AIRFIELD

Helicopter Crash

WAAF-HC-4-SO	
Date	10/21/2022
Depth	0-2 ft
PFOS	**0.0017**
PFOA	**0.00059**
PFBS	0.00012 U
PFNA	**0.00037**
PFHxS	**0.000057 J**

WAAF-HC-1-SO	
Date	10/21/2022
Depth	0-2 ft
PFOS	**0.0011**
PFOA	**0.00030 J**
PFBS	0.00024 U
PFNA	**0.00019 J**
PFHxS	0.00024 U

WAAF-HC-2-SO	
Date	10/21/2022
Depth	0-2 ft
PFOS	**0.00044**
PFOA	**0.00013 J**
PFBS	0.00023 U
PFNA	**0.000071 J**
PFHxS	**0.000074 J**

WAAF-HC-3-SO	
Date	10/21/2022
Depth	0-0.83 ft
PFOS	**0.055**
PFOA	**0.00099**
PFBS	**0.000041 J**
PFNA	**0.0015**
PFHxS	**0.00031**

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.
3. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.

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

0 50 100
Feet

Installation Boundary
AOPI
Stormwater/Surface Runoff Flow Direction
Shallow Soil Sampling Location

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

Data Sources:
USAG-HI, GIS Data, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 7-7
Wheeler Gulch
PFOS, PFOA, PFBS, PFNA, and PFHxS Analytical Results

Chemical	Residential Scenario Risk Screening Level	Industrial/Commercial Scenario Risk Screening Level
	Soil (mg/kg)	Soil (mg/kg)
PFOS	0.013	0.16
PFOA	0.019	0.25
PFBS	1.9	25
PFNA	0.019	0.25
PFHxS	0.13	1.6

WAAF-WG-1-SO	
Date	10/19/2022
Depth	0-0.17 ft
PFOS	**0.016**
PFOA	**0.00063**
PFBS	**0.000098 J**
PFNA	**0.00038**
PFHxS	**0.0013**

WAAF-WG-3-SO	
Date	10/19/2022
Depth	0-2 ft
PFOS	**0.011**
PFOA	**0.00019 J**
PFBS	0.00027 U
PFNA	**0.00044**
PFHxS	**0.00013 J**

WAAF-WG-5-SO	
Date	10/19/2022
Depth	0-0.5 ft
PFOS	**0.0082**
PFOA	**0.00044**
PFBS	0.00021 U
PFNA	**0.00071**
PFHxS	**0.00017 J**

WAAF-WG-6-SO	
Date	10/19/2022
Depth	0-0.25 ft
PFOS	**0.0034**
PFOA	**0.0015**
PFBS	**0.000046 J**
PFNA	**0.0016**
PFHxS	**0.00033**

WAAF-WG-2-SO	
Date	10/19/2022
Depth	0-0.83 ft
PFOS	**0.0080**
PFOA	**0.00030 J**
PFBS	**0.000047 J**
PFNA	**0.00030**
PFHxS	**0.00063**

WAAF-WG-4-SO	
Date	10/19/2022
Depth	0-0.042 ft
PFOS	**0.0023**
PFOA	**0.00017 J**
PFBS	0.00020 U
PFNA	**0.00020**
PFHxS	**0.000088 J**

Waikele Stream

Wheeler Army Airfield

Wheeler Gulch

3-2802-001
Schofield MW2-6

Notes:
1. Soil results are reported in milligrams per kilogram (mg/kg).
2. Bolded values indicate detections.
3. Results that exceed Office of the Secretary of Defense (OSD) residential scenario risk screening levels (OSD 2022) are highlighted gray.

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

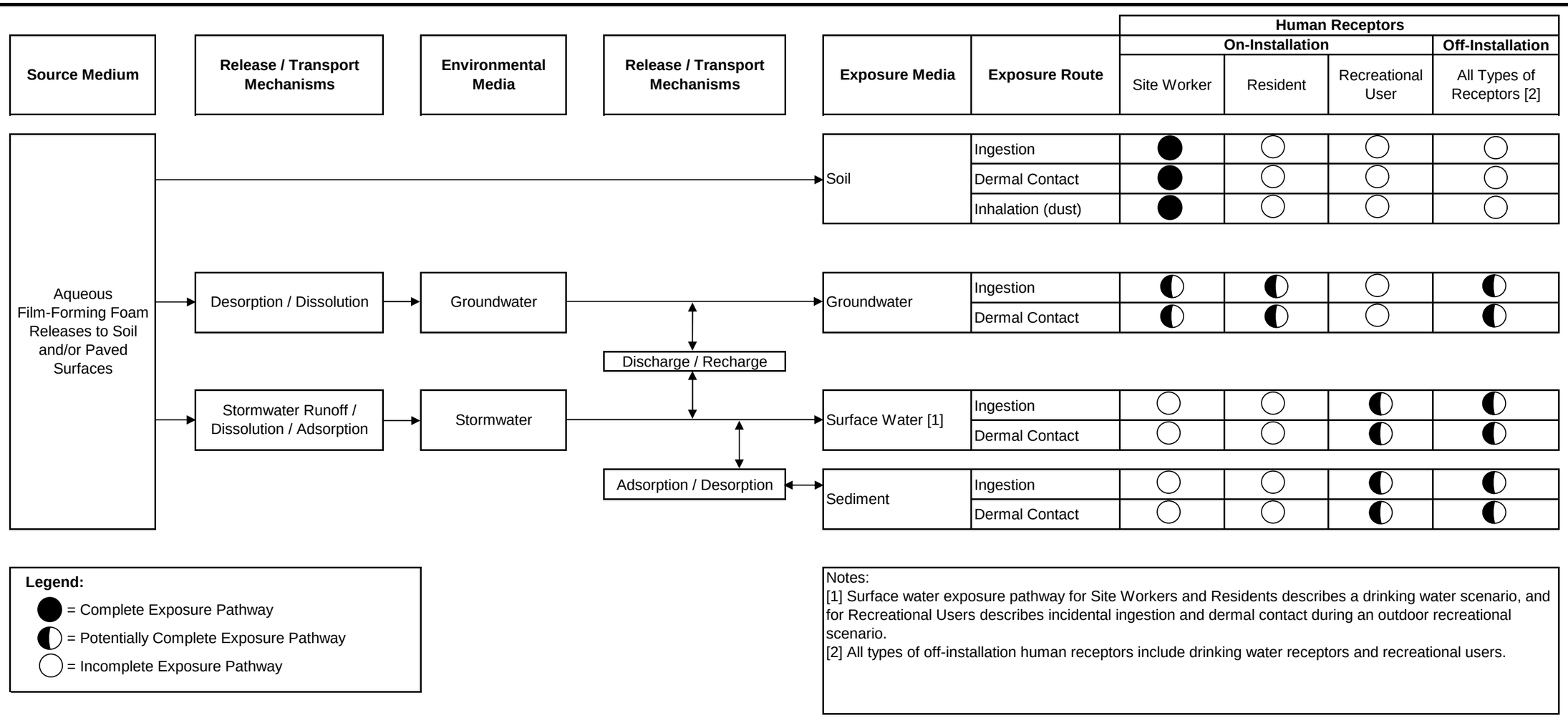
0 50 100
Feet

Installation Boundary
AOPI
Stream (Perennial)
Stormwater/Surface Runoff Flow Direction
Surface Water Flow Direction
Monitoring Well
Shallow Soil Sampling Location

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

Data Sources:
USAG-HI, GIS Data, 2018
HGGRC, Well Data, 2019
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

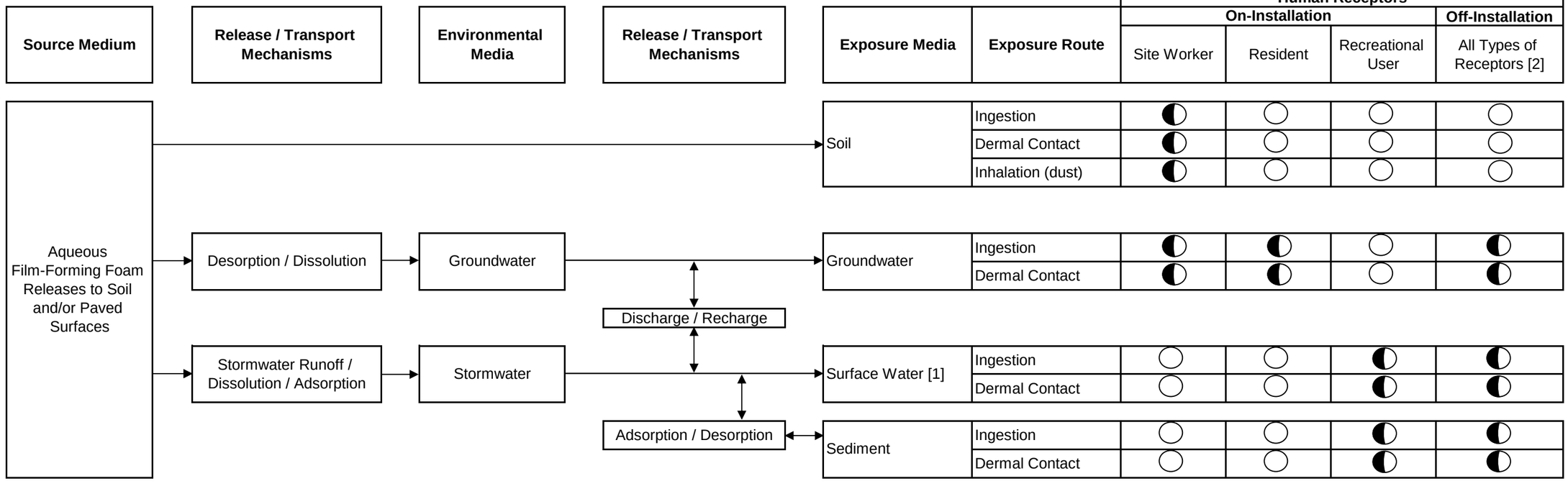


Conceptual Site Model for Building 200: Fire Station #14, Fire Truck Water Tank Drainage Area, Building 100: Car Fire, Runway AFFF Training Area, Helicopter Crash, and Wheeler Gulch AOPIs

USAEC PFAS Preliminary Assessment / Site Inspection

Wheeler Army Airfield, Hawaii

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 an outdoor recreational scenario.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

ARCADIS

Conceptual Site Model for Building 251: Civil Air Patrol Hangar AOPI
USAEC PFAS Preliminary Assessment / Site Inspection
Wheeler Army Airfield, Hawaii

Figure 7-9