FINAL PRELIMINARY ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES

U.S. Army Garrison-Hawaii Sub-installations Dillingham Military Reservation, Kahuku Training Area, Kipapa Ammunition Storage Site, Kunia Field Station, Makua Military Reservation, and Waikakalaua Ammunition Storage Tunnels

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Preliminary Assessment of Per- and Polyfluoroalkyl Substances

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PRELIMINARY ASSESSMENT OF PFAS AT U.S. ARMY GARRISON-HAWAII SUB-INSTALLATIONS DILLINGHAM MILITARY RESERVATION, KAHUKU TRAINING AREA, KIPAPA AMMUNITION STORAGE SITE, KUNIA FIELD STATION, MAKUA MILITARY RESERVATION, AND WAIKAKALAUA AMMUNITION STORAGE TUNNELS

CONTENTS

Executive Summary ES-1

1 Introduction 1

1.1 Project Background 1

1.2 PA Objectives 2

1.3 PA Process Description 2

1.3.1 Pre-Site Visit 2

1.3.2 Preliminary Assessment Site Visit 3

1.3.3 Post-Site Visit 3

2 Installation Overviews 4

2.1 Dillingham Military Reservation 4

2.1.1 Site Location 4

2.1.2 Mission and Brief Site History 4

2.1.3 Current and Projected Land Use 4

2.1.4 Climate 5

2.1.5 Topography 5

2.1.6 Geology 5

2.1.7 Hydrogeology 5

2.1.8 Surface Water Hydrology 5

2.1.9 Relevant Utility Infrastructure 6

2.1.9.1 Stormwater Management System Description 6

2.1.9.2 Sewer System Description 6

2.1.10 Potable Water Supply and Drinking Water Receptors 6

2.1.11 Ecological Receptors 7

2.1.12 Previous PFAS Investigations 7

2.2 Kahuku Training Area 7

2.2.1 Site Location 7

2.2.2 Mission and Brief Site History 7

2.2.3 Current and Projected Land Use 7

2.2.4 Climate 8

2.2.5 Topography 8
2.2.6 Geology 8
2.2.7 Hydrogeology 8
2.2.8 Surface Water Hydrology 8
2.2.9 Relevant Utility Infrastructure 9
2.2.9.1 Stormwater Management System Description 9
2.2.9.2 Sewer System Description 9
2.2.10 Potable Water Supply and Drinking Water Receptors 9
2.2.11 Ecological Receptors 9
2.2.12 Previous PFAS Investigations 9
2.3 Kipapa Ammunition Storage Site 10
2.3.1 Site Location 10
2.3.2 Mission and Brief Site History 10
2.3.3 Current and Projected Land Use 10
2.3.4 Climate 10
2.3.5 Topography 10
2.3.6 Geology 10
2.3.7 Hydrogeology 11
2.3.8 Surface Water Hydrology 11
2.3.9 Relevant Utility Infrastructure 11
2.3.9.1 Stormwater Management System Description 11
2.3.9.2 Sewer System Description 11
2.3.10 Potable Water Supply and Drinking Water Receptors 12
2.3.11 Ecological Receptors 12
2.3.12 Previous PFAS Investigations 12
2.4 Kunia Field Station 12
2.4.1 Site Location 12
2.4.2 Brief Site History 12
2.4.3 Current and Projected Land Use 13
2.4.4 Climate 13
2.4.5 Topography 13

2.4.6 Geology 13
2.4.7 Hydrogeology 13
2.4.8 Surface Water Hydrology 13
2.4.9 Relevant Utility Infrastructure 14
2.4.9.1 Stormwater Management System Description 14
2.4.9.2 Sewer System Description 14
2.4.10 Potable Water Supply and Drinking Water Receptors 14
2.4.11 Ecological Receptors 14
2.4.12 Previous PFAS Investigations 15
2.5 Makua Military Reservation 15
2.5.1 Site Location 15
2.5.2 Mission and Brief Site History 15
2.5.3 Current and Projected Land Use 16
2.5.4 Climate 16
2.5.5 Topography 16
2.5.6 Geology 16
2.5.7 Hydrogeology 17
2.5.8 Surface Water Hydrology 17
2.5.9 Relevant Utility Infrastructure 17
2.5.9.1 Stormwater Management System Description 17
2.5.9.2 Sewer System Description 17
2.5.10 Potable Water Supply and Drinking Water Receptors 17
2.5.11 Ecological Receptors 18
2.5.12 Previous PFAS Investigations 18
2.6 Waikakalaua Ammunition Storage Tunnels 18
2.6.1 Site Location 18
2.6.2 Mission and Brief Site History 18
2.6.3 Current and Projected Land Use 19
2.6.4 Climate 19
2.6.5 Topography 19
2.6.6 Geology 19

2.6.7 Hydrogeology 19
2.6.8 Surface Water Hydrology 20
2.6.9 Relevant Utility Infrastructure 20
2.6.9.1 Stormwater Management System Description 20
2.6.9.2 Sewer System Description 20
2.6.10 Potable Water Supply and Drinking Water Receptors 20
2.6.11 Ecological Receptors 20
2.6.12 Previous PFAS Investigations 21
3 Summary of PA Activities 22
3.1 Records Review 22
3.2 Personnel Interviews 22
3.3 Site Reconnaissance 23
4 Potential PFAS Use, Storage, and/or Disposal Areas 24
4.1 AFFF Use, Storage, and Disposal Areas 24
4.2 Other PFAS Use, Storage, and/or Disposal Areas 24
4.3 Readily Identifiable Off-Post PFAS Sources 25
5 Summary and Discussion of PA Results 31
5.1 Areas Not Retained for Further Investigation 31
6 Conclusions and Recommendations 36
7 References 37
Acronyms 39

TABLES

Table 4-3-1. Off-Post PFAS Sources (KTA) 25
Table 4-3-2. Off-Post PFAS Sources (KASS) 26
Table 4-3-3. Off-Post PFAS Sources (KFS) 27
Table 4-3-4. Off-Post PFAS Sources (MMR) 28
Table 4-3-5. Off-Post PFAS Sources (WAST) 29
Table 5-1-1. Installation Areas Not Retained for Further Investigation 32

FIGURES

Figure 2-1-1 Dillingham Military Reservation Site Location

Figure 2-1-2 Dillingham Military Reservation Site Layout

Figure 2-1-3 Dillingham Military Reservation Topographic Map

Figure 2-1-4 Dillingham Military Reservation Off-Post Potable Supply Wells

Figure 2-2-1 Kahuku Training Area Site Location

Figure 2-2-2 Kahuku Training Area Site Layout

Figure 2-2-3 Kahuku Training Area Topographic Map

Figure 2-2-4 Kahuku Training Area Off-Post Potable Supply Wells

Figure 2-3-1 Kipapa Ammunition Storage Site - Site Location

Figure 2-3-2 Kipapa Ammunition Storage Site - Site Layout

Figure 2-3-3 Kipapa Ammunition Storage Site Topographic Map

Figure 2-3-4 Kipapa Ammunition Storage Site Off-Post Potable Supply Wells

Figure 2-4-1 Kunia Field Station Site Location

Figure 2-4-2 Kunia Field Station Site Layout

Figure 2-4-3 Kunia Field Station Topographic Map

Figure 2-4-4 Kunia Field Station Off-Post Potable Supply Wells

Figure 2-5-1 Makua Military Reservation Site Location

Figure 2-5-2 Makua Military Reservation Site Layout

Figure 2-5-3 Makua Military Reservation Topographic Map

Figure 2-5-4 Makua Military Reservation Off-Post Potable Supply Wells

Figure 2-6-1 Waikakalaua Ammunition Storage Tunnels Site Location

Figure 2-6-2 Waikakalaua Ammunition Storage Tunnels Site Layout

Figure 2-6-3 Waikakalaua Ammunition Storage Tunnels Topographic Map

Figure 2-6-4 Waikakalaua Ammunition Storage Tunnels Off-Post Potable Supply Wells

Figure 5-1-1 AOPI Decision Flowchart (in text)

APPENDICES

Appendix A	Office of the Secretary of Defense. 2021. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.
Appendix B	Preliminary Assessment Quality Control Checklist
Appendix C	Antiterrorism/Operations Security Review Cover Sheet
Appendix D	Not used
Appendix E	Installation EDR Survey Reports (included in Final PA Report electronic deliverable only)
Appendix F	Research Log
Appendix G	Compiled Interview Logs
Appendix H	Site Reconnaissance Photo Log
Appendix I	Compiled Site Reconnaissance Logs

EXECUTIVE SUMMARY

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate, perfluorooctanoic acid, and perfluorobutanesulfonic acid, at Army installations (installations) nationwide. The PA identifies areas of potential interest (AOPIs) where PFAS-containing materials were used, stored, and/or disposed, or areas where known or suspected releases to the environment occurred. The PA was completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, National Oil and Hazardous Substances Pollution Contingency Plan, and Army/Department of Defense policy and guidance.

This report provides the PA for U.S. Army Garrison-Hawaii Sub-installations Dillingham Military Reservation (DMR), Kahuku Training Area (KTA), Kipapa Ammunition Storage Site (KASS), Kunia Field Station (KFS), Makua Military Reservation (MMR), and Waikakalaua Ammunition Storage Tunnels (WAST).

Dillingham Military Reservation

DMR is located on the northwest side of Oahu, Hawaii, approximately 4 miles west of the town of Waialua. Situated between the Pacific Ocean to the north and the Waianae Mountain Range to the south, DMR consists of 664 acres and is surrounded by remote and sparsely populated land. DMR was acquired in 1925 and used as an Army encampment and for training purposes. The installation was transferred from the Army to the U.S. Air Force after World War II and was closed in 1948. In 1961, a Nike-Hercules Missile Launching site was constructed, which was closed in 1970 (Bennett 2010). The State of Hawaii began leasing DMR for general aviation use in 1962 and, circa 1974, DMR was transferred from the U.S. Air Force back to the Army. The installation consists of three training areas: a privately used/owned cantonment area with administration buildings and aircraft hangers for small aircraft; a joint-use civilian/military airfield with a runway with associated critical infrastructure, as well as several hangers, a tie-down area for recreational aircraft, and three airborne drop zones. Currently, the State of Hawaii manages the airport under authority of a revocable lease. The facility is a joint-use airfield with the Army having first priority for air-land operations and helicopter night-vision training. Although the State of Hawaii initially intended to terminate their lease on June 30, 2020, the lease was extended to December 31, 2021. Based on the results of the PA for DMR, no AOPIs were identified. Therefore, further investigation for PFAS at DMR is not warranted at this time.

Kahuku Training Area

KTA is located on the north side of Oahu, Hawaii, approximately 2 miles west of the town of Kahuku. KTA is situated on 9,480 acres, the majority of which is in the Koolau Mountains, that abuts Kawailoa Training Area (an Army installation) to the southwest and is surrounded by agricultural land, other private land, and government owned properties. The Pacific Ocean is located approximately one mile north of the installation's northern boundary. KTA was initially established in 1944 for use as a training area. Over half of KTA is used for ground maneuver training and, although KTA does not have a defined cantonment area, the installation does have several compounds to support Army-related operations. KTA also has designated helipads/landing zones for military helicopters and parachute drop zones for personnel and

equipment. Based on the results of the PA for KTA, no AOPIs were identified. Therefore, further investigation for PFAS at KTA is not warranted at this time.

Kipapa Ammunition Storage Site

KASS is located in the Kipapa Stream Valley of central Oahu, Hawaii, southeast of Wheeler Army Airfield and consists of two areas, Upper Kipapa and Lower Kipapa, that total approximately 400 acres and are located approximately one mile apart. Upper Kipapa is located immediately adjacent to the southeastern side of the city of Mililani Town and Lower Kipapa is located south of the city of Mililani Town. KASS is comprised of 80 underground storage tunnels that were reportedly constructed during World War II for the purpose of storing incendiaries and high explosives. The tunnels were subsequently used to store insecticides and chemical agents prior to being put out of service in the early 1960s and 1970s. After removal of the chemicals and ammunition, a few of the tunnels were used by the Army for other purposes including prisoner of war training. KASS is not currently utilized, with the exception of one tunnel used by the National Oceanic and Atmospheric Administration to store geophysical earthquake detection equipment. Based on the results of the PA for KASS, no AOPIs were identified. Therefore, further investigation for PFAS at KASS is not warranted at this time.

Kunia Field Station

KFS is located in central Oahu, Hawaii, approximately 1.5 miles southwest of the town of Wahiawa. The installation occupies approximately 30 acres adjacent to Wheeler Army Airfield and Schofield Barracks in an area surrounded by agricultural and/or vegetated land. KFS is an underground, three-story facility that was constructed as an underground aircraft assembly facility after the attack on Pearl Harbor, between 1943 and 1944. Historically, KFS has been maintained and/or operated by the U.S. Air Force and the U.S. Navy. The facility has been used for ammunition and torpedo storage and, between 1958 and 1959, was converted to the U.S. Pacific Fleet operations and Control Center. In 1981, KFS became part of the U.S. communications network providing rapid and secure radio relay communications for defense. KFS is currently used by the National Security Agency. Based on the results of the PA for KFS, no AOPIs were identified. Therefore, further investigation for PFAS at KFS is not warranted at this time.

Makua Military Reservation

MMR is located on the west side of Oahu, Hawaii, approximately 3 miles north of the town of Makaha. Situated between the Pacific Ocean to the west and the Waianae Mountain Range to the north, east, and south, MMR consists of 4,190 acres in a remote and sparsely populated area. Neighboring properties along the Waianae Mountain ridgelines are occupied by private landowners and forest reserves. The primary mission of the MMR is training activities; generally week-long exercises by the U. S. Army or Marine Corps rifle company, however, as of 2011, it no longer includes live-fire training. MMR was first utilized after the bombing of Pearl Harbor in 1941 and the U.S. Military has maintained a presence until the time of this writing. MMR is currently used as the largest training area on Oahu that conducts maneuver training. Based on the results of the PA for MMR, no AOPIs were identified. Therefore, further investigation for PFAS at MMR is not warranted at this time.

Waikakalaua Ammunition Storage Tunnels

WAST is located in central Oahu, Hawaii, immediately south of Wheeler Army Airfield. Although WAST was initially comprised of approximately 315 acres, portions of the initial installation have been transferred to Wheeler Army Airfield and to a private golf course. As a result, the size of the installation has

decreased to 176 acres. WAST consisted of 52 tunnels built into a hillside that were used to store ammunition during and after World War II. Ordnance storage tunnels and underground fuel storage tanks were reportedly constructed between 1942 and 1945. The installation was active until the 1950s, after which it remained inactive and undeveloped. Based on the results of the PA for WAST, no AOPIs were identified. Therefore, further investigation for PFAS at WAST is not warranted at this time.

1 INTRODUCTION

The United States (U.S.) Army (Army) is performing preliminary assessments (PAs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), at Army installations (installations) nationwide. The Army is the lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Executive Order 12580 and is conducting the PA consistent with its authority under CERCLA, 42 U.S. Code §§ 9600, et seq. (as amended), and the Defense Environmental Restoration Program, 10 U.S. Code §§ 2701, et seq. The purpose of this PA is to identify locations that are areas of potential interest (AOPIs) at U.S. Army Garrison-Hawaii (USAG-HI) Sub-installations Dillingham Military Reservation (DMR), Kahuku Training Area (KTA), Kipapa Ammunition Storage Site (KASS), Kunia Field Station (KFS), Makua Military Reservation (MMR), and Waikakalaua Ammunition Storage Tunnels (WAST) 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). This report provides the PA for USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST 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 U.S. Environmental Protection Agency (USEPA) established a lifetime health advisory of 70 nanograms per liter (ng/L) in drinking water for PFOS or PFOA and for the sum of PFOS and PFOA when both are present (USEPA 2016). On 15 October 2019, the Office of the Secretary of Defense (OSD) provided guidance on the investigation of PFOS, PFOA, and PFBS at Department of Defense (DoD) restoration sites (OSD 2019). The DoD guidance provides risk screening levels for PFOS, PFOA, and PFBS in tap water or soil, calculated using the USEPA's Regional Screening Level calculator for residential and industrial/commercial worker receptor scenarios. Following the issuance of the 2019 OSD memo, on 8 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). The September 2021 Memorandum: Investigating PFAS within the DoD Cleanup Program is provided for reference as **Appendix A**. The OSD risk screening levels for tap water (also used to evaluate groundwater or surface water used as drinking water sources) are 40 ng/L for PFOS and PFOA, and 600 ng/L for PFBS. The PFOS and PFOA soil screening levels for the residential and industrial/commercial scenarios are 0.13 milligrams per kilogram (mg/kg; residential) and 1.6 mg/kg (industrial/commercial). The soil screening levels for PFBS are 1.9 mg/kg (residential) and 25 mg/kg (industrial/commercial).

1.2 PA Objectives

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

1.3 PA Process Description

For USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST, the PA development followed a similar process as described in Sections 1.3.1 through 1.3.3, below. Section 3 provides a summary of the PA activities completed at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST. The PA processes are documented in the PA 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 U.S. Army Environmental Command (USAEC), U.S. Army Corps of Engineers, USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST, and Arcadis U.S., Inc. (Arcadis). The kickoff call occurred on 7 January 2019, to discuss the goals and scope of the PA, project scheduling, installation access, timeline for the site visit, access to installation-specific databases, and to request available records.

Records review was conducted before the site visit to obtain electronically available documents from the installation and external sources for review. The purpose of the records research was to identify any area on the installations 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 USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST.

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

- The Installation Management Command operation order
- The Army PA Operations Security requirements package, which includes the antiterrorism/operations security review cover sheet (**Appendix C**).
- The PFAS PA kickoff call minutes.
- An information paper on the PA portion of the Army's PFAS PA.
- 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

Of the six installations discussed in this PA Report (DMR, KTA, KASS, KFS, MMR, and WAST), site visits were conducted at two installations, DMR and KTA. The site visit at DMR was conducted on 15 March 2019 and the site visit at KTA was conducted on 6 March 2019. Based on information gathered from available documents and from interviews with USAG-HI personnel, it was determined the historical or current missions, structures, and practices/activities at KASS, KFS, MMR, and WAST are consistent with the lack of use, storage, and/or disposal of PFAS-containing materials (specifically aqueous film-forming foam [AFFF]). Therefore, given there were no PFAS use, storage, and/or disposal locations identified, site visits were not warranted at KASS, KFS, MMR, and WAST. 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 of USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST. 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, and 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, and visual staining), surface water bodies and surface flow, potential receptors, and the distance to the installation boundary. Access to existing groundwater monitoring wells, if present, were also noted during the site reconnaissance in case the monitoring wells could be proposed for SI sampling. Photo documentation of the preliminary locations was collected, and access limitations or advantages related to potential future sampling activities were noted.

An exit briefing was offered to installation personnel at the conclusion of the site visit to raise any items identified during the site visit, discuss any follow-up items, and review the schedule for submitting deliverables. The exit briefing was conducted on 21 March 2019 with USAG-HI to discuss preliminary findings of the PA site visit.

1.3.3 Post-Site Visit

Information collected before, during, and after the site visit was reviewed and corroborated by cross-referencing records and reviewing interview details and observations noted during site visit reconnaissance. A site visit trip report was completed and provided to the installation POC, applicable USAEC POCs, and U.S. Army Corps of Engineers regional POCs following the site visit.

2 INSTALLATION OVERVIEWS

The following subsections provide general information about USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST, including location and layout, the installation missions over time, brief site histories, current and projected land uses, climate, topography, geology, hydrogeology, surface water hydrology, potable wells within a 5-mile radius of the installations, and applicable ecological receptors.

2.1 Dillingham Military Reservation

2.1.1 Site Location

DMR is located on the northwest side of Oahu, Hawaii, approximately 4 miles west of the town of Waialua (**Figure 2-1-1**). DMR consists of 664 acres situated between the Pacific Ocean (to the north) and the Waianae Mountain Range (to the south; **Figure 2-1-2**; Center for Environmental Management of Military Lands, Colorado State University [CEMML] 2010). The installation is surrounded by remote and sparsely populated land owned by state and private landholders (CEMML 2010).

2.1.2 Mission and Brief Site History

DMR lands were traditionally used for their coastal resources and for farming (CEMML 2010). In 1925, the installation was acquired and used as an Army encampment and for training purposes (CEMML 2010). The airfield at DMR (formerly Mokuleia Army Airfield) was constructed during World War II and consisted of a runway with parallel taxiways, revetments, various buildings (e.g., barracks, latrines, mess halls, control tower, fire station), an Air Operations Bunker, civil engineering projects (e.g., a well and pumping station, water chlorination plant, storage tanks and lines, cesspools and sewer lines, roadways, electrical distribution lines), a communications system, a radio station, fuel storage system, and ordnance storage area (Bennett 2010). The installation was transferred to the U.S. Air Force after World War II and subsequently closed in 1948, by which time most of the buildings had fallen into disrepair (Bennett 2010). In 1961, a Nike-Hercules Missile Launching site was constructed, which was closed in 1970 (Bennett 2010). The State of Hawaii began leasing DMR for general aviation use in 1962 and, circa 1974, DMR was transferred from the U.S. Air Force back to the Army (State of Hawaii 2021). The State of Hawaii acquired a longer-term lease from the Army in 1974 and signed a 25-year lease for general aviation use in 1983 (State of Hawaii 2021). The airfield has been used for recreation such as glider soaring, hang-gliding, parachuting, and sky diving, as well as for operations by small single-engine and light twin-engine aircraft, sailplanes, ultra-light aircraft, and helicopters (CEMML 2010). Historically, the primary mission of DMR was to operate and maintain a safe, modernized, local training area for USAG-HI, U.S. Army Pacific Command, and other U.S. Pacific Command military units (CEMML 2010).

2.1.3 Current and Projected Land Use

Available records indicate the Army no longer maintains a cantonment area at DMR and that the installation consists of three training areas: a privately used/owned cantonment area with administration buildings and aircraft hangers for small aircraft; a joint-use civilian/military airfield with a runway with associated critical infrastructure, several hangers, and a tie-down area for recreational aircraft; and three airborne drop zones (CEMML 2010). The airport is owned by the U.S. Army and managed by the Hawaii

Department of Transportation Airports Division (HDOTA) under authority of a revocable lease (State of Hawaii 2021). The State of Hawaii Dillingham Airfield website indicates the following: HDOTA leases 272 acres at DMR and "operates the single 5,000-foot runway primarily for commercial glider and sky diving operations"; "the facility is a joint-use airfield with the Army having first priority for air-land operations and helicopter night-vision training"; and, although the State of Hawaii initially intended to terminate their lease on 30 June 2020, the lease was extended to 31 December 2021 (State of Hawaii 2021).

2.1.4 Climate

The climate at DMR can be characterized as having average temperatures ranging from 60 to 86 degrees Fahrenheit (°F) The average monthly rainfall ranges from less than 1.0 inch in the summer to 5.0 inches in the winter (CEMML 2010).

2.1.5 Topography

The northern portion of DMR is near sea level and generally flat (**Figure 2-1-3**). Land elevation increases on the southern portion of DMR, towards the Waianae Mountain Range. The elevation of DMR's southern boundary ranges from approximately 200 to 600 feet above mean sea level (amsl).

2.1.6 Geology

Oahu is composed of the weathered remnants of the Koolau and Waianae extinct shield volcanoes (Edward K. Noda and Associates, Inc. [EKN] 2002]). DMR, which is situated on the northern flank of the Waianae Mountains, is located on a narrow coastal plain, a relatively thick wedge of interbedded sediments and marine deposits, that was formed at the base of wave-cut cliffs (EKN 2002). The bottom of the stratigraphic section is composed of the Waianae basalts (EKN 2002). Beach soils are common at DMR including: Jaucas Sand, Lualualei Clay, Haleiwa Silty Clay, Pulehu Stony Clay Loam, Kaena Very Stony Clay, and Kawaihapai Stony Clay Loam soils (CEMML 2010). For these soils, the runoff potential is slow, and the hazard of erosion is slight, with the exception of Kaena Very Stony Clay which has medium to rapid runoff and moderate to severe threat of erosion (CEMML 2010).

2.1.7 Hydrogeology

DMR is located in the Mokuleia groundwater area, where the general direction of regional groundwater flow is towards the northwest (Oki 1998). Groundwater at DMR is contained in two aquifers within the Mokuleia Aquifer System (Mink and Lau 1990). The upper aquifer is classified as an unconfined basal sedimentary aquifer and the lower aquifer is classified as a confined basal flank aquifer (Mink and Lau 1990).

2.1.8 Surface Water Hydrology

In general, streams in the region flow from the Waianae Mountain Range, located south of DMR, towards the Pacific Ocean, located north of DMR. The distance from DMRs northern installation boundary to the Pacific Ocean ranges from approximately 200 to 800 feet. The following surface water features flow from the Waianae Mountain Range onto DMR: an unnamed intermittent stream, which extends across the southern installation boundary; a surface water feature identified as an intermittent stream named

Mokuleia, which runs parallel to and terminates on the southeastern installation boundary; and a perennial stream, Kawaihapai Stream, which crosses the eastern portion of the installation (**Figure 2-1-2**). There is also a wetland area near the center of the installation. In addition, according to a previous report, there is a perched wetland "located on the slopes of the southern [DMR] property boundary" (CEMML 2010). However, records do not indicate the exact location of the perched wetland. On-installation surface water features are not used as drinking water sources for the installation. Surface water features in the surrounding area include several streams, small water bodies, and the Kawaihapai Reservoir.

2.1.9 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 at DMR.

2.1.9.1 Stormwater Management System Description

Based on topography, most stormwater runoff in the area likely flows from the higher elevations of the Waianae Mountain Range, located south of DMR, to the north, towards the Pacific Ocean. At DMR, precipitation either infiltrates the ground, drains to drywells, or flows to drainage culverts that discharge to the Pacific Ocean (EKN 2002). Adjacent properties also utilize drainage culverts that drain to the Pacific Ocean (EKN 2002).

2.1.9.2 Sewer System Description

According to a previous environmental report, there was no public sewage system in proximity to the installation in 2002, and it appeared "that sanitary wastes in the vicinity are (were) handled using on-site wastewater treatment and disposal systems" (EKN 2002). Historically, DMR utilized cesspools for waste disposal; however, in 2002, "all cesspools were converted to septic tanks" (HDOTA 2007). USAG-HI asset records confirm there is a septic tank and drain field at DMR and indicate there is a sewer and industrial waste line on the installation.

2.1.10 Potable Water Supply and Drinking Water Receptors

Information regarding water sources at DMR was provided by two USAG-HI Directorate of Public Works (DPW) staff members. One USAG-HI staff member indicated the Army supplies water to the installation via a well operated by the state. The second staff member indicated the following: DMR has at least one well on-installation that is run by the state; in addition to the airfield, DMR might supply water to some residences; and there are several wells on-installation that are now closed. Available records indicate one Public Water Supply System (PWSS) well and four unused installation water wells are associated with the installation (**Figure 2-1-2**). Additionally, a development plan for the installation indicated that, in 2007, the on-post "water system" had "lots of maintenance but is in need of complete replacement and eventually connection to the County water system" (HDOTA 2007). On-post drinking water receptors include airfield staff and installation visitors.

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 DMR, which, along with state and county GIS provided by the installation, identified several off-post private and public wells (including PWSS wells) within 5 miles of the installation boundary (**Figure 2-1-4**). The EDR report providing well search results is provided as **Appendix E**.

2.1.11 Ecological Receptors

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

There are various types of flora at DMR, including forests, grasslands, lowland dry forest and shrubland, and non-native vegetation (CEMML 2010). Those flora provide terrestrial habitat for a variety of fauna. Available records indicate the following fauna may be present at DMR: a variety of birds (including waterbirds, seabirds, and raptors); feral pigs; lizards; amphibians; and invertebrates (CEMML 2010).

2.1.12 Previous PFAS Investigations

There are no readily available records for DMR that would indicate drinking water at the installation has been analyzed for PFAS.

2.2 Kahuku Training Area

2.2.1 Site Location

KTA is located on the north side of Oahu, Hawaii, approximately 2 miles west of the town of Kahuku (**Figure 2-2-1**). KTA is situated on 9,480 acres, the majority of which is in the Koolau Mountains (**Figure 2-2-2**) (CEMML 2010). KTA abuts Kawailoa Training Area (an Army installation) to the southwest and is surrounded by agricultural land, other private land, and government owned properties (CEMML 2010). The Pacific Ocean is located approximately 1 mile north of the installation's northern boundary.

2.2.2 Mission and Brief Site History

KTA provides training lands for the Army and U.S. Marine Corps units (CEMML 2010). KTA was initially established in 1944 when the Territory of Hawaii permitted 1,150 acres be used as a training area (CEMML 2010). Larger areas of land were leased by the U.S. government over time, which ultimately resulted in the current KTA footprint; however, the Army later purchased most of KTA from a private owner in 2000 (CEMML 2010).

2.2.3 Current and Projected Land Use

Over half of KTA is used for ground maneuver training (CEMML 2010). Although KTA does not have a defined cantonment area, the installation does have several compounds to support Army-related operations (CEMML 2010). The installation also has designated helipads/landing zones for military helicopters and parachute drop zones for personnel and equipment (CEMML 2010).

Recreational activities conducted at KTA include hunting (wild pigs, goats, and game birds), motocross racing, hiking, and biking (CEMML 2010). KTA will presumably continue to be used as a training area, as well as for recreational activities, in the future.

2.2.4 Climate

The climate at KTA can be characterized as having average monthly temperatures ranging from 48 to 91°F in January and 55 to 95°F in October (CEMML 2010). The average annual rainfall ranges from 40 to 50 inches near the coast to 150 inches near the top of the Koolau Mountains.

2.2.5 Topography

The majority of KTA is situated in the Koolau Mountains (**Figure 2-2-3**). The northern portion of the installation consists of rolling grasslands and shrublands with moderate relief, whereas the southern portion of the installation is more elevated with rugged terrain and dense vegetation (CEMML 2010). Elevations at KMR range from approximately 100 feet amsl near the northern installation boundary to approximately 2,000 feet amsl near the southern installation boundary.

2.2.6 Geology

The Koolau Mountains are a remnant of an eroded shield volcano (CEMML 2010). Much of the lava surfaces of the shield volcano remain intact along the Kahuku slopes, along drainages, and in the outcrops of the upland areas (CEMML 2010). Common soil types at KTA include: Kapaa Silty Clay, Kemoo-Badland Complex, Kaena Very Stony Clay, Kawaihapai Stony Clay Loam, Keemo Silty Clay, Paumalu Silty Clay, and Paumalu- Badland Complex (CEMML 2010).

2.2.7 Hydrogeology

The majority of groundwater at KTA is contained within two aquifers in the Koolauloa Aquifer System (Mink and Lau 1990). The aquifer on the east side of KTA is classified as an unconfined basal flank aquifer, and the aquifer on the west side of KTA is classified as an unconfined high level dike aquifer (Mink and Lau 1990). The installation is located within the Northern Koolau Rift Zone, where groundwater discharges to the Pacific Ocean (east and north of KTA); however, the general direction of groundwater flow on the west side of KTA is towards the west (Oki 1998).

2.2.8 Surface Water Hydrology

Multiple intermittent and perennial streams transect KTA. The streams flow from the mountainous central and southern portions of KTA towards the northern and eastern installation boundaries (**Figure 2-2-3**). Available records also indicate there is a pond, identified as Onion Pond, located on the south side of KTA; however, records do not specify Onion Pond's exact location (CEMML 2010). On-installation surface water features are not used as drinking water sources for the installation. Surface water features in the surrounding area include swamps/marshes, lakes/ponds, and streams (CEMML 2010).

2.2.9 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 at KTA.

2.2.9.1 Stormwater Management System Description

Available records do not provide information regarding stormwater management at KTA. However, based on topography, stormwater runoff flows from the mountainous central and southern portions of KTA towards the northern and eastern installation boundaries (**Figure 2-2-3**).

2.2.9.2 Sewer System Description

According to USAG-HI personnel, the range at KTA has portable toilet facilities; however, there is a bathroom at the wash rack. The wash rack at KTA is used to wash vehicles (i.e., remove seeds and large clumps of soil that may accumulate on the vehicles) prior to leaving the installation (CEMML 2010). USAG-HI personnel also indicated there is a septic tank at KTA for the wash rack.

2.2.10 Potable Water Supply and Drinking Water Receptors

USAG-HI DPW staff noted the following: the installation does not have water; personnel bring in their own water when conducting exercises; and KTA has a non-potable water well. There are currently no drinking water receptors at KTA because, according to USAG-HI DPW staff, drinking water is not provided by the installation.

An EDR report was generated for KTA, which along with state and county GIS provided by the installation identified several off-post private and public wells (including PWSS wells) within 5 miles of the installation boundary (**Figure 2-2-4**). The EDR report providing well search results is provided as **Appendix E**.

2.2.11 Ecological Receptors

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

In addition to forests, which occupy approximately 1,766 acres at KTA, vegetation communities at the installation include grasslands, shrubland, wetlands, and non-native vegetation (CEMML 2010). In general, the northern portion of KTA consists of rolling grasslands and shrublands and the southern portion of KTA consists of dense vegetation (CEMML 2010). The flora at KTA provides habitat for a variety of fauna, including mammals, fish, birds, amphibians, and reptiles (CEMML 2010).

2.2.12 Previous PFAS Investigations

According to USAG-HI DPW personnel, the installation does not have water, and personnel bring in their own water when conducting exercises. Therefore, there are no available PFAS investigation records for KTA.

2.3 Kipapa Ammunition Storage Site

2.3.1 Site Location

KASS is located in the Kipapa Stream Valley of central Oahu, Hawaii, southeast of Wheeler Army Airfield (**Figure 2-3-1**). The installation consists of two areas, Upper Kipapa and Lower Kipapa, that total approximately 400 acres and are located approximately 1 mile apart (**Figure 2-3-2**; USAG-HI 2016a). Upper Kipapa is located immediately adjacent to the southeastern side of the city of Mililani Town and Lower Kipapa is located south of the city of Mililani Town (**Figure 2-3-1**).

2.3.2 Mission and Brief Site History

The installation is comprised of 80 underground storage tunnels that were reportedly constructed during World War II for the purpose of storing incendiaries and high explosives (USAG-HI 2016a). The tunnels were subsequently used to store insecticides and chemical agents prior to being put out of service in the early 1960s and 1970s (USAG-HI 2016a). After removal of the chemicals and ammunition, a few of the tunnels were used by the Army for other purposes (USAG-HI 2016a).

2.3.3 Current and Projected Land Use

The installation is not currently utilized, with the exception of one tunnel used by the National Oceanic and Atmospheric Administration to store geophysical earthquake detection equipment (USAG-HI 2018b). Available records indicate there are no personnel that routinely work at the installation and that future land use may include reactivation of historical activities (storage of government-owned supplies and equipment) or commercial/light industrial activities (USAG-HI 2018b).

2.3.4 Climate

Temperatures in the vicinity of KASS remain relatively constant throughout the year with lows near 60°F in the winter to a little over 80°F in the summer (USAG-HI 2018b). Monthly rainfall in central Oahu (where the installation is located) varied from 3.87 inches in August to 7.74 inches in December from 1981 to 2010 (USAG-HI 2018b). The mean annual rainfall in the area is 64 inches per year (USAG-HI 2018b).

2.3.5 Topography

The elevation at Upper Kipapa ranges from approximately 360 to 600 feet amsl, and the elevation at Lower Kipapa ranges from approximately 200 to 400 feet amsl (**Figure 2-3-3**). Based on elevation contours (**Figure 2-3-3**) and aerial images, land along the Upper Kipapa and Lower Kipapa installation boundaries is steep, with more gradual changes in elevation near the center of each area. Aerial images also indicate both the Upper Kipapa and Lower Kipapa are heavily vegetated.

2.3.6 Geology

KASS is located in an area beneath which there are tertiary lava flows of the Koolau volcanic series (USAG-HI 2018b). Soils are predominantly comprised of the Helemano-Wahiawa association, which are

generally deep, well-drained soils with a fine-textured subsoil. No karst topography has been identified in the vicinity of KASS.

2.3.7 Hydrogeology

KASS is located in the Pearl Harbor groundwater area, where the general direction of regional groundwater flow is towards the south (Oki 1998). Groundwater at KASS is contained in an aquifer within the Waiawa Aquifer System of the Pearl Harbor Aquifer Sector (Mink and Lau 1990). The aquifer is classified as an unconfined basal flank aquifer (Mink and Lau 1990). Basal groundwater is likely to be encountered at the installation at a depth of approximately 300 feet bgs (USAG-HI 2018b). Shallow groundwater may be encountered at approximately 15 to 30 feet bgs because of the proximity to Kipapa Stream.

2.3.8 Surface Water Hydrology

Kipapa Stream is a perennial stream that flows northeast to southwest, transects through the center of both Upper Kipapa and Lower Kipapa, and merges with Waikele Stream south of the installation (**Figure 2-3-3**). Although the installation is primarily drained by Kipapa Stream, small tributaries of Kipapa Stream also collect runoff from the installation (USAG-HI 2018b). Additionally, there are ditches located near multiple tunnel entrances; however, no clearly defined drainage channels exist from the tunnel entrances to Kipapa Stream. On-installation surface water features are not used as drinking water sources for the installation. Surface water features in the surrounding area include streams and relatively small surface water bodies (e.g., ponds).

2.3.9 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 at KASS.

2.3.9.1 Stormwater Management System Description

Although available records do not provide information regarding a stormwater management system at KASS, USAG-HI asset records indicate there is a storm sewer on the installation. Based on topography, stormwater runoff along the installation boundaries likely flows towards the lower elevations near the center of Upper Kipapa and Lower Kipapa and continues towards the southwest (**Figure 2-3-3**).

2.3.9.2 Sewer System Description

Available records do not provide information regarding a sewer system at KASS. However, although a few of the tunnels were used by the Army for other purposes, the installation consists of tunnels that have been primarily used to store incendiaries and high explosives, insecticides, and chemical agents (USAG-HI 2016a). Therefore, it is unlikely that a sewer system exists at KASS.

2.3.10 Potable Water Supply and Drinking Water Receptors

According to USAG-HI DPW personnel, water is not supplied to KASS.

An EDR report was generated for KASS, which, along with state and county GIS provided by the installation, identified several off-post private and public wells (including PWSS wells) within 5 miles of the installation boundary (**Figure 2-3-4**). The EDR report providing well search results is provided as **Appendix E**.

2.3.11 Ecological Receptors

Given that KASS is heavily vegetated, there are likely various ecological receptors (e.g., birds, amphibians, reptiles) present at KASS. According to a previous report: there are no drinking water intakes or designated fisheries downstream of KASS along Kipapa Stream; aquatic species, including fish, are found in Waikele Stream; fishing may occur in Waikele Stream; and, the Hawaiian hoary bat, which is present throughout Oahu, could potentially be found on-installation (USAG-HI 2018b).

2.3.12 Previous PFAS Investigations

According to USAG-HI DPW personnel, water is not supplied to KASS. Therefore, there are no available PFAS investigation records for KASS.

2.4 Kunia Field Station

2.4.1 Site Location

KFS is located in central Oahu, Hawaii, approximately 1.5 miles southwest of the town of Wahiawa (**Figure 2-4-1**). The installation occupies approximately 30 acres in an area immediately surrounded by agricultural and/or vegetated land (**Figure 2-4-2**). KFS is adjacent to Wheeler Army Airfield to the east (across HI-750 [Kunia Road]) and Schofield Barracks to the north, west, and southwest.

2.4.2 Brief Site History

KFS was constructed after the attack on Pearl Harbor, between 1943 and 1944, (U.S. Department of Veterans Affairs [USVA] 2021; USAG-HI 2013a). Available records indicate at the end of World War II, KFS was maintained by the U.S. Air Force; subsequently, ownership of KFS was transferred from the U.S. Air Force to the U.S. Navy, which operated the facility from 1953 until it was deactivated in 1976. After the installation was transferred from the U.S. Air Force to the U.S. Navy, KFS was used for ammunition and torpedo storage and, between 1958 and 1959, was converted to the U.S. Pacific Fleet operations and Control Center. In 1981, KFS was transferred to the U.S. Army and became part of the U.S. communications network providing rapid and secure radio relay communications for defense. In fiscal year 1997, responsibility for maintenance of the facility changed from the U.S. Army to the U.S. Navy (USAG-HI 1997, USVA 2021, and USAG-HI 2013a).

2.4.3 Current and Projected Land Use

Currently, the National Security Agency uses the installation (USVA 2021). Readily available records do not identify the projected future land use for KFS.

2.4.4 Climate

The climate of KFS can be characterized as having an annual mean temperature of 71.5°F (U.S. Department of Commerce 2021). The area surrounding KFS receives approximately 45 inches of rainfall per year, most of which falls during October to April (USAG-HI 2018a). KFS receives northeasterly trade winds from 4 to 12 miles per hour in the summer months, while the winter months bring more subtle southeasterly winds. There is also a risk for drought and wildfire in the area that is highest in the summer and early fall (CEMML 2010).

2.4.5 Topography

Land elevation at KFS ranges from approximately 740 feet amsl near the center of the installation to approximately 800 feet amsl near the installation boundaries (**Figure 2-4-3**). A large portion of the site footprint consists of the underground tunnels mentioned above. The reminder of the site is primarily flat with little change in surface contours. KFS generally slopes to the east (**Figure 2-4-3**).

2.4.6 Geology

Soils at KFS are part of the Kunia Series, consisting of well-drained soils found on upland terraces. Specifically, KFS is characterized by the presence of as Kunia silty clay, a dark reddish-brown silty clay with a sub-angular blocky structure. Kunia soils are typically found near the base of the Waianae Mountain Range and are associated geographically with the Kolekole, Lahaina, and Wahiawa soils (USAG-HI 2018a).

2.4.7 Hydrogeology

The general direction of regional groundwater flow in the area is towards the south (Oki 1998). Groundwater at KFS is contained in an aquifer within the Wahiawa Aquifer System of the Central Aquifer Sector and is classified as an unconfined high level dike aquifer (Mink and Lau 1990). Regional groundwater is estimated to be approximately 600 bgs (USAG-HI 2013a).

2.4.8 Surface Water Hydrology

Surface water flow from KFS primarily drains to the Waikele Stream (**Figure 2-4-3**). Waikele Stream is a perennial stream that transects KFS from the north and exits the site to the southeast. Surface water features in the surrounding area include multiple streams and the Wahiawa Reservoir. On-installation surface water features are not used as drinking water sources for the installation.

2.4.9 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 at KFS.

2.4.9.1 Stormwater Management System Description

USAG-HI asset records indicate there are active storm sewer and industrial waste lines as well as several vegetated storm drainage ditches at KFS.

2.4.9.2 Sewer System Description

USAG-HI asset records indicate there are active sanitary sewer and industrial waste lines connected to installation facilities.

2.4.10 Potable Water Supply and Drinking Water Receptors

According to USAG-HI DPW personnel, water at KFS is supplied by Schofield Barracks. USAG-HI DPW personnel also noted the following: there is an existing well at KFS that is currently used for cooling/air conditioning; they were unaware if the well had been tested; there are two wells in the surrounding area that are used to assess trichloroethene concentrations in groundwater and that those wells utilize a "scrubber"; and there is a water supply source at Kunia Village (located south of KFS). According to USAG-HI GIS data, there are three installation wells associated with KFS(**Figure 2-4-2**). However, USAG-HI GIS data also indicates two of those wells are abandoned and one is unused. Therefore, although USAG-HI DPW personnel noted there is an existing well at KFS that is currently used for cooling/air conditioning and that they were unaware if the well had been tested, the three installation wells would currently not be used for cooling and would not be tested (because, according to USAG-HI GIS data, they are either abandoned or unused). Available records do indicate the Kunia Village well is a PWSS well (**Figure 2-4-4**), and a previous report indicates there are two wells south of Kunia Field Station that have wellhead strippers to remove contaminants from groundwater (presumably the "scrubbers" mentioned by USAG-HI personnel; Cape Environmental Management, Inc. 2019). Information regarding the drinking water wells at Schofield Barracks will be provided in a separate PA/site inspection report for that installation. On-post drinking water receptors at KFS include installation personnel and visitors. An EDR report was generated for KFS, which, along with state and county GIS provided by the installation, identified several off-post private and public wells (including PWSS wells) within 5 miles of the installation boundary (**Figure 2-4-4**). The EDR report providing well search results is provided as **Appendix E**.

2.4.11 Ecological Receptors

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

Except for the perimeter, the footprint of KFS has been largely developed with buildings and a parking lot. There is likely little habitat suitable to support ecological receptors within the footprint of KFS. However, the surrounding area, particularly to the west and high in the Wai‘anae Mountains, can be categorized as having significant biological activity (CEMML 2010).

2.4.12 Previous PFAS Investigations

According to USAG-HI DPW personnel, water at KFS is supplied by Schofield Barracks. Information regarding the drinking water wells at Schofield Barracks (including previous PFAS investigations) will be provided in a separate PA/site inspection report prepared for that installation. There are no readily available records for KFS that would indicate the installation water wells have been analyzed for PFAS constituents.

2.5 Makua Military Reservation

2.5.1 Site Location

MMR is located on the west side of Oahu, Hawaii, approximately 3 miles north of the town of Makaha (**Figure 2-5-1**). MMR consists of 4,190 acres situated between the Pacific Ocean to the west and the Waianae Mountain Range to the north, east, and south (**Figure 2-5-2**; USAG-HI 2013b). Neighboring properties along the Waianae Mountain ridgelines are occupied by private landowners and forest reserves, and the surrounding area is remote and sparsely populated (CEMML 2010).

2.5.2 Mission and Brief Site History

The primary mission of the MMR is training activities, generally week-long exercises by the U.S. Army or Marine Corps rifle company. It is also occasionally used on weekends by Reserve components and National Guard units (CEMML 2010). The previous primary mission of MMR included extensive amounts of live-fire training, allowing for simulated assaults on mock military objectives by combined artillery, ground troops, naval ships, and helicopters. However, this mission was suspended and ultimately stopped in 2011 in the pursuit of more sustainable land use practices and for the protection of federally listed endangered and threatened species in the area (CEMML 2010 and Geotechnical and Structures Laboratory Waterways Experiment Station [GSL] 2015).

Prior to the 1920s, settlements, habitations, and agricultural practices were recorded within the current footprint of MMR. During the 1920s, three parcels on the upper Makua Valley floor were purchased by the U.S. Armed Forces for howitzer emplacements (GSL 2015). After the bombing of Pearl Harbor in 1941 and during a period of Marshall law, the entire Makua valley area was acquired by the U.S. Army for military security and training operations (CEMML 2010).

In 1943, the Territory of Hawaii issued a permit to the U.S. Military initiating a Real Estate Directive and allowing the U.S Military to acquire private and territorial lands in the Makua Valley to assist with the war effort for the duration of the war and 6 months thereafter. The installation was first recorded as a live fire training area shortly after the acquisition by the U.S. Military.

Available historic records indicate that the U.S. Military maintained its presence at the installation after the permit had officially expired with unwritten consent of the Territory of Hawaii. In 1959, Hawaii was admitted to the Union and the entire area was acquired by the State of Hawaii (CEMML 2010). In 1964, following it admission to the Union, President Johnson signed Executive Order number 11166, setting aside 3,236 acres of the Makua Valley for the U.S. An additional 1,509 acres of the lower portion of the Makua Valley was leased to the U.S. Army starting in August of 1964 for a term 65 years. This lease permitted the Army to continue military utilization of the additional area of the Makua Valley. A portion of the 1,509 acres was eventually leased back to the State of Hawaii to be used as a beach park, mentioned below in Section 2.5.3, bringing the installation to its present size. The lease expires on 16 August 2029 (CEMML 2010).

2.5.3 Current and Projected Land Use

MMR is currently the largest training area on Oahu that conducts maneuver training (CEMML 2010). Additionally, MMR has approximately 2.5 miles of coastal shorefront that has been leased to the State of Hawaii as a Public Park and is not currently used for training purposes by the Army. However, when the Army deems it necessary, the beach and Farrington Highway may be closed for the Marine Corps to conduct amphibious assault operations (CEMML 2010 and GSL 2015).

Future land use activities include an ongoing monitoring/sampling effort that takes place at MMR. Surface water and stream soils from all three streams within the project footprint that flow to the ocean are sampled for a range of constituents. (CEMML 2010). According to available records, it is presumed that the future mission and resulting land use of MMR will undoubtedly change over the next five years but the decision-making framework, will be guided by natural resource conservation and training impact, and will remain consistent with today's uses (CEMML 2010).

2.5.4 Climate

The climate on the west side of Oahu, where MMR is located, has a coastal arid climate. The winter brings cooler temperatures and greater precipitation while the summer is hotter and drier. However, conditions are mild and similar year-round. Average annual precipitation is 29 inches, and the mean temperature is approximately 73^{o}F (USAG-HI 2013c).

2.5.5 Topography

MMR is situated within the adjoining Makua Valley to the south and Kahanahaiki Valley to the north (USAG-HI 2013b). Due to the surrounding mountains, elevations at MMR can range from 20 to 400 feet amsl on the valley floor to 2,100 to 2,900 feet amsl at the Waianae Mountain ridgeline (**Figure 2-5-3**).

2.5.6 Geology

Primarily, the geology of MMR is comprised of lava flows and noncalcareous sedimentary materials. The coastal portion of MMR consists of beach dune sands underlain by calcareous cemented sands, rubble, and remnants of an emerged ancient reef. As a result of the many microenvironments at MMR, the soils are a complex mix and can vary drastically in slope and valley floor. Soils found at MMR include stony land, stony clays, and rock land (USAG-HI 2021).

2.5.7 Hydrogeology

Groundwater at MMR flows to the west toward the Pacific Ocean. The groundwater on the installation is hydraulically contained to the valleys within the footprint of the installation (GSL 2015).

2.5.8 Surface Water Hydrology

There are two intermittent streams and one perennial stream at MMR. The intermittent streams, the Kaiahi Gulch and the Punapohaku Stream, run along the northwest and southwest portions of the installation, respectively. The perennial stream, Makua Stream, runs centrally thought the installation with headwaters in the north, east, and south of boundaries of the installation (**Figure 2-5-1**). Typically, surface water flows are only seen in the Makua Valley after periods of significant precipitation resulting in 2 to 5 inches of rainfall within a 24-hour period (GSL 2015).

2.5.9 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 at MMR.

2.5.9.1 Stormwater Management System Description

Although available records do not provide information regarding a stormwater management system at MMR, USAG-HI asset records indicate there is a storm sewer on the installation. Based on topography, stormwater runoff at MMR likely flows towards the lower elevations from east to west and ultimately discharges to the Pacific Ocean (**Figure 2-5-3**).

2.5.9.2 Sewer System Description

Facilities on MMR include an administration building, a classroom building, and a battery shop (CEMM 2010). USAG-HI asset records indicate there are an active sewage treatment, septic tank and drain field, and sewer and industrial waste line on MMR.

2.5.10 Potable Water Supply and Drinking Water Receptors

USAG-HI DPW staff noted there is potentially one building that has water with a direct storage line. However, historical records indicate that drinking water is obtained via a pipeline connected to the nearby municipal system (CEMML 2010). An EDR report was generated for MMR, which along with state and county GIS provided by the installation identified several off-post private and public wells (including PWSS wells) within 5 miles of the installation boundary (**Figure 2-5-4**). The EDR report providing well search results is provided as **Appendix E**.

2.5.11 Ecological Receptors

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

MMR is characterized by the Lowland Mesic and Lowland Dry vegetative communities. Additionally, MMR is host to four forest communities that spans 469 acres and 33 federally listed plant species. Additionally, notable fauna at MMR is comprised of one federally listed bird, one mammal, two marine mammals, three non-native mammals, and one snail species present at MMR. Informal bird observations have reported two forest, one raptor, one sea bird, one migratory shorebird, and 11 non-native species at MMR. Notably, there are an uncharacteristically large number of non-native species found at MMR. (CEMML 2010).

Historical studies attempting to characterize the impact training exercises have had on marine fauna have determined that trace levels of explosives, below the regulatory limits, were reported in a few samples (CEMML 2010).

2.5.12 Previous PFAS Investigations

Historical records indicate that drinking water is obtained via a pipeline connected to the nearby municipal system (CEMML 2010). Additionally, based on available information, there are no potable wells on-installation. Therefore, there are no available PFAS investigation records for MMR.

2.6 Waikakalaua Ammunition Storage Tunnels

2.6.1 Site Location

WAST is located in central Oahu, Hawaii, immediately south of Wheeler Army Airfield (**Figures 2-6-1** and **2-6-2**). WAST was initially comprised of approximately 315 acres; however, portions of the initial installation footprint have been transferred to Wheeler Army Airfield and to a private golf course (USAG-HI 2016b). As a result, the size of the installation has decreased to 176 acres (USAG-HI 2016b).

2.6.2 Mission and Brief Site History

WAST consisted of tunnels built into a hillside that were used to store ammunition during and after World War II (USAG-HI 2016b). Available records indicate ordnance storage tunnels and underground fuel storage tanks were reportedly constructed between 1942 and 1945 (USAG-HI 2016b). The installation was active until the 1950s, after which it remained inactive and undeveloped (USAG-HI 2016b).

Available records also indicate that, in 1946, an explosion occurred within one of the tunnels (tunnel 24A) that blew large pieces of concrete baffle out of the tunnel with such force that it destroyed a railroad track 300 feet away and formed a 20-foot depression above the tunnel (USAG-HI 2016b). As a result of the explosion, munitions response sites (MRSs) were later identified at WAST and investigation activities (e.g., preliminary assessment, site inspection, remedial investigation) were conducted (USAG-HI 2016b). Portions of the MRSs were recommended for no further action designations, while other portions of the MRSs were recommended for remedial action and long-term monitoring (USAG-HI 2016b).

2.6.3 Current and Projected Land Use

WAST is inactive and undeveloped (USAG-HI 2016b). Readily available records do not identify the projected future land use for WAST.

2.6.4 Climate

The average annual temperature at WAST is 71.5ºF (U.S. Department of Commerce 2021). The mean annual rainfall in the surrounding area is 64 inches per year (USAG-HI 2018b).

2.6.5 Topography

The Site is located within Waikakalaua Gulch and contains a portion of the Waikele Stream (Weston Solutions, Inc. [Weston] 2015). The gulch walls rise steeply from the Waikele streambed approximately 250 feet to the central Oahu plain. From the tunnel entrance, located on the eastern side of Waikele Stream, the site topography rises steeply up the gulch wall until it intersects with the adjacent property at the plateau at approximately 570 feet in elevation. Remnants of a former railroad bed exist immediately to the west of the Waikele Stream which date back to World War II. The topography immediately west of the railroad bed rises steeply, contains areas of slopes of 72 degrees and sheer rock cliff faces, and is mostly inaccessible. The western cliff faces terminate at the plateau area at 580 feet elevation, consisting of agricultural farmlands. The elevation at WAST ranges from approximately 600 feet amsl near the northern installation boundary to approximately 300 feet amsl near the southern installation boundary (**Figure 2-6-3**). Based on aerial images, WAST appears to be heavily vegetated.

2.6.6 Geology

The WAST installation is located in the physiographic province known as the Schofield Plateau, which is bounded to the east by the Koolau Mountain Range and to the west by Waianae Mountain Range (Weston 2015). The Schofield Plateau was formed by lava flows from the Koolau Range that overlap onto the flank of the Waianae Range. A sequence of volcanic basalt flows and associated dikes can be found beneath the Schofield Plateau.

The surface topography ranges from nearly flat around Schofield Barracks (north of WAST) to steeply sloping terrain rising up to the mountain ranges east and west of Schofield Barracks. Surface elevations range from approximately 700 feet near the central portion to approximately 4,000 feet in the Waianae Range (Weston 2015). Surficial material of the Schofield Plateau consists of soil formed by in-situ geochemical decomposition and weathering of the basaltic bedrock, which has reached depths of approximately 100 to 200 feet bgs. The gulch walls are imbedded with boulders between soil and saprolite. The stream bed consists of alluvium and colluvium which includes gravel and sands.

2.6.7 Hydrogeology

WAST is located in the Pearl Harbor groundwater area, where the general direction of regional groundwater flow is towards the south (Oki 1998). Groundwater at WAST is contained in an aquifer within the Waipahu Aquifer System of the Pearl Harbor Aquifer Sector (Mink and Lau 1990). The aquifer is classified as an unconfined basal flank aquifer (Mink and Lau 1990).

2.6.8 Surface Water Hydrology

WAST is transected by Waikele Stream, a perennial stream that flows north to south along the installation's western boundary (**Figure 2-6-3**). Two perennial streams (Poliwai Gulch and Ekahanui Gulch) merge west of WAST, flow onto WAST, and merge with Waikele Stream on the southwest side of the installation (**Figure 2-6-3**). On-installation surface water features are not used as drinking water sources for the installation. Surface water features in the surrounding area include several perennial streams and small water bodies (**Figure 2-6-3**).

2.6.9 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 at WAST.

2.6.9.1 Stormwater Management System Description

Available records do not provide information regarding stormwater management at WAST. However, based on topography and surface water hydrology at the installation (i.e., Waikele Stream), stormwater runoff at WAST likely drains towards the south (**Figure 2-6-3**).

2.6.9.2 Sewer System Description

Available records do not provide information regarding a sewer system at WAST. However, WAST was primarily used as a storage facility and is inactive and undeveloped (USAG-HI 2016b). Therefore, it is unlikely that a sewer system exists at the installation.

2.6.10 Potable Water Supply and Drinking Water Receptors

According to USAG-HI DPW personnel, water is not supplied to WAST.

An EDR report was generated for WAST, which, along with state and county GIS provided by the installation, identified several off-post private and public wells (including PWSS wells) within 5 miles of the installation boundary (**Figure 2-6-4**). The EDR report providing well search results is provided as **Appendix E**.

2.6.11 Ecological Receptors

The site has been severely disturbed by activity related to the installation including construction of the storage tunnels within the hillside, access roads, and the historical railroad (Weston 2015). The explosion in tunnel 24A further disturbed the area. Although the area has become re-vegetated since the disturbances, there have been no indications that any critical or sensitive habitats exist at WAST.

Potential ecological receptors include local populations and communities of terrestrial biota such as nesting birds and endangered plants (Weston 2016). No endangered, threatened, or candidate species of fish are known to occur in this region of Hawaii. No surveys for endangered insects or snails have been conducted within the MRSs associated with WAST. However, based on the distribution and habitat

requirements of endangered, threatened, and candidate species of arthropods in Hawaii and the history of the WAST MRSs, the likelihood of occurrences of endangered insects at WAST is low. Rare plant surveys have not been conducted at WAST. Most federally listed plants on Oahu occur only in the Waianae and/or Koolau mountains. None of these species have mapped distributions at the MRSs; however, it is possible that previously unrecorded populations may occur at the site if suitable habitat is present.

2.6.12 Previous PFAS Investigations

According to USAG-HI DPW personnel, water is not supplied to WAST. Therefore, there are no available PFAS investigation records for WAST.

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 USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST, data was collected from three principal sources of information:

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

These sources of data, along with their relative application to this PA, are discussed below. The specific findings of records review, personnel interviews, and site reconnaissance relevant to PFAS-containing materials at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST are described in Section 4.

3.1 Records Review

The records reviewed for this PA included, but were not limited to, various Installation Restoration Program administrative record documents, compliance documents, fire department documents (as applicable), USAG-HI DPW documents, and GIS files. Internet searches were also conducted to identify publicly available and other relevant information. A list of the specific documents reviewed for USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST is provided in **Appendix F**.

3.2 Personnel Interviews

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

The list of roles for the installation personnel interviewed during the PA process for USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST is presented below (affiliation is with USAG-HI unless otherwise noted).

- District 1 Fire Chief, Federal Fire Department (FFD)
- Airfield Manager, Dillingham Airfield, State of Hawaii
- Battalion Chief, Honolulu County Fire Department
- Fire Chief, Honolulu Airport Fire Rescue
- Safe Drinking Water and Clean Air Program Manager, DPW
- Clean Water Program Manager, DPW
- Clean Water Program Support, DPW
- Installation Restoration Program/Military Munitions Response Program and Aboveground Storage Tank/Underground Storage Tank Program Manager, DPW

- Installation Restoration Program/Military Munitions Response Program Support, DPW
- Spill Prevention, Control, and Countermeasures Support (Colorado State University Contractor), DPW
- Supply Branch Chief, DPW
- Archaeologist, Cultural Resources Section, DPW
- General Engineer Supervisor; Operations and Maintenance Division Chief, DPW
- Captain, Fire Station #14, Wheeler Army Airfield, FFD
- Lieutenant, Fire Station #14, Wheeler Army Airfield, FFD
- Range Scheduler
- Wheeler Army Airfield, Airfield Operations Manager
- Hazardous Waste Program Manager, DPW
- Environmental Division Chief, DPW
- Natural Resources Manager, DPW
- Manager of Army water supply systems on Oahu, DPW

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

3.3 Site Reconnaissance

Site reconnaissance and visual surveys were conducted at the preliminary locations identified at DMR and KTA during the records review process, the installation in-brief meeting, and/or during the installation personnel interviews. These areas were classified as an area not retained for further investigation or an AOPI based on a combination of information collected (e.g., records reviewed, personnel interviews, internet searches) as described in Section 5. Photo logs from the site reconnaissance conducted at DMR and KTA are provided in **Appendix H**; photos were used to assist in verification of qualitative data collected in the field. The site reconnaissance logs are provided in **Appendix I**. Based on information gathered from available documents and from interviews with USAG-HI personnel, the historical or current missions, structures, practices/activities at KASS, KFS, MMR, and WAST are consistent with the lack of use, storage, and/or disposal of PFAS-containing materials (specifically AFFF); therefore, site reconnaissance visits were not conducted at KASS, KFS, MMR, and WAST.

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

A summary of the observations made, and data collected through records reviews (**Appendix F**), installation personnel interviews (**Appendix G**), and site reconnaissance logs (**Appendix I**) during the PA process for USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST is presented in Section 4.

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

USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST were evaluated for all potential current and historical use, storage, and/or disposal of PFAS-containing materials. There are a variety of PFAS-containing materials used in relation to current and historical Army operations. However, the use, storage, and/or disposal of AFFF is the most prevalent potential source of PFAS chemicals at DoD facilities. As such, this section is organized to summarize the AFFF-related usage 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.

Following the review of data collected during PA activities (i.e., records review, personnel interviews, site reconnaissance) there is no evidence of current or historical AFFF use, storage, or disposal at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST.

Available data indicated there was formerly a fire station, as well as a pick-up truck with a skid mount on the back and a 500-pound dry chem extinguisher system, at DMR. However, USAG-HI, Honolulu Airport Fire Rescue, and Dillingham Airfield personnel noted there were no known or documented AFFF storage locations, locations where AFFF was used (including fire response sites), or AFFF disposal locations at the fire station or elsewhere on the installation. There were also no known or documented areas where AFFF was used (including at fire response sites), stored, or disposed of at KTA, KASS, KFS, MMR, and WAST.

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

Following document research, personnel interviews, and site reconnaissance at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST, other potential PFAS source types were either not identified at the installations or did not prompt further research or constitute categorization as AOPIs.

It was noted during a discussion with a USAEC Pest Management Consultant that the larger group of pesticides are generally not of PFAS concern. Specifically, products containing Sulfluramid (i.e., associated with insecticides) may have contained PFAS and were phased out in 1996. The USAEC Pest

Management Consultant has records of pesticides used and stored at Installation Management Command installations and did not identify DMR, KTA, KASS, KFS, MMR, or WAST as installations ever containing PFAS-containing pesticides/insecticides.

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

4.3 Readily Identifiable Off-Post PFAS Sources

An exhaustive search to identify all potential off-post PFAS sources (i.e., not related to operations at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST) is not part of the PA. An attempt was made to identify potential off-post PFAS sources within a 5-mile radius of the installations during the records search and site visit for the most common facility types with potential PFAS sources. No off-post PFAS sources were identified within a 5-mile radius of DMR. **Tables 4-3-1** through **4-3-5**, below, summarize off-post search results for USAG-HI Sub-installations KTA, KASS, KFS, MMR, and WAST, respectively.

Table 4-3-1. Off-Post PFAS Sources (KTA)

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation (miles)
Turtle Bay Wastewater Treatment Plant (WWTP)	57-091 Kamehameha Highway, Kahuku, Hawaii, 96731	WWTP	0.7, NW
Kahuku WWTP	56-701 Kamehameha Highway, Kahuku, Hawaii 96731	WWTP	2.5, SE
Laie Convenience Center	56-020 Kamehameha Highway, Laie, Hawaii 96762	Landfill	4.6, SE
Fire Station 13 Kahuku	56-460 Kamehameha Highway, Kahuku, Hawaii 96731	Fire Station	3.2, SE
Kahuku Medical Center	56-117 Pualalea Street, Kahuku, Hawaii 96731	Hospital	2.0, SE
James Campbell National Wildlife Refuge	Kahuku, Hawaii 96731	Prescribed Burn Area	0.4, NE
Kahuku Farms	56-800 Kamehameha Highway, Kahuku, Hawaii 96731	Pesticide Use	1.0, NE
Waihuena Farm	59-414 Kamehameha Highway, Haleiwa, Hawaii 96712	Pesticide Use	4.8, SW

Notes:
NW = northwest
SE = southeast

Table 4-3-2. Off-Post PFAS Sources (KASS)

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation
Honolulu City Wahiawa Wastewater	111 California Avenue, Wahiawa, Hawaii 96786	WWTP	3.9, NE
Wahiawa Convenience Center	71-129 Wilikina Drive, Wahiawa, Hawaii 96786	Landfill	5.0, NW
Waipahu Convenience Center	94-9 Waipahu Depot Street, Waipahu, Hawaii 96797	Landfill	4.8, SW
Fire Station 36 Mililani	95-269 Kipapa Drive, Mililani, Hawaii 96789	Fire Station	1.3, NW
Fire Station 42 Waikele	94-840 Lumiaina Place, Waipahu, Hawaii 96797	Fire Station	3.4, SW
Fire Station 38 Waiau	98-1109 Komo Mai Drive, Pearl City, Hawaii 96782	Fire Station	4.4, SE
Isle Wash	95-280 Kipapa Drive, Mililani, Hawaii 96789	Car Wash	1.3, NW
CarWash808 Express	94-430 Ukee Street, Waipahu, Hawaii	Car Wash	1.8, SW
Tony Autoplex	94-1299 Ka Uka Boulevard, Waipahu, Hawaii 96797	Car Wash	1.8, SW
Royal Kunia	94-640 Kupuohi Street, Waipahu, Hawaii 96797	Car Wash	4.8, SW
Wahiawa General Hospital	128 Lehua Street, Wahiawa, Hawaii 96786	Hospital	3.8, NW
PPG Paint Store	94-101 Kopake Street, Waipahu, Hawaii 96797	Paint Facility/Manufacturer	4.2, SW
Sherwin-Williams Paint Store	94-810 Moloalo Street, Suite 102, Waipahu, Hawaii 96797	Paint Facility/Manufacturer	4.5, SW
Rainbow State Paint	98-1277 Kaahumanu Street, Aiea, Hawaii 96701	Paint Facility/Manufacturer	5.0, SE
COATED. Decorative Metal Finishing	1272 Waihona Street #3, Pearl City, Hawaii 96782	Metal Plating (Chromium Plating)	3.0, SE
Waipio Auto Repair	94-547 Ukee Street #312, Waipahu, Hawaii 96797	Automobile Maintenance Shop	2.0, SW
Wahiawa Laundromat	34 Maalo Street, Wahiawa, Hawaii 96786	Laundry/Water Proofing Facilities	3.8, NW
Almas Laundry	48 Mango Street, Wahiawa, Hawaii 96786	Laundry/Water Proofing Facilities	3.8, NW

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation
Waipahu Laundry Center	94-883 Kahuailani Street, Waipahu, Hawaii 96797	Laundry/Water Proofing Facilities	4.4, SW
Castor's Laundry Center	94-300 Farrington Highway, Waipahu, Hawaii 96797	Laundry/Water Proofing Facilities	5.0, SW
Aloha Dry Cleaners and Laundry	94-321 Leonui Street, Waipahu, Hawaii 96797	Laundry/Water Proofing Facilities	5.0, SW
Hawaii Laundry Services	98-820 Moanalua Road, Aiea, Hawaii 96701	Laundry/Water Proofing Facilities	5.0, SE
Mililani Agricultural Park	94-840 Lanikuhana Avenue, Mililani, Hawaii 96789	Pesticide Use	1.0,W/NW
Kunia Loa Ridge Farmlands	94-1100 Kunia Road, Waipahu, Hawaii 96797	Pesticide Use	3.4, W
Aloun Farms	91-1440 Farrington Highway, Kapolei, Hawaii 96707	Pesticide Use	3.2, SW

Notes:
NW = northwest
SE = southeast
SW = southwest
W = west

Table 4-3-3. Off-Post PFAS Sources (KFS)

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation
Honolulu City Wahiawa Wastewater	111 California Avenue, Wahiawa, Hawaii 96786	WWTP	1.4, N
Wahiawa Convenience Center	71-129 Wilikina Drive, Wahiawa, Hawaii 96786	Landfill	1.9, N
Fire Station 36 Mililani	95-269 Kipapa Drive, Mililani, Hawaii 96789	Fire Station	2.7, SE
Isle Wash	95-280 Kipapa Drive, Mililani, Hawaii 96789	Car Wash	2.7, SE
Wahiawa General Hospital	128 Lehua Street, Wahiawa, Hawaii 96786	Hospital	2.4, NW
Waipio Auto Repair	95-547 Ukee Street Waipahu, Hawaii 96797	Automobile Maintenance Shop	4.7, SE
Wahiawa Automotive	58 S Kamehameha Highway, Wahiawa, Hawaii 96786	Automobile Maintenance Shop	2.9, NE

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation
LS Automotive Repair	720 Kilani Avenue, Wahiawa, Hawaii 96786	Automobile Maintenance Shop	3.4, NE
Wahiawa Laundromat	34 Maalo Street, Wahiawa, Hawaii 96786	Laundry/Water Proofing Facilities	2.1, NE
Almas Laundry	48 Mango Street, Wahiawa, Hawaii 96786	Laundry/Water Proofing Facilities	2.1, NE
Dole Plantation	64-1550 Kamehameha Highway, Wahiawa, Hawaii 96786	Pesticide Use	3.5, NE
Mililani Agricultural Park	94-840 Lanikuhana Avenue, Mililani, Hawaii 96789	Pesticide Use	3.6, SE
Kunia Loa Ridge Farmlands	94-1100 Kunia Road, Waipahu, Hawaii 96797	Pesticide Use	3.2, SW

Notes:
NE = northeast
SE = southeast
SW = southwest

Table 4-3-4. Off-Post PFAS Sources (MMR)

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation
EU Tech Hawaii	84-305 Makaha Valley Road, Waianae, Hawaii 96792	Automobile Maintenance Shop	3.5, S
Waianae Speed Wash	85-802 Farrington Highway, Waianae, Hawaii 96792	Laundry/Water Proofing Facilities	4.5, S
Makua Military Reservation	Makua Valley Road, Waianae, Hawaii 96792	Prescribed Burn Area	0.0, E (On 22 July 2003, the Army lost control of a prescribed burn at MMR that scorched 2,100 acres. The fire burned approximately six acres on adjoining state lands.)

Notes:
E = east
S = south

Table 4-3-5. Off-Post PFAS Sources (WAST)

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation
Wahiawa Convenience Center	71-129 Wilikina Drive, Wahiawa, Hawaii 96786	Landfill	5.0, NW
Waipahu Convenience Center	94-9 Waipahu Depot Street, Waipahu, Hawaii 96797	Landfill	4.0, SE
Fire Station 36 Mililani	95-269 Kipapa Drive, Mililani, Hawaii 96789	Fire Station	2.0, NE
Isle Wash	95-280 Kipapa Drive, Mililani, Hawaii 96789	Car Wash	2.0, NE
Royal Kunia	94-640 Kupuohi Street, Waipahu, Hawaii 96797	Car Wash	2.9, SW
Queens Medical Center West Oahu	91-2141 Fort Weaver Road, Ewa Beach, Hawaii 96706	Hospital	3.9, S
Kahi Mohala	91-2301 Old Fort Weaver Road, Ewa Beach, Hawaii 96706	Hospital	3.9, S
Sherwin-Williams Paint Store	94-810 Moloalo Street, Suite 102, Waipahu, Hawaii 96797	Paint Facility/Manufacturer	3.7, SE
Alloy Wheel Repair Specialists	94-1388 Moaniani Street #322, Waipahu, Hawaii 96797	Metal Plating (Chromium Plating)	1.8, E
COATED. Decorative Metal Finish	1272 Waihona Street, #3 Pearl City, Hawaii 96782	Metal Plating (Chromium Plating)	2.9, E
Waipio Auto Repair	95-547 Ukee Street Waipahu, Hawaii 96797	Automobile Maintenance Shop	1.2, NE
Performance Auto Repair LS Automotive & Transmission Repairs Done Right	94-165A Leonui Street, Waipahu, Hawaii 96797	Automobile Maintenance Shop	2.3, S
Hokama Auto repair	1011 Lehua Avenue, Pearl City, Hawaii 96782	Automobile Maintenance Shop	3.6, SE
Wahiawa Laundromat	34 Maalo Street, Wahiawa, Hawaii 96786	Laundry/Water Proofing Facilities	3.4, N
Almas Laundry	48 Mango Street, Wahiawa, Hawaii 96786	Laundry/Water Proofing Facilities	3.4, N
Aloha Dry Cleaners	94-321 Leonui Street, Waipahu, Hawaii 96797	Laundry/Water Proofing Facilities	3.2, S
Castor's Laundry Center	94-300 Farrington Highway, Waipahu, Hawaii 96797	Laundry/Water Proofing Facilities	3.1, S

Facility Name	Facility Address	Type of Facility	Distance and Direction from Installation
Waipahu Laundry Center	94-883 Kahuailani Street, Waipahu, Hawaii 96797	Laundry/Water Proofing Facilities	3.1, SE
Mililani Agricultural Park	94-840 Lanikuhana Avenue, Mililani, Hawaii 96789	Pesticide Use	0.1, E
Kunia Loa Ridge Farmlands	94-1100 Kunia Road, Waipahu, Hawaii 96797	Pesticide Use	2.0, W
Aloun Farms	91-1440 Farrington Highway, Kapolei, Highway 96707	Pesticide Use	2.9, SW

Notes:
E = east
N = north
NE = northeast
NW = northwest
S = south
SE = southeast
SW = southwest
W = west

5 SUMMARY AND DISCUSSION OF PA RESULTS

The areas evaluated for potential use, storage, and/or disposal of PFAS-containing materials at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST, 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, no areas have been identified as AOPIs. The process used for refining these areas is presented on **Figure 5-1-1**, below.

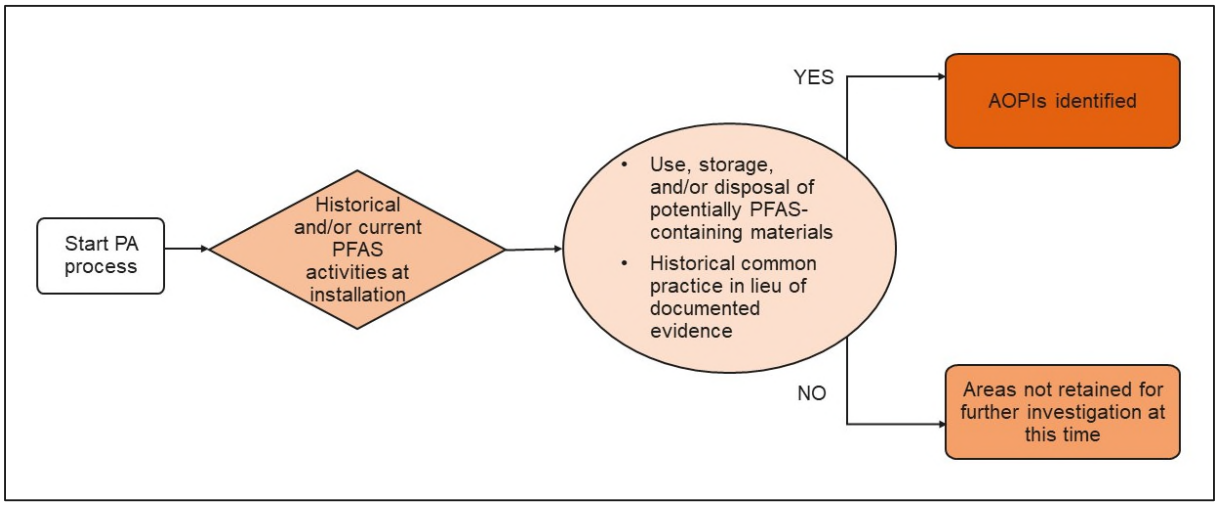

Figure 5-1-1: AOPI Decision Flowchart

The areas not retained for further investigation are presented in Section 5.1.

Data limitations for this PA at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST are presented in Section 6.

5.1 Areas Not Retained for Further Investigation

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

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

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

Installation and Area Description	Dates of Operation	Relevant Site History	Rationale
DMR Former Fire Station	Late 1960s to 1980s	Available records indicate a fire station was built at DMR (formerly Mokuleia Army Airfield) during construction of the airfield during World War II (Bennett 2010). The installation was transferred to the U.S. Air Force after World War II and subsequently closed in 1948, by which time most of the buildings had fallen into disrepair (Bennett 2010). The State of Hawaii began leasing DMR for general aviation use in 1962 and, circa 1974, DMR was transferred from the U.S. Air Force back to the Army (State of Hawaii 2021). The State of Hawaii acquired a longer-term lease from the Army in 1974 and signed a 25-year lease for general aviation use in 1983 (State of Hawaii 2021). It is not believed that the former fire station was utilized by the Army or civilian aviation operations after DMR was transferred back to the Army in 1974.The State of Hawaii currently leases 272 acres at DMR for general aviation operations (State of Hawaii 2021). According to USAG-HI staff, a fire station along the airfield runway (presumably the same fire station constructed during World War II) was torn down in the 1980s. Honolulu Airport Fire Rescue personnel had no knowledge of fire and/or crash incidents involving AFFF prior to transfer of airfield operations to the State of Hawaii (which they believed occurred circa 1975 to 1977). There are no available records to indicate AFFF was used, stored, or disposed of, and no interviewees had knowledge of AFFF use, storage, or disposal, at the former fire station.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location
DMR Former Fire Station (Truck)	Approximately 1985 to approximately 2010	Available records indicate a “fire station” was added to the installation in 1985 or 1986 (State of Hawaii 2021). Instead of a “fire station”, however, Honolulu Airport Fire Rescue personnel noted that, from 1985 or 1986 to 2009 or 2010, there was a pick-up truck with a skid mount on the back and a 500-pound dry chem extinguisher system at DMR. Honolulu Airport Fire Rescue personnel also indicated the following: they had no knowledge of fire and/or crash incidents involving AFFF prior to approximately 1975 or 1977 (approximately the same time as DMR was transferred from the U.S. Air Force back to the Army); no AFFF was kept on the premises; firefighting training was conducted at Honolulu Airport or Kalaeloa Airport (not at DMR); and the firefighting responsibility was transferred to the State of Hawaii in 2009 or 2010.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location

Installation and Area Description	Dates of Operation	Relevant Site History	Rationale
DMR Helipad	1975 to present	The airfield at DMR is a joint-use airfield with the Army having first priority for air-land operations and helicopter night-vision training (State of Hawaii 2021). There are no available records to indicate AFFF was used, stored, or disposed of, and no interviewees had knowledge of AFFF use, storage, or disposal, at helipads on the installation.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location
DMR Former Missile Launch Site	1961 to 1970	In 1961, a Nike-Hercules Missile Launching site was constructed, which was closed in 1970 (Bennett 2010). According to USAG-HI DPW staff, an annual test launch was conducted at the installation. There are no available records regarding, and no interviewees had knowledge of, standby fire service for the annual test launches. There are also no available records to indicate AFFF was used, stored, or disposed of, and no interviewees had knowledge of AFFF use, storage, or disposal, at the missile launch site.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location
DMR Aircraft Crash	21 June 2019	On 21 June 2019, a twin-engine aircraft crashed on the DMR airfield runway. State of Hawaii Dillingham Airfield staff confirmed foam was not used on the aircraft, and Honolulu County Fire Department personnel confirmed the resulting fire was mostly self-extinguished when they arrived and sprayed the crash site with water.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location
KTA Former Wash Rack	Unknown to Approximately 2013	KTA utilizes a wash rack to wash vehicles (i.e., remove seeds and large clumps of soil that may accumulate on the vehicles) prior to leaving the installation (CEMML 2010). According to USAG-HI personnel, a new wash rack was installed circa 2013. There is no known use of AFFF at the former wash rack and no records to indicate fire trucks that used AFFF would have been washed at the former wash rack.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location
KTA Wash Rack	Approximately 2013 to present	The wash rack at KTA is used to wash vehicles (e.g., remove seeds and large clumps of soil that may accumulate on the vehicles) prior to leaving the installation (CEMML 2010). According to USAG-HI personnel, KTA has a septic tank for the wash rack, which was installed circa 2013. Detergents and waxes are not used at the wash rack and no fire truck has been used (or deployed AFFF) at KTA since the new wash rack became operational.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location

Installation and Area Description	Dates of Operation	Relevant Site History	Rationale
KTA Black Hawk Helicopter Crash	12 February 2001	Two Black Hawk helicopters collided at KTA during a night training exercise on 12 February 2001. Honolulu County Fire Department personnel confirmed that, since 2000, they have not responded to any calls at KTA in which AFFF was used. Federal Fire Department personnel also indicated it was unlikely that AFFF would have been used because emergency personnel were likely responding to the helicopter collision as a rescue effort (as opposed to a firefighting effort).	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location
KTA Helipads	Unknown to 2006	KTA has designated helipads/landing zones for military helicopters (CEMML 2010). USAG-HI personnel indicated the helipads were used until 2006. There are no available records to indicate AFFF was used, stored, or disposed of, and no interviewees had knowledge of AFFF use, storage, or disposal, at helipads on the installation.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location
KASS Former Fire Station #6	Unknown	KASS, which consists of 80 underground storage tunnels, was constructed during World War II for storing incendiaries and high explosives, was later used to store insecticides and chemical agents, and was subsequently put out of service in the early 1960s and 1970s (USAG-HI 2016a). According to FFD personnel, there may have been a fire station (Fire Station 6) at KASS that was closed in the early 1990s; however, they could not confirm whether or not there was a fire station at KASS or if the fire station was in a different location. There are no available records to indicate AFFF was used, stored, or disposed of at the installation.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at the installation
MMR Helipads	Unknown to 2004	MMR has designated helicopter landing pads (CEMML 2010). Helicopters were required to be on the installation for firefighting purposes when live-fire training occurred (CEMML 2010). Live-fire training ceased at MMR in 2004 and, in 2011, the Army announced that live-fire training would not be resumed at MMR (GSL 2015). Based on available electronic records dating as far back as 2000, Honolulu County Fire Department personnel confirmed that, since 2000, they have not responded to any calls at MMR in which AFFF was used. There are no available records to indicate AFFF was used, stored, or disposed of, and no interviewees had knowledge of AFFF use, storage, or disposal, at helipads on the installation.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location

Installation and Area Description	Dates of Operation	Relevant Site History	Rationale
MMR Firebreak Road	Unknown	USAG-HI personnel noted that, in the past, the Army safety office used fire retardant outside the firebreak road during a few prescribed burns. However, there is no indication AFFF was used.	No evidence of PFOS, PFOA, or PFBS containing materials used, stored, and/or disposal of at this location

6 CONCLUSIONS AND RECOMMENDATIONS

The PFAS PA evaluated possible AOPIs at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST 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).

A combination of document review, internet searches, interviews with installation personnel, and installation site visits (where applicable) were used to identify specific areas of suspected PFOS, PFOA, and PFBS use, storage, and/or disposal at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST. Following the evaluation, no AOPIs were identified.

Data collected during the PA (Sections 3 through 5) were sufficient to draw conclusions and recommendations summarized above. The data limitations relevant to the development of this PA for PFOS, PFOA, and PFBS at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST are discussed below.

Records gathered for the use, storage, and/or disposal of PFAS-containing materials were reviewed during the PA process. Documentation specific to AFFF may have been limited (e.g., each AFFF use, procurement records, documentation of AFFF used during crash responses or fire training activities) due to lack of recordkeeping requirements for the full timeline of common AFFF practices. Anecdotal accounts of AFFF use (and therefore likely PFOS, PFOA, and PFBS use) were limited to available installation personnel, whose knowledge of AFFF use may have been restricted by their time spent at the installation or previous roles held that limited their relevant knowledge of potential AFFF (or other PFAS-containing material) use. Identification of potential off-post PFAS sources was limited to readily available sources; therefore, there may be additional potential PFAS source facilities in surrounding areas than those identified in this report.

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

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

Further investigation of PFAS is not recommended at USAG-HI Sub-installations DMR, KTA, KASS, KFS, MMR, and WAST at this time.

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ACRONYMS

°F	degrees Fahrenheit
%	percent
AFFF	aqueous film-forming foam
amsl	above mean sea level
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
CEMML	Center for Environmental Management of Military Lands, Colorado State University
DMR	Dillingham Military Reservation
DoD	Department of Defense
DPW	Directorate of Public Works
EDR	Environmental Data Resources, Inc.
EKN	Edward K. Noda and Associates, Inc.
E	east
FFD	Federal Fire Department
GIS	geographic information system
GSL	Geotechnical and Structures Laboratory Waterways Experiment Station
HDOTA	Hawaii Department of Transportation Airports Division
installation	United States Army or Reserve installation
KASS	Kipapa Ammunition Storage Site
KFS	Kunia Field Station
KTA	Kahuku Training Area
mg/kg	milligram per kilogram
MMR	Makua Military Reservation
MRS	munitions response site
N	north
ng/L	nanogram per liter

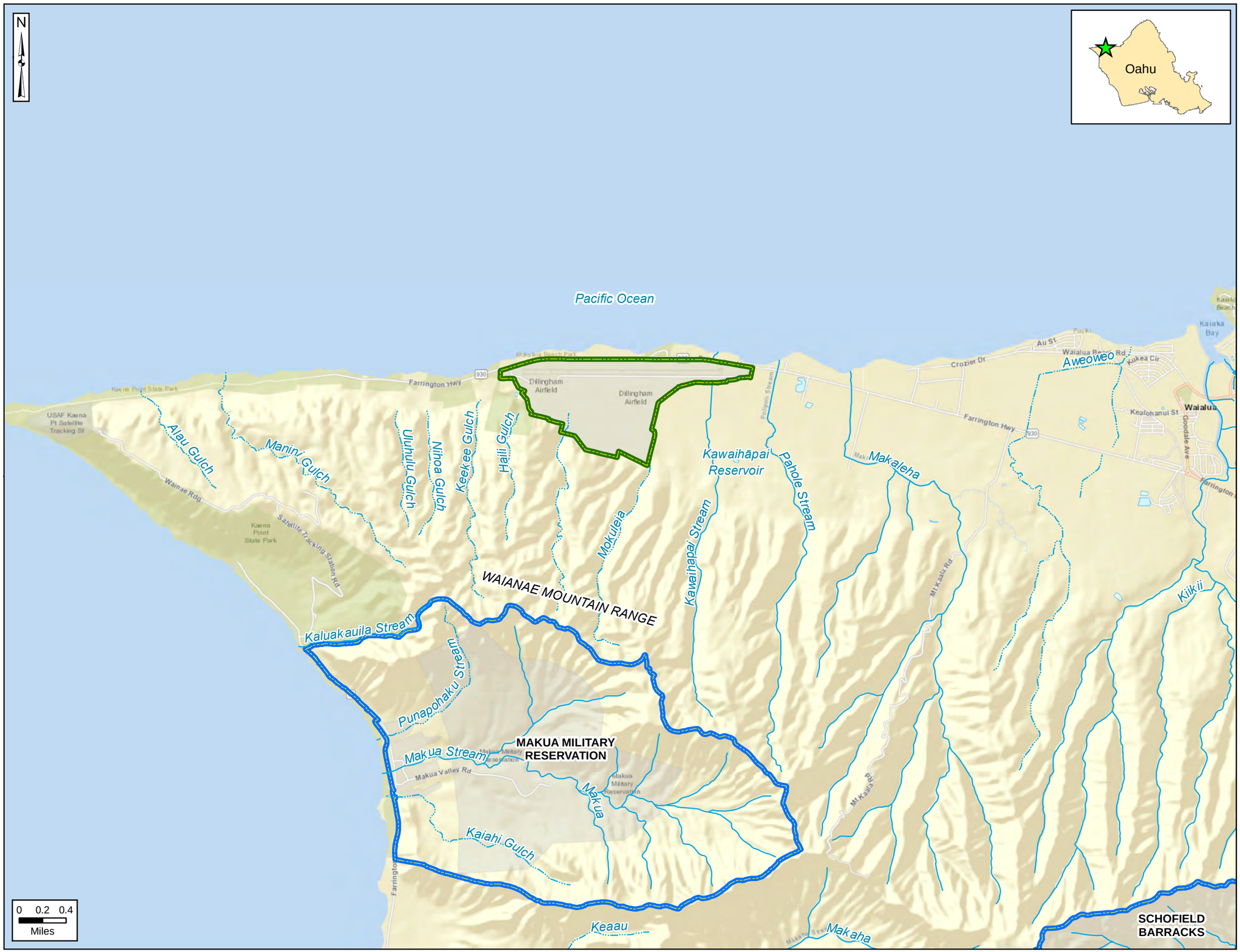
NE	northeast
NW	northwest
OSD	Office of the Secretary of Defense
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
PWSS	Public Water Supply System
S	south
SE	southeast
SW	southwest
U.S.	United States
USAEC	United States Army Environmental Command
USAG-HI	United States Army Garrison – Hawaii
USEPA	United States Environmental Protection Agency
USVA	United States Department of Veterans Affairs
W	west
WAST	Waikakalaua Ammunition Storage Tunnels
Weston	Weston Solutions, Inc.
WWTP	wastewater treatment plant

FIGURES

USAEC PFAS
Preliminary Assessment
U.S. Army Garrison-Hawaii Sub-installations

ARCADIS

Figure 2-1-1
Dillingham Military Reservation
Site Location



Legend

- Dillingham Military Reservation
- Other Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body

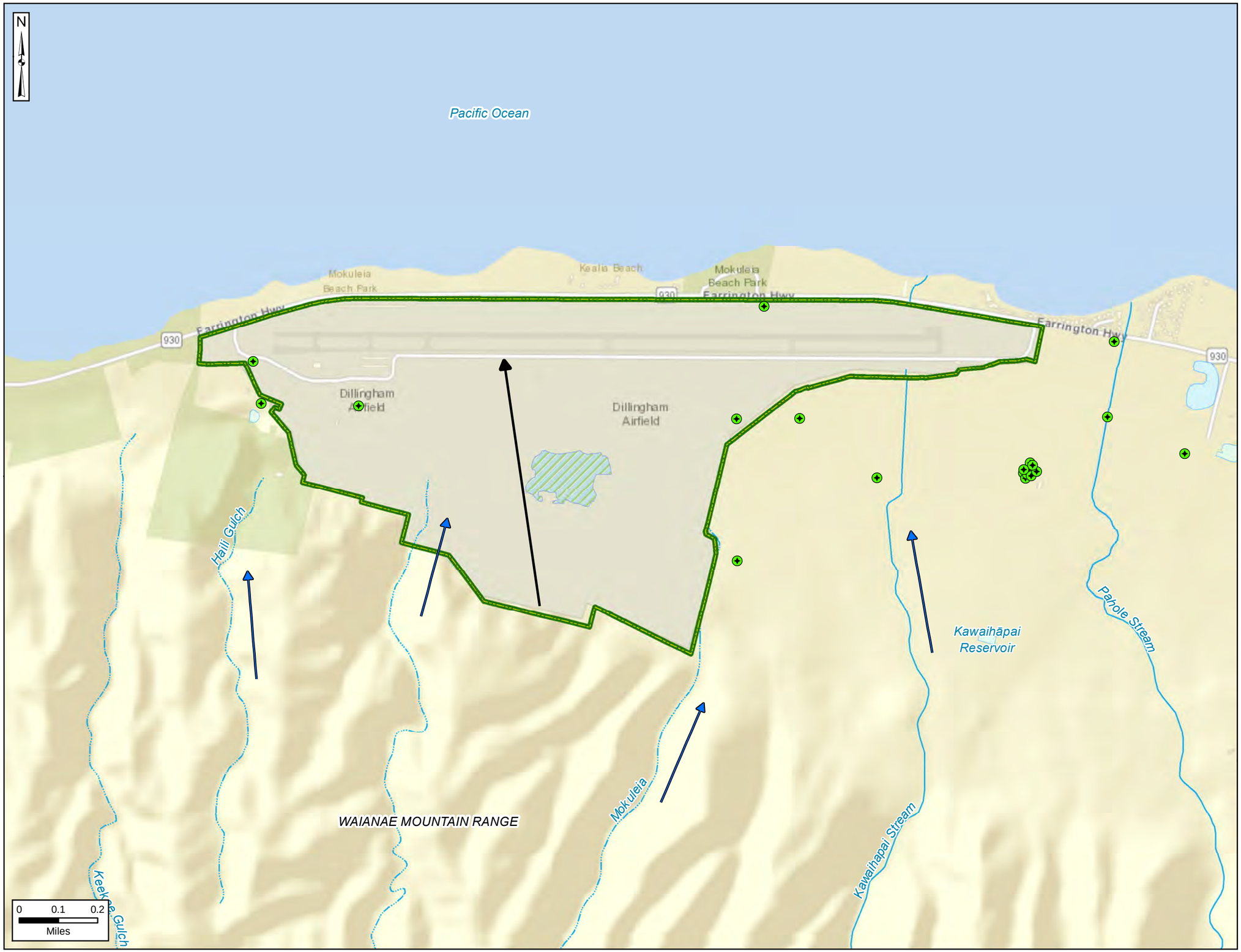
Data Sources:
USAG-HI, GIS Data, 2018
HI State GIS, Rivers/Streams, 2018
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS
Preliminary Assessment
U.S. Army Garrison-Hawaii Sub-installations

ARCADIS

Figure 2-1-2
Dillingham Military Reservation
Site Layout



Legend

- Dillingham Military Reservation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Wetland
- Groundwater Flow Direction
- Surface Water Flow Direction
- Water Well (HGGRC Data)

HGGRC = Hawaii Groundwater & Geothermal Resources Center

Data Sources:
USAG-HI, GIS Data, 2018
HI State GIS, Rivers/Streams, 2018
HGGRC, Wells, 2019
USFWS, Wetlands, 2021
ESRI, ArcGIS Online, StreetMap Data

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS
Preliminary Assessment
U.S. Army Garrison-Hawaii Sub-installations

ARCADIS

Figure 2-1-3
Dillingham Military Reservation
Topographic Map

Legend

- Dillingham Military Reservation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Groundwater Flow Direction
- Surface Water Flow Direction

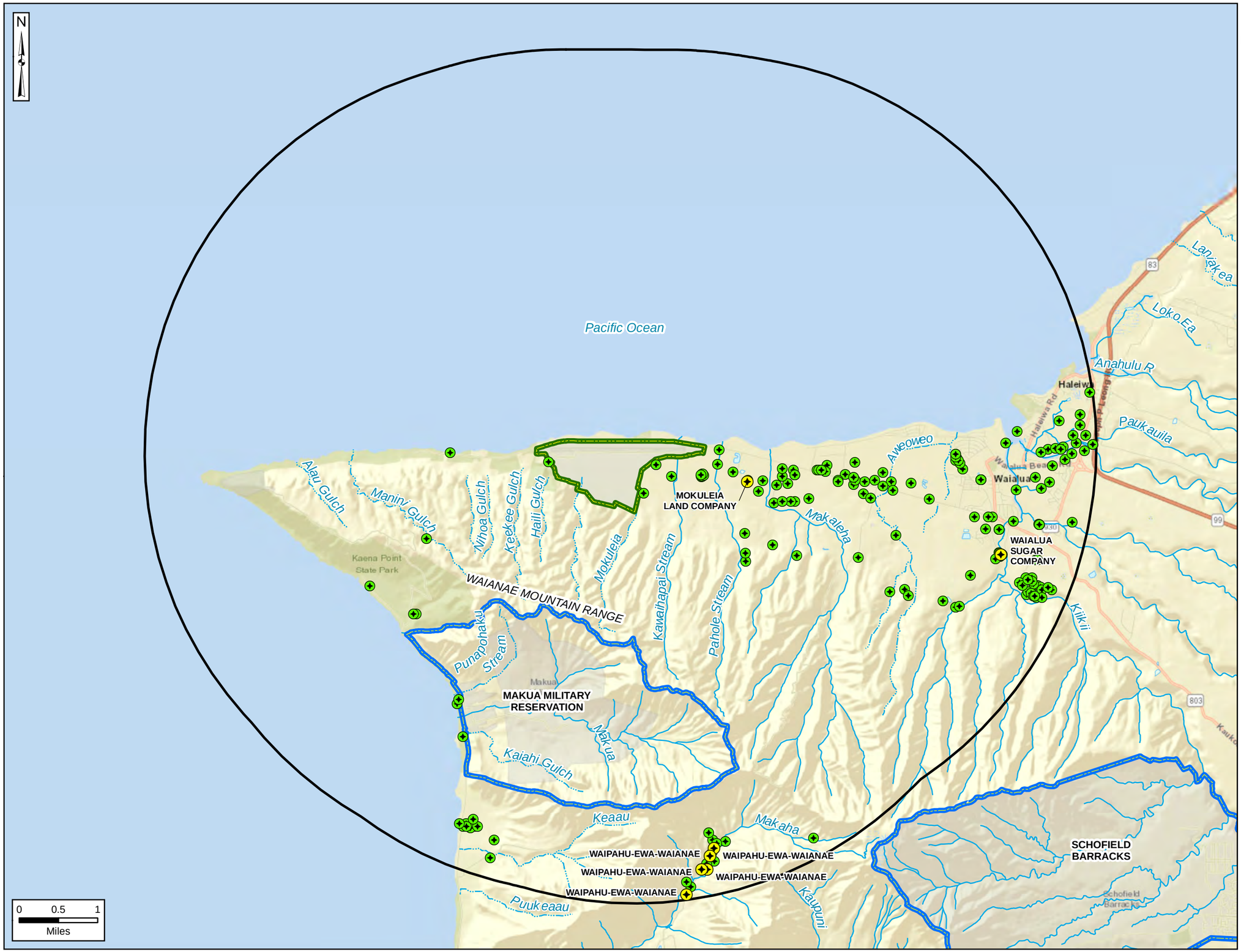
Contour Interval = 40 feet

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

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS
Preliminary Assessment
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-1-4
Dillingham Military Reservation
Off-Post Potable Supply Wells



Legend

- Dillingham Military Reservation
- 5-Mile Radius
- Other Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Public Water Supply System Well (EDR Data)
- Water Well (HGGRC Data) (well use not specified)

EDR = Environmental Data Resources
HGGRC = Hawaii Groundwater & Geothermal Resources Center

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems which provides water to at least 25 people for at least 60 days annually. Well owner labels are as provided in the EDR Report. See Appendix E for further information.

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

Coordinate System:
WGS 1984, UTM Zone 4 North

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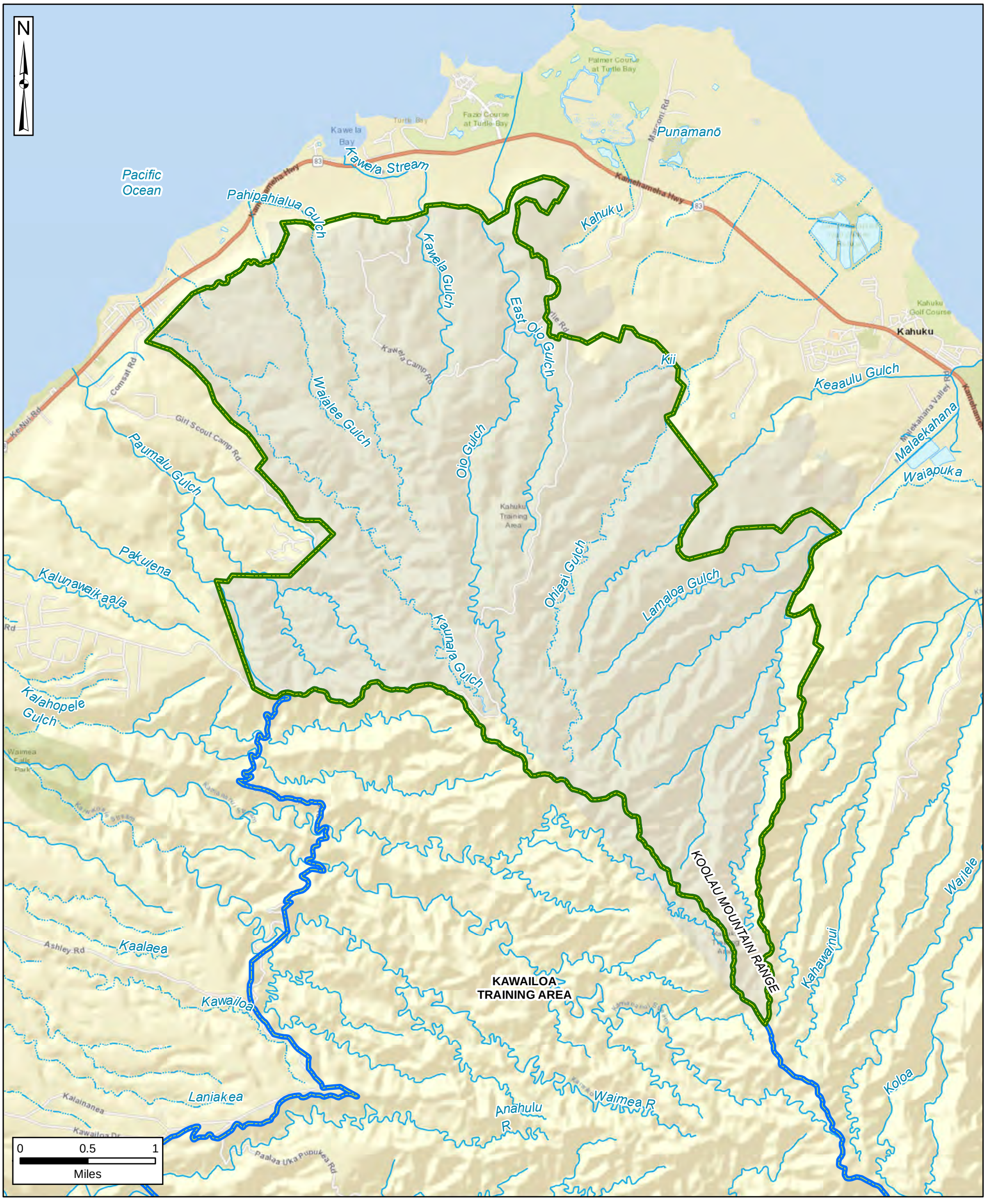
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-2-1
Kahuku Training Area
Site Location



Kahuku Training Area

Other 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

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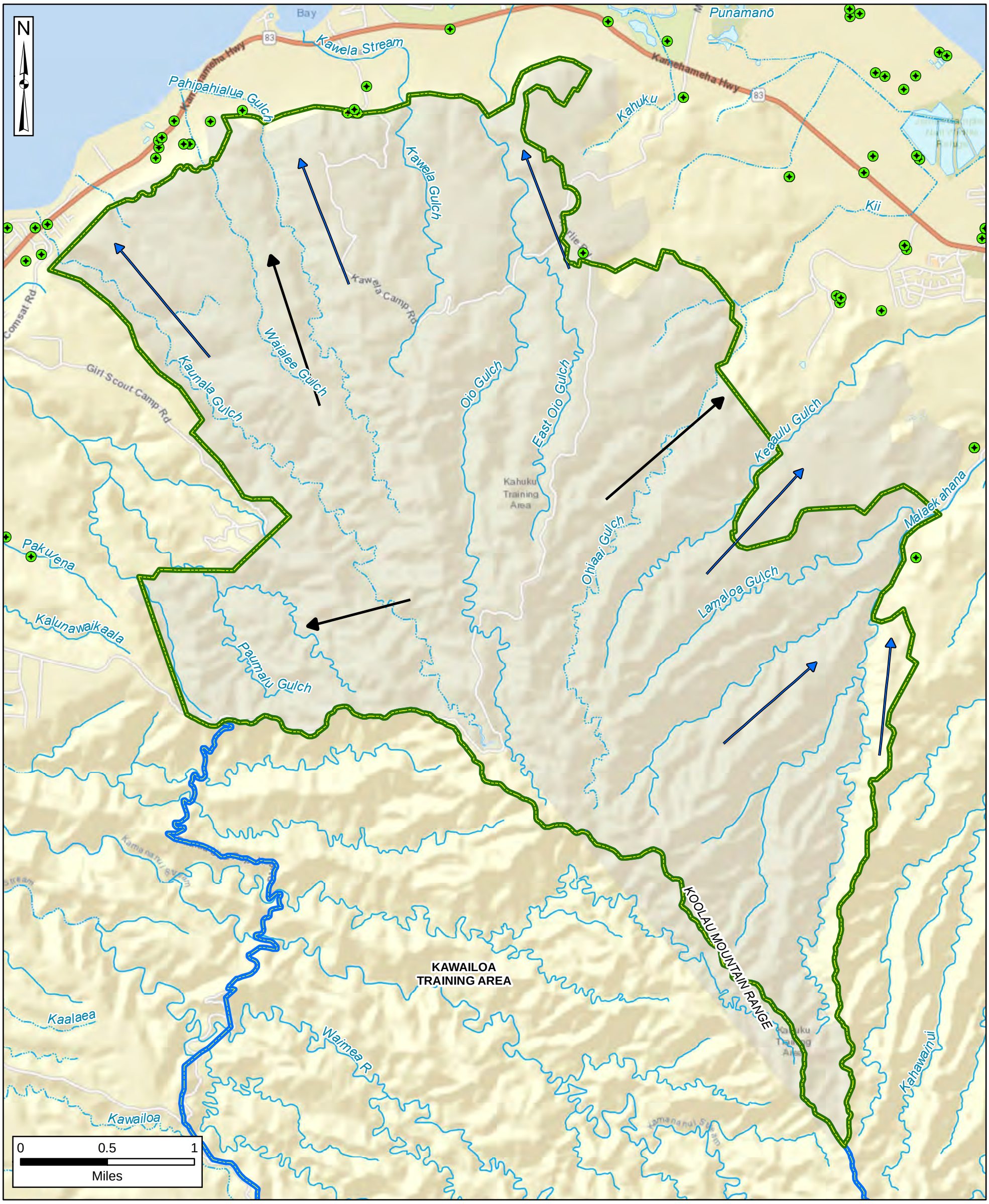
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-2-2
Kahuku Training Area
Site Layout



Installation Boundary
Other Military Installation
Stream (Perennial)
Stream (Intermittent)
Water Body
Surface Water Flow Direction
Groundwater Flow Direction
Water Well (HGGRC Data)

HGGRC = Hawaii Groundwater & Geothermal Resources Center

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

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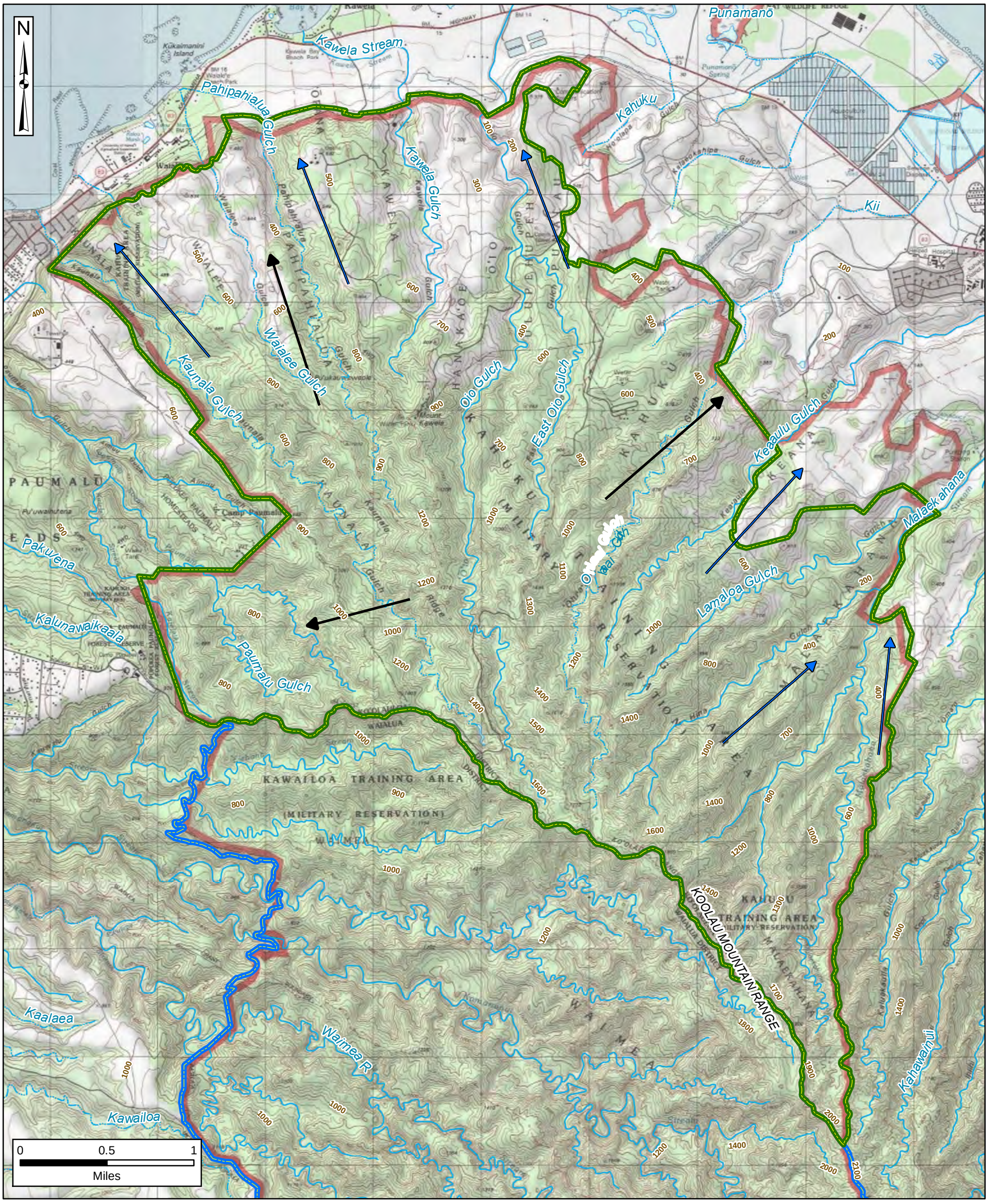
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-2-3
Kahuku Training Area
Topographic Map



Kahuku Training Area
Other Military Installation
Stream (Perennial)
Stream (Intermittent)
Water Body

Surface Water Flow Direction
Groundwater Flow Direction

Contour Interval = 40 feet

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

Coordinate System:
WGS 1984, UTM Zone 4 North

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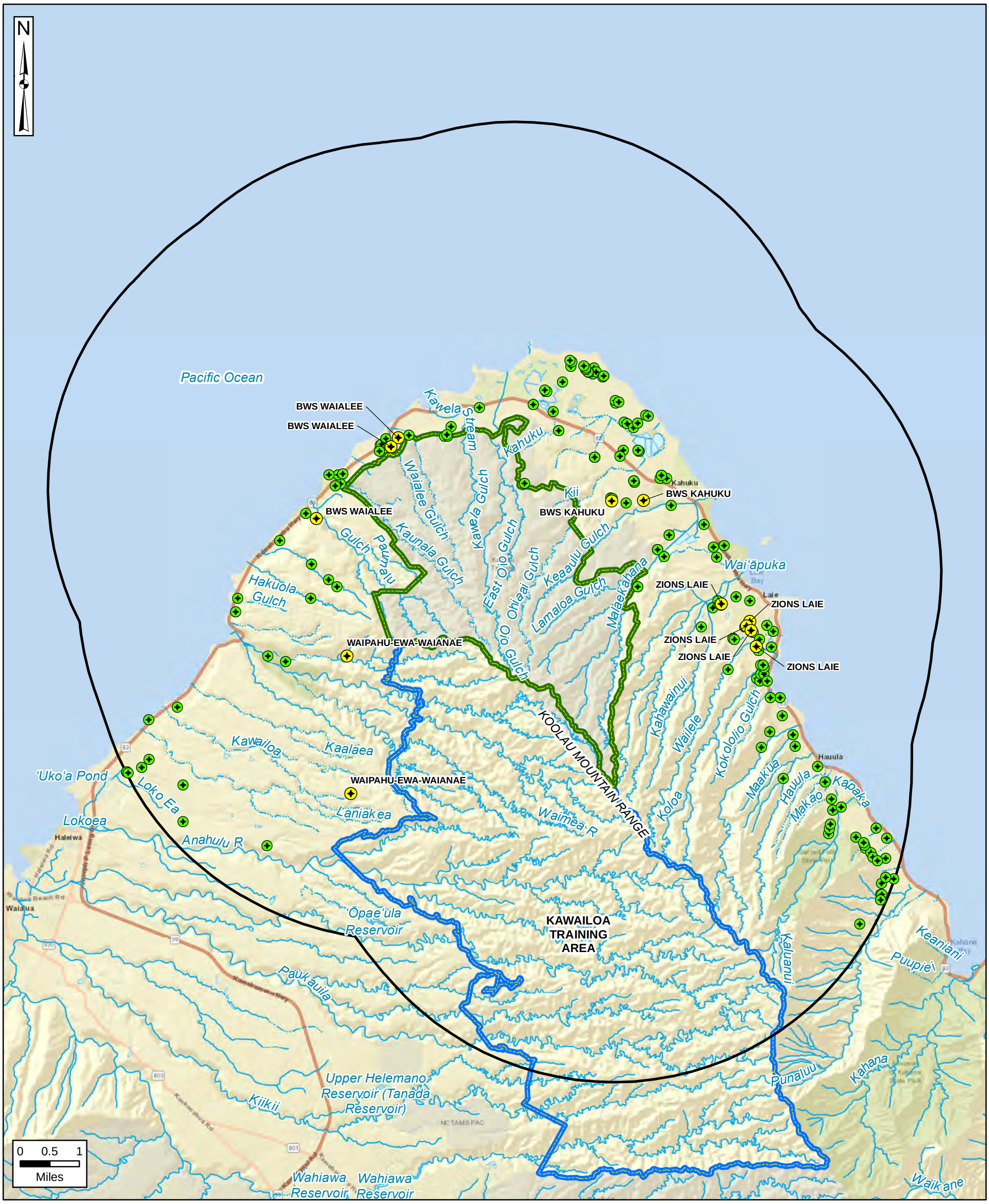
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-2-4
Kahuku Training Area
Off-Post Potable Supply Wells



Kahuku Training Area
5-Mile Radius
Other Military Installation
Stream (Perennial)
Stream (Intermittent)
Water Body

Public Water Supply System Well (EDR Data)
Water Well (HGGRC Data) (well use not specified)

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems which provides water to at least 25 people for at least 60 days annually. Well owner labels are as provided in the EDR Report. See Appendix E for further information.

EDR = Environmental Data Resources
HGGRC = Hawaii Groundwater & Geothermal Resources Center

Data Sources:
USAG-HI, GIS Data, 2018
EDR, Well 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

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U.S. Army Garrison-Hawaii Sub-installations

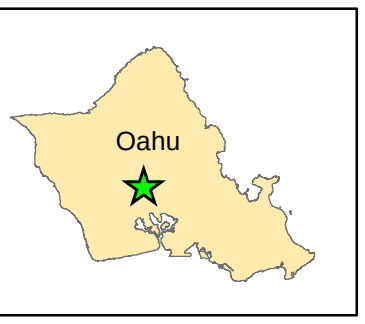
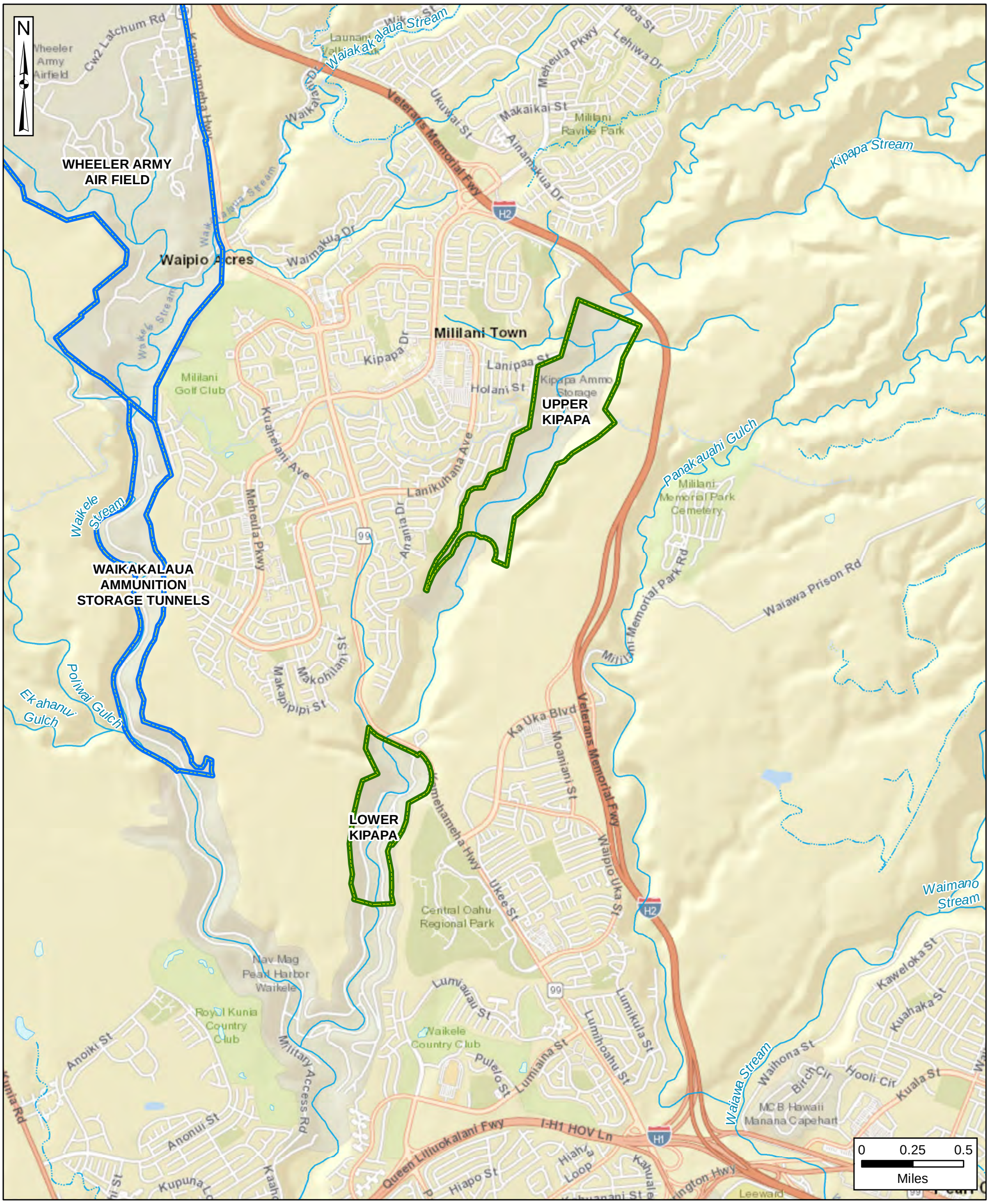


Figure 2-3-1
Kipapa Ammunition Storage Site
Site Location



Kipapa Ammunition Storage Site

Other Military Installation

Stream (Perennial)

Stream (Intermittent)

Water Body

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

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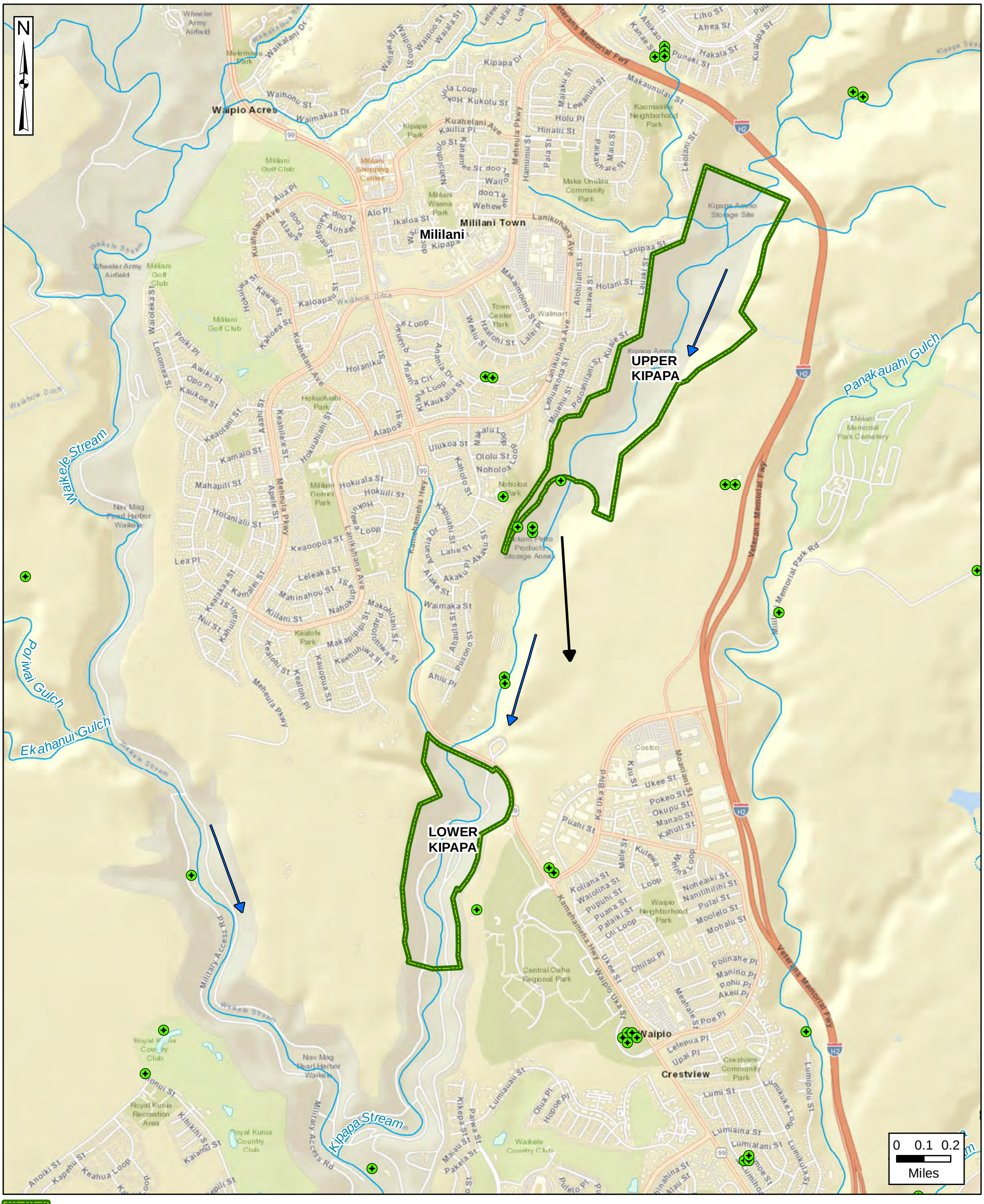
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-3-2
Kipapa Ammunition Storage Site
Site Layout



Kipapa Ammunition Storage Site
Water Well (HGGRC Data)
Stream (Perennial)
Stream (Intermittent)
Water Body
Groundwater Flow Direction
Surface Water Flow Direction

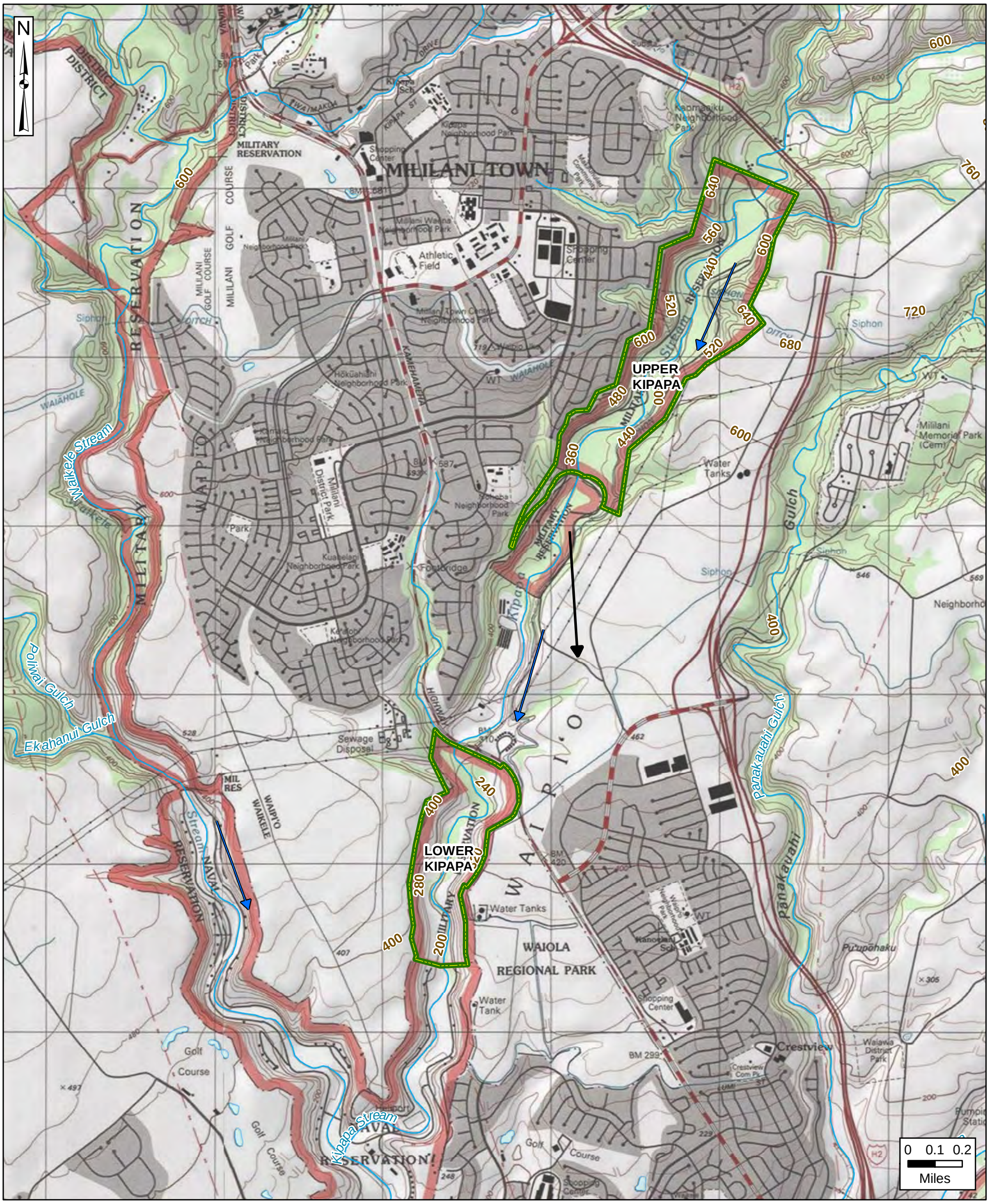
HGGRC = Hawaii Groundwater & Geothermal Resources Center

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
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-3-3
Kipapa Ammunition Storage Site
Topographic Map



Kipapa Ammunition Storage Site

Contour Interval = 40 feet

Stream (Perennial)

Stream (Intermittent)

Water Body

Groundwater Flow Direction

Surface Water Flow Direction

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

Coordinate System:
WGS 1984, UTM Zone 4 North

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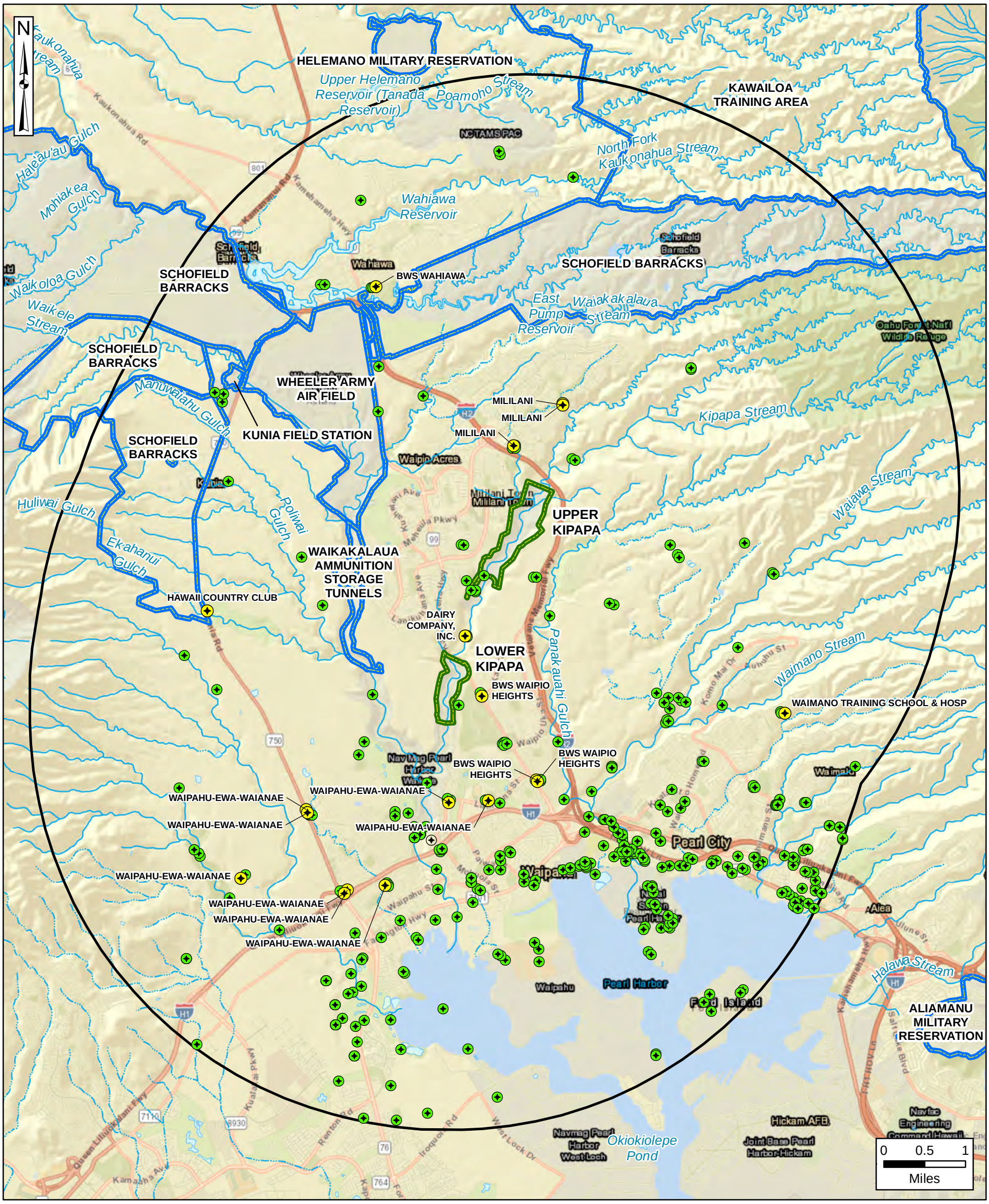
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-3-4
Kipapa Ammunition Storage Site
Off-Post Potable Supply Wells



Kipapa Ammunition Storage Site

5-Mile Radius

Other Military Installation

Stream (Perennial)

Stream (Intermittent)

Water Body

Public Water Supply System Well (EDR Data)

Water Well (HGGRC Data) (well use not specified)

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems which provides water to at least 25 people for at least 60 days annually. Well owner labels are as provided in the EDR Report. See Appendix E for further information.

EDR = Environmental Data Resources
HGGRC = Hawaii Groundwater & Geothermal Resources Center

Data Sources:
USAG-HI, GIS Data, 2018
EDR, Well 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
U.S. Army Garrison-Hawaii Sub-installations

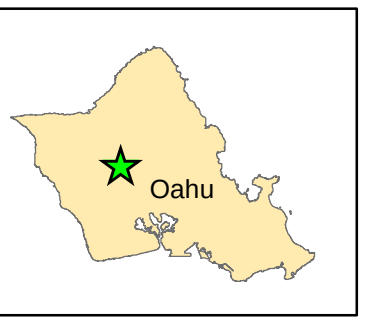


Figure 2-4-1
Kunia Field Station
Site Location

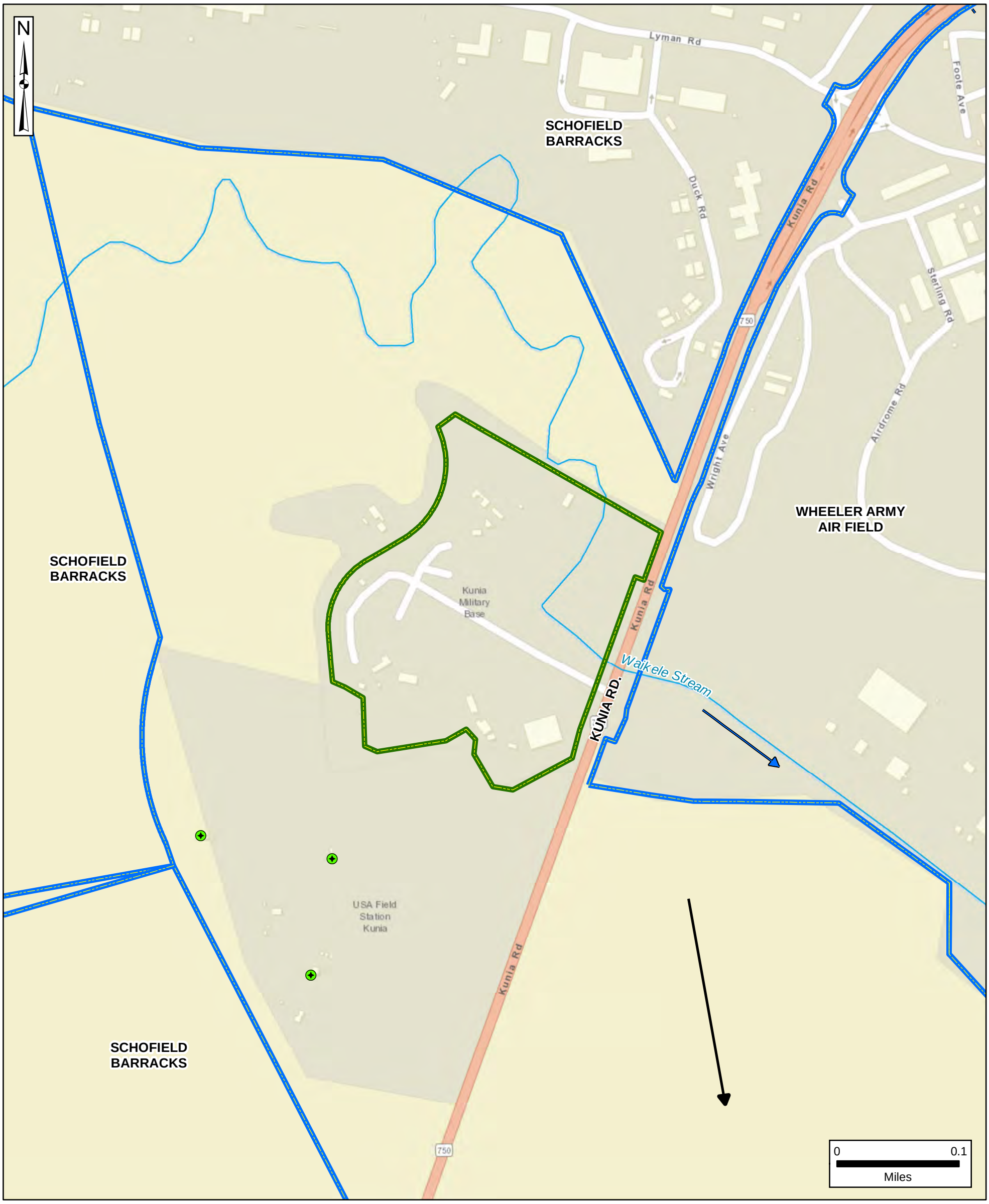
Kunia Field Station
Other Military Installation
Stream (Perennial)
Stream (Intermittent)
Water Body

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
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-4-2
Kunia Field Station
Site Layout



Kunia Field Station
Other Military Installation
Stream (Perennial)
Surface Water Flow Direction
Groundwater Flow Direction
Water Well (HGGRC Data)

HGGRC = Hawaii Groundwater & Geothermal Resources Center

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

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U.S. Army Garrison-Hawaii Sub-installations

Figure 2-4-3
Kunia Field Station
Topographic Map

Kunia Field Station
Other Military Installation
Stream (Perennial)
Water Body
Surface Water Flow Direction
Groundwater Flow Direction

Contour Interval = 20 feet

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

Coordinate System:
WGS 1984, UTM Zone 4 North

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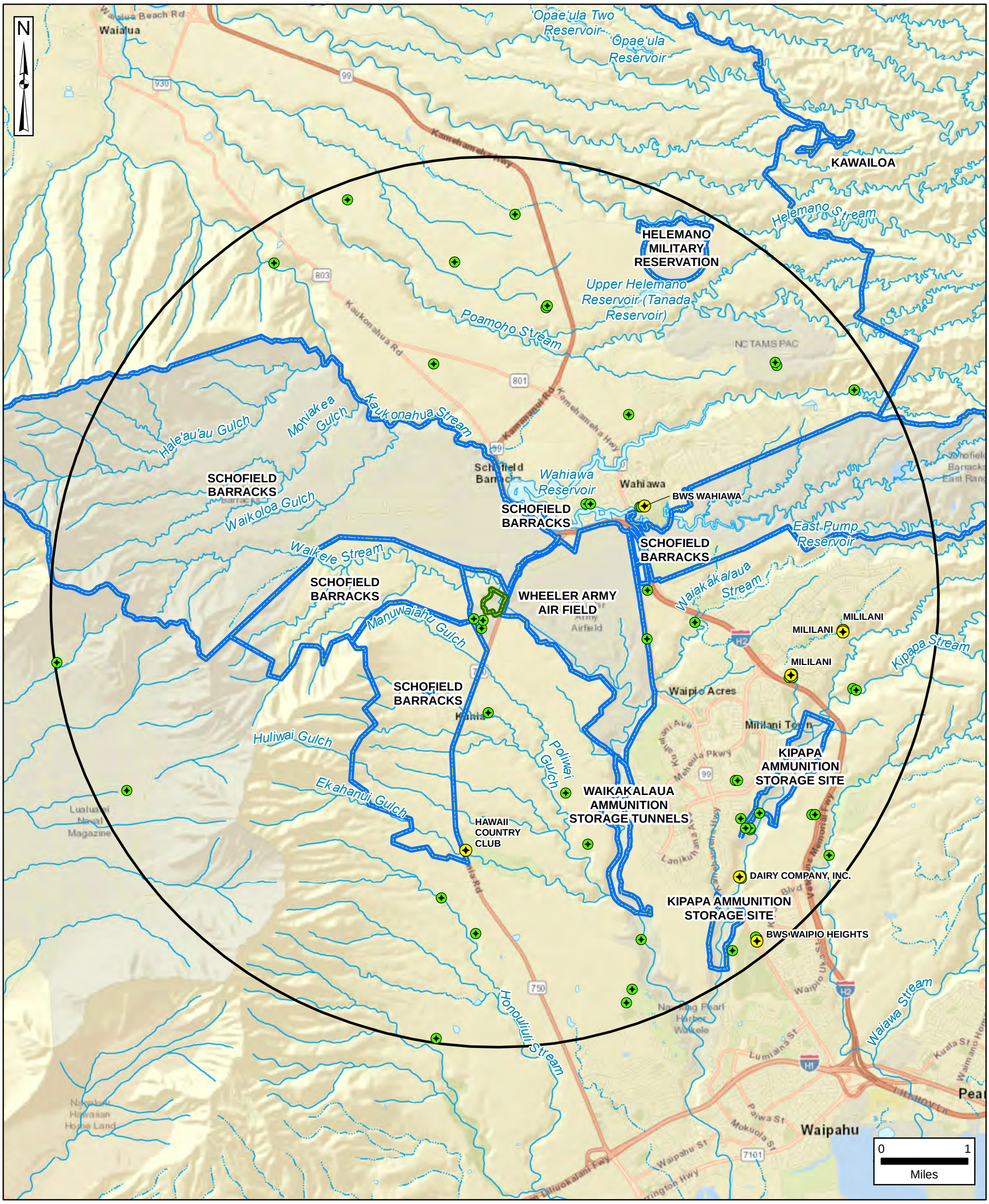
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-4-4
Kunia Field Station
Off-Post Potable Supply Wells



- Kunia Field Station
- 5-Mile Radius
- Other Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Public Water Supply System Well (EDR Data)
- Water Well (HGGRC Data) (well use not specified)

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems which provides water to at least 25 people for at least 60 days annually. Well owner labels are as provided in the EDR Report. See Appendix E for further information.

EDR = Environmental Data Resources
HGGRC = Hawaii Groundwater & Geothermal Resources Center

Data Sources:
USAG-HI, GIS Data, 2018
EDR, Well 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

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Preliminary Assessment
U.S. Army Garrison-Hawaii Sub-installations

ARCADIS

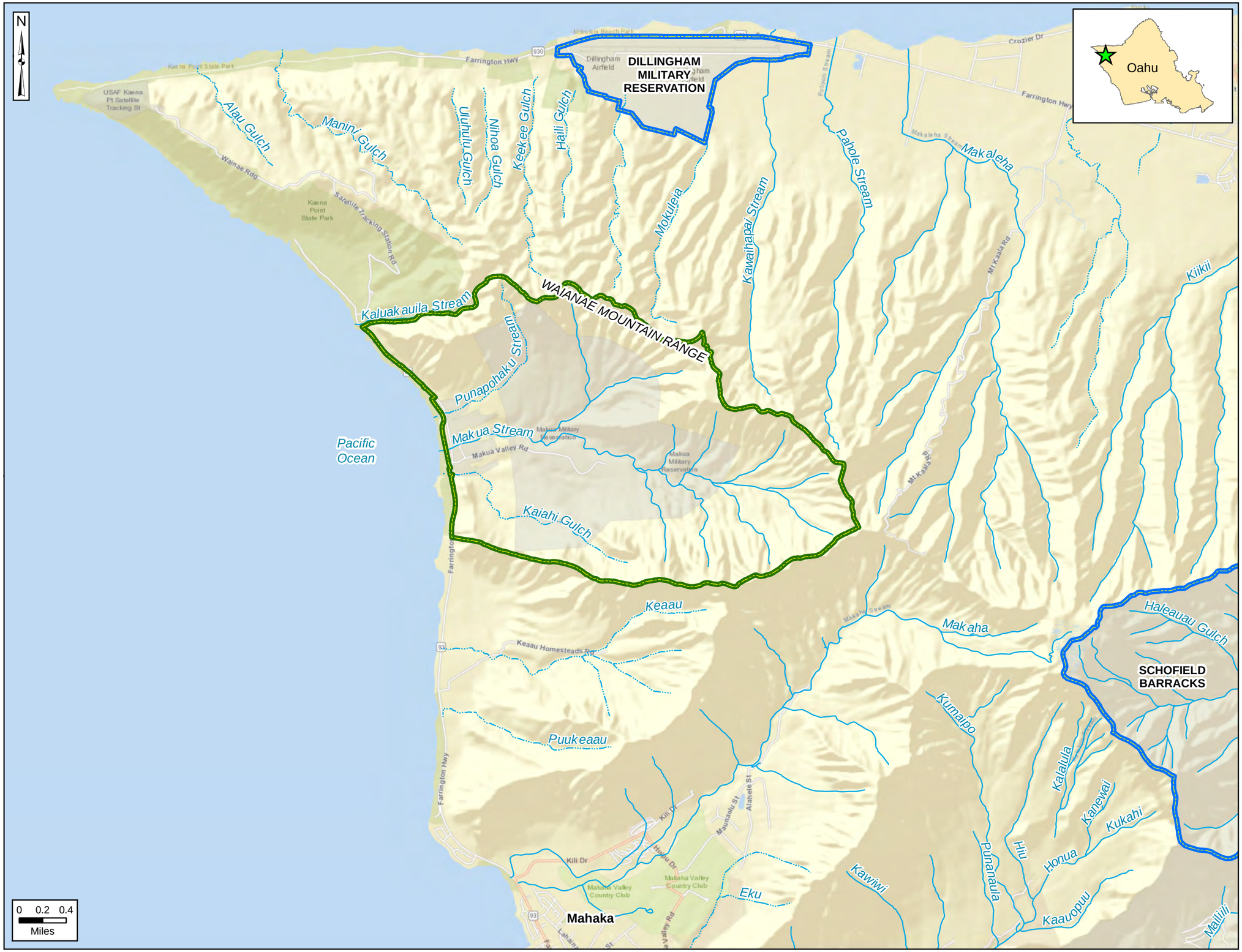
Figure 2-5-1
Makua Military Reservation
Site Location

Legend

- Makua Military Reservation
- Other Military Installation
- Stream (Perennial)
- Stream (Intermittent)

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



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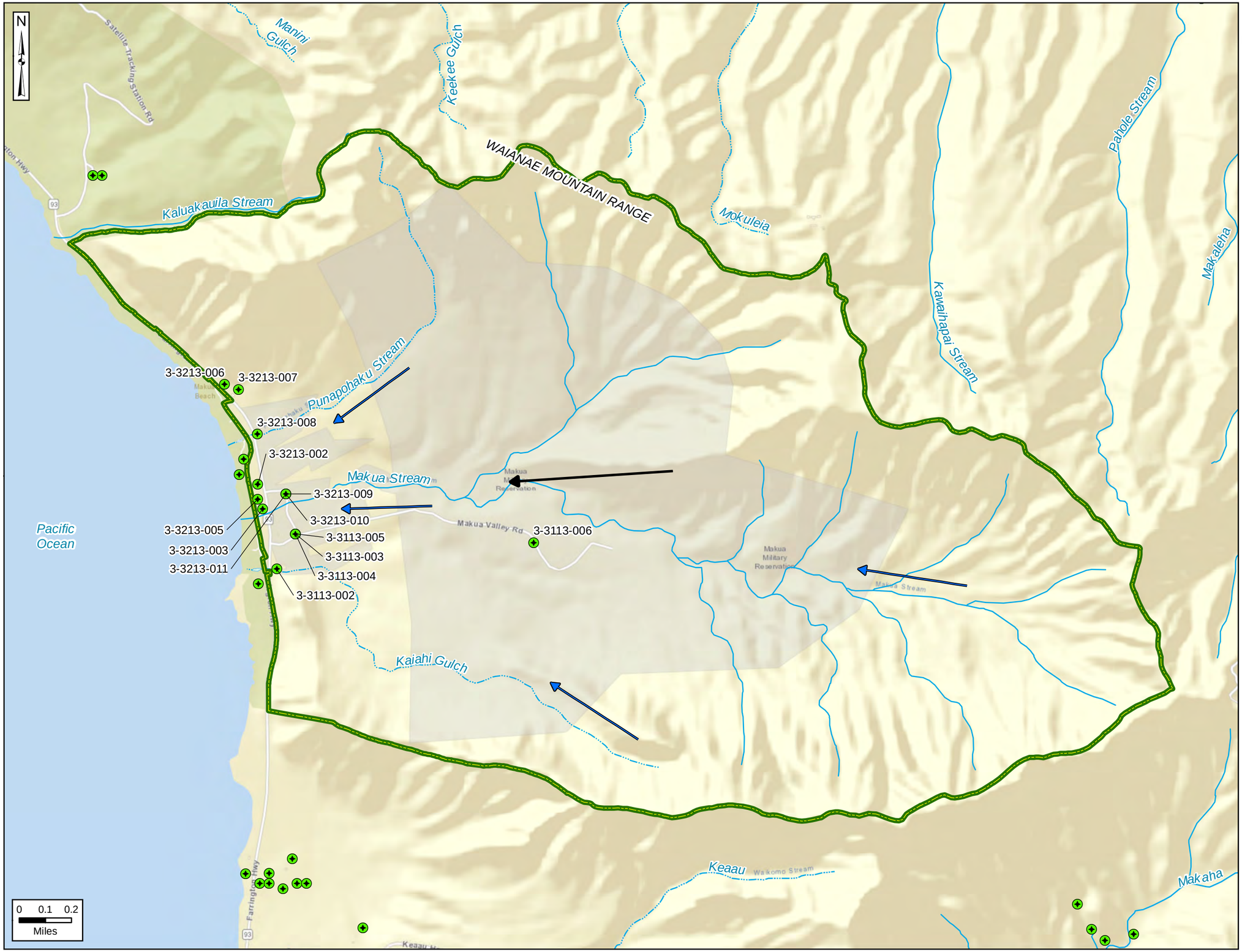
U.S. Army Garrison-Hawaii Sub-installations

ARCADIS

Figure 2-5-2
Makua Military Reservation
Site Layout



Legend

- Makua Military Reservation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Groundwater Flow Direction
- Water Well (HGGRC Data)

HGGRC = Hawaii Groundwater & Geothermal Resources Center

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

Coordinate System:
WGS 1984, UTM Zone 4 North

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Preliminary Assessment
U.S. Army Garrison-Hawaii Sub-installations

ARCADIS

Figure 2-5-3
Makua Military Reservation
Topographic Map

Legend

- Makua Military Reservation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Surface Water Flow Direction
- Groundwater Flow Direction

Contour Interval = 100 feet

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

Coordinate System:
WGS 1984, UTM Zone 4 North

0 0.1 0.2
Miles

INTERNAL DELIBERATIVE – DO NOT RELEASE

N

DILLINGHAM MILITARY RESERVATION

MOKULEIA LAND COMPANY

WAIALUA SUGAR COMPANY

WAIPAHU-EWA-WAIANAE

WAIANAE MILITARY REC CAMP

SCHOFIELD BARRACKS

Alau Gulch
Maniní Gulch
Nihoa Gulch
Keekee Gulch
Haili Gulch
Mokuleia
Kawaihapai Reservoir
Kawaihapai Stream
Pahole Stream
Makaleha
Aweoweo
Kilikii
Kawailoa
Lanikea
Uko'a Pond
Loko Ea
Lokoea
Haleiwa
Anahulu R
Opaeula
Helemano
Poamoho North
Poamoho
Kaena Point State Park
Pacific Ocean
Makua Stream
Makua Military Reservation
Kaiahi Gulch
Keaau
Makaha
Puukeaau
Hiu
Kaiopuu
Kawiwi
Eku
Kaupuni
Mailiili
Haleauau Gulch
Waikoloa Gulch
Mohiakea Gulch
Waikele
Poliwai Gulch
Huliwai Gulch
Ekahanui Gulch
Honouliuli
Kaukonahua
Waialua Beach Rd
Kaukonahua Rd
Joseph P Leong Hwy
Farrington Hwy
Lualualei Naval Magazine

0 0.5 1
Miles

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ARCADIS

Figure 2-5-4
Makua Military Reservation
Off-Post Potable Supply Wells

Legend

- Makua Military Reservation
- 5-Mile Radius
- Other Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Public Water Supply System Well (EDR Data)
- Water Well (HGGRC Data) (well use not specified)

EDR = Environmental Data Resources
HGGRC = Hawaii Groundwater & Geothermal Resources Center

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems which provides water to at least 25 people for at least 60 days annually. Well owner labels are as provided in the EDR Report. See Appendix E for further information.

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

Coordinate System:
WGS 1984, UTM Zone 4 North

USAEC PFAS Preliminary Assessment
U.S. Army Garrison-Hawaii Sub-installations

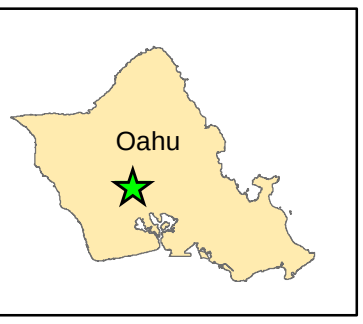

Figure 2-6-1
Waikakalaua Ammunition Storage Tunnels
Site Location

Waikakalaua Ammunition Storage Tunnels
Other Military Installation
Stream (Perennial)
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

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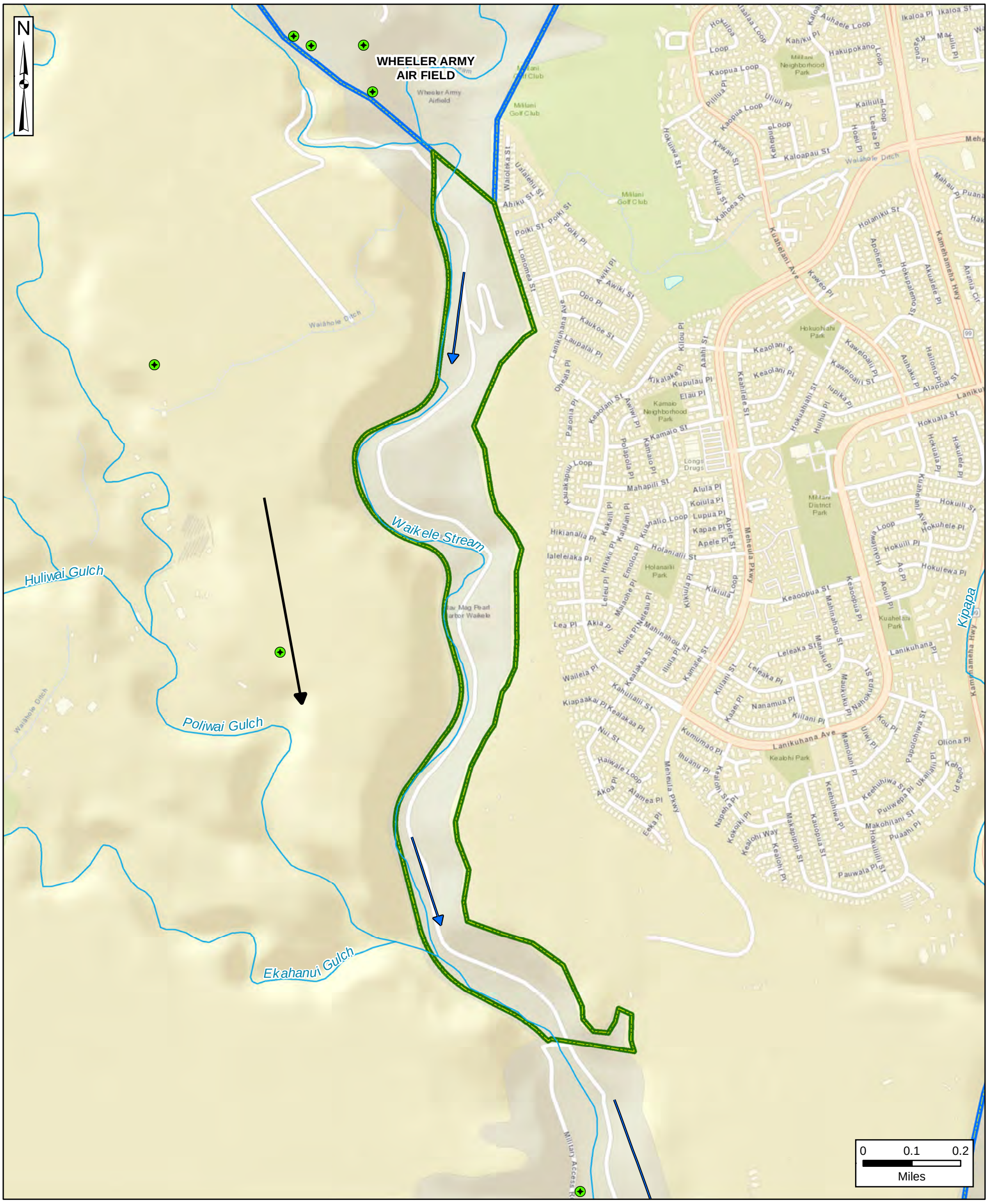
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-6-2
Waikakalaua Ammunition Storage Tunnels
Site Layout



- Waikakalaua Ammunition Storage Tunnels
- Other Military Installation
- Stream (Perennial)
- Water Body
- Groundwater Flow Direction
- Surface Water Flow Direction
- Water Well (HGGRC Data)

HGGRC = Hawaii Groundwater & Geothermal Resources Center

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

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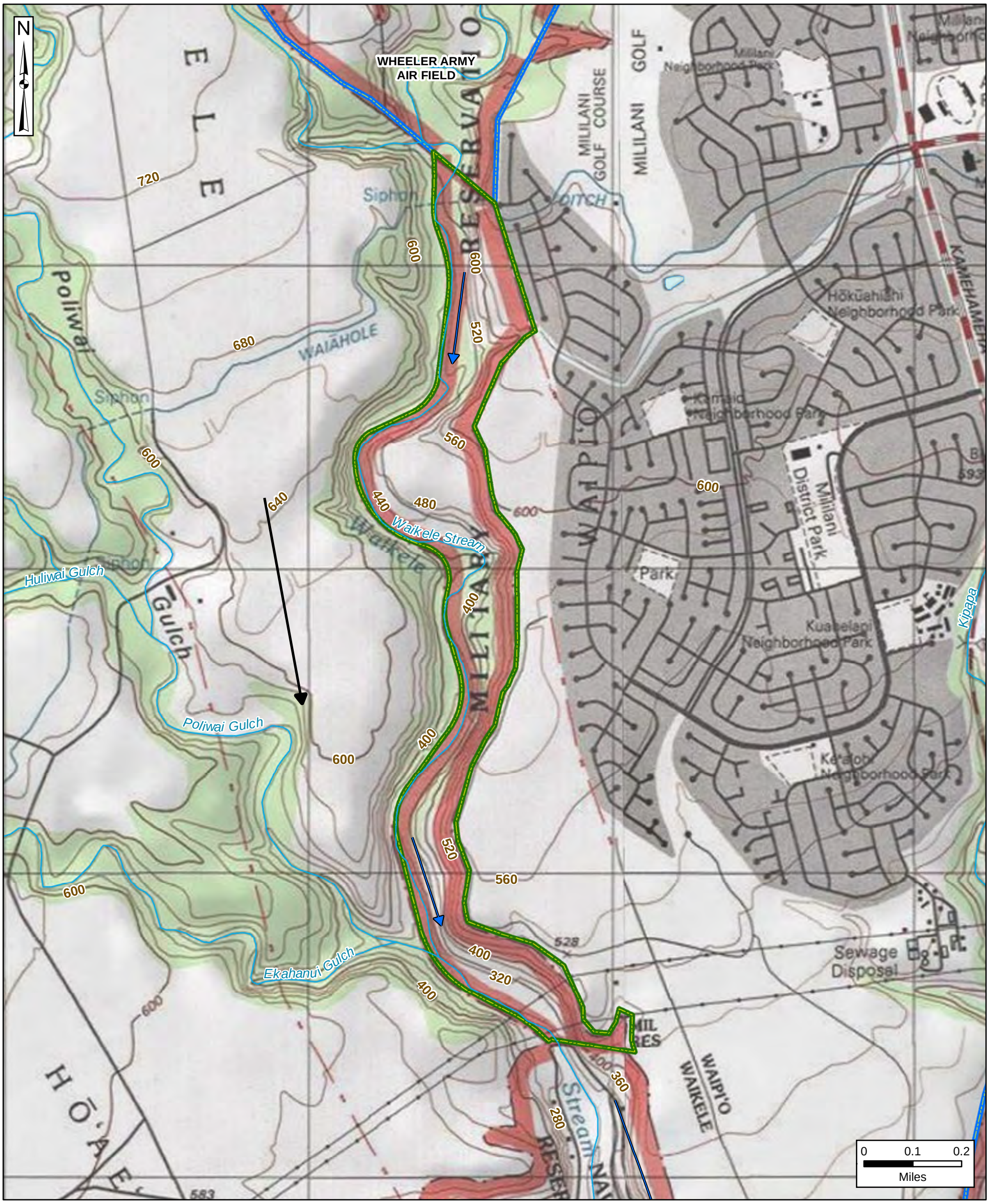
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-6-3
Waikakalaua Ammunition Storage Tunnels
Topographic Map



Waikakalaua Ammunition Storage Tunnels

Stream (Perennial)

Water Body

Groundwater Flow Direction

Surface Water Flow Direction

Contour Interval = 40 feet

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

Coordinate System:
WGS 1984, UTM Zone 4 North

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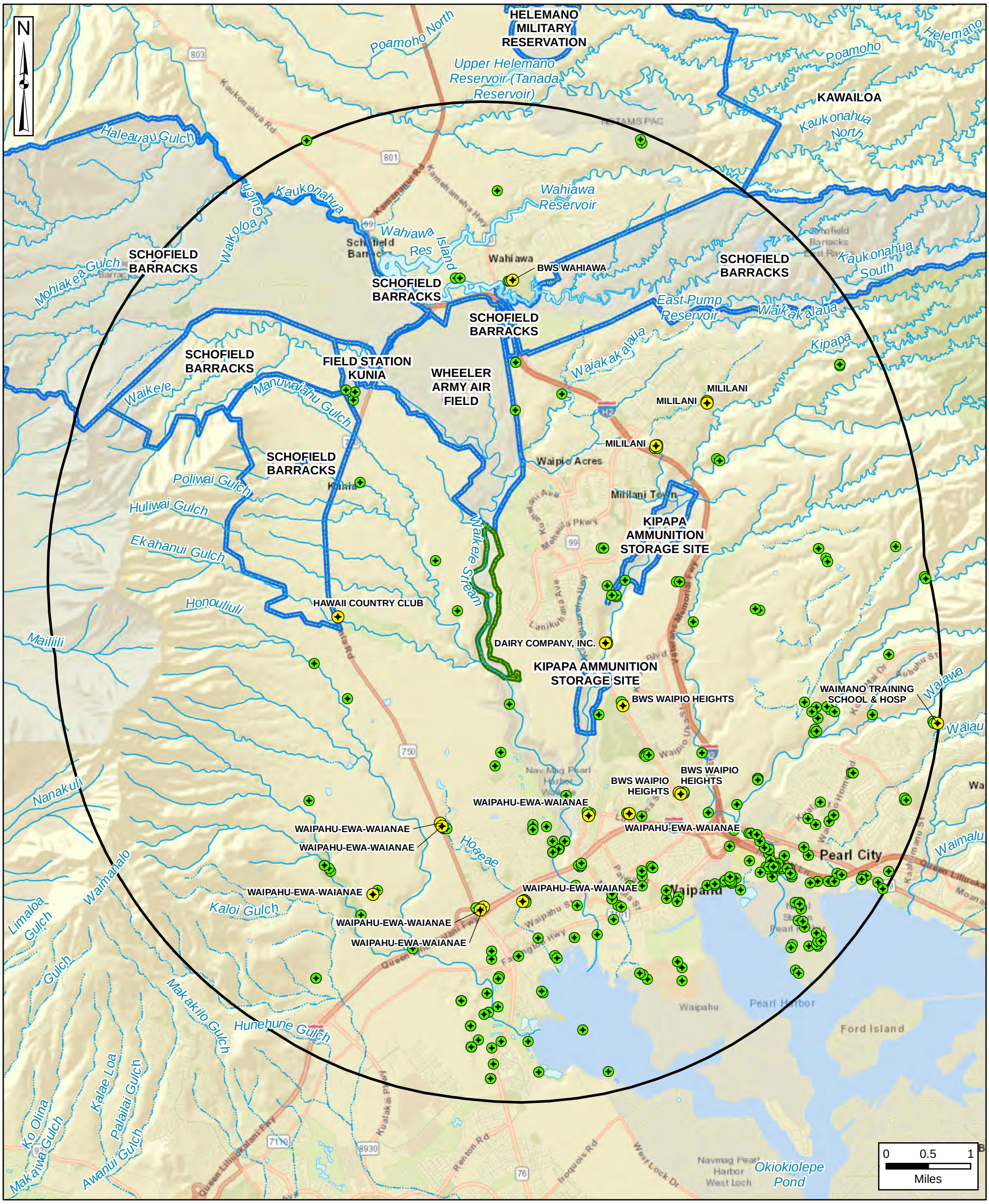
U.S. Army Garrison-Hawaii Sub-installations

Figure 2-6-4
Waikakalaua Ammunition Storage Tunnels
Off-Post Potable Supply Wells



- Waikakalaua Ammunition Storage Tunnels
- 5-Mile Radius
- Other Military Installation
- Stream (Perennial)
- Stream (Intermittent)
- Water Body
- Public Water Supply System Well (EDR Data)
- Water Well (HGGRC Data) (well use not specified)

Note: Public Water Supply System Well data from the Federal Reporting Data System and includes water systems which provides water to at least 25 people for at least 60 days annually. Well owner labels are as provided in the EDR Report. See Appendix E for further information.

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

Coordinate System:
WGS 1984, UTM Zone 4 North