FINAL
Site Inspection Report
Fort Allen
Juana Díaz, Puerto Rico

Site Inspections for Perfluorooctanoic Acid (PFOA), Perfluorooctanesulfonic Acid (PFOS), Perfluorohexanesulfonic Acid (PFHxS), Perfluorononanoic Acid (PFNA), Hexafluoropropylene oxide dimer acid (HFPO-DA) and Perfluorobutanesulfonic Acid (PFBS)
ARNG Installations, Nationwide

August 2023

Prepared for:

Army National Guard Headquarters
111 S. George Mason Drive
Arlington, VA 22204

UNCLASSIFIED

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TABLE OF CONTENTS

LIST OF APPENDICES

* A Technical Project Planning Meeting was not held for Fort Allen; regulators did not respond to the request to attend a Technical Project Planning Meeting.

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
%	Percent
µg/kg	Microgram(s) per kilogram
AECOM	AECOM Technical Services, Inc.
AFFF	Aqueous film forming foam
amsl	Above mean sea level
AOI	Area of Interest
ARNG	Army National Guard
bgs	Below ground surface
btoc	Below top of casing
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	Conceptual site model
DoD	Department of Defense
DPT	Direct-push technology
DQO	Data quality objective
DUA	Data Usability Assessment
EA	EA Engineering, Science, and Technology, Inc., PBC
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EB	Equipment blank
FedEx	Federal Express
Fort Allen	Fort Allen in Puerto Rico, Juana Diaz
ft	Foot (feet)
HDPE	High-density polyethylene
HFPO-DA	Hexafluoropropylene oxide dimer acid
ID	Identification
IDW	Investigation-derived waste
in.	Inch(es)
ITRC	Interstate Technology Regulatory Council
LC/MS/MS	Liquid chromatography tandem mass spectrometry
LOQ	Limit of quantification

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

MS	Matrix spike
MSD	Matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
ng/L	Nanogram(s) per liter
No.	Number
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutanesulfonic acid
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PID	Photoionization detector
ppt	Part(s) per thousand
PRARNG	Puerto Rico Army National Guard
PRDNER	Puerto Rico Department of Natural and Environmental Resources
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
QSM	Quality Systems Manual
RI	Remedial investigation
SI	Site Inspection
SL	Screening level
TOC	Total organic carbon
TPP	Technical Project Planning
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Services

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EXECUTIVE SUMMARY

The Army National Guard (ARNG) G-9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at ARNG facilities nationwide based on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) (Assistant Secretary of Defense) dated 6 July 2022. The six compounds listed in the OSD memorandum include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA).[1] These compounds are collectively referred to as "relevant compounds" throughout the document and the applicable screening levels (SLs) are provided in **Table ES-1**.

The PA identified one Area of Interest (AOI) where PFAS-containing materials may have been used, stored, disposed, or released historically (see **Table ES-2** for AOI locations). The objective of the SI is to identify whether there has been a release to the environment from the AOI identified in the PA and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on SLs for the relevant compounds. This SI was completed at Fort Allen, in Juana Diaz, Puerto Rico and determined further evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted for AOI 1. Fort Allen will also be referred to as the "Facility" throughout this document.

The Facility, operated by Puerto Rico ARNG (PRARNG), encompasses approximately 900 acres near the southern coast of Puerto Rico within the municipality of Juana Diaz. The Facility lies approximately 10 miles east of Ponce, Puerto Rico. Juana Diaz has a predominately flat topography and is made up of residential and agricultural areas, with a vast wetland located immediately to the east of the Facility. The Caribbean Sea is approximately 2 miles south of the Facility. In 1941, Fort Allen was known as Losey Army Airfield and then Camp Losey from 1949 to 1950 and was originally established as a hub for U.S. Navy communications prior to the commencement of World War II. Today, the Facility maintains an active role in the education and training of U.S. Armed Forces as well as the PRARNG.

The PA identified one AOI for investigation during the SI phase. SI sampling results from the AOI were compared to OSD SLs. **Table ES-2** summarizes the SI results for the AOI. Based on the results of this SI, further evaluation under CERCLA in a remedial investigation (RI) for AOI 1.

[1] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table ES-1. Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg)[1] (0 to 2 ft bgs)	Industrial/Commercial Composite Worker (Soil) (µg/kg)[1] (2 to 15 ft bgs)	Tap Water (Groundwater) (ng/L)[1]
PFOA	19	250	6
PFOS	13	160	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
1. Office of the Assistant Secretary of Defense. 2022. Risk Based Screening Levels Calculated for Groundwater and Soil using U.S. Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. 6 July 2022.
2. Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

µg/kg = Microgram(s) per kilogram
ng/L = Nanogram(s) per liter

Table ES-2. Summary of Site Inspection Findings and Recommendations

AOI	Potential PFAS Release Area	Soil Source Area	Groundwater Source Area	Future Action
1	Fire Station	◐	●	Proceed to RI

Legend:
● = Detected; exceedance of screening levels
◐ = Detected; no exceedance of screening levels
○ = Not detected

1. INTRODUCTION

1.1 PROJECT AUTHORIZATION

The Army National Guard (ARNG) G-9 is the lead agency in performing Preliminary Assessments (PAs) and Site Inspections (SIs) at ARNG facilities nationwide based on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense 2022). The six compounds listed in the OSD memorandum will be referred to as "relevant compounds" throughout this document and include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and hexafluoropropylene oxide-dimer acid (HFPO-DA)[2] at ARNG facilities nationwide. The ARNG performed this SI at Fort Allen in Juana Diaz, Puerto Rico. Fort Allen will be referred to as the "Facility" throughout this document.

The SI project elements were performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S. Environmental Protection Agency [USEPA] 1980), as amended, the National Oil and Hazardous Substances Pollution Contingency Plan (40 Code of Federal Regulations Part 300; USEPA 1994), and in compliance with U.S. Department of the Army (DA) requirements and guidance for field investigations.

1.2 SITE INSPECTION PURPOSE

A PA was performed at Fort Allen (AECOM Technical Services, Inc. [AECOM] 2020) and identified one Area of Interest (AOI) where PFAS-containing materials were used, stored, disposed, or released historically. The objective of the SI is to identify whether there has been a release to the environment from the AOI identified in the PA and determine whether further investigation is warranted, a removal action is required to address immediate threats, or no further action is required based on screening levels (SLs) for the relevant compounds.

[2] Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

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2. FACILITY BACKGROUND

2.1 FACILITY LOCATION AND DESCRIPTION

Fort Allen is located near the southern coast of Puerto Rico, within the municipality of Juana Díaz, and approximately 10 miles east of Ponce, Puerto Rico. There are two controlled entrance gates to the facility; one is located on Highway PR-149, and one is located on Calle 158 (**Figure 2-1).** Fort Allen was established as a hub for U.S. Navy communications shortly before the involvement in World War II. In 1941, Fort Allen was acquired by the U.S. Army to establish an additional U.S. military installation in Puerto Rico. Losey Army Airfield already existed in the current Fort Allen area. The Base was renamed Camp Losey in 1949. In 1950, the Facility was renamed Fort Allen and provided operational support for the United States and North Atlantic Treaty Organization troops during the Korean War.

Fort Allen continues to be a stronghold of communications and operational support for the Fort Allen U.S. Armed Forces Reserve, Puerto Rico National Guard, U.S. Navy, and the U.S. Army Reserve. There are also several detachments at Fort Allen that operate to support the National Guard Youth Challenge Program (AECOM 2020). The approximately 900-acre Facility is comprised of a cantonment area with office spaces, recreational areas, barracks, vehicle maintenance facilities, a fire station, a non-operational airfield, an operational helipad, and range areas. A parcel of land formerly used by the U.S. Navy as a radar communication station bisects Fort Allen, separating the northern and southern halves of the PRARNG Facility (AECOM 2020).

2.2 FACILITY ENVIRONMENTAL SETTING

Fort Allen is located in the municipality of Juana Díaz, due east of Ponce, on the south-central coast of Puerto Rico (**Figure 2-2)**. The Caribbean Sea is located approximately 2 miles to the south of the Facility, and there is a vast wetland to the immediate east of the cantonment area, known as Hacienda Ursula. Residential and agricultural areas are also located east of the northern portions of Fort Allen; agricultural land is located to the west, and residential areas are located south of the cantonment area. Topography across the Facility is generally flat, and some small streams are located on the periphery of the property as well as in the adjacent areas. Much of the Juana Diaz municipality is currently used for sugar cane agriculture and beige marble production (AECOM 2020).

The following sections include information on geology, hydrogeology, hydrology, climate, and current and future land use. The topography at Fort Allen is shown on **Figure 2-2**. The regional geology and groundwater features are shown on **Figure 2-3**. The regional surface water features and drainage basins are shown on **Figure 2-4**. Groundwater elevations and contours are presented on **Figure 2-5**.

2.2.1 Geology

Fort Allen is located on the southern slope of the Cordillera Central Mountain Range. The mountains are composed of highly faulted and folded sedimentary and volcanic formations. The volcaniclastic and sedimentary rocks consist of massive- to thick-bedded andesitic tuff, welded

tuff, porphyritic basalt, volcanic breccia, sandstone, and siltstone. A principal structural feature of the strata is a dominant southwesterly dip. The volcanic complex of south-central Puerto Rico is overlain by the Juana Diaz Formation, which consists of basal beds of sand, pebbles, and cobbles overlain by sandy to silty clay. Fort Allen is located on the southern part of the Juana Diaz Formation.

Soils encountered during the SI field activities consisted of loose sands of fine to medium grain, silt, clay/interbedded clays, and gravel. General chemistry and grain size analysis was performed for AOI 1. Soil pH was noted as 8.4 (slightly basic) with a total organic carbon (TOC) level of 1,900 milligrams per kilogram (mg/kg), indicating low organic-matter content. The grain size analysis showed that the soils were composed of 16 percent (%) clay, 13.8% gravel, 9.9% sand (7% fine, 2.4% medium, and 0.5% coarse), and 60% silt, indicative of a silty loam.

2.2.2 Hydrogeology

Groundwater primarily moves through structural features such as joints, fractures, and bedding planes in the portions of the installation directly overlying volcanic and sedimentary bedrock units (AECOM 2020). **Figure 2-3** depicts groundwater features as well as the groundwater wells within a 2-mile radius of the Facility. The principal aquifer in this region underlying Fort Allen is the South Coastal Alluvial Plain aquifer system, spanning roughly 470 square kilometers along the southern coast of Puerto Rico. This system spans the Rio Jacaguas and Coastal Watersheds (**Figure 2-4)**. Fort Allen lies within the Coastal Watersheds and often sees recharge through infiltration of precipitation (AECOM 2020).

Information gathered during the PA indicated that depth to ground water was about 20- 30 ft bgs and the groundwater flow direction was unknown but was presumed to be southeast towards Hacienda Ursula and the Caribbean Sea. Based on the observed depths to groundwater and surveyed well elevations collected during the SI, the groundwater contour map provided as **Figure 2-5** was generated.

The Juana Diaz municipality obtains its water from Lago Toa Vaca, a lake located approximately 6.5 miles north of Fort Allen. According to PRARNG interviewees at Fort Allen, the adjacent communities to the east and south receive municipal drinking water; however, it is possible that unregistered drinking water wells exist in those areas (AECOM 2020).

Fort Allen is served by three drinking water wells located in the facility cantonment area (**Figure 2-3)**. These wells are in close proximity to the firehouse, with one well cross-gradient and two downgradient of the Firehouse. Well screening/pumping intake levels are shown as starting at between 18 to 28 ft bgs from the three wells, according to available Facility records. Sampling of the Facility wells for PFAS was reportedly conducted by the ARNG in June 2017(AECOM 2020). As part of the current SI effort, two of the three drinking water wells were sampled (the third well was reported as inactive during the planning and sampling timeframe) and the results are discussed in Section 5.1.3.

Depths to water measured in May 2022 during the SI ranged from 16.08 to 19.95 ft bgs. Groundwater elevation contours from the SI are presented on **Figure 2-5** and indicate the groundwater flow direction at the Facility is primarily to the southeast.

2.2.3 Hydrology

Fort Allen is located on the southern slope of the Cordillera Central Mountain range, which forms the main drainage divide of Puerto Rico. The steep topography of the southern slope of the Cordillera Central results in rapid runoff and occasional flash flooding along the intermittent streams that traverse near Fort Allen. All surface water in Fort Allen flows south to the Caribbean Sea, roughly 2 miles from the installation boundary. Freshwater wetlands listed by the National Wetlands Inventory exist in the northern portion of the Facility, and adjacent to the Facility to the east and south (**Figure 2-4**) (AECOM 2020).

2.2.4 Climate

Puerto Rico has a mildly tropical Caribbean climate and a complex rainfall pattern that is controlled mainly by the orographic effects of the Cordillera Central Mountain range. The Cordillera Central forms a barrier to the prevailing northeast trade winds and affects the distribution of rainfall throughout Puerto Rico. The trade winds persist throughout the year, producing a wind pattern varying from northeast to southeast according to the season. Average daily wind speeds range from 2 to 9 knots. Much of the south coast, including Fort Allen, lies in a rain shadow, averaging 35 to 45 inches (in.) per year, whereas the northern and higher elevations of the island average approximately 80 in. per year. The average annual rainfall in Juana Diaz is 42.15 in. Over 80% of the rainfall occurs in May through November, with October typically being the wettest month (AECOM 2020).

Seasonal variation in temperatures in Puerto Rico is very low. The average temperature in the summer in Ponce is 82.3 degrees Fahrenheit (°F), while the average temperature in the winter is 77.2°F (AECOM 2020).

2.2.5 Current and Future Land Use

Fort Allen is currently being used as an ARNG training and education center (AECOM 2020). Access to the Facility is controlled by two entrance gates to the facility; one is located on Highway PR-149, and one is located on Calle 158. Reasonably anticipated future land use is not expected to change from the current land use described above.

2.2.6 Sensitive Habitat and Threatened/Endangered Species

A wildlife survey has not occurred at the facility, but the Facility does not have any significant areas of habitat. The following species have not been identified at the Facility but may be present in the surrounding area.

The following species are listed as federally endangered, threatened, proposed, and/or candidate species in Juana Diaz, Puerto Rico (U.S. Fish and Wildlife Services [USFWS] 2022):

- Reptiles: Puerto Rican Boa (*Chilabothrus inornatus).*

2.3 HISTORY OF PFAS USE

One potential PFAS- release area was identified in the PA where aqueous film forming foam (AFFF) may have been used, stored, disposed, or released historically at the Fort Allen Facility (AECOM 2020). Interviews and records obtained during the PA indicate that PFAS-containing materials were stored on the property in the form of a Rosenbauer R-1 Airwolf Fire truck equipped with a 40-gallon (gal) AFFF tank which currently holds Chemguard 3% AFFF C306. According to facility personnel, AFFF has not been released on-site. However, it is possible that unknown or undocumented releases may have occurred at the Facility through PFAS-tainted water discharge or leakage from the tank (AECOM 2020). A description of the AOI and the potential release scenarios is presented in **Section 3**.

Army National Guard Site Inspections
Site Investigation Report
Fort Allen, Puerto Rico

Figure 2-1
Facility Location

Facility Data

Facility Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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Army National Guard Site Inspections
Site Investigation Report
Fort Allen, Puerto Rico

Figure 2-2
Topography

Facility Data

Facility Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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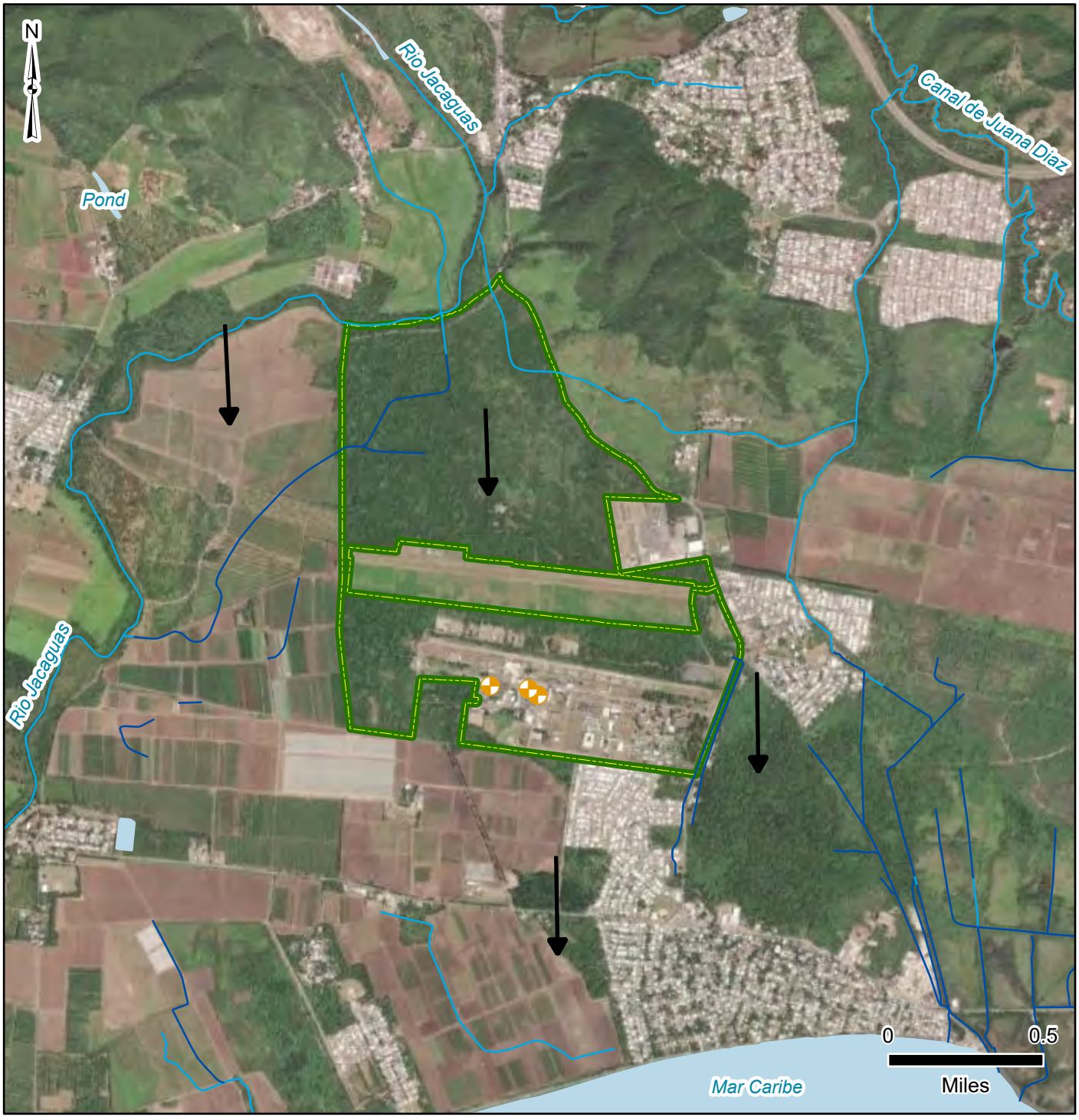
Army National Guard Site Inspections
Site Investigation Report
Fort Allen, Puerto Rico

Figure 2-3
Groundwater Features



Facility Data
- Facility Boundary

Well Type
- Potable

Hydrology/Hydrogeology
- Inferred Groundwater Flow Direction
- Perennial Creek/Stream
- Canal/Ditch
- Waterbody

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2022
Prepared By:.....EA
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Projection:.....WGS 84 UTM 20N

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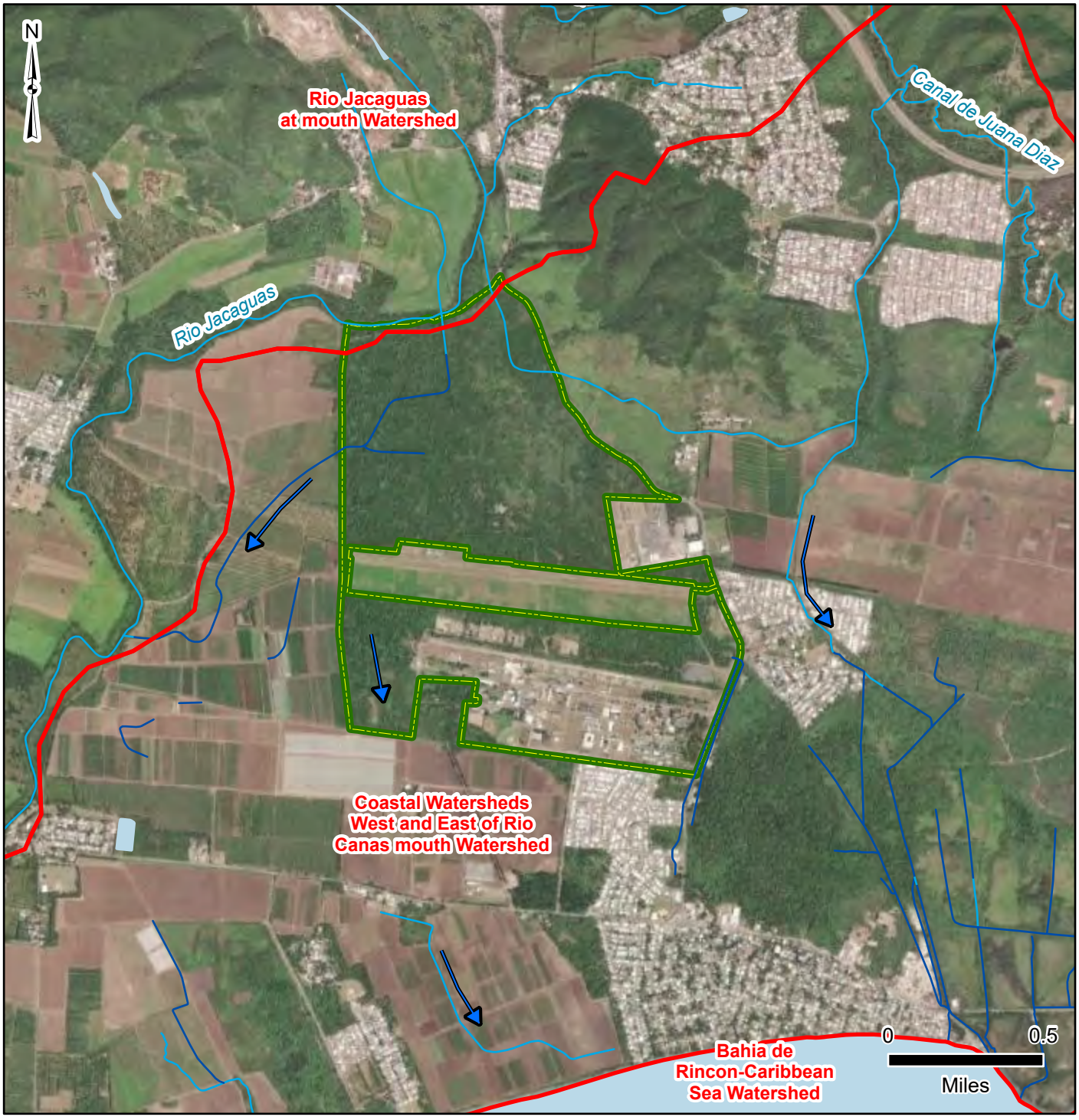
Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 2-4
Surface Water Features



Facility Data
- Facility Data

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Canal/Ditch
- Waterbody
- Watershed Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2020
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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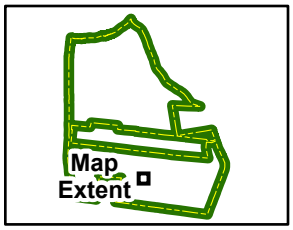
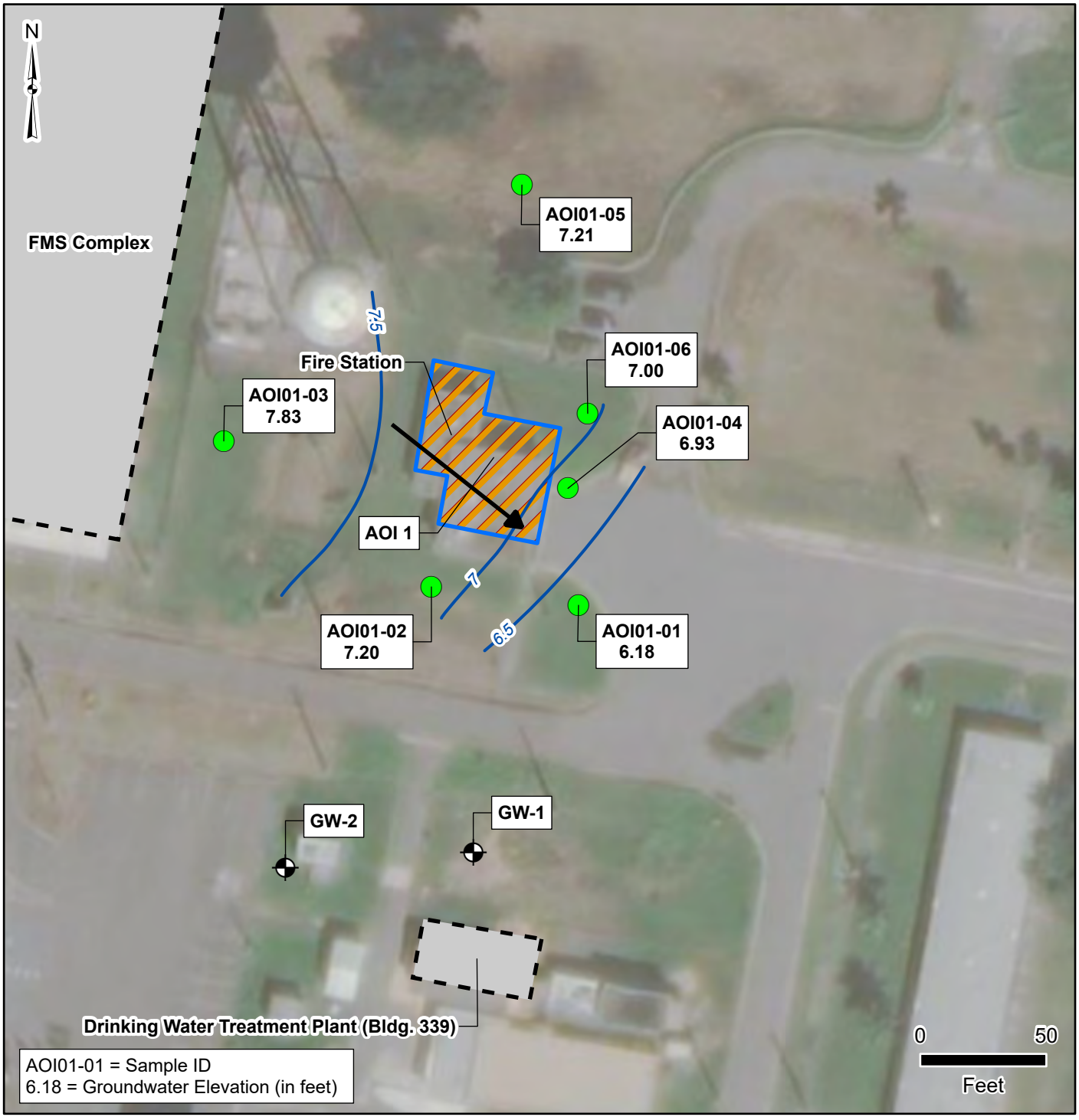
Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 2-5
May 2022 Groundwater Elevations





Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Sample Locations
- DPT
- Groundwater

Hydrology/Hydrogeology
- Groundwater Flow Direction
- Groundwater Elevation Contour Interval (0.5 Foot)

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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3. SUMMARY OF AREAS OF INTEREST

The PA evaluated areas where PFAS-containing materials may have been used, stored, disposed, or released historically. Based on the PA findings, one potential release area was identified at Fort Allen and designated as AOI 1. The AOI is shown on **Figure 3-1**.

3.1 AOI 1 – FIRE STATION

The Fort Allen Fire Station is located in the northwestern portion of the cantonment area near the former airfield (**Figure 3-1**). The Fire Station, Building 340, is currently operational and is used for the storage of equipment and materials associated with firefighting. It was reported in the Preliminary Assessment that the Fire Station stores one Rosenbauer R-1 Airwolf Firetruck equipped with a 40-gal tank containing Chemguard 3% AFFF C306, a 300-gal water tank, and a dry chemical extinguishant tank. The vehicle was delivered to Fort Allen from the near-by Camp Santiago facility in 2017. No documentation concerning a discharge at Fort Allen exists. The vehicle has been used for training purposes at off-facility locations and to fight forest fires at Fort Allen but has been reported to only ever have discharged water. No additional AFFF is stored at the Fire Station. The Fire Department also formerly stored one Humvee Skid Unit vehicle equipped with a 300-gal water tank, but no AFFF. The Fort Allen Fire Chief stated during interviews that none of the firefighting vehicles stored at Fort Allen have a history of leaking or other maintenance issues that may result in the release of AFFF. Fire department vehicles are maintained at the off-facility Camp Santiago Maneuver Area Training Equipment Site. The fire station does not have an affixed fire suppression system nor any other AFFF release mechanisms. Floor drains at the Fire Station connect to municipal sanitary sewers (AECOM 2020).

The Fort Allen Fire Department has a mutual aid agreement with the Ponce Fire Department and Juana Díaz Fire Department. These fire departments aid Fort Allen during emergencies. The fire departments have their own fire training academy in Salinas where fire training occurs; they do not come onto Fort Allen to perform any sort of fire training (AECOM 2020).

Although no evidence indicates that AFFF has ever been released at the Fire Station, the corrosive nature of AFFF often compromises firefighting equipment that uses it. It is possible that unknown leaks of AFFF have occurred, or that water discharged from the vehicles historically stored at the Fire Station may be tainted with PFAS. As such, the Fire Station is considered a potential PFAS-release area (AECOM 2020).

3.2 ADJACENT SOURCES

One potential off-facility source of PFAS not under the control of the PRARNG is located adjacent and potentially upgradient to the Facility. A description of this off-facility source is presented below and shown on **Figure 3-1**.

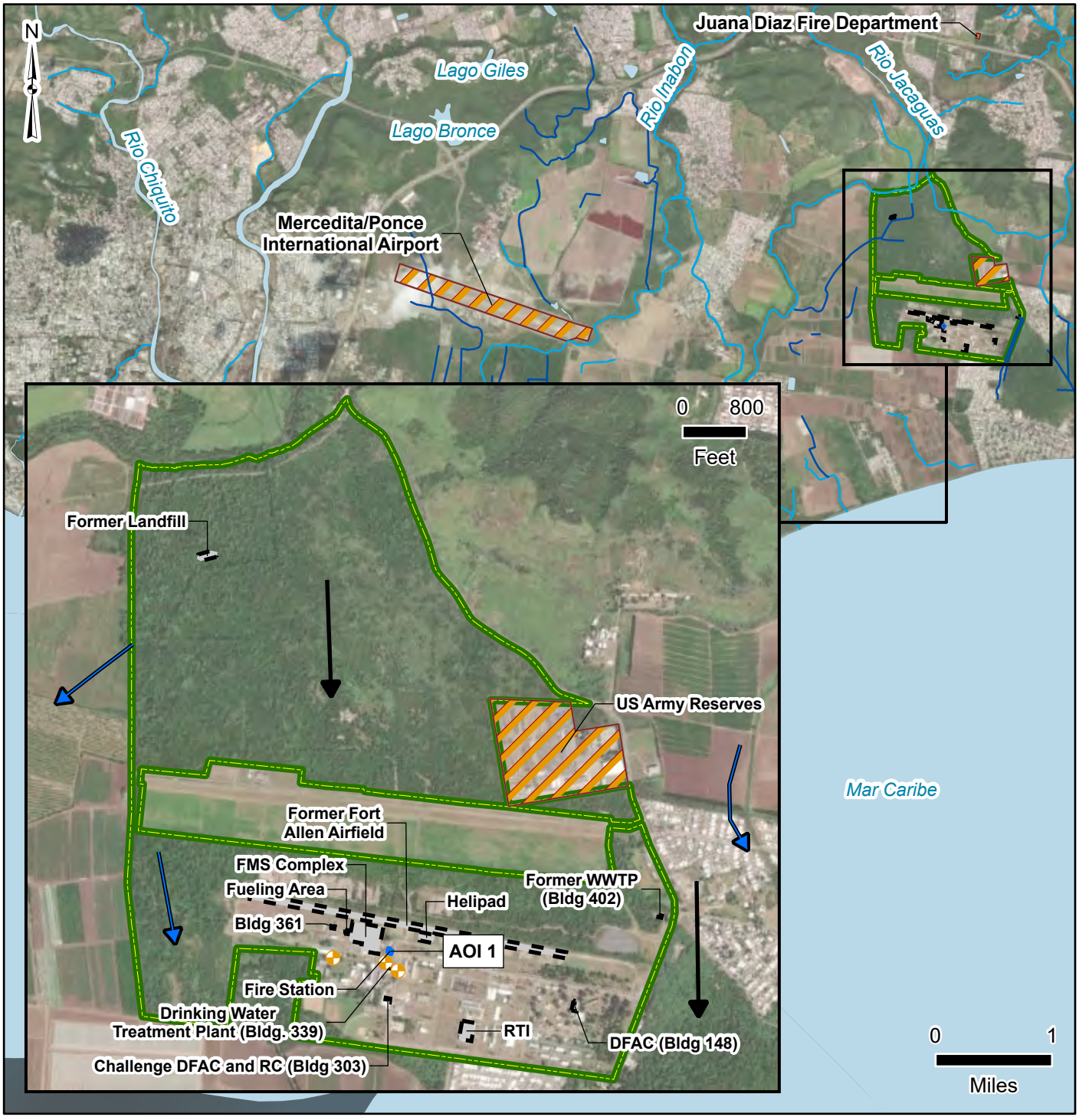
3.2.1 U.S. Army Reserve

The U.S. Army Reserve occupies an approximately 40-acre property adjacent to the eastern boundary of Fort Allen (**Figure 3-1**). According to Fort Allen personnel, the adjacent property is

used for equipment and materials storage. It is unknown whether the U.S. Army Reserve has ever used the space for any kind of hands-on training. The earliest historical aerial imagery included in the Environmental Data Resources report showing the development of the property is from 1991. The contents of any fire suppression systems located on the property are also unknown. Even though evidence of AFFF storage and use at has not been noted, the area is considered a potential PFAS-release area based on the known use and storage of AFFF by other non-ARNG Department of Defense (DoD) entities at other locations. This area is located upgradient/side gradient of AOI 1 (AECOM 2020).

Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 3-1
Areas of Interest



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Well Type
- Potable

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Inferred Groundwater Flow Direction
- Perennial Creek/Stream
- Canal/Ditch
- Waterbody

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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4. PROJECT DATA QUALITY OBJECTIVES

As identified during the data quality objective (DQO) process and outlined in the SI Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) Addendum (EA 2021a), the objective of the SI is to identify whether there has been a release to the environment at the AOIs identified in the PA. For each AOI, ARNG determines if further investigation is warranted, a removal action is required to address immediate threats, or whether no further action is warranted. This SI evaluated groundwater and soil for presence or absence of relative compounds at each of the sampled AOIs.

4.1 PROBLEM STATEMENT

ARNG will recommend an AOI for Remedial Investigation (RI) if related soil and groundwater samples have concentrations of the relevant compounds above OSD risk-based SLs. The SLs are presented in **Section 6.1** of this report.

4.2 INFORMATION INPUTS

Primary information inputs for the SI include the following:

- The PA Report for Fort Allen (AECOM 2020)
- Analytical data collected during other environmental sampling efforts at each ARNG installation.
- Groundwater and soil sample data collected as part of this SI in accordance with the site-specific UFP-QAPP Addendum (EA 2021a)
- Field data collected including groundwater elevation and water quality parameters measured at the time of sampling.

4.3 STUDY BOUNDARIES

The scope of the SI was bounded horizontally by the property limits of the Facility (**Figure 2-2**). Off-facility sampling was not included in the scope of this SI. If future off-facility sampling is required, the proper stakeholders will be notified, and necessary rights-of-entry will be obtained by ARNG with property owner(s). The vertical boundaries of the subsurface investigation were based on the depth of target samples and advancement to achieve temporary well construction. Temporal boundaries were limited to the earliest available time field resources were available to complete the study.

4.4 ANALYTICAL APPROACH

Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC, accredited under the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP); Accreditation No. 101 and the National Environmental Laboratory Accreditation

Program (NELAP); Certificate No. 6408. Data results were compared to applicable SLs and decision rules as defined in the UFP-QAPP Addendum (EA 2021a).

4.5 DATA USABILITY ASSESSMENT

The Data Usability Assessment (DUA), which is provided in **Appendix A**, is an evaluation at the conclusion of data collection activities that uses the results of both data verification and validation in the context of the overall project decisions or objectives. Using both quantitative and qualitative methods, the assessment determines whether project execution and the resulting data have met installation specific data quality objectives (DQOs). Both sampling and analytical activities are considered to assess whether the collected data are of the right type, quality, and quantity to support the decision-making (DoD 2019a, 2019b; USEPA 2017).

Based on the DUA, the environmental data collected during the SI were found to be acceptable and usable for this SI evaluation with the qualifications documented in the DUA and its associated data validation reports. These data are of sufficient quality to meet the objectives and requirements of the UFP-QAPP Addendum (EA 2021a).

5. SITE INSPECTION ACTIVITIES

This section describes the environmental investigation and sampling activities that occurred as part of the SI. The SI sampling approach was based on the findings of the PA and was implemented in accordance with the following approved documents:

- *Final Preliminary Assessment Report, Fort Allen, Juana Diaz, Puerto Rico,* dated March 2020 (AECOM 2020)
- *Final Programmatic Uniform Federal Policy-Quality Assurance Project Plan, Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide,* dated December 2020 (EA 2020a)
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Fort Allen, Juana Diaz, Puerto Rico,* dated August 2021 (EA 2021a)
- *Final Programmatic Accident Prevention Plan, Revision 1,* dated November 2020 (EA 2020b)
- *Final Site Safety and Health Plan, Fort Allen, Juana Diaz, Puerto Rico,* dated March 2021 (EA 2021b).

The SI field activities were conducted from 10 to 16 May 2022 and consisted of direct-push technology (DPT) borings and soil sample collection, temporary monitoring well installation, and grab groundwater sample collection. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021a), except as noted in **Section 5.9**.

The following samples were collected during the SI and analyzed for a subset of 24 PFAS via liquid chromatography/tandem mass spectrometry (LC/MS/MS) compliant with QSM Version 5.3 Table B-15, as well as three samples for TOC, pH, and grain size to fulfill the project DQOs:

- Eighteen (18) soil samples from 6 soil boring locations
- Six (6) grab groundwater samples from 6 temporary well locations
- Eleven (11) quality assurance/quality control samples.

Figure 5-1 provides the sample locations for all media across the Facility. **Table 5-1** presents the list of samples collected for each medium. Field documentation is provided in **Appendix B**. A log of Daily Notice of Field Activity was completed throughout the SI field activities, which is provided in **Appendix B1**. Field notes are provided in **Appendix B2**. Survey data is presented in **Appendix B3**. Additionally, a photographic log of field activities is provided in **Appendix C**.

5.1 PRE-INVESTIGATION ACTIVITIES

In preparation for the SI field activities, project team members participated in Technical Project Planning (TPP) meetings, performed utility clearance, and sampled decontamination source water. Details of these activities are presented below.

5.1.1 Technical Project Planning

The U.S. Army Corps of Engineers (USACE) TPP Process, Engineers Manual (EM) 200-1-2 (Department of the Army 2016) defines four phases to project planning: (1) defining the project phase; (2) determining data needs; (3) developing data collection strategies; and (4) finalizing the data collection plan. The process encourages stakeholder involvement in the SI, beginning with defining overall project objectives, including DQOs, and formulating a sampling approach to address the AOIs identified in the PA.

The stakeholders for this SI include ARNG, USACE, Puerto Rico Department of Natural and Environmental Resources (PRDNER), and PRARNG representatives familiar with the Facility, the regulations, and the community. There was no PRDNER regulatory involvement in the planning process; therefore, the initial meetings included ARNG, PRARNG, USACE, and representatives familiar with the Facility. ARNG attempted to engage PRDNER, however, PRDNER did not provide a response. A future TPP meeting, if needed, will provide an opportunity to discuss results, findings, and future actions where warranted.

5.1.2 Utility Clearance

EA contacted the Departamento de Transportación y Obras Públicas to notify them of intrusive work at the Facility, as well as Jaca and Sierra Engineering to perform a utility clearance at each of the proposed boring locations on 9 May 2022 with input from PRARNG and the EA field team. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 ft of each boring were pre-cleared by EA's drilling subcontractor, Jaca and Sierra Engineering, using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and PFAS Sampling Equipment Acceptability

Prior to mobilization for drilling, water samples were collected from onsite potable water sources (supply wells) to determine if source water could be used for drilling equipment decontamination. On 18 January 2022, samples were collected from two Facility potable water source wells (GW-1 [Well #1] and GW-2 [Well #2]), located south of the Fire Station (AOI 1) prior to mobilization. Samples were collected at the well head taps (pre-treatment) and samples consist of native groundwater which has not been treated. Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (EA 2021a). PFAS concentrations were reported to be below the SLs in both wells and below the limit of quantitation (LOQ) in GW-2 which met acceptance criteria presented in the UFP-QAPP Addendum for the source water to be used for decontamination of

drilling equipment (EA 2021a). These results can be found in **Appendix F and G**. Materials that were used for the sampling were confirmed as acceptable for use in the PFAS sampling environment. The checklist of acceptable materials for use in the PFAS sampling environment was provided in the Standard Operating Procedures appendix (**Appendix A**) to the Programmatic UFP-QAPP (EA 2020a).

5.2 HAND AUGER SOIL SAMPLING

The first 5 ft of each boring were pre-cleared by EA's drilling subcontractor, Jaca and Sierra Engineering, using a hand auger to verify utility clearance in the shallow subsurface where utilities would typically be encountered. No borings were advanced exclusively by hand auger based on terminal depth. Soil samples collected from depths shallower than 5 ft bgs were collected using the hand auger. All soil sample locations are shown on **Figure 5-1** and described in the subsequent section. Non-dedicated sampling equipment (e.g., hand auger) was decontaminated between sampling locations.

5.3 SOIL BORINGS AND SOIL SAMPLING

Soil samples were collected via DPT drilling methods in accordance with Standard Operating Procedure 047 *Direct-Push Technology Sampling* (EA 2021a). A Geoprobe® 7822DT dual-tube sampling system was used to collect continuous soil cores to the target depth. A hand auger was used to collect soil from the top 5 ft of the boring in accordance with utility clearance procedures.

Three discrete soil samples were collected for chemical analysis from each soil boring: one sample at the surface (0 to 2 ft bgs) and two subsurface soil samples. One subsurface soil sample was collected approximately 1 ft above the groundwater table, and one collected at the midpoint between the surface and the groundwater table (not to exceed 15 ft bgs). Groundwater was encountered at depths ranging from 15 to 25 ft bgs during drilling. Total boring completion depths, to accommodate temporary well installation, ranged from 20 to 35 ft bgs. At boring locations AOI01-01 and AOI01-03, moisture was observed at 5 ft and 4 ft, respectively, while also encountering groundwater at 20 ft; the shallow water encountered is thought to have been saturated soils due to an adjacent observed source (leaking water tower).

All soil sample locations are shown on **Figure 5-1**, and boring sample depths are provided in **Table 5-1**. The soil boring locations were selected based on the AOI information provided in the PA (AECOM 2020) and as agreed upon by stakeholders during the TPP and review of the UFP-QAPP Addendum (EA 2021a).

During the drilling, the soil cores were continuously logged for lithological descriptions by a field geologist using the Unified Soil Classification System. A photoionization detector (PID) was used to screen the breathing zone during boring activities as a part of personal safety requirements. Observations and measurements were recorded on sampling forms (**Appendix B2**) and in a non-treated field logbook. Depth interval, recovery thickness, PID concentrations, moisture, relative density, Munsell color, and Unified Soil Classification System texture were recorded. The boring logs are provided in **Appendix E**.

The hand auger, post-hole digger, throw bar (where applicable), and cutting shoe were decontaminated between locations use using a six-step, PFAS-free decontamination procedure with Liquinox, PFAS-free deionization water, and methyl alcohol (methanol). The drill casing was also rinsed with PFAS-free deionization water between locations, though the casing did not come in contact with soil samples due to the use of the acetate core liner.

Each sample was collected into a laboratory-supplied PFAS-free high-density polyethylene (HDPE) bottle and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via Federal Express (FedEx) under standard chain-of-custody procedures to the laboratory and analyzed for PFAS (LC/MS/MS compliant with QSM Version 5.3 Table B-15), TOC (USEPA Method 9060A) and pH (USEPA Method 9045D) in accordance with the UFP-QAPP Addendum (EA 2021a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. Matrix spike (MS)/matrix spike duplicates (MSDs) were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, one equipment blank (EB) was collected per day and analyzed for the same parameters as the soil samples. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 degrees Celsius (°C) during shipment.

DPT borings were converted to temporary wells, which were subsequently abandoned after sampling and surveying in accordance with the UFP-QAPP Addendum (EA 2021a). After removal of the casings, boreholes were abandoned using bentonite chips. Borings were installed in grass areas to avoid disturbing concrete or asphalt surfaces.

5.4 TEMPORARY WELL INSTALLATION AND GROUNDWATER GRAB SAMPLING

Temporary wells were installed using a Geoprobe® 7822DT dual-tube DPT system as described in Section 5.3. Once the borehole was advanced to the desired depth, a temporary well was constructed of a 10-ft section of 1-in. Schedule 40 polyvinyl chloride (PVC) screen with sufficient casing to reach the ground surface. New PVC pipe and screen were used at each location to avoid cross contamination between locations. The screen intervals for the temporary wells are provided in **Table 5-2**.

Groundwater samples were collected after a period of time following well installation to allow groundwater to infiltrate and recharge the temporary well screen intervals. After the recharge period, groundwater samples were collected using PFAS-free HDPE tubing and a peristaltic pump. The temporary wells were purged at a rate determined in the field to reduce turbidity and draw down prior to sampling. However, due to the tightness of the formation, some wells experienced poor groundwater recharge. In these cases, temporary wells were purged until dry and then sampled immediately upon recharge. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**) during purging at 5-minute intervals. After parameters adequately stabilized as listed in the UFP-QAPP Addendum (EA 2021a) or 1-hour of purging, each groundwater grab sample was collected in a

separate container. Additionally, a subsample of each groundwater sample was collected in a separate container, and a shaker test was completed to identify if there were any foaming. No foaming was noted in any of the groundwater samples.

Each sample was collected into laboratory-supplied PFAS-free HDPE bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard CoC procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 in accordance with the SI QAPP Addendum (EA 2021a).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as their accompanying parent samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters. One field reagent blank was collected per day in accordance with the UFP-QAPP Addendum (EA 2021a).

A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6°C during shipment. Samples were packaged on ice and transported via FedEx under standard chain-of-custody procedures to the laboratory and analyzed for PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 in accordance with the UFP-QAPP Addendum (EA 2021a).

5.5 SYNOPTIC WATER LEVEL MEASUREMENTS

Groundwater levels were measured across the AOI in order to the determine groundwater flow direction and develop a potentiometric surface. Synoptic water level elevation measurements were collected from the newly installed temporary monitoring wells; the northern side of the well casing was used as the measurement reference elevation point. Due to the on-site water level probe not being PFAS-free, water level measurements were taken after all wells had been sampled and prior to the wells being pulled and abandoned. Groundwater elevation data is provided in **Table 5-3**.

5.6 SURVEYING

A well survey was performed by EA's subcontractor MForce, a PR licensed surveyor, on 13 May 2022 prior to well abandonment. When surveying the newly installed temporary wells, the SOP is to survey the northern side of each new temporary well casing. Due to the temporary nature of the wells (lack of supporting material in the annular space) and the flexibility of the casing materials the temporary wells were not stable and were determined to be unsuitable for direct measurement. Instead, the ground elevation at each well location was surveyed, along with length of the casing sticking out of the ground (top of casing). Positions were collected in Universal Transverse Mercator Zone 19Q projection with World Geodetic System 1984 datum (horizontal) and Puerto Rico Vertical Datum 2002 (vertical). Surveying data were collected on 13 May 2022 and are provided in **Appendix B3**.

5.7 INVESTIGATION-DERIVED WASTE

As of the date of this report, the disposal of PFAS investigation-derived waste (IDW) is not regulated federally. IDW generated during the SI is considered non-hazardous waste and was managed in accordance with the UFP-QAPP Addendum (EA 2021a).

Solid IDW (i.e., soil cuttings) generated during SI activities were left in place at the point of the source. The soil cuttings were replaced in the borehole and distributed on the downgradient side of the borehole. Liquid IDW generated during SI activities (i.e., purge water, development water, and decontamination fluids) were discharged directly to the ground surface slightly downgradient of the source of generation (downgradient of each well location).
Other solids such as spent personal protective equipment, plastic sheeting, tubing, rope, unused monitoring well construction materials, and other consumables generated during the field activities were properly disposed of as municipal solid waste.

5.8 LABORATORY ANALYTICAL METHODS

Samples were analyzed for PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 at Eurofins Lancaster Laboratories Environmental, LLC, in Lancaster, Pennsylvania, a DoD ELAP- and NELAP-certified laboratory.

One soil sample from AOI 1 in a location close to the source area (AOI01-01-SB-2-3) was analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D. Additionally, this sample was submitted for grain size analysis (ASTM International [ASTM] D-422) (i.e., clay content). The grain size analysis was collected from one location where clays were identified by the field geologist.

5.9 DEVIATIONS FROM SITE INVESTIGATION UFP-QAPP ADDENDUM

Deviations from the UFP-QAPP Addendum occurred based on conditions encountered during the field investigation activities. These deviations were discussed between EA, ARNG, USACE, and PRARNG. Deviations from the UFP-QAPP Addendum are noted below:

- The approved SI UFP-QAPP Addendum (EA 2021a) states that once the borehole has been advanced to the specified depth, a temporary well with a 5-ft section of 1-in. Schedule 40 PVC screen will be installed to the target interval; the target screen interval being 5 ft from the top of the groundwater table. During drilling activities, the field geologists determined that, based on the lithological conditions, insufficient water would likely be generated within some of the wells (AOI01-01 through AOI01-05) using a 5-ft screen interval and the field team switched to a 10-ft screen interval to ensure a groundwater sample could be collected.

- Further, field conditions were such that the water table was both shallower than expected (estimated at 30–35 ft in the UFP-QAPP Addendum [EA 2021a] while seen to be between 16–25 ft bgs during gauging) and difficult to estimate from soil observations based on the fine-grained silts and clays encountered (i.e., moist instead of fully saturated soils were indeed indicative of the groundwater table). Due to these challenges, several monitoring wells were set at what was estimated to be the correct screen elevation, but when the well was set and the water level was gauged it was determined that the screen was fully submerged below the water table instead of capturing the top of the phreatic surface.

- Due to the fine-grained silts and clays encountered and filling/recharge rates, true water levels were not seen during boring installation/well completion, as a result only one of the deep subsurface soil samples (AOI01-03) was collected immediately above the soil/water interface. The remaining samples were collected from soils which ended up being in the saturated zone. With regards to location AOI01-01, the field team interpreted groundwater in this location as being 9-10 ft bgs; therefore, there is no deep subsurface soil result presented in the tables for AOI01-01. After the well was set and the groundwater level was measured it was determined that groundwater was present lower than 10 ft bgs.

- Lastly, due to poor recovery in the 0-2 foot sample from AOI01-01, the grain size, TOC, and pH sample was collected from the next interval (2-3 ft bgs) at AOI01-01 which had similar lithology.

- Equipment calibration was conducted, but the calibration sheets used did not match the ones shown in the QAPP. According to SOP 43, the pH calibration should be done with two standards, however a single standard was used. The equipment was calibrated prior to arrival and was checkd daily, so it is unlikely that this affected any of the readings.

Table 5-1. Samples by Medium
Fort Allen, Juana Diaz, Puerto Rico
Site Inspection Report

Sample Identification	Sample Collection Date	Sample Depth (ft bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
Soil Samples							
AOI1-01-SB-0-2	5/11/2022	0-2	X				
AOI1-01-SB-2-3	5/11/2022	2-3		X	X	X	
AOI1-01-SB-4-5	5/11/2022	4-5	X				
AOI1-01-SB-9-10	5/11/2022	9-10	X				
AOI1-02-SB-0-2	5/11/2022	0-2	X				
AOI1-02-SB-9-10	5/12/2022	9-10	X				
AOI1-02-SB-19-20	5/12/2022	19-20	X				
AOI1-03-SB-0-2	5/12/2022	0-2	X				
AOI1-03-SB-8-9	5/12/2022	8-9	X				
AOI1-03-SB-18-19	5/12/2022	18-19	X				
AOI1-04-SB-0-2	5/10/2022	0-2	X				
FA-FD-SB-05102022	5/10/2022	0-2	X				Field Duplicate for AOI-04-SB-0-2
AOI1-04-SB–12-13	5/10/2022	12-13	X				
AOI1-04-SB-24-25	5/10/2022	24-25	X				
AOI1-05-SB-0-2	5/11/2022	0-2	X				MS/MSD
AOI1-05-SB-9-10	5/11/2022	9-10	X				
AOI1-05-SB-19-20	5/11/2022	19-20	X				
AOI1-06-SB-0-2	5/10/2022	0-2	X				MS/MSD
AOI1-06-SB-9-10	5/10/2022	9-10	X				
AOI1-06-SB-19-20	5/10/2022	19-20	X				
Groundwater Samples							
AOI01-01-GW	5/11/2022	—	X				
AOI01-02-GW	5/12/2022	—	X				
AOI01-03-GW	5/12/2022	—	X				
AOI01-04-GW	5/11/2022	—	X				
AOI01-05-GW	5/11/2022	—	X				
AOI01-06-GW	5/10/2022	—	X				
FA-FD-GW	5/11/2022	—	X				Field Duplicate for AOI01-04-GW
Blank Samples							
FA-FB-05102022	5/10/2022	—	X				Field Blank
FA-RB-05102022	5/10/2022	—	X				Rinse Blank
FA-FB-05112022	5/11/2022	—	X				Field Blank
FA-RB-05112022	5/11/2022	—	X				Rinse Blank
FA-FB-05122022	5/12/2022	—	X				Field Blank
FA-RB-05122022	5/12/2022	—	X				Rinse Blank

Table 5-2. Soil Boring Depths and Temporary Well Screen Intervals
Fort Allen, Juana Diaz, Puerto Rico
Site Inspection Report

Area of Interest	Temporary Monitoring Well / Soil Boring ID	Soil Boring Depth (ft bgs)	Temporary Monitoring Well Screen Interval (ft bgs)
1	AOI1-01	18	8-18
	AOI1-02	30	20-30
	AOI1-03	30	20-30
	AOI1-04	33	23-33
	AOI1-05	30	20-30
	AOI1-06	28	23-28

Table 5-3. Groundwater Elevations
Fort Allen, Juana Diaz, Puerto Rico
Site Inspection Report

Temporary Monitoring Well ID	Top of Casing Elevation (ft amsl)	Ground Surface Elevation (ft NAVD 88)	Depth to Water (ft btoc)	Depth to Water (ft bgs)	Groundwater Elevation (ft NAVD 88)
AOI1-01	26.13	22.65	19.95	16.47	6.18
AOI1-02	23.28	22.33	16.08	15.13	7.20
AOI1-03	27.24	22.99	19.41	15.16	7.83
AOI1-04	25.59	23.27	18.66	16.34	6.93
AOI1-05	24.91	23.56	17.70	16.35	7.21
AOI1-06	23.81	23.31	16.81	16.31	7.00

Notes:
1. Elevation measurements were collected relative to the Puerto Rico Vertical Datum of 2002.
amsl = Above mean sea level
btoc = below top of casing
bgs = below ground surface
ft = feet
NAVD 88 = North American Vertical Datum 1988
ID = Identification

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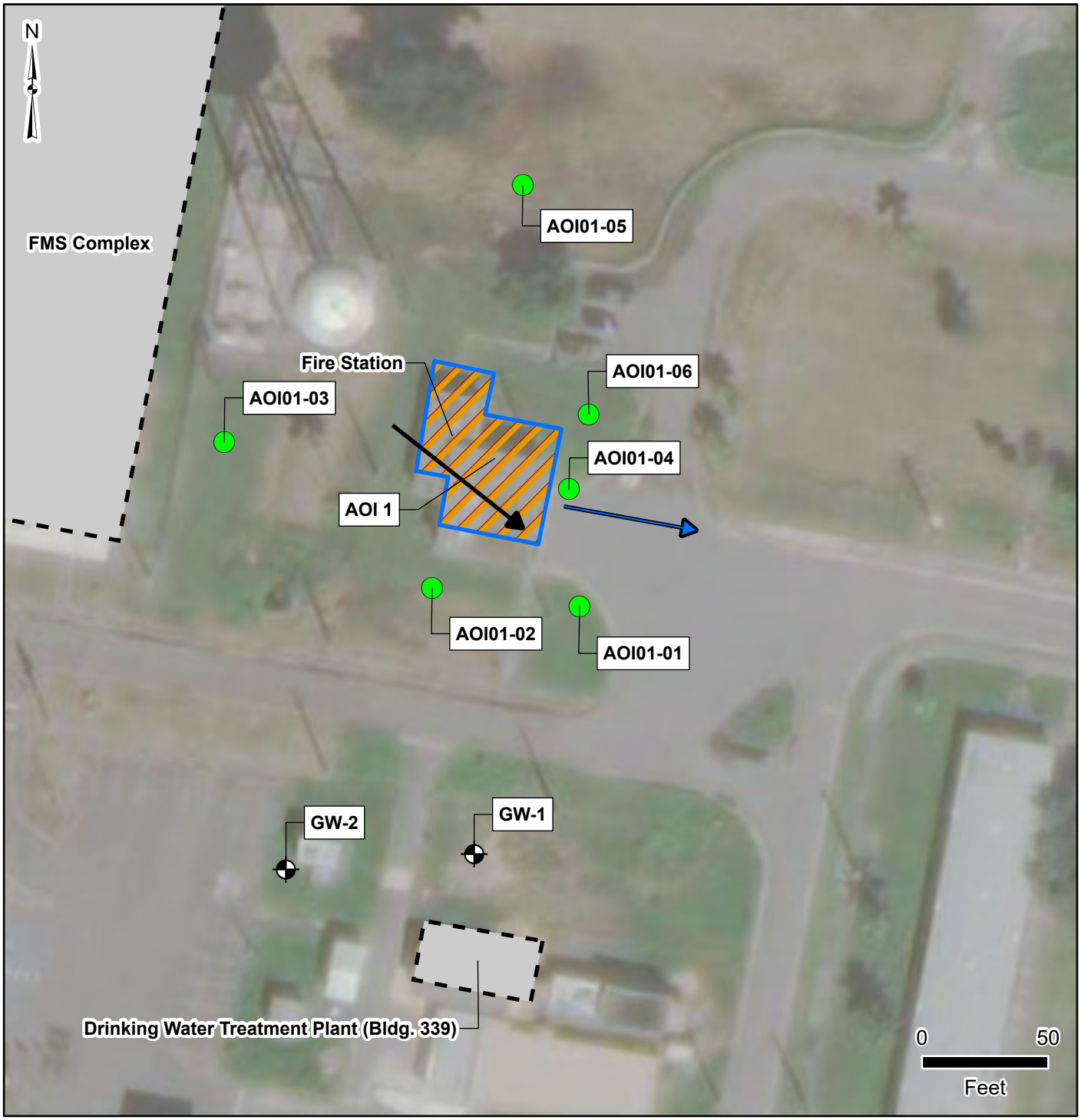
Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 5-1
Site Inspection Sample Locations



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Sample Locations
- DPT
- Groundwater

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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6. SITE INSPECTION RESULTS

This section presents the analytical results of the SI. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for the AOI is provided in **Section 6.3**. **Tables 6-2 through 6-5** present results for the relevant compounds in soil and groundwater. Tables that contain all results are provided in **Appendix F**, and the laboratory reports are provided in **Appendix G**.

6.1 SCREENING LEVELS

The DoD has adopted a policy to retain facilities in the CERCLA process based on risk-based SLs for soil and groundwater, as described in a memorandum from the OSD dated 6 July 2022 (Assistant Secretary of Defense 2022). The ARNG program under which this SI was performed follows this DoD policy. Should the maximum site concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to the five compounds presented on **Table 6-1**.

Table 6-1. Screening Levels (Soil and Groundwater)

Analyte	Residential (Soil) (µg/kg)[1] 0 to 2 ft bgs	Industrial/Commercial Composite Worker (Soil) (µg/kg) [1] 2 to 15 ft bgs	Tap Water (Groundwater) (ng/L) [1]
PFOA	19	250	6
PFOS	13	1,60	4
PFBS	1,900	25,000	601
PFHxS	130	1,600	39
PFNA	19	250	6

Notes:
1. Assistant Secretary of Defense. July 2022. Risk Based Screening Levels Calculated for Groundwater and Soil using USEPA's Regional Screening Level Calculator. Hazard Quotient=0.1. May 2022.
2. Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS..

µg/kg = Microgram(s) per kilogram
ng/L = Nanogram(s) per liter

The data in the subsequent sections are compared against the SLs presented in **Table 6-1**. The SLs for groundwater are based on direct ingestion. The SLs for soil are based on incidental ingestion and are applied to the depth intervals reasonably anticipated to be encountered by the receptors identified at the facility; the residential scenario is applied to surface soil results (0 to 2 ft bgs) and the industrial/commercial worker scenario is applied to all subsurface soil results (2 to 15 ft bgs). The SLs are not applied to deep subsurface soil results (greater than 15 ft bgs) because 15 ft is the anticipated limit of construction activities.

6.2 SOIL PHYSICOCHEMICAL ANALYSES

To provide basic soil parameter information, soil samples were analyzed for TOC, pH, and grain size, which are important for evaluating transport through the soil medium. **Appendix F** contains the results of the TOC, pH, and grain size sampling.

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport. According to the Interstate Technology Regulatory Council (ITRC), several important PFAS partitioning mechanisms include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions, and are therefore relatively mobile in groundwater (Xiao et al. 2015) but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy 2006; Guelfo and Higgins 2013). When sufficient organic carbon is present, organic carbon-normalized distribution coefficients (K_{oc} values) can help in evaluating transport potential, though other geochemical factors (for example, pH and presence of polyvalent cations) may also affect PFAS sorption to solid phases (ITRC 2018).

Soil pH was measured as 8.4 in samples collected from AOI 1. TOC was 8.6 g/kg in the sample collected from AOI 6.

Grain size was analyzed from a single composite sample (as the material was observed to be homogeneous) and compared with United Soil Classification grain size ranges. The combined silt and clay content was over 41.5%. The content of sand was 56.5% and grain size ranged from 16% to 13.2. Only 2.2% gravel was noted in the sample.

6.3 AOI 1

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 1: Fire Station. The soil and groundwater results are summarized in **Tables 6-2 through 6-5**. Soil and groundwater results are presented on **Figures 6-1 through 6-7**.

6.3.1 AOI 1 – Soil Analytical Results

Figures 6-1 through 6-5 present the ranges of detections in soil. **Tables 6-2 through 6-4** summarize the soil results.

Soil was sampled at six boring locations associated with the potential release area at AOI 1. Soil was sampled from three intervals at each of the boring location except location AOI01-01 where 4 samples were collected (only 3 were analyzed for PFAS and one was collected/analyzed for TOC, pH, and grain size). Samples were generally collected from: surface (0–2 ft bgs), shallow subsurface soil (8-10 ft bgs), and deep subsurface soil (18-20 ft bgs). The exception to this is AOI 1 where no deep subsurface soil sample was collected as discussed in Section 5.9 which present deviations from the SI UFP-QAPP Addendum.

Soil was sampled from surface soil (0 to 2 ft bgs) from boring locations AOI01-01 through AOI01-06. PFBS was not detected in any of the surface soil samples. PFOA, PFOS, PFHxS, and PFNA were detected below SLs in one or more of the surface soil samples. PFHxS was detected

below the SL in 4 of the 6 locations (AOI01-01, AOI01-02, AOI01-04, and AOI01-06) and ranged from 0.29 J µg/kg in AOI01-01 to 1.7 J µg/kg in AOI01-04. PFNA was detected below the SL at four of the six locations (AOI01-01, AOI01-04, AOI01-05, and AOI01-06) and ranged from 0.47 J µg/kg to 6.8 µg/kg in AOI01-01 and AOI01-06, respectively. PFOS was detected below the SL at four of the six locations (AOI01-01, AOI01-02, AOI01-04, and AOI01-06) and ranged from 0.7 J+ µg/kg to 8.9 J µg/kg in samples collected from AOI01-02 and AOI01-04, respectively. PFOA was detected below the SL in four of the six locations (AOI01-01, AOI01-04, AOI01-05, and AOI01-06) and ranged from 1.0 µg/kg to 11.0 µg/kg in samples collected from AOI01-01 and AOI01-06, respectively.

Shallow subsurface soil samples were collected from soil boring locations AOI01-01 through AOI01-06 at depths ranging from 4 to 5 ft bgs to 12 to 13 ft bgs. Two shallow subsurface samples were collected from AOI01-01 as discussed in Section 5.9. PFBS was not detected in any of the seven shallow subsurface soil samples. PFHxS was detected below the SL in one of the seven samples, boring location AOI01-02 at a concentration of 0.93 µg/kg. PFNA was detected below the SL in one of the seven samples, boring location AOI01-01 at a concentration of 0.24 J µg/kg. PFOS was detected below the SL in two of the seven samples, boring locations AOI01-01 and AOI01-02 at concentrations of 2.0 J+ µg/kg and 2.2 J+ µg/kg, respectively. PFOA was detected below the SL in two of the seven samples, boring locations AOI01-01 and AOI01-06, and ranged from 0.27 J µg/kg and 0.31 J µg/kg, respectively.

None of the relevant compounds were detected in any of the deep subsurface soil samples.

6.3.2 AOI 1 – Groundwater Analytical Results

Groundwater samples were collected from six temporary wells associated within the potential release area of AOI 1. All five relevant compounds, PFOA, PFOS, PFBS, PFHxS, and PFNA, were detected in groundwater at AOI 1. Each temporary well had at least three compounds detected, with four of the six wells (AOI1-01, AOI1-03, AOI01-04 and AOI1-06) having reported detections of all five relevant compounds.

PFBS was detected below the SL (601 ng/L) in all six wells with values ranging from 0.87 J ng/L to 15ng/L, associated with well locations AOI01-05 and AOI01-01, respectively. PFHxS was detected above the SL (39 ng/L) at one location from AOI01-01 (190 ng/L), and below the SL at the remaining 5 locations which ranged from 12 ng/L (AOI01-03) to 0.89 J ng/L (AOI01-05). PFNA was detected in four of the six wells (AOI01-01, AOI01-03, AOI01-04 and AOI01-06. PFNA exceeded the SL (6 ng/L) at one location AOI01-01 with a concentration of 120 ng/L. The remaining detections of PFNA ranged from 2 ng/L (AOI01-04) to 3.8 ng/L (AOI01-06).

PFOS was detected above the SL (4 ng/L) in all six wells, with values ranging from 11 ng/L from AOI01-05 to 540 ng/L from AOI01-01. PFOA was detected at five of the six temporary wells. PFOA exceeded the SL (6 ng/L) at three locations, AOI01-01, AOI01-03, and AOI01-06, at concentrations of 240 ng/L, 7.6 ng/L, and 7.3 ng/L, respectively.

6.3.3 AOI 1 – Conclusions

Based on the results of the SI, PFOA, PFOS, PFNA, and PFHxS were detected in soil below their respective SLs. All five relevant compounds (PFOA, PFOS, PFHxS, PFNA, and PFBS) were detected in groundwater, with four of the five relevant compounds (PFOA, PFOS, PFNA, and PFHxS) detected at concentrations above their respective SLs. Based on the exceedances of the SLs in groundwater, further evaluation at AOI 1 is warranted.

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Table 6-2. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Fort Allen

	Location ID	AOI01-01		AOI01-02		AOI01-03		AOI01-04		AOI01-04		AOI01-05		AOI01-06	
	Sample Name	AOI01-01-SB-0-2		AOI01-02-SB-0-2		AOI01-03-SB-0-2		AOI01-04-SB-0-2		FA-FD-SB		AOI01-05-SB-0-2		AOI01-06-SB-0-2	
	Parent Sample ID									AOI01-04-SB-0-2					
	Sample Date	5/11/2022		5/11/2022		5/12/2022		5/10/2022		5/10/2022		5/11/2022		5/10/2022	
	Depth (ft bgs)	0-2		0-2		0-2		0-2		0-2		0-2		0-2	
Analyte	**Screening Level[1,2]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (ug/kg)															
Perfluorobutanesulfonic acid (PFBS)	1900	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid (PFHxS)	130	0.29	J	0.53	J	ND	U	1.7	J	ND	UJ	ND	U	0.75	
Perfluorononanoic acid (PFNA)	19	0.47	J	ND	U	ND	U	2.3	J	ND	UJ	0.58	J	6.8	
Perfluorooctanesulfonic acid (PFOS)	13	0.92	J+	0.7	J+	ND	U	8.9	J	ND	UJ	ND	U	2.2	J+
Perfluorooctanoic acid (PFOA)	19	1		ND	U	ND	U	2	J	ND	UJ	1.2		11	

Notes:
J = Estimated concentration
J+ = Estimated concentration, biased high
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit.
UJ = Analyte was not detected and was reported less than the adjusted detection limit. Associated numerical value is approximate.
µg/kg = Microgram(s) per kilogram
1. Assistant Secretary of Defense. July 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.
2. The Screening Levels for soil are based on a residential scenario for direct ingestion of contaminated soil.
Values exceeding the Screening Level are shaded gray.
ft bgs = Foot (feet) below ground surface
ND = Analyte not detected above the limit of detection.
Qual = Qualifier

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Table 6-3. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Fort Allen

	Location ID	AOI01-01		AOI01-02		AOI01-03		AOI01-04		AOI01-05		AOI01-06	
	Sample Name	AOI01-01-SB-4-5		AOI01-02-SB-9-10		AOI01-03-SB-8-9		AOI01-04-SB-12-13		AOI01-05-SB-9-10		AOI01-06-SB-9-10	
	Parent Sample ID												
	Sample Date	5/11/2022		5/12/2022		5/12/2022		5/10/2022		5/11/2022		5/10/2022	
	Depth (ft bgs)	4-5		9-10		8-9		12-13		9-10		9-10	
Analyte	**Screening Level[1,2]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (µg/kg)													
Perfluorobutanesulfonic acid (PFBS)	25000	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid (PFHxS)	1600	ND	U	0.93		ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid (PFNA)	250	0.24	J	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	160	2	J+	2.2	J+	ND	U	ND	U	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	250	0.27	J	ND	U	ND	U	ND	U	ND	U	0.31	J

Notes:
J = Estimated concentration
J+ = Estimated concentration, biased high
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit.
µg/kg = Microgram(s) per kilogram.
1. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient (HQ)=0.1. May 2022.
2. The Screening Levels for soil are based on incidental ingestion of soil in a industrial/commercial worker scenario.
Values exceeding the Screening Level are shaded gray.
ft bgs = Foot (feet) below ground surface
ND = Analyte not detected above the limit of detection.
Qual = Qualifier

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Table 6-4. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Deep Subsurface Soil
Site Inspection Report, Fort Allen

Location ID		AOI01-01		AOI01-02		AOI01-03		AOI01-04		AOI01-05		AOI01-06	
Sample Name		AOI01-01-SB-9-10		AOI01-02-SB-19-20		AOI01-03-SB-18-19		AOI01-04-SB-24-25		AOI01-05-SB-19-20		AOI01-06-SB-19-20	
Parent Sample ID													
Sample Date		5/11/2022		5/12/2022		5/12/2022		5/10/2022		5/11/2022		5/10/2022	
Depth (ft bgs)		9-10		19-20		18-19		24-25		19-20		19-20	
Analyte	**Screening Level[1,2,3]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (µg/kg)													
Perfluorobutanesulfonic acid (PFBS)	25000	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid (PFHxS)	1600	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid (PFNA)	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	160	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	250	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U

Notes:
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit.
1. The Screening Levels for soil are based on incidental ingestion of soil in a industrial/commercial
2. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional
3. Industrial/Commercial worker scenario was also applied to deep subsurface soils collected from soil borings 18-25ft, providing a conservative estimate of that potential exposure route for the industrial/commerical worker
µg/kg = Microgram(s) per kilogram
ft bgs = Foot (feet) below ground surface
ND = Analyte not detected above the limit of detection
Qual = Qualifier

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Table 6-5. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Fort Allen

	Location ID	AOI01-01		AOI01-02		AOI01-03		AOI01-04		AOI01-04		AOI01-05		AOI01-06	
	Sample Name	AOI01-01-GW		AOI01-02-GW		AOI01-03-GW		AOI01-04-GW		FA-FD-GW		AOI01-05-GW		AOI01-06-GW	
	Parent Sample ID									AOI01-04-GW					
	Sample Date	5/11/2022		5/12/2022		5/12/2022		5/11/2022		5/11/2022		5/11/2022		5/10/2022	
Analyte	**Screening Level[1]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS (E537M) (ng/L)															
Perfluorobutanesulfonic acid (PFBS)	601	15		1.3	J	8.1		1.7	J	1.6	J	0.87	J	1.6	J
Perfluorohexanesulfonic acid (PFHxS)	39	190		5.3		12		5.1		4.9		0.89	J	5.5	
Perfluorononanoic acid (PFNA)	6	120		ND	U	2.1		2		2		ND	U	3.8	
Perfluorooctanesulfonic acid (PFOS)	4	540		24		57		43		43		11		87	
Perfluorooctanoic acid (PFOA)	6	240	J+	ND	U	7.6		2.4		1.9		1.8		7.3	

Notes:
J = Estimated concentration
J+ = Estimated concentration, biased high
U = The analyte was not detected at a level greater than or equal to the adjusted detection limit.
ng/L = Nanogram(s) per liter
1. Assistant Secretary of Defense. 2022. Risk-Based Screening Levels in Groundwater and Soil using EPA's Regional Screening Level Calculator. Hazard Quotient
Values exceeding the Screening Level are shaded gray.
ND = Analyte not detected above the limit of detection.
Qual = Qualifier

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Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 6-1
AOI 1
PFOS Detections in Soil

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Notes:
PFOS = Perfluorooctanesulfonic acid
Exceedances of the OSD SL are depicted with a yellow halo. Depth intervals shown represent respective sampling position within a given soil boring location.

Data Sources:
ESRI 2022
AECOM 2019

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 6-2
AOI 1
PFOA Detections in Soil

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Notes:
PFOA = Perfluorooctanoic acid
Exceedances of the OSD SL are depicted with a yellow halo. Depth intervals shown represent respective sampling position within a given soil boring location.

Data Sources:
ESRI 2022
AECOM 2019

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 6-3
AOI 1
PFBS Detections in Soil

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Notes:
PFBS = Perfluorobutanesulfonic acid
Exceedances of the OSD SL are depicted with a yellow halo. Depth intervals shown represent respective sampling position within a given soil boring location.

Data Sources:
ESRI 2022
AECOM 2019

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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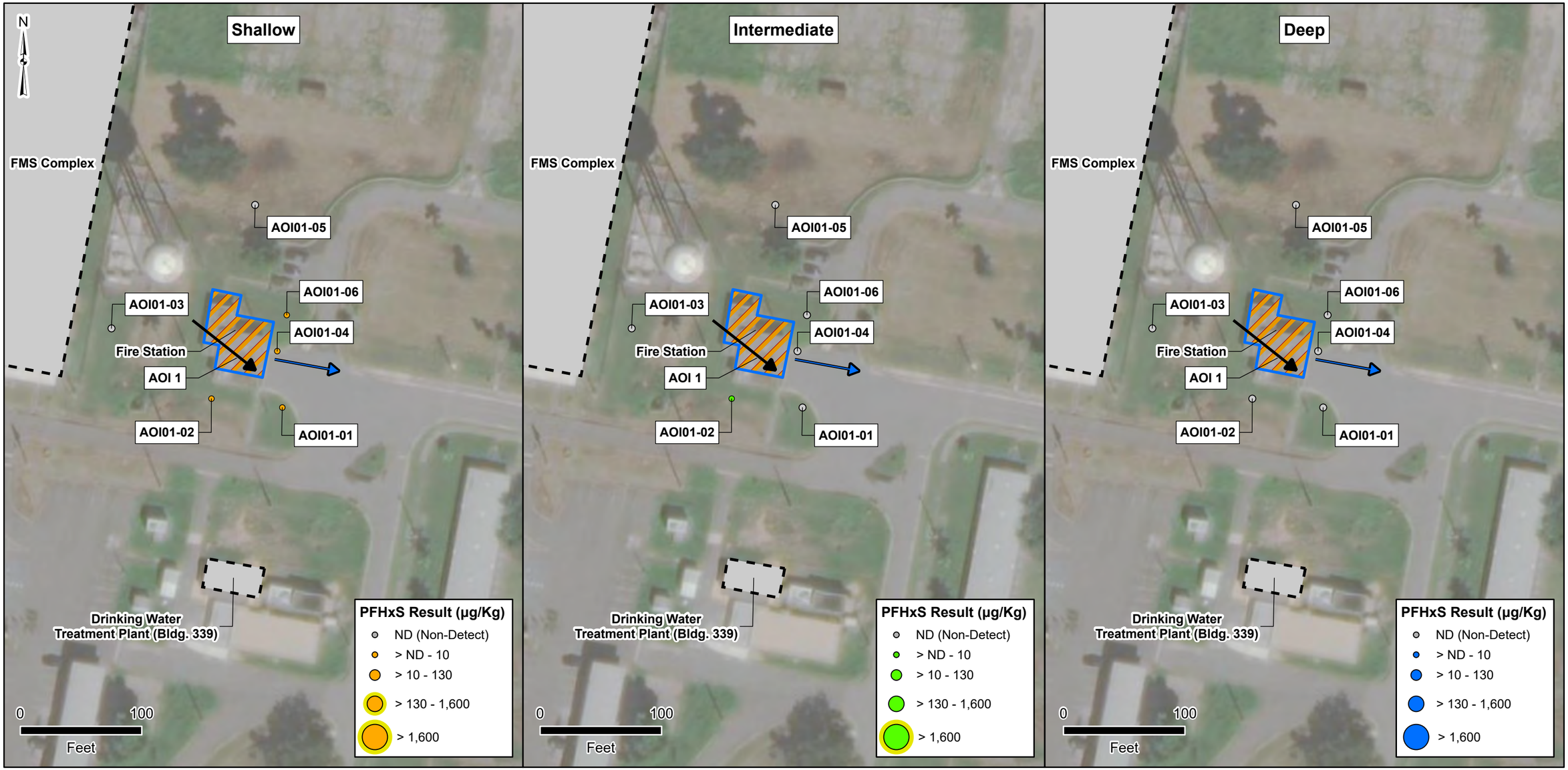
Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 6-4
AOI 1
PFHxS Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Notes:
PFHxS = Perfluorohexanesulfonic acid
Exceedances of the OSD SL are depicted with a yellow halo. Depth intervals shown represent respective sampling position within a given soil boring location.

Data Sources:
ESRI 2022
AECOM 2019

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 6-5
AOI 1
PFNA Detections in Soil

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Notes:
PFNA = Perfluorononanoic acid
Exceedances of the OSD SL are depicted with a yellow halo. Depth intervals shown represent respective sampling position within a given soil boring location.

Data Sources:
ESRI 2022
AECOM 2019

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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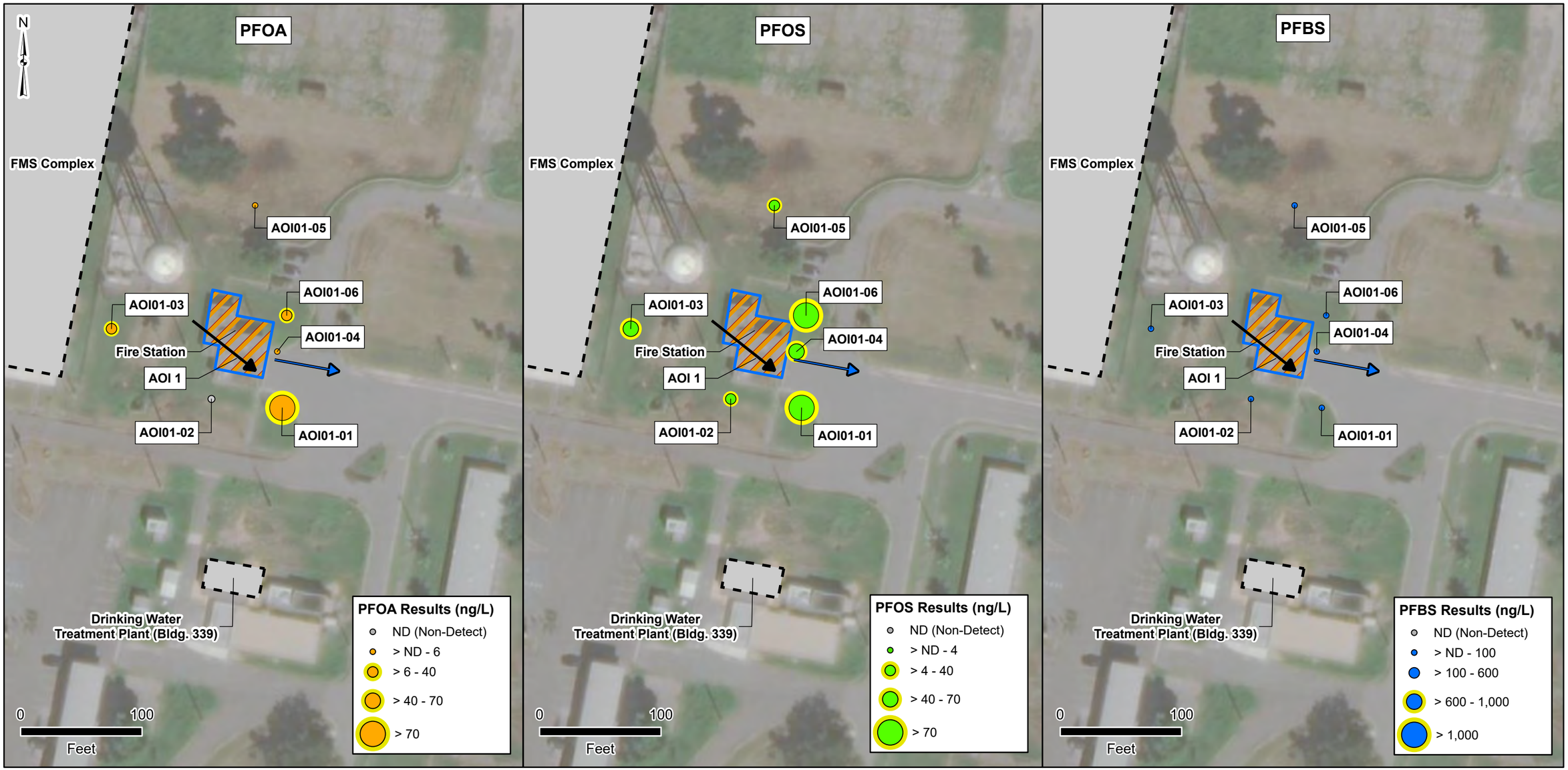
Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 6-6
PFOA, PFOS and PFBS Detections in Groundwater (AOI 1)



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Note:
PFOA = Perfluorooctanesulfonic acid
PFOS = Perfluorooctanoic acid
PFBS = Perfluorobutanesulfonic acid
Exceedances of the OSD SL are depicted with a yellow halo

Data Sources:
ESRI 2022
AECOM 2019

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

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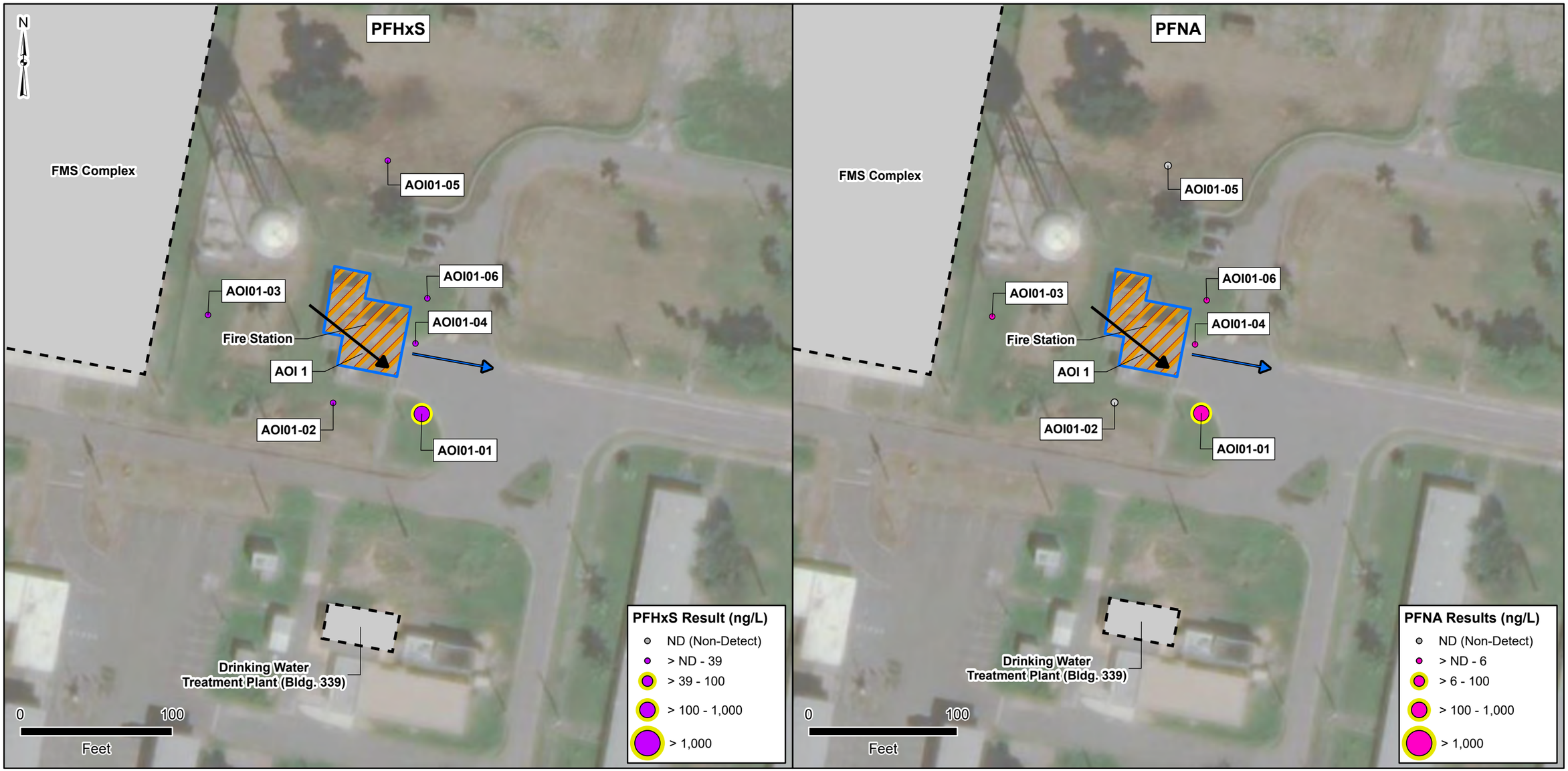
Army National Guard Site Inspections
Site Inspection Report
Fort Allen, Puerto Rico

Figure 6-7
PFHxS and PFNA Detections in Groundwater



Map Extent

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release
- No Suspected Release

Hydrology/Hydrogeology
- Surface Water Flow Direction
- Groundwater Flow Direction

Notes:
PFHxS = Perfluorohexanesulfonic acid
PFNA = Perfluorononanoic acid
Exceedances of the OSD SL are depicted with a yellow halo.

Data Sources:
ESRI 2020
AECOM 2020

Date:.....December 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 20N

Path: \\lovetongis\GISdata\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\FortAllen\FortAllenSI.aprx

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7. EXPOSURE PATHWAYS

The conceptual site model (CSM) for the AOI, revised based on the SI findings, is presented on **Figure 7-1**. Please note that while the CSM discussion assists in determining if a receptor may be impacted, the decision to move from SI to RI or interim action is determined based upon exceedances of the SLs for the relevant compounds and whether the release is more than likely attributable to the DoD. A CSM presents the current understanding of the site conditions with respect to known and suspected sources, potential transport mechanisms and migration pathways, and potentially exposed human receptors. A human exposure pathway is considered potentially complete when the following conditions are present:

1. Contaminant source
2. Environmental fate and transport
3. Exposure point
4. Exposure route
5. Potentially exposed populations.

If any of these elements are missing, the pathway is incomplete. The CSM figures use an empty circle symbol to represent an incomplete exposure pathway. Areas with no identified complete pathway generally warrant no further action. However, the pathway is considered potentially complete if the relevant compounds are detected, in which case the CSM figure uses a half-filled circle symbol to represent a potentially complete exposure pathway. Additionally, a completely filled circle symbol is used to indicate when a potentially complete exposure pathway has detections of relevant compounds above the SLs. Areas with an identified potentially complete pathway that have detections of the relevant compounds above the SLs may warrant further investigation. Although the CSMs indicate whether potentially complete exposure pathways may exist, the recommendation for future study in an RI or no action at this time is based on the comparison of the SI analytical results for the relevant compounds to the SLs.

In general, the potential routes of exposure for the relevant compounds are ingestion and inhalation. Human exposure via the dermal contact pathway may occur, and current risk practice suggests it is an insignificant pathway compared to ingestion; however, exposure data for dermal pathways are sparse and continue to be the subject of toxicological study. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA 2001). Receptors at the facility include site workers (e.g., facility staff and visiting soldiers), construction workers, trespassers (though unlikely due to restricted access), residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 SOIL EXPOSURE PATHWAY

The SI results for soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at AOI 1 based on the aforementioned criteria.

7.1.1 AOI 1

AOI 1 encompasses potential AFFF released at the Fort Allen Fire Station located in the northwestern portion of the facility cantonment area, near the former airfield. Although no

evidence indicates that AFFF has ever been released at the Fire Station, the corrosive nature of AFFF potentially stored at this location may have led to unknown releases of AFFF.

PFOA, PFOS, PFNA, and PFHxS were detected in surface soil at AOI 1 below the applicable residential or industrial/commercial SLs. Site workers and construction workers could contact constituents in surface soil via incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathway for site workers and construction workers are potentially complete. Further, PFHxS, PFNA, PFOS, and PFOA were detected in subsurface soil at AOI 1 below the industrial/commercial SLs. Ground-disturbing activities to subsurface soil could result in construction worker exposure to detected constituents via incidental ingestion. Therefore, the exposure pathways for subsurface soil are potentially complete for the construction worker. The CSM is presented in **Figure 7-1**.

7.2 GROUNDWATER EXPOSURE PATHWAY

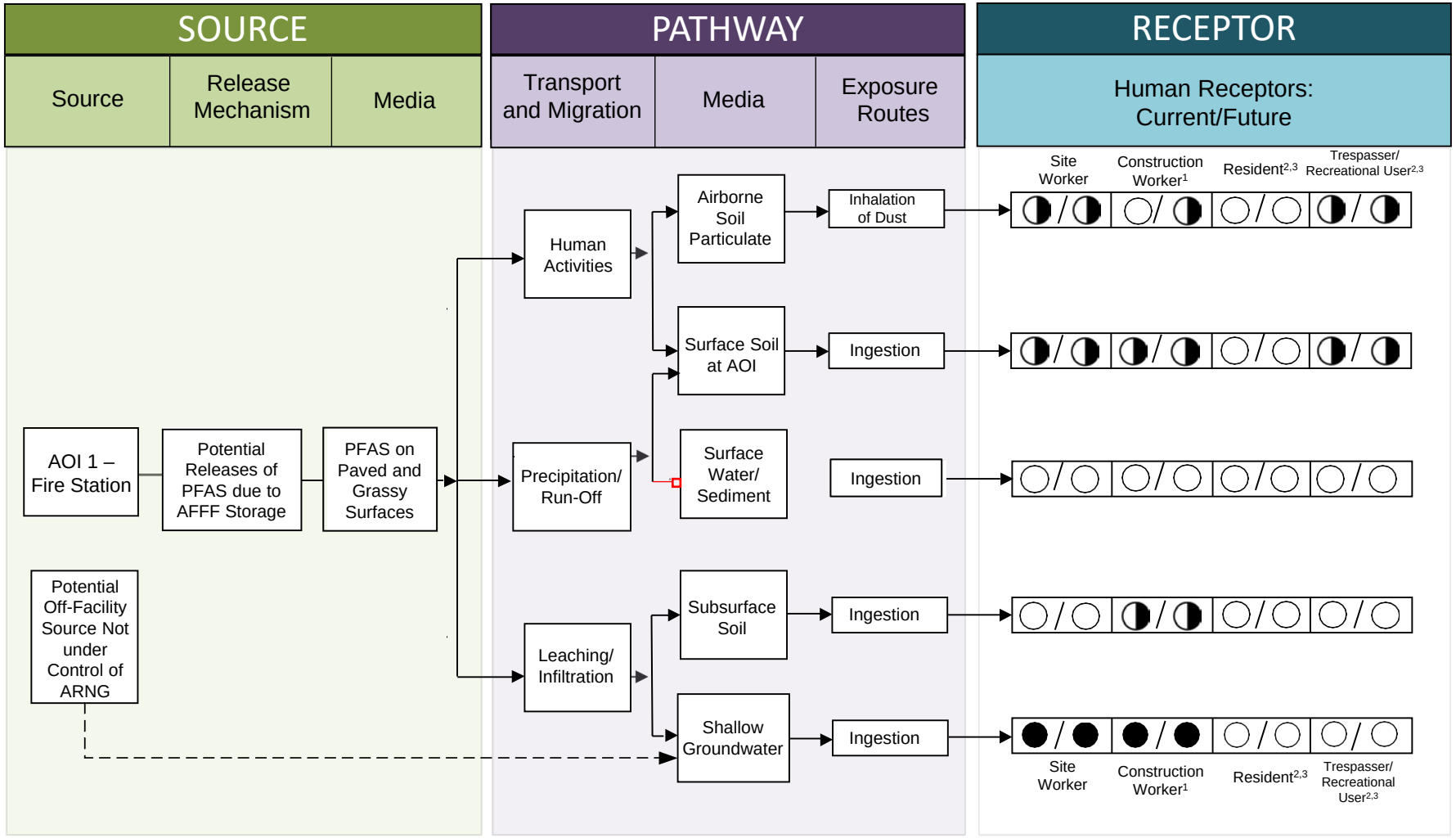
The SI results in groundwater were used to determine whether a potentially complete pathway exists between the source and potential receptors based on the aforementioned criteria.

7.2.1 AOI 1

PFOA, PFNA, PFOS, and PFHxS were detected in groundwater above their respective SLs. PFBS was detected in groundwater at concentrations below the associated SL.

The Juana Diaz municipality obtains its water from Lago Toa Vaca, a lake located approximately 6.5 miles north (upgradient) of Fort Allen. According to PRARNG interviewees at Fort Allen, the adjacent communities to the east and south receive municipal drinking water; however, the PA also noted the potential for unidentified residential wells to exist downgradient of the Facility.

Samples collected from the AOI exceeded the SLs and the depth to groundwater measured in AOI 01 ranged from 16 to 25 ft bgs. Fort Allen is served by three drinking water wells located in the facility cantonment area. These wells are in close proximity of AOI 1, but likely cross gradient of AOI 1. Well screening/pumping intake levels are shown as occurring at between 18 to 28 ft bgs according to well records. Two of the three drinking water wells were sampled (the third well was reported as inactive during the planning and sampling timeframe). Sample results indicate detections of relevant compound below SLs. Therefore, the ingestion exposure pathway for future site workers and construction workers is considered potentially complete, although exposure is likely insignificant because groundwater is deeper than 15 ft bgs. Based on the information presented in the PA regarding surrounding communities being on municipal drinking water, and the lack of migration pathway for water, the groundwater pathways for the Resident and trespasser/Recreational User are considered incomplete. Given the lack of surface water features the pathway for surface water and sediment is considered incomplete. The CSM is presented in **Figure 7-1**.



LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Potentially Complete Pathway with Exceedance of Screening Level

Notes:

1. No current active construction at the facility.
2. The resident and recreational users refer to off-site receptors.
3. Inhalation of dust for off-site receptors is likely insignificant.

Figure 7-1
Conceptual Site Model
AOI 1 Fort Allen, Puerto Rico

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8. SUMMARY AND OUTCOME

This section summarizes SI activities and findings. The most significant findings are summarized in this section and are reproduced directly or abstracted from information contained in this report. The outcome provides general and comparative interpretations of the findings relative to the SLs.

8.1 SITE INSPECTION ACTIVITIES

The SI field activities at the facility were conducted from 10 to 16 May 2022. The SI field activities included utility clearance, soil sample collection, temporary monitoring well installation and grab groundwater sample collection, sampling of facility wells, and land surveying. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021a), except as previously noted in **Section 5.9**.

To fulfill the project DQOs set forth in the approved SI UFP-QAPP Addendum (EA 2021a), samples were collected and analyzed for a subset of PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15 as follows:

- Eighteen (18) soil samples from 6 locations (soil borings locations)
- Six (6) grab groundwater samples from 6 temporary well locations
- Eleven (11) quality assurance/quality control samples.

An SI is conducted when the PA determines an AOI exists based on probable use, storage, and/or disposal of PFAS-containing materials. The SI includes multi-media sampling at the AOI to determine whether or not a release has occurred. The SI may conclude further investigation is warranted, a removal action is required to address immediate threats, or no further action is required. Additionally, the CSM was refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure at the AOI, which is described in **Section 7**.

8.2 OUTCOME

Based on the results of this SI, further evaluation under CERCLA in the form of an RI is warranted for AOI 1 (see Table 8-1). Based on the CSMs developed and revised in light of the SI findings, there is potential for exposure to drinking water receptors from releases during historical DoD activities at the Facility. Sample analytical concentrations collected during this SI were compared with the project SLs in soil and groundwater, as described in **Table 6-1**. A summary of the results of the SI data relative to SLs is as follows:

- AOI 1:
    - PFOA, PFOS, PFNA, and PFHxS were detected in surface soil (0-2 ft bgs) and shallow subsurface soil at depths ranging from 4 to 10 ft bgs at AOI 1 at concentrations below the SLs. PFBS was not detected in soil at any location at AOI 1.

— All five relevant compounds were detected in the groundwater at AOI 1. PFOS, PFOA, PFNA, and PFHxS concentrations exceeded the SL in groundwater in one temporary well with maximum concentrations of 540 ng/L, 240 ng/L, 120 ng/L, and 190 ng/L, respectively. PFOS exceeded the SL in all six temporary well locations, with PFOA exceeding the SL in three of the six locations. PFBS did not exceed the SL. Based on the results of the SI, further evaluation of AOI 1 is warranted in the RI.

Of the six PFAS compounds presented in the 6 July 2022 OSD memorandum, HFPO-DA (commonly referred to as GenX) was not included as an analyte at the time of this SI. Based on the conceptual site model (CSM) developed during the PA and revised based on SI findings, the presence of HFPO-DA is not anticipated at the facility because HFPO-DA is generally not a component of military specification (MIL-SPEC) aqueous film forming foam (AFFF) and based on its history including distribution limitations that restricted use of GenX, it is generally not a component of other products the military used. In addition, it is unlikely that GenX would be an individual chemical of concern in the absence of other PFAS.

Table 8-1 summarizes the SI results for soil and groundwater used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI.

Table 8-1. Summary of Site Inspection Findings and Recommendations

AOI	Potential PFAS Release Area	Soil Source Area	Groundwater Source Area	Future Action
1	Fire Station	◐	●	Proceed to RI

Legend:
● = Detected; exceedance of screening levels
◐ = Detected; no exceedance of screening levels
○ = Not detected

9. REFERENCES

AECOM Technical Services, Inc. (AECOM). 2020. *Final Preliminary Assessment Report, Fort Allen, Juana Diaz, Puerto Rico.* .

Assistant Secretary of Defense. 2022. *Investigation Per- and Polyfluoroalkyl Substances within The Department of Defense Cleanup Program*. United States Department of Defense. 6 July.

Department of the Army. 2016. *EM-200-1-2, Environmental Quality, Technical Project Planning Process*. 29 February.

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