FINAL
Site Inspection Report
Ellington Field Army Aviation Support Facility
Houston, Texas

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

September 2023

Prepared for:

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

UNCLASSIFIED

The seal appearing on this document was authorized by Samuel Whipkey, P.G. 15175 on May 23, 2023, for the information contained herein for Texas Commission on Environmental Quality Facility ID No 71008, in accordance with applicable TCEQ requirements.

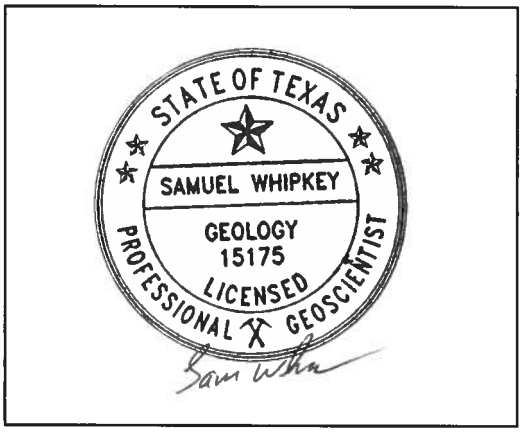

Table of Contents

Appendices

Figures

Tables

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Acronyms and Abbreviations

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
AASF	Army Aviation Support Facility
AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film-forming foam
AOI	Area of Interest
ARNG	Army National Guard
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	chain of custody
CSM	conceptual site model
DA	Department of the Army
DoD	Department of Defense
DOT	Department of Transportation
DPT	direct push technology
DQO	data quality objective
DUA	data usability assessment
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
ERB	equipment rinsate blank
FedEx	Federal Express
GCAS	Gulf Coast Aquifer System
GPRS	Ground Penetrating Radar Systems, LLC
HDPE	high-density polyethylene
HFPO-DA	hexafluoropropylene oxide dimer acid
IDW	investigation-derived waste
ITRC	Interstate Technology Regulatory Council
JRB	Joint Reserve Base
LC/MS/MS	liquid chromatography with tandem mass spectrometry
MIL-SPEC	military specification
NASA	National Aeronautics and Space Administration
NELAP	National Environmental Laboratory Accreditation Program
ng/L	nanograms per liter
OSD	Office of the Secretary of Defense
OWS	oil/water separator
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
PQAPP	Programmatic UFP-QAPP
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
SI	Site Inspection
SL	screening level
SOP	standard operating procedure
TOC	total organic carbon
TPP	Technical Project Planning
TXANG	Texas Air National Guard
TXARNG	Texas Army National Guard
UFP	Uniform Federal Policy
US	United States
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

Executive Summary

The Army National Guard (ARNG) G-9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on the 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 include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS). 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 two Areas of Interest (AOIs) where PFAS-containing materials may have been used, stored, disposed, or released historically (see **Table ES-2**). The objective of the SI is to identify whether there has been a release to the environment from the AOIs 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 relevant compounds. This SI was completed at the Ellington Field Army Aviation Support Facility (AASF) in Houston, Texas and determined further evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted for AOI 1 and AOI 2. The Ellington Field AASF will also be referred to as the "facility" throughout this document.

Ellington Field AASF occupies the northwest corner of the Ellington Field Joint Reserve Base in Houston, Texas. In 1976, Ellington Field Joint Reserve Base was officially inactivated, however, Texas ARNG and other military branches still maintain a military presence at the base. The Ellington Field airfield is jointly used by the Department of Defense and private parties (AECOM Technical Services, Inc., 2020).

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

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

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

b.) 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 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 MIL-SPEC 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-2: Summary of Site Inspection Findings and Recommendations

AOI	Potential Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary	Future Action
1	Wash Rack	◐	●	●	Proceed to RI
2	Flight Line	◐	N/A	●	Proceed to RI

Legend:
N/A = not applicable
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

1

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) 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) 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 perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA)[1], and perfluorobutanesulfonic acid (PFBS) at ARNG facilities nationwide. The ARNG performed this SI at the Ellington Field Army Aviation Support Facility (AASF) in Houston, Texas. The Ellington Field AASF is also referred to as the "facility" throughout this document.

The SI project elements were performed in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; United States [US] 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 US Department of the Army (DA) requirements and guidance for field investigations.

1.2 SI Purpose

A PA was performed at Ellington Field AASF (AECOM Technical Services, Inc. [AECOM], 2020) that identified two Areas of Interest (AOIs) where PFAS-containing materials may have been 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 AOIs 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.

[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.

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2. Facility Background

2.1 Facility Location and Description

Ellington Field AASF occupies 17.6 acres of the northwest corner of the Ellington Field Joint Reserve Base (JRB), which was built in the 1970s. Ellington Field AASF is located in Harris County, Texas, approximately 16 miles southeast of downtown Houston and 11 miles west of Trinity Bay (**Figure 2-1**). Ellington Field AASF is home to the 149th Attack Reconnaissance Battalion of the Texas ARNG (TXARNG). The southern portion of Ellington Field JRB has been leased to the National Aeronautics and Space Administration (NASA) by the City of Houston. The Ellington Field JRB airfield is jointly used by Department of Defense (DoD) and private parties (147 CES/CEV, 2013). Ellington Field JRB was officially deactivated by the Air Force in 1976, and all Air Force Reserve squadrons were transferred to other military facilities; however, the TXARNG, Texas Air National Guard (TXANG), US Army Reserve, US Navy Reserve, US Marine Corps Reserve, US Coast Guard, and the Civil Air Patrol still maintain a military presence at the JRB. In 2009, the Air Force issued a permit with a term expiring in 2039 for the TXARNG's use of land and facilities at Ellington Field Air National Guard Base.

2.2 Facility Environmental Setting

Ellington Field AASF is located in south-eastern Texas, approximately 32 miles northwest of the Gulf of Mexico. The facility is situated near Horsepen Bayou, which feeds into Clear Lake, which then flows into Trinity Bay and Galveston Bay. The topography of the facility is relatively flat with an elevation of approximately 35 feet above mean sea level (**Figure 2-2**). There are no significant natural topographic features surrounding the facility.

2.2.1 Geology

The Houston area is located in the Gulf Coast Plain physiographic province, which includes fluvial, fluvial-deltaic, barrier-strand plain, and bay-estuary lagoon depositional environments. The geology directly underlying the City of Houston and Harris County consist primarily of the Pleistocene-aged Beaumont Formation and more recent Quaternary alluvium along surface water channels (**Figure 2-3**). The Beaumont Formation is a poorly bedded, calcareous clay that contains discontinuous stringers and beds of silt and fine-grained sand. The Beaumont Formation ranges in total thickness from about 500 feet in Harris County to about 700 feet near Galveston (Leidos, 2018).

During the SI, low to medium plasticity clay was observed as the dominant lithology of the unconsolidated sediments below the Ellington Field AASF. The borings were completed at depths between 15 and 25 feet below ground surface (bgs). Varying quantities of silt were noted in the clay layers, ranging from zero percent (%) to 40% silt. Isolated layers of silty sand and sandy silt were also observed with thicknesses ranging from 2 to 3.5 feet. Samples for grain size analysis were collected at two locations, AOI01-01 and AOI02-01, from 0 to 2 feet bgs and analyzed via American Society for Testing and Materials (ASTM) Method D-422. The results indicate that the soil samples are comprised primarily of silt (50.11% to 54.20%), clay (21.37% to 21.51%), and fine sand (21.59% to 23.88%). These results and facility observations are consistent with the Beaumont Formation. Boring logs are presented in **Appendix E** and grain size results are presented in **Appendix F**.

2.2.2 Hydrogeology

The Gulf Coast Aquifer System (GCAS) is the primary hydrogeologic unit in the Gulf Coast Plain physiographic province. The GCAS consists of interbedded clays, silts, sands, and gravels of

Cenozoic age, which are hydrologically connected to form a large, leaky, artesian aquifer system. This system comprises four units separated by different sedimentary, water-producing formations. The deepest formation is the Catahoula confining system, which contains groundwater near the outcrop in relatively restricted sand layers. Above the Catahoula is the Jasper aquifer, which is primarily contained within the Oakville Sandstone and the Fleming Formation. The Burkeville confining layer separates the Jasper aquifer from the overlying Evangeline aquifer, which is contained within the Goliad Sand. The Chicot aquifer is the uppermost unit of the GCAS and is composed of (from stratigraphically youngest to oldest) alluvial deposits, the Beaumont Formation, the Bentley and Montgomery formations (often grouped together as the Lissie Formation), and the Willis Sand. Not all formations are present throughout the system, and nomenclature often differs from one end of the system to the other. Maximum total sand thickness ranges from 700 feet in the south to 1,300 feet in the northern extent.

The facility's drinking water is supplied by the City of Houston. A query of the Texas Water Development Board Submitted Driller's Reports and Groundwater Database identified 4 industrial wells, 32 monitoring wells, 4 public supply wells, and 1 domestic well within a 1-mile radius of the facility. The industrial water supply wells range in depth from 376 to 555 feet bgs. The monitoring wells range in depth from 15 to 90 feet bgs. The public supply wells range in depth from 391 to 583 feet bgs, and the depth of the domestic well is 548 feet bgs. Using additional online resources, such as state and local Geographic Information System databases, wells were researched to a 4-mile radius of the facility. In the 1 to 4-mile radius, an additional public supply well, 10 domestic wells, 4 irrigation wells, 1 industrial well, 16 injection wells, and 373 monitoring wells were identified. Wells surrounding the facility are shown on **Figure 2-3**.

Depths to water measured in June 2022 during the SI ranged from 4.14 to 8.67 feet bgs. Groundwater elevation contours from the SI are presented on **Figure 2-4** and indicate the groundwater flow direction at Ellington Field AASF is to the southeast.

2.2.3 Hydrology

No natural or significant surface water bodies, navigable waterways, or wetlands are present at the facility (Leidos, 2018). Armand Bayou is located approximately 4.5 miles east of the facility, and the Houston Ship Channel is located approximately 9 miles north of the facility. Surface water flow at the facility is dictated by the facility's constructed surface drainage system, which is shared by TXARNG and TXANG, as well as other occupants located at Ellington Field JRB. The system contains multiple ditches/channels for surface flow. The stormwater pollution prevention plan for TXANG 147 RW Ellington Field details six surface water drainage areas that drain to their respective stormwater discharge outfalls. Most of Ellington Field AASF is located within Drainage Basin 001; however, the Flight Line is within Drainage Basin 005. Surface water within Drainage Basin 001 flows through ditches/channels and underground pipes, ultimately to two box culverts via Stormwater Discharge Outfall 001. Surface water within Drainage Basin 005 flows through a series of catch basins and underground pipes which convey south through Stormwater Discharge Outfall 005 (a drop inlet structure beneath the aircraft parking apron; Cardno TEC, 2015). From the stormwater discharge outfalls stormwater moves by open channel flow and underground drainage pipes until the runoff reaches Horsepen Bayou, located approximately 2 miles southeast of the facility. Horsepen Bayou flows to the east and eventually combines with Armand Bayou (**Figure 2-5**) (Leidos, 2018).

2.2.4 Climate

Houston has a humid subtropical climate, with long, hot, and humid summers and short, mild winters. Houston's proximity to large water bodies brings in warm air for much of the year. Houston occasionally faces severe tornadoes, thunderstorms, hurricanes, and tropical storms. The average high temperature in Houston reaches 95 degrees Fahrenheit (°F) at the peak of August.

Winters are mild to cool with the average daily high temperature above 60°F. Average annual precipitation is 51 inches, with even distribution over the year (National Weather Service, 2023).

2.2.5 Current and Future Land Use

The facility currently includes a hangar, wash rack, paved vehicle parking areas, aircraft and equipment parking areas, and supporting facilities such as sidewalks and administrative buildings. The hangar (Building 1183) is used to service army aviation vehicles such as helicopters. East of the hangar is the TXARNG aircraft parking area, where aircraft are parked and minor maintenance is performed, and further east of the aircraft parking area is the flight line. South of the hangar is a wash rack. The facility shares its northern boundary with the Ellington JRB fire station which is operated by TXANG. During the SI, the northern property boundary was corrected as shown in **Figure 2-1** through **Figure 6-7**.

Current land use directly adjacent to Ellington Field AASF is comprised of Ellington Field JRB buildings, airfields, and properties in all directions. Beyond the JRB land use includes industrial to the north, residential development to the east, a mixture of undeveloped, commercial, and residential areas to the south, and a municipal golf course and an oil & gas company to the west. The nearest residence is approximately 0.9 miles northeast of the facility, surrounded by a commercial nursery and south of Clean Harbors Environmental. The nearest residential development is approximately 1 mile west-southwest of the facility.

2.2.6 Sensitive Habitat and Threatened/ Endangered Species

The following birds, plants, and mammals are federally endangered, threatened, proposed, and/ or are listed as candidate species in Harris County, Texas (US Fish and Wildlife Service [USFWS], 2022).

- **Birds:** Whooping crane, *Grus americana* (endangered); Red knot, *Calidris canutus rufa* (threatened); Eastern Black rail, *Laterallus jamaicensis ssp. jamaicensis* (threatened)
- **Flowering Plants:** Texas prairie dawn-flower, *Hymenoxys texana* (endangered)
- **Mammals:** West Indian Manatee, *Trichechus manatus* (threatened);

2.3 History of PFAS Use

Two potential release areas were identified in the PA where AFFF may have been used, stored, disposed, or released historically at the Ellington Field AASF (AECOM, 2020). AFFF may have historically been released at the facility during familiarization training and fire training activities as early as 1990. Additionally, Tri-Max™ fire suppression units were stored along the Flight Line and in 2007 were used to extinguish an aircraft fire on the Flight Line. The potential release areas were identified as AOI 1 and AOI 2, based on preliminary data, and a description of each AOI is presented in **Section 3**.

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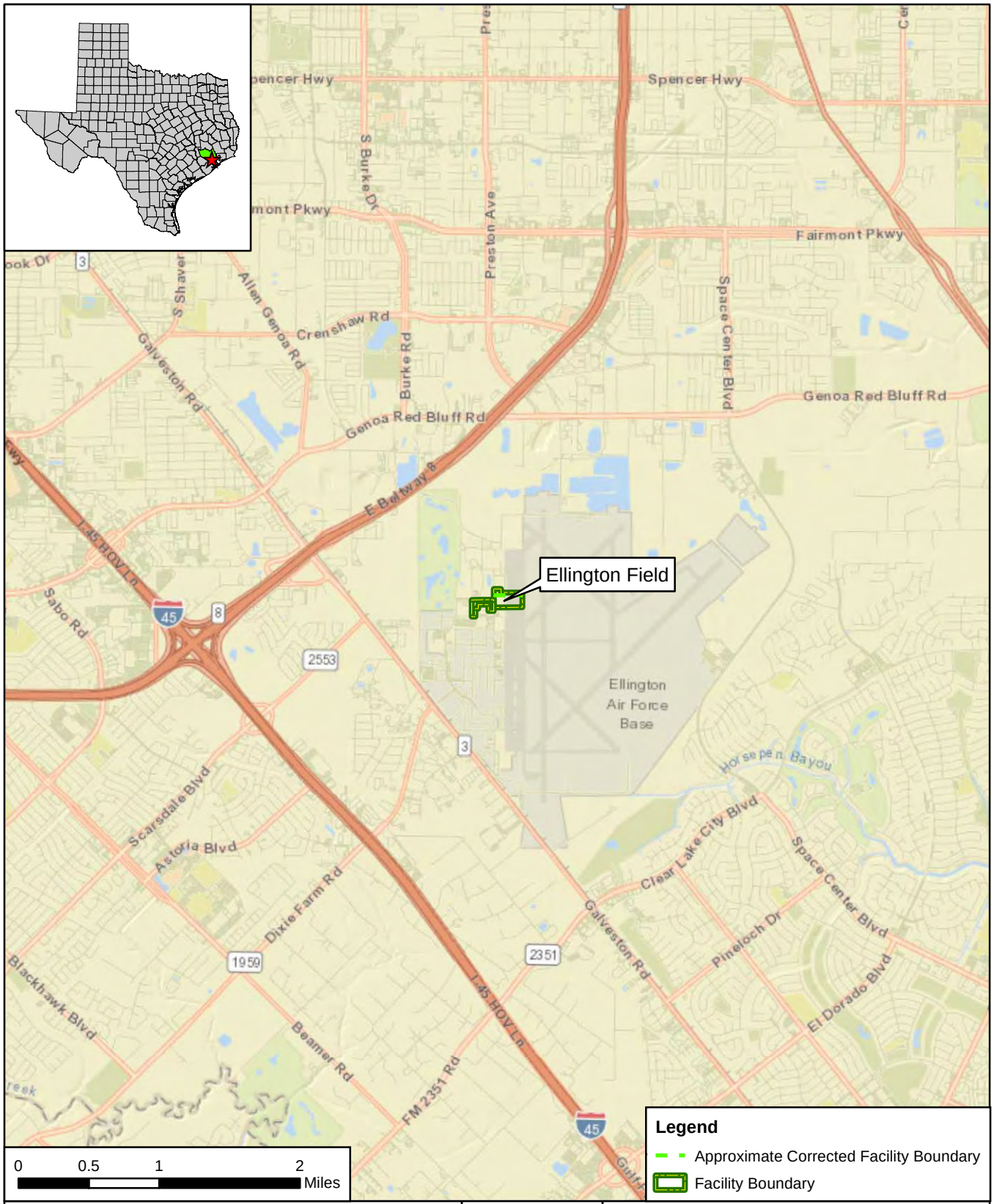

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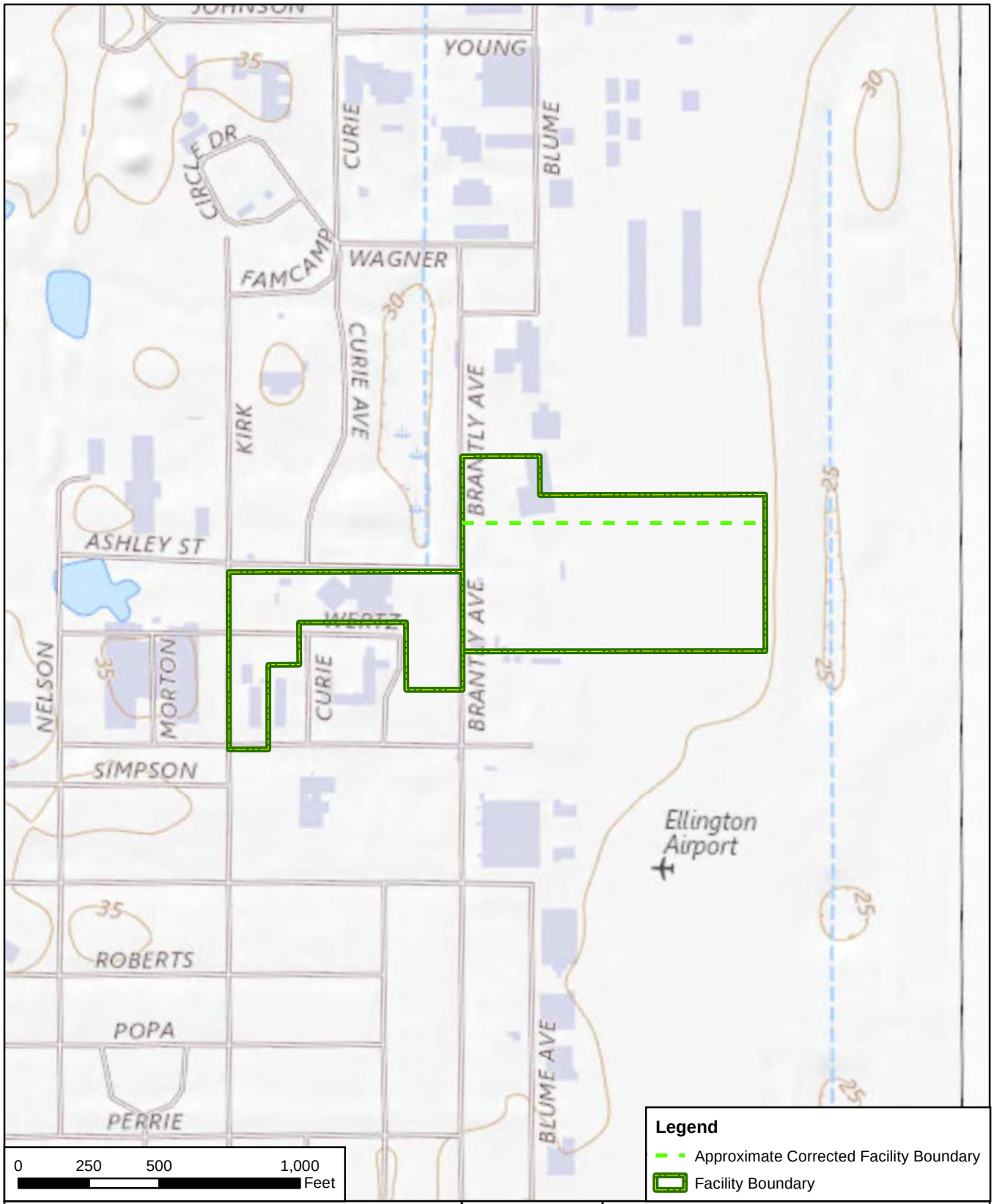
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	CM	12/2/2022

Facility Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1



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Base Map: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program,		PM	CM	12/2/2022

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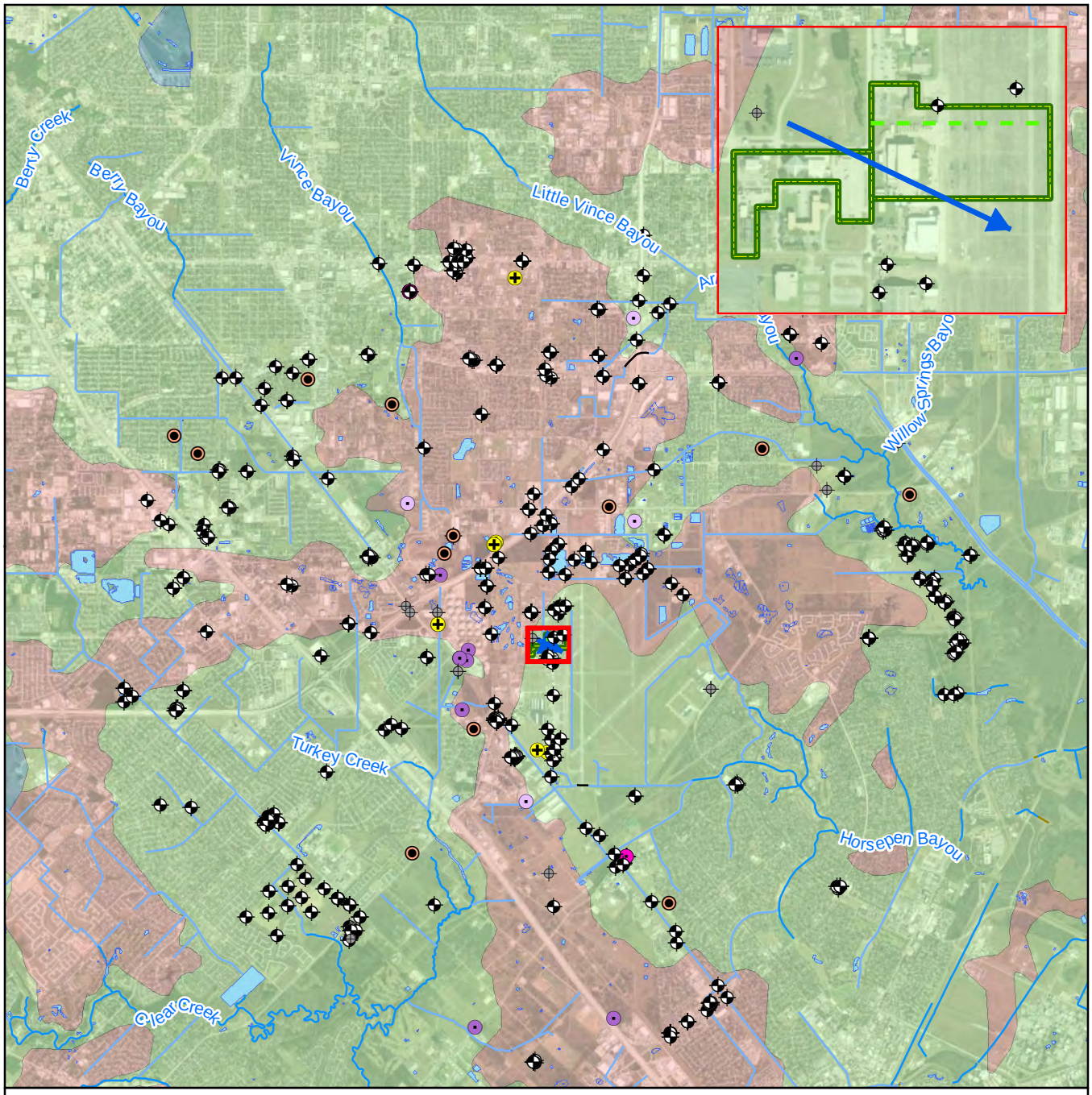
Facility Topography

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2



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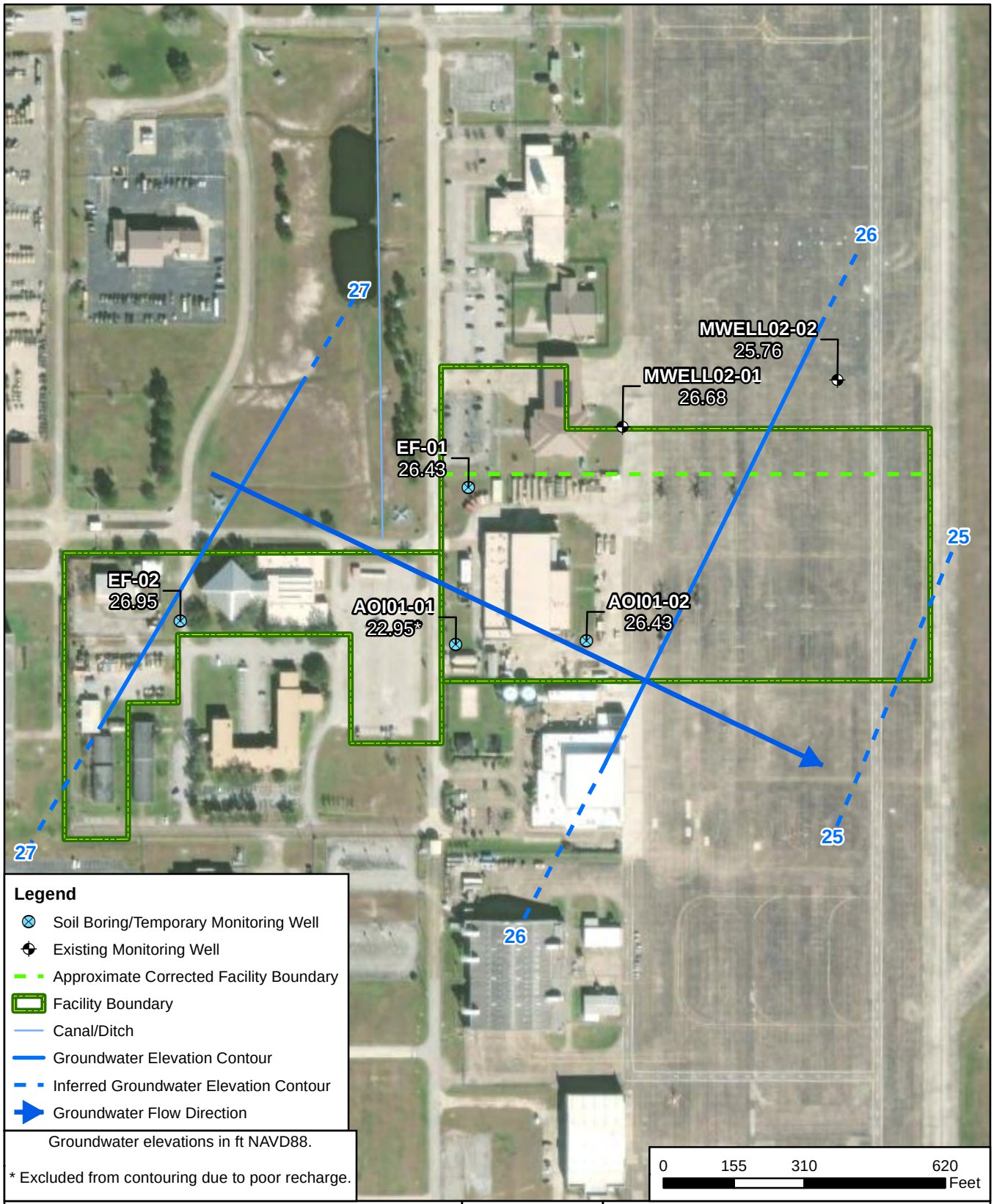
Groundwater Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3



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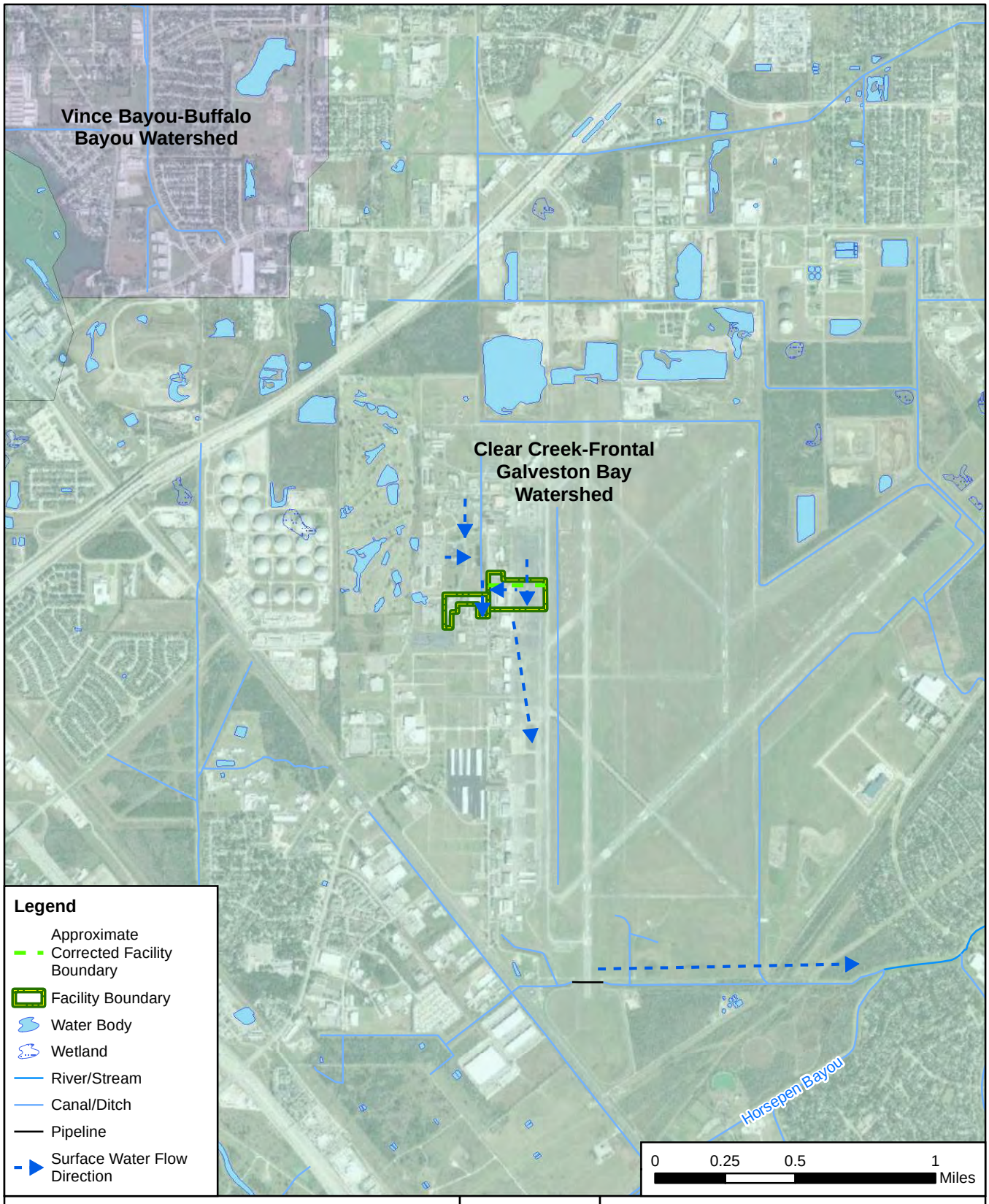
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	5/8/2023

Groundwater Elevations, June 2022

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-4



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Surface Water Features

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-5

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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, two potential release areas were identified at Ellington Field AASF and designated as AOI 1 and AOI 2 (AECOM, 2020). The potential release areas are shown on **Figure 3-1**.

3.1 AOI 1 Wash Rack

Starting in the early 1990s, TXARNG personnel trained with one or two Tri-Max™ units once a year with the TXANG fire department at the Wash Rack (AOI 1) or the Flight Line (AOI 2). The fire training consisted of Ellington Field AASF personnel extinguishing flames from a metal burn box that was set on fire. The Tri-Max™ units were disposed of between 2007 and 2009 due to deteriorating hoses. Around 2010, AFFF at the facility was donated to the TXANG fire department, and Tri-Max™ units were replaced with Purple K units. TXARNG personnel onsite since 1986 were not aware of any bulk AFFF stored at the facility. No bulk AFFF was discovered on-site during an annual building inspection conducted by the TXANG fire chief in 2010 (AECOM, 2020).

Releases at the Wash Rack may have been conveyed to the oil/water separator (OWS), then flowed to the sanitary sewer system, and ultimately discharged to the Metro Central Waste Treatment Facility, located approximately 1.8 miles south of the facility. Underground conveyances to the OWS, as well as the OWS itself, may have leaks that released AFFF to the subsurface. It is also possible that releases at the Wash Rack were conveyed directly into the stormwater system, due to a malfunctioning diverter valve in the Wash Rack system. It has been noted by facility personnel that this diverter valve has malfunctioned historically; therefore, it is not certain which direction potential releases may have drained. During training exercises, AFFF may have migrated from the paved Wash Rack area to the grassy areas south of the Wash Rack and infiltrated into soil. Runoff could also have caused AFFF to migrate to the ditch to the east of the Wash Rack, where it would eventually discharge through Stormwater Discharge Outfall 001 at the southern end of the facility. Once inside the box culverts, the stormwater flow continues south, until the runoff reaches Horsepen Bayou (BB&E, Inc., 2016).

3.2 AOI 2 Flight Line

AOI 2 is the Flight Line and is located on the eastern portion of the facility. TXARNG personnel practiced with one or two Tri-Max™ units once a year with the TXANG fire department at the Wash Rack or the Flight Line. During fire training, a metal burn box was set on fire, and Ellington Field AASF personnel would practice putting it out.

Tri-Max™ units were on-site in the early 1990s and were stationed along the Flight Line. Initially, Ellington Field AASF personnel were responsible for maintaining the Tri-Max™ units, but that responsibility was later given to the TXANG fire department, and then to a third-party contractor. At peak operation (before 1995), there were between 30 to 40 helicopters on-site. Historically, there was one Tri-Max™ fire extinguisher staged between every two helicopters stored on the Flight Line. The PA Report indicated that the Tri-Max™ units rusted frequently and repairs and hydrostatic testing were performed on the units by an outside contractor. These repairs and tests occurred off-site (AECOM, 2020). Additionally, in 1997 an aviation ground power unit caught on fire on the Ellington Field AASF Flight Line, and Tri-Max™ units were used to extinguish the flame.

AFFF released on the Flight Line would likely flow to Stormwater Discharge Outfall 005, which is located within the Flight Line. TXANG sampled surface water from Stormwater Discharge Outfall 005 during their PFAS SI. The sample contained 700 nanograms per liter (ng/L) PFOA and PFOS, combined (Leidos, 2018). The outfall conveys flow south to Horsepen Bayou, and then to Armand

Bayou (BB&E, 2016). AFFF may have flowed off paved surfaces or through cracks or joints in pavement.

3.3 Adjacent Sources

Seven off-facility, potential sources were identified adjacent to the Ellington Field AASF during the PA and are not associated with ARNG activities. The adjacent potential sources are shown on **Figure 3-1** and described in the following sections for informational purposes only and will not be investigated as part of this SI. Findings noted in Sections 3.3.1 through 3.3.5 are results of a 2018 SI (Leidos, 2018) conducted at the JRB by the TXANG.

3.3.1 TXANG Old Fire Station

The Old Fire Station (Building 694) was operated by TXANG from pre-1988 to 2012 and was reported to having minor leaks of AFFF from crash response trucks and firetrucks over the years (BB&E, Inc., 2016). The old fire station is located approximately 2,600 feet south of the TXARNG hangar.

During the 2018 TXANG SI, a monitoring well was installed adjacent to the old fire station in 2018 to determine PFAS levels in shallow groundwater. Results indicated levels of the individual relevant compounds ranging from 110 ng/L to 44,000 J ng/L (Leidos, 2018). This area is cross-gradient of the facility and shares the same stormwater network as TXARNG; therefore, it is possible the that potential impacts from the AFFF leaks are migrating towards the Ellington Field AASF.

3.3.2 TXANG New Fire Station

Ellington Field AASF currently receives fire protection from the TXANG New Fire Station (Building 1190), which was constructed in 2012 and is located adjacent to the north of the TXARNG hangar. The TXANG Fire Chief (onsite since 1988) reported their department switched from AFFF with longer-chain (C8) PFAS to AFFF with short-chain (C6) PFAS in December 2016 (AECOM, 2020).

The TXANG Fire Chief reported that his department has never trained with the AFFF spray from a firetruck. However, TXANG has conducted joint fire training using AFFF-containing mobile carts with TXARNG staff at the TXARNG wash rack and flight line from the early 1990s to approximately 2009. The new fire station currently uses fire/crash response vehicles and firetrucks that are equipped with AFFF-containing short-chain PFAS but does not currently conduct fire training exercises involving AFFF with the TXARNG.

During the 2018 ANG SI at the JRB, groundwater sampling results from a monitoring well installed adjacent to the TXANG New Fire Station indicate levels of the individual relevant compounds ranging from 33 J ng/L to 6,300 J ng/L (Leidos, 2018). This area is upgradient of AOI 2 and shares the same stormwater network as TXARNG; therefore, it is possible the that potential impacts from the AFFF leaks are migrating towards the facility.

3.3.3 TXANG Aircraft Parking Apron

Groundwater samples from four monitoring wells installed during the 2018 TXANG SI at the aircraft parking apron, north of TXARNG facility, had detections of the individual relevant compounds ranging from 0.54 J ng/L to 50,000 J ng/L (Leidos, 2018). This area is cross-gradient of the facility and shares the same stormwater network as TXARNG; therefore, it is possible the that potential impacts from this area are migrating towards the facility.

3.3.4 TXANG Hangars 1382 and 1394

Hangars 1382 and 1394 both previously contained AFFF-equipped fire suppression systems with a few minor AFFF leaks reported in the past. During the 2018 TXANG SI, a groundwater sample collected just east of Hangar 1382 had detections of the individual relevant compounds ranging from 23 ng/L to 50,000 J ng/L. A groundwater sample collected just south of Hangar 1394 had detections of the individual relevant compounds ranging from 11 to 1,700 J ng/L (Leidos, 2018). These areas are cross-gradient of the facility and share the same stormwater network as TXARNG; therefore, it is possible the that potential impacts from the hangars are migrating towards the facility.

3.3.5 Stormwater Discharge Outfalls 001 and 005

Stormwater from TXANG that may contain PFAS, as demonstrated in the TXANG SI Report (Leidos, 2018), is transported through the TXARNG facility in the shared drainage system, eventually reaching Horsepen Bayou. Stormwater discharge outfalls were tested for PFAS in 2018 during the TXANG SI. Results of a surface water samples taken from Stormwater Discharge Outfalls 001 (located south of the facility) and 005 (located in the flight line of TXARNG facility) indicated levels of the individual relevant compounds ranging from 2.6 ng/L to 970 J ng/L (Leidos, 2018).

3.3.6 NASA

NASA leases the southern portion of Ellington Field JRB from the City of Houston and hosts various privately held companies on its property. No personnel from NASA were interviewed, and AFFF use is unknown but may have been used for firefighting purposes. This area is located south and downgradient of the facility and is, therefore, unlikely to impact Ellington Field AASF.

3.3.7 Brio Superfund Site

The Brio Superfund Site is located at 2501 Dixie Farm Road in Friendswood, Texas, approximately 3.5 miles southwest and cross-gradient of Ellington Field AASF. As mentioned in the PA, there is no known use of PFAS at the site, and groundwater flow to the southeast is unlikely to bring contamination from the Brio Site to Ellington Field AASF.

3.3.8 Enterprise Echo Terminal

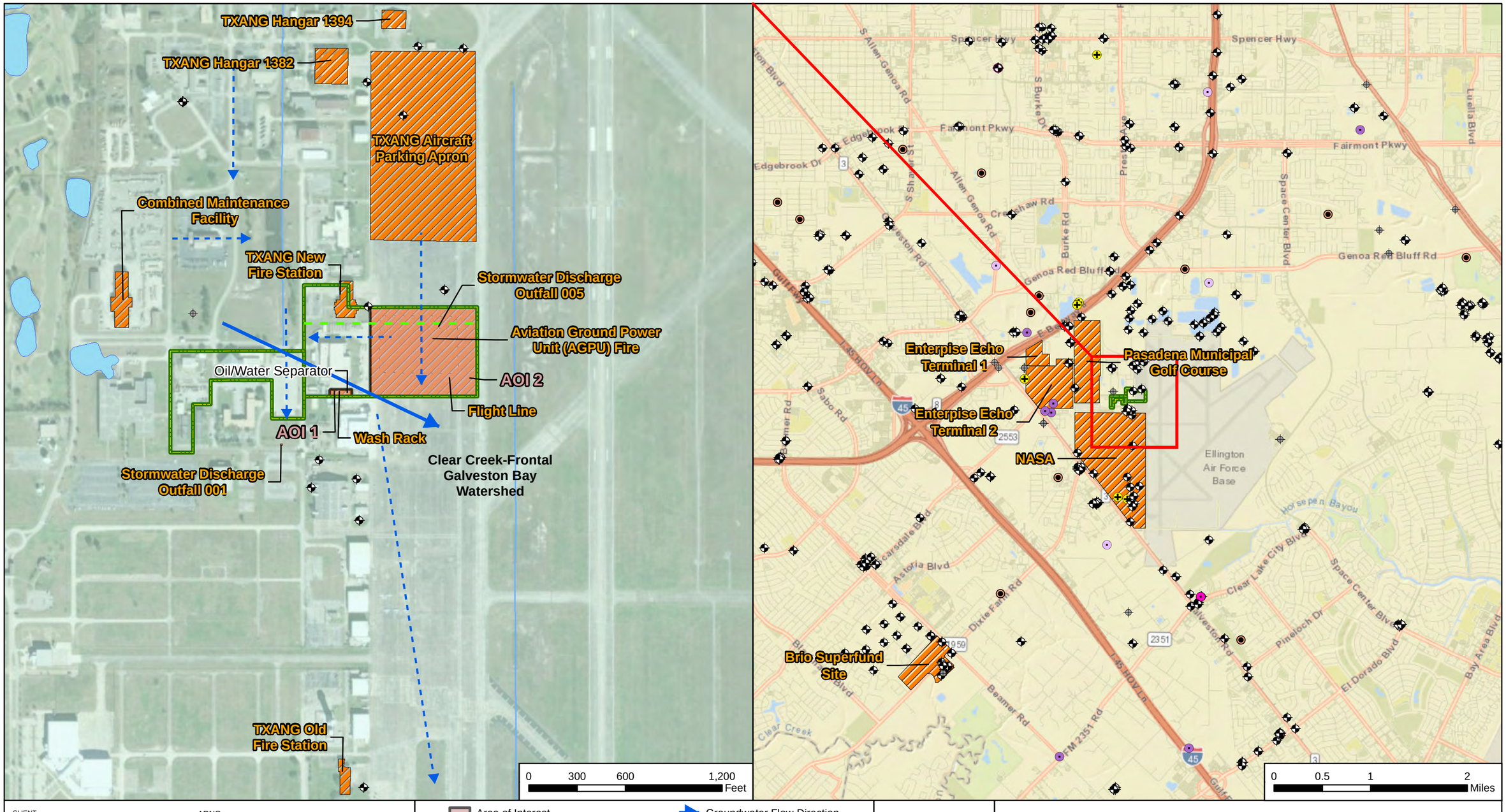
The Enterprise Echo Terminal is located at 6849 East Sam Houston Parkway in Houston, Texas, approximately 0.4 miles northwest and upgradient of Ellington Field AASF. The terminal is an industrial storage facility for Enterprise Products and Partners L.P., an oil and natural gas company. This property may present a potential offsite source as use of PFAS at this terminal is unknown.

3.3.9 Combined Maintenance Facility

A combined maintenance facility, shared between the Marines, Navy, and Army National Guard, is located approximately 300 feet upgradient, at the end of Aerospace Avenue near Ashely Street. This property may present a potential offsite source as use of PFAS is unknown.

3.3.10 Pasadena Municipal Golf Course

The Pasadena Municipal Golf Course is located at 1000 Duffer Lane in Houston, Texas, approximately 625 feet west and upgradient of Ellington Field AASF. This property may present a potential offsite source as use of PFAS at this location is unknown.



CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	5/8/2023	GIS BY	MS	5/8/2023
SCALE	1:63,360	CHK BY	MB	5/8/2023
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	CM	5/8/2023

- Area of Interest
- Potential Release Area
- Approximate Corrected Facility Boundary
- Facility Boundary
- Water Body
- Canal/Ditch
- Surface Water Flow Direction
- Groundwater Flow Direction

Wells

- Domestic Well
- Industrial Well
- Monitoring Well
- Public Supply Well
- Other Well

N

Areas of Interest

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

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4. Project Data Quality Objectives

As identified during the Data Quality Objective (DQO) process and outlined in the SI Quality Assurance Project Plan (QAPP) Addendum (AECOM, 2022b), 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 relevant 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 the OSD risk-based SLs. The SLs are presented in **Section 6.1** of this report.

4.2 Information Inputs

Primary information inputs included:

- The PA for Ellington Field AASF (AECOM, 2020);
- The TXANG SI for Ellington Field JRB (Leidos, 2018);
- Analytical data from groundwater and soil samples collected as part of this SI in accordance with the site-specific Uniform Federal Policy (UFP)-QAPP Addendum (AECOM, 2022b); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured at the time of sampling.

4.3 Study Boundaries

The scope of the SI was bounded by the property limits of the facility (**Figure 2-2**), except for two existing off-facility wells located directly north of AOI 2 within the Ellington Field JRB. These two wells were sampled during the SI. The SI scope was bounded vertically by the observed depths of the surficial groundwater table. Temporal boundaries were limited to the spring season, which was the earliest time field resources were available to complete the study.

4.4 Analytical Approach

Samples were analyzed by Pace Analytical Gulf Coast, accredited under the DoD Environmental Laboratory Accreditation Program (ELAP; Accreditation Number 74960) and the National Environmental Laboratory Accreditation Program (NELAP; Certificate Number 01955). Data were compared to applicable SLs within this document and decision rules as defined in the SI QAPP Addendum (AECOM, 2022b).

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 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; DoD, 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 SI QAPP Addendum (AECOM, 2022b).

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 implemented in accordance with the following approved documents:

- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP)* dated March 2018 (AECOM, 2018a);
- *Final Programmatic Accident Prevention Plan* dated July 2018 (AECOM, 2018b);
- *Final Preliminary Assessment Report, Ellington Field Army Aviation Support Facility, Houston, Texas* dated July 2020 (AECOM, 2020);
- *Final Site Safety and Health Plan, Ellington Field Army Aviation Support Facility, Houston, Texas* dated May 2022 (AECOM, 2022a); and
- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Ellington Field Army Aviation Support Facility, Houston, Texas* dated June 2022 (AECOM, 2022b).

The SI field activities were conducted from 1 to 9 June 2022 and consisted of utility clearance, direct push boring, soil sample collection, temporary monitoring well installation, grab groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2022b), except as noted in **Section 5.8**.

The following samples were collected during the SI and analyzed for a subset of 18 compounds by liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.3 Table B-15 to fulfill the project DQOs:

- Sixteen (16) soil samples from four boring locations and four hand auger locations;
- Four grab groundwater samples from four temporary wells and two groundwater samples from two existing permanent wells;
- Twelve (12) quality assurance (QA)/quality control (QC) 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 media. 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**. Sampling forms are provided in **Appendix B2,** land survey data are provided in **Appendix B3**, and a Nonconformance and Corrective Action Report is provided in **Appendix B4**. 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 for each of these activities are presented below.

5.1.1 Technical Project Planning

The US Army Corps of Engineers (USACE) TPP Process, Engineer Manual (EM) 200-1-2 (USACE, 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.

A combined TPP Meeting 1 and 2 was held on 3 May 2022, prior to SI field activities. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2. The stakeholders for this SI include the ARNG, TXARNG, USACE, TXANG, and Texas Commission on Environmental Quality. Stakeholders were provided the opportunity to make comments on the technical sampling approach and methods at the combined TPP Meeting 1 and 2. The outcome of the combined TPP Meeting 1 and 2 was memorialized in the SI QAPP Addendum (AECOM, 2022b).

A TPP Meeting 3 was held on 11 July 2023 to discuss the results of the SI. Meeting minutes for TPP 3 will be included in **Appendix D** of this report. Future TPP meetings will provide an opportunity to discuss the results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

AECOM placed a ticket with the Texas 811 utility clearance provider to notify them of intrusive work on 1 June 2022. Additionally, AECOM contracted Ground Penetrating Radar Systems, LLC (GPRS), a private utility location service, to perform utility clearance. GPRS performed utility clearance of the proposed boring locations on 1 June 2022 with input from the AECOM field team and Ellington Field AASF facility staff. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 feet of each boring were pre-cleared using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and Sampling Equipment Acceptability

The Wash Rack spigot was sampled at Ellington Field AASF on 12 May 2022 to assess the usability of the water for decontamination of drilling equipment. Water from the spigot was transferred to a tote to allow for decontamination staging in an alternate area. Water from the tote was sampled on 8 June 2022. The samples were analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15. Results of the samples collected at the wash rack spigot (EFF-PW-01) and the tote (EF-DECON-01) confirmed this source and container to be acceptable for use in this investigation; therefore, they were used throughout the field activities. The results of the decontamination water sample associated with the Wash Rack spigot source used during the SI are provided in **Appendix F**. A discussion of the results is presented in the DUA (**Appendix A**).

Materials that were used within the sampling zone were confirmed as acceptable for use in the sampling environment. The checklist of acceptable materials for use in the sampling environment was provided in the Standard Operating Procedures (SOPs) appendix to the SI QAPP Addendum (AECOM, 2022b). Prior to the start of field work each day, a Sampling Checklist was completed as an additional layer of control. The checklist served as a daily reminder to each field team member regarding the allowable materials within the sampling environment.

5.2 Soil Borings and Soil Sampling

Soil samples were collected via hand auger at locations designated for surface soil (0 to 2 feet bgs) sampling only. Subsurface soil samples were collected via direct push technology (DPT), in accordance with the SI QAPP Addendum (AECOM, 2022b). 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 feet of the boring, in accordance with AECOM utility clearance procedures. The soil boring locations are shown on **Figure 5-1**, and depths are provided **Table 5-1**.

In general, three discrete soil samples were collected from the vadose zone for chemical analysis from each soil boring advanced using DPT: one surface soil sample (0 to 2 feet bgs), one subsurface soil sample approximately 2 feet above the groundwater table, and one subsurface soil sample at the mid-point between the surface and the groundwater table.

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

Soil borings completed during the SI found low to medium plasticity lean clay as the dominant lithology of the unconsolidated sediments below the Ellington Field AASF. The borings were completed at depths between 15 and 25 feet bgs. Layers of silty sand and sandy silt were also observed in the boring logs at thicknesses ranging from 2 to 3.5 feet. These observations are consistent with the understood depositional environment of the region.

Each soil sample was collected into laboratory-supplied PFAS-free high-density polyethylene (HDPE) bottles and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via FedEx under standard chain of custody (CoC) procedures to the laboratory and analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15, total organic carbon (TOC) (USEPA Method 9060A), pH (USEPA Method 9045D), and grain size (ASTM Method D-422) in accordance with the SI QAPP Addendum (AECOM, 2022b).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. Matrix spike (MS)/MS 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, equipment rinsate blanks (ERBs) were collected at a rate of 5% 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 in accordance with the SI QAPP Addendum (AECOM, 2022b) using bentonite chips at completion of sampling activities. Borings were installed in grass areas to avoid disturbing concrete or asphalt surfaces.

5.3 Temporary Well Installation and Groundwater Sampling

Temporary wells were installed using a GeoProbe® 7822DT dual-tube sampling system. Once the borehole was advanced to the desired depth, a temporary well was constructed of a 5-foot section of 1-inch Schedule 40 poly-vinyl chloride (PVC) screen with sufficient casing to reach ground surface. New PVC pipe and screen were used to avoid cross contamination between locations. The screen intervals for the temporary wells are provided in **Table 5-2**.

Grab 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 a peristaltic pump with PFAS-free HDPE tubing. The temporary wells were purged at a rate determined in the field to reduce turbidity and draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, turbidity, and oxidation-reduction potential) were measured using a water quality meter and recorded on the field sampling form (**Appendix B2**) before each sample was collected. 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.

Groundwater samples were also collected from two existing permanent monitoring wells (MW-ELL02-01 and MW-ELL02-02) located off facility, just north of AOI 2. Samples were collected via low-flow sampling methods using a peristaltic pump with PFAS-free HDPE tubing. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, turbidity, and oxidation-reduction potential) were measured using a water quality meter with a flow through cell and recorded on the field sampling form (**Appendix B2**). All non-dedicated sampling materials were decontaminated between boring locations. A shaker test was also completed for the groundwater samples collected from the permanent wells, and no foaming was noted.

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 (AECOM, 2022b).

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSDs were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. One field reagent blank was collected in accordance with the PQAPP (AECOM, 2018a). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 °C during shipment.

Following well surveying (described below in **Section 5.5**), temporary wells were abandoned in accordance with the SI QAPP Addendum (AECOM, 2022b) by removing the PVC and backfilling the hole with bentonite chips. Upon completion of well abandonment, the ground surface at each location was patched to match existing surrounding conditions.

5.4 Synoptic Water Level Measurements

A synoptic groundwater gauging event was performed on 9 June 2022. Groundwater elevation measurements were collected from the four new temporary monitoring wells and two existing permanent monitoring wells. Water level measurements were taken from the northern side of the well casing. An accurate stable water level measurement was unable to be obtained from temporary monitoring well AOI01-01 due to poor recharge. However, sufficient data were collected from the other wells to estimate a local groundwater flow direction at the facility. A groundwater flow contour map is provided in **Figure 2-4**. Groundwater elevation data are provided in **Table 5-2**.

5.5 Surveying

The northern side of each well casing was surveyed by Texas-licensed land surveyors following guidelines provided in the SOPs provided in the SI QAPP Addendum (AECOM, 2022b). Survey data from the newly installed wells on the facility were collected on 9 June 2022 in the applicable Universal Transverse Mercator zone projection with North American Datum 1983 (horizontal) and North American Vertical Datum 1988 (vertical). The surveyed well data are provided in **Appendix B3**.

5.6 Investigation-Derived Waste

As of the date of this report, the disposal of 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 SI QAPP Addendum (AECOM, 2022b) and with the DA Guidance for Addressing Releases of PFAS, Q18 (DA, 2018).

Soil IDW (i.e., soil cuttings) generated during the SI activities were contained in a labeled, 55-gallon Department of Transportation (DOT)-approved steel drum and left onsite in a designated waste storage area. The soil IDW was not sampled and assumes the characteristics of the associated soil samples collected from that source location. ARNG will coordinate waste profiling, transportation, and disposal of the solid IDW.

Liquid IDW generated during SI activities (i.e., purge water, development water, and decontamination fluids) were contained in a labeled, 55-gallon DOT-approved steel drum, and left onsite in a designated waste storage area. The liquid IDW was not sampled and assumes the characteristics of the associated groundwater samples collected from that source location. Containerized liquid IDW will be managed and disposed of by ARNG (either by offsite disposal or onsite disposal with treatment, as appropriate) under a separate contract in accordance with SOP No. 042A (EA, 2021).

Other solids such as spent personal protective equipment, plastic sheeting, tubing, rope, unused monitoring well construction materials, and other environmental media generated during the field activities were disposed of at a licensed solid waste landfill.

5.7 Laboratory Analytical Methods

Samples were analyzed by LC/MS/MS compliant with QSM 5.3 Table B-15 at Pace Analytical Gulf Coast in Baton Rouge, Louisiana, a DoD ELAP and NELAP certified laboratory. Soil samples were also analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D.

5.8 Deviations from SI QAPP Addendum

A deviation from the SI QAPP Addendum was identified during review of the field documentation. The deviation is noted below and is documented in a Nonconformance and Corrective Action Reports (**Appendix B4**):

- Per the SI QAPP Addendum, two ERB samples were to be collected from non-dedicated soil sampling equipment. Due to a misunderstanding of the QAPP, the field team collected ERB samples from the water level meters used during groundwater sampling. Although no soil related ERB samples were collected, the same decontamination procedures were followed for the water level meters and soil sampling equipment. The ERB samples collected from the water level meters were non-detect for analyzed compounds. Additionally, no data usability issues were noted in the data usability assessment (**Appendix A**). This action was documented in a nonconformance and corrective action report provided in **Appendix B4**.

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Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Ellington Field AASF, Texas

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
Soil Samples							
AOI01-01-SB-00-02	6/7/2022 13:53	0 - 2	x			x	
AOI01-01-SB-05-07	6/7/2022 14:15	5 - 7	x	x	x		
AOI01-01-SB-09-11	6/7/2022 14:20	9 - 11	x				
AOI01-02-SB-00-02	6/7/2022 11:20	0 - 2	x	x	x		
AOI01-02-SB-00-02-D	6/7/2022 11:20	0 - 2	x				FD
AOI01-02-SB-10-12	6/7/2022 12:20	10 - 12	x				
AOI01-02-SB-18-20	6/7/2022 12:25	18 - 20	x				
AOI01-03-SB-00-02	6/7/2022 13:05	0 - 2	x				
AOI02-01-SB-00-02	6/8/2022 12:05	0 - 2	x	x	x	x	
AOI02-01-SB-00-02-D	6/8/2022 12:05	0 - 2	x				FD
AOI02-02-SB-00-02	6/7/2022 10:52	0 - 2	x				
AOI02-02-SB-00-02-MS	6/7/2022 11:30	0 - 2	x	x	x		MS
AOI02-02-SB-00-02-MSD	6/7/2022 11:30	0 - 2	x	x	x		MSD
AOI02-03-SB-00-02	6/7/2022 10:25	0 - 2	x				
EF-01-SB-00-02	6/7/2022 15:17	0 - 2	x				
EF-01-SB-05-07	6/7/2022 15:58	5 - 7	x				
EF-01-SB-10-12	6/7/2022 16:02	10 - 12	x				
EF-02-SB-00-02	6/8/2022 8:30	0 - 2	x				
EF-02-SB-05-07	6/8/2022 10:00	5 - 7	x				
EF-02-SB-10.5-12	6/8/2022 10:05	10.5 - 12	x				
Groundwater Samples							
AOI01-01-GW	6/8/2022 15:30	NA	x				
AOI01-02-GW	6/8/2022 12:45	NA	x				
AOI01-02-GW-D	6/8/2022 12:45	NA	x				FD
AOI01-02-GW-MS	6/8/2022 12:45	NA	x				MS
AOI01-02-GW-MSD	6/8/2022 12:45	NA	x				MSD
EF-01-GW	6/8/2022 10:55	NA	x				
EF-02-GW	6/8/2022 14:20	NA	x				
MW-ELL02-01-060822	6/8/2022 15:10	NA	x				
MW-ELL02-02-060922	6/9/2022 9:25	NA	x				

Table 5-1
Site Inspection Samples by Medium
Site Inspection Report, Ellington Field AASF, Texas

Sample Identification	Sample Collection Date/Time	Sample Depth (feet bgs)	LC/MS/MS compliant with QSM 5.3 Table B-15	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D-422)	Comments
Quality Control Samples							
EFF-PW-01	5/12/2022 11:50	NA	x				wash rack spigot
EF-FRB-01	6/8/2022 14:30	NA	x				collected following sampling at EF-02-GW
EF-ERB-01	6/8/2022 11:00	NA	x				water level probe
EF-ERB-02	6/8/2022 14:25	NA	x				water level probe
EF-DECON-01	6/8/2022 14:40	NA	x				decon water tote

Notes:
AOI = area of interest
ASTM = American Society for Testing and Materials
bgs = below ground surface
EF = Ellington Field
ERB = equipment rinsate blank
FD = field duplicate
FRB = field reagent blank
GW = groundwater
LC/MS/MS = Liquid Chromatography Mass Spectrometry
MS/MSD = matrix spike/ matrix spike duplicate
MW = monitoring well
NA = not applicable
QSM = Quality Systems Manual
SB = soil boring
TOC = total organic carbon
USEPA = United States Environmental Protection Agency

Table 5-2
Soil Boring Depths, Temporary Well Screen Intervals, and Groundwater Elevations
Site Inspection Report, Ellington Field AASF, Texas

Area of Interest	Location	Soil Boring Depth (feet bgs)	Well Screen Interval (feet bgs)	Top of Casing Elevation (feet NAVD88)	Ground Surface Elevation (feet NAVD88)	Depth to Water (feet btoc)	Depth to Water (feet bgs)	Groundwater Elevation (feet NAVD88)
1	AOI01-01	15	10 - 15	31.97	31.62	9.02	8.67	22.95
	AOI01-02	25	20 - 25	31.78	31.43	5.35	5.00	26.43
	EF-01	15	10 - 15	32.40	32.05	5.97	5.62	26.43
	EF-02	15	10 - 15	33.26	32.91	6.31	5.96	26.95
	MW-ELL02-01	NA	2.8 - 12.8	30.69	30.82	4.01	4.14	26.68
	MW-ELL02-02	NA	4.35 - 14.35	30.10	30.33	4.34	4.57	25.76

Notes:

1. Well screen, top of casing, and ground surface elevation information for exisitng permanent wells MW-ELL002-01 and MW-ELL02-02 obtained from Leidos, 2018.

AOI = area of interest
bgs = below ground surface
btoc = below top of casing
EF = Ellington Field
MW = monitoring well
NA = not applicable
NAVD88 = North American Vertical Datum 1988

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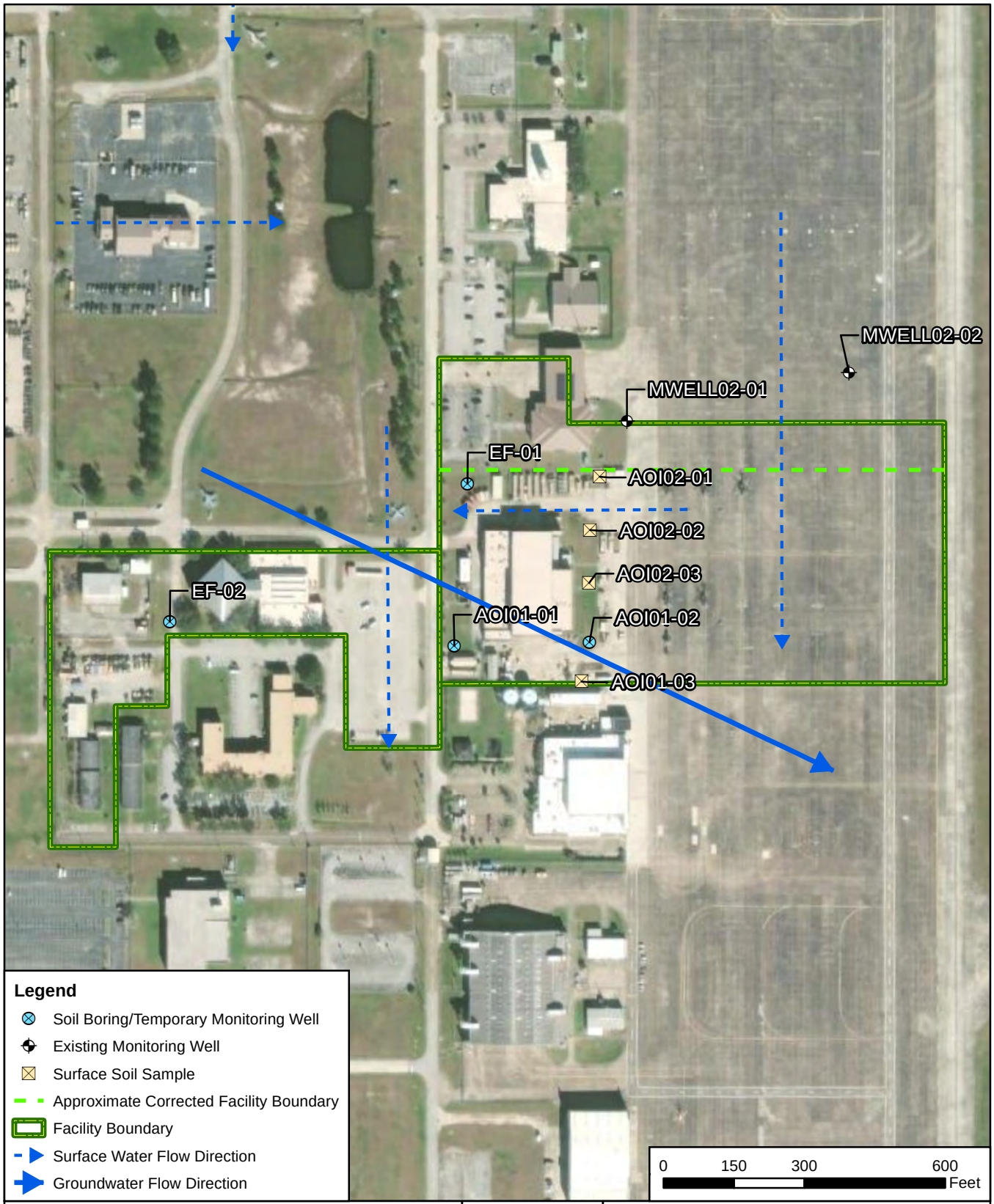

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	5/8/2023	GIS BY	MS	5/8/2023
SCALE	1:3,600	CHK BY	SK	5/8/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	5/8/2023

Site Inspection Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 5-1

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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 each AOI is provided in **Section 6.3** and **Section 6.4**. **Table 6-2** through **Table 6-5** present results in soil or groundwater for the relevant compounds. 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** below.

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

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

Notes:
bgs = below ground surface; µg/kg = micrograms per kilogram; ng/L = nanograms per liter

a.) Assistant Secretary of Defense, 2022. Risk Based Screening Levels in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. Hazard Quotient (HQ) = 0.1. 6 July 2022.

b.) 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 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 MIL-SPEC 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.

The data in the subsequent sections are compared to the SLs presented in **Table 6-1**. The SLs for groundwater are based on direct ingestion and have been conservatively applied for groundwater at the Ellington Field AASF although it is not used as a drinking water source at the facility. 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 feet bgs) and the industrial/commercial worker scenario is applied to shallow subsurface soil results (2 to 15 feet bgs). The SLs are not applied to deep subsurface soil results (>15 feet bgs) because 15 feet 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 ITRC, several important 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).

6.3 AOI 1

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 1: Wash Rack. The soil and groundwater results are summarized on **Table 6-2** through **Table 6-5**. Soil and groundwater results are presented on **Figure 6-1** through **Figure 6-7**.

6.3.1 AOI 1 Soil Analytical Results

Surface soil was sampled from 0 to 2 feet bgs at boring locations AOI01-01 through AOI01-03, and EF-02 located upgradient of AOI 1. Shallow subsurface soil was sampled at depths of 5 to 7 feet bgs and between 9 to 12 feet bgs at AOI01-01 and EF-02. Soil was also sampled from shallow subsurface soil (10 to 12 feet bgs) and deep subsurface soil intervals (18 to 20 feet bgs) at AOI01-02. **Figure 6-1** through **Figure 6-5** present the ranges of detections in soil. **Table 6-2** through **Table 6-4** summarize the soil results.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected below their SLs in soil as summarized below:

- All five relevant compounds were detected below their SLs in shallow soil with the following maximum concentrations: PFOA at 0.137 J micrograms per kilogram (µg/kg), PFOS at 6.92 µg/kg, PFHxS at 3.06 µg/kg, PFNA at 0.082 J µg/kg, and PFBS at 0.272 J µg/kg.
- PFOA, PFOS, PFHxS, and PFBS were detected below their SLs in shallow subsurface soil with the following maximum concentrations: PFOA at 0.101 J µg/kg, PFOS at 1.79 µg/kg, PFHxS at 8.10 µg/kg, and PFBS at 1.27 µg/kg. PFNA was not detected in shallow subsurface soil.
- PFHxS was detected in deep subsurface soil, with a concentration of 0.072 J µg/kg. PFOA, PFOS, PFNA, and PFBS were not detected in deep subsurface soil.

6.3.2 AOI 1 Groundwater Analytical Results

Figure 6-6 and **Figure 6-7** present the ranges of detections in groundwater. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from upgradient temporary well EF-02 which was intended to determine presence of impacts on the facility from potential adjacent sources. PFOS was detected

above the SL of 4 ng/L, with a concentration of 6.62 J ng/L. PFHxS and PFBS were detected below their SLs, with concentrations of 30.6 J ng/L and 6.28 J ng/L, respectively. PFOA and PFNA were not detected.

At the AOI 1 source area, groundwater was sampled from temporary monitoring wells AOI01-01 and AOI01-02. The following concentrations with respect to the SLs were measured:

- PFOA was detected above the SL of 6 ng/L at both wells, with concentrations of 151 J ng/L at AOI01-01 and 14.0 J ng/L at AOI01-02.
- PFOS was detected above the SL of 4 ng/L at both wells, with concentrations of 2,150 J ng/L at AOI01-01 and 127 ng/L J at AOI01-02.
- PFHxS was detected above the SL of 39 ng/L at both wells, with concentrations of 17,700 J ng/L at AOI01-01 and 376 J ng/L at AOI01-02.
- PFBS was detected above the SL of 601 ng/L, with a concentration of 2,750 J ng/L at AOI01-01. PFBS was detected below the SL at AOI01-02 with a concentration of 72.2 J ng/L.
- PFNA was detected below the SL of 6 ng/L, with a concentration of 1.54 J ng/L at AOI01-02. PFNA was not detected at AOI01-01.

6.3.3 AOI 1 Conclusions

Based on the results of the SI, none of the detected relevant compounds in any soil sample were above their SLs. PFOA, PFOS, PFHxS, and PFBS were detected in groundwater at concentrations above their SLs. Based on the exceedances of the SLs in groundwater, further evaluation at AOI 1 is warranted.

6.4 AOI 2

This section presents the analytical results for soil and groundwater in comparison to SLs for AOI 2: Flight Line. The results in soil are summarized on **Table 6-2**. Soil results are presented on **Figure 6-1** through **Figure 6-5**.

6.4.1 AOI 2 Soil Analytical Results

Soil was sampled from surface soil (0 to 2 feet bgs) from boring locations AOI02-01 through AOI02-03. **Figure 6-1** through **Figure 6-5** present the ranges of detections in soil. **Table 6-2** summarizes the soil results.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected below their SLs in surface soil with the following maximum concentrations: PFOA at 0.388 J µg/kg, PFOS at 12.7 J µg/kg, PFHxS at 0.813 J µg/kg, PFNA at 0.253 J µg/kg, and PFBS at 0.047 J µg/kg.

6.4.2 AOI 2 Groundwater Analytical Results

Figure 6-6 and **Figure 6-7** present the ranges of detections in groundwater. **Table 6-5** summarizes the groundwater results.

Groundwater was sampled from temporary monitoring wells EF-01 and EF-02, as well as permanent monitoring well MW-ELL02-01, all of which are located upgradient of AOI 2. Groundwater was also sampled from permanent monitoring well MW-ELL02-02 located cross-gradient of AOI 2. No groundwater was sampled downgradient of the AOI 2 source area as drilling in this area would impact the flight line. Detections in samples collected upgradient of AOI 2 may

indicate a potential unknown off-facility source. The following concentrations with respect to the SLs were measured:

- PFOA was detected above the SL of 6 ng/L at MW-ELL02-01, with a concentration of 206 J ng/L. PFOA was detected below the SL at MW-ELL02-02 and EF-01. PFOA was not detected at EF-02.
- PFOS was detected above the SL of 4 ng/L at three of the four wells, with concentrations ranging from 6.62 J ng/L to 4,010 J ng/L. PFOS was detected below the SL at EF-01.
- PFHxS was detected above the SL of 39 ng/L at three of the four wells, with concentrations ranging from 42.6 J ng/L to 3,260 J ng/L. PFHxS was detected below the SL at EF-02.
- PFNA was detected above the SL of 6 ng/L at MW-ELL02-01, with a concentration of 30.3 J ng/L ng/L. PFNA was not detected at EF-01, EF-02, or MW-ELL02-02.
- PFBS was detected below the SL of 601 ng/L at all four wells, with a maximum concentration of 250 J ng/L at MW-ELL02-01.

6.4.3 AOI 2 Conclusions

Based on the results of the SI, none of the relevant compounds were detected in any surface soil sample above their respective SLs. Though no groundwater was sampled within AOI 2 (the entire area is covered by flight line concrete), PFOA, PFOS, PFHxS, and PFNA were detected at concentrations above their SLs in groundwater in nearby wells upgradient and cross-gradient of AOI 2. Based on the exceedances of the SLs in groundwater surrounding AOI 2 in combination with the detections in soil at AOI 2, further evaluation at AOI 2 is warranted.

Table 6-2
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil
Site Inspection Report, Ellington Field AASF

Area of Interest		AOI01								AOI02								EF-01		EF-02	
Sample ID		AOI01-01-SB-00-02		AOI01-02-SB-00-02		AOI01-02-SB-00-02-D		AOI01-03-SB-00-02		AOI02-01-SB-00-02		AOI02-01-SB-00-02-D		AOI02-02-SB-00-02		AOI02-03-SB-00-02		EF-01-SB-00-02		EF-02-SB-00-02	
Sample Date		06/07/2022		06/07/2022		06/07/2022		06/07/2022		06/08/2022		06/08/2022		06/07/2022		06/07/2022		06/07/2022		06/08/2022	
Depth		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft		0-2 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)																					
PFBS	1900	0.052	J	0.265	J	0.272	J	ND	U	0.028	J	0.047	J	0.026	J	0.038	J	ND	U	ND	UJ
PFHxS	130	3.06		0.587	J	0.799	J	0.186	J	0.507	J	0.528	J	0.453	J	0.813	J	0.768	J	0.035	J
PFNA	19	ND	U	ND	U	ND	U	0.082	J	0.161	J	0.090	J	0.079	J	0.253	J	0.024	J	ND	UJ
PFOA	19	0.137	J	ND	U	ND	U	ND	U	0.174	J	0.123	J	0.121	J	0.388	J	0.157	J	ND	UJ
PFOS	13	1.37		ND	U	ND	U	6.92		12.7	J	4.88	J	2.37		6.21		0.694	J	ND	UJ

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on residential scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

UJ = The analyte was not detected at a level greater than or equal to the adjusted DL. However, the reported adjusted DL is approximate and may be inaccurate or imprecise.

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
EF	Ellington Field
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-3
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Shallow Subsurface Soil
Site Inspection Report, Ellington Field AASF

Area of Interest		AOI01						EF-01				EF-02			
Sample ID		AOI01-01-SB-05-07		AOI01-01-SB-09-11		AOI01-02-SB-10-12		EF-01-SB-05-07		EF-01-SB-10-12		EF-02-SB-05-07		EF-02-SB-10.5-12	
Sample Date		06/07/2022		06/07/2022		06/07/2022		06/07/2022		06/07/2022		06/08/2022		06/08/2022	
Depth		5-7 ft		9-11 ft		10-12 ft		5-7 ft		10-12 ft		5-7 ft		10.5-12 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B-15 (µg/kg)															
PFBS	25000	0.153	J	1.27		0.066	J	ND	U	ND	UJ	ND	UJ	ND	UJ
PFHxS	1600	2.57		8.10		0.504	J	0.409	J	ND	UJ	ND	UJ	ND	UJ
PFNA	250	ND	U	ND	U	ND	U	ND	U	ND	UJ	ND	UJ	ND	UJ
PFOA	250	ND	U	0.101	J	ND	U	ND	U	ND	UJ	ND	UJ	ND	UJ
PFOS	160	1.23		1.79		0.172	J	0.109	J	ND	UJ	ND	UJ	ND	UJ

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

UJ = The analyte was not detected at a level greater than or equal to the adjusted DL. However, the reported adjusted DL is approximate and may be inaccurate or imprecise.

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
EF	Ellington Field
ft	feet
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
OSD	Office of the Secretary of Defense
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
USEPA	United States Environmental Protection Agency
µg/kg	micrograms per kilogram

Table 6-4
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Deep Subsurface Soil
Site Inspection Report, Ellington Field AASF

Area of Interest	AOI01	
Sample ID	AOI01-02-SB-18-20	
Sample Date	06/07/2022	
Depth	18-20 ft	
Analyte	**Result**	**Qual**
Soil, LCMSMS compliant with QSM 5.3 Table B		
PFBS	ND	U
PFHxS	0.072	J
PFNA	ND	U
PFOA	ND	U
PFOS	ND	U

Interpreted Qualifiers

J = Estimated concentration

U = The analyte was not detected at a level greater than or equal to the adjusted DL

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
ft	feet
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
ND	analyte not detected above the LOD
QSM	Quality Systems Manual
Qual	interpreted qualifier
SB	soil boring
µg/kg	micrograms per kilogram

Table 6-5
PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Groundwater
Site Inspection Report, Ellington Field AASF

	Area of Interest	AOI01						Sitewide							
	Sample ID	AOI01-01-GW		AOI01-02-GW		AOI01-02-GW-D		EF-01-GW		EF-02-GW		MW-ELL02-01-060822		MW-ELL02-02-060922	
	Sample Date	06/08/2022		06/08/2022		06/08/2022		06/08/2022		06/08/2022		06/08/2022		06/09/2022	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, LCMSMS compliant with QSM 5.3 Table B-15 (ng/l)															
PFBS	601	2750	J	72.2	J	59.2	J	17.4	J	6.28	J	250	J	7.35	J
PFHxS	39	17700	J	376	J	307	J	59.8	J	30.6	J	3260	J	42.6	J
PFNA	6	ND	UJ	1.54	J	1.24	J	ND	UJ	ND	UJ	30.3	J	ND	UJ
PFOA	6	151	J	14.0	J	11.6	J	ND	UJ	ND	UJ	206	J	3.07	J
PFOS	4	2150	J	127	J	106	J	3.23	J	6.62	J	4010	J	14.2	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, July 2022. Risk Based Screening Levels Calculated for PFOA, PFOS, PFBS, PFHxS, and PFNA in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1, May 2022 Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

UJ = The analyte was not detected at a level greater than or equal to the adjusted DL. However, the reported adjusted DL is approximate and may be inaccurate or imprecise.

Notes

ND = Analyte not detected above the LOD. LOD values are presented in Appendix F.

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

Acronyms and Abbreviations

AASF	Army Aviation Support Facility
AOI	Area of Interest
D	duplicate
DL	detection limit
EF	Ellington Field
ELL	Ellington
GW	groundwater
HQ	hazard quotient
ID	identification
LCMSMS	liquid chromatography with tandem mass spectrometry
LOD	limit of detection
LOQ	limit of quantitation
MW	Monitoring Well
OSD	Office of the Secretary of Defense
PFAS	per- and polyfluoroalkyl substances
QSM	Quality Systems Manual
Qual	interpreted qualifier
USEPA	United States Environmental Protection Agency
ng/l	nanogram per liter
-	not applicable
<	analyte not detected above the LOD

Shallow

EF-01
AOI02-01
AOI02-02
AOI02-03
EF-02
AOI01-01
AOI01-02
AOI01-03

Intermediate

EF-01
EF-02
AOI01-01
AOI01-02

Deep

EF-01
EF-02
AOI01-01
AOI01-02

Legend

- Approximate Corrected Facility Boundary
- Facility Boundary

PFOA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

N

0 125 250 500 Feet

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

PFOA Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	2/14/2023	GIS BY	MS	2/14/2023
SCALE	1:3,000	CHK BY	SW	2/14/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/14/2023

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-1

Shallow

EF-01
AOI02-01
AOI02-02
AOI02-03
EF-02
AOI01-01
AOI01-02
AOI01-03

Intermediate

EF-01
EF-02
AOI01-01
AOI01-02

Deep

EF-01
EF-02
AOI01-01
AOI01-02

Legend

- Approximate Corrected Facility Boundary
- Facility Boundary

PFOS Results (µg/Kg)

- ND
- >ND - 13
- >13 - 160
- >160 - 1,600
- >1,600

N

0 125 250 500 Feet

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

PFOS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	2/14/2023	GIS BY	MS	2/14/2023
SCALE	1:3,000	CHK BY	SK	2/14/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/14/2023

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-2

Shallow

EF-01
AOI02-01
AOI02-02
AOI02-03
EF-02
AOI01-01
AOI01-02
AOI01-03

Intermediate

EF-01
EF-02
AOI01-01
AOI01-02

Deep

EF-01
EF-02
AOI01-01
AOI01-02

Legend

- Approximate Corrected Facility Boundary
- Facility Boundary

PFBS Results (µg/Kg)

- ND
- >ND - 10
- >10 - 1,900
- >1,900 - 25,000
- >25,000

N

0 125 250 500 Feet

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

PFBS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	2/14/2023	GIS BY	MS	2/14/2023
SCALE	1:3,000	CHK BY	SK	2/14/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/14/2023

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-3

Shallow

EF-01
AOI02-01
AOI02-02
AOI02-03
EF-02
AOI01-01
AOI01-02
AOI01-03

Intermediate

EF-01
EF-02
AOI01-01
AOI01-02

Deep

EF-01
EF-02
AOI01-01
AOI01-02

Legend

- Approximate Corrected Facility Boundary
- Facility Boundary

PFHxS Results (µg/Kg)

- ND
- >ND - 10
- >10 - 130
- >130 - 1,600
- >1,600

N

0 125 250 500 Feet

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

PFHxS Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	2/14/2023	GIS BY	MS	2/14/2023
SCALE	1:3,000	CHK BY	SK	2/14/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/14/2023

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-4

Shallow

EF-01
AOI02-01
AOI02-02
AOI02-03
EF-02
AOI01-01
AOI01-02
AOI01-03

Intermediate

EF-01
EF-02
AOI01-01
AOI01-02

Deep

EF-01
EF-02
AOI01-01
AOI01-02

Legend

- Approximate Corrected Facility Boundary
- Facility Boundary

PFNA Results (µg/Kg)

- ND
- >ND - 19
- >19 - 250
- >250 - 2,500
- >2,500

N

0 125 250 500 Feet

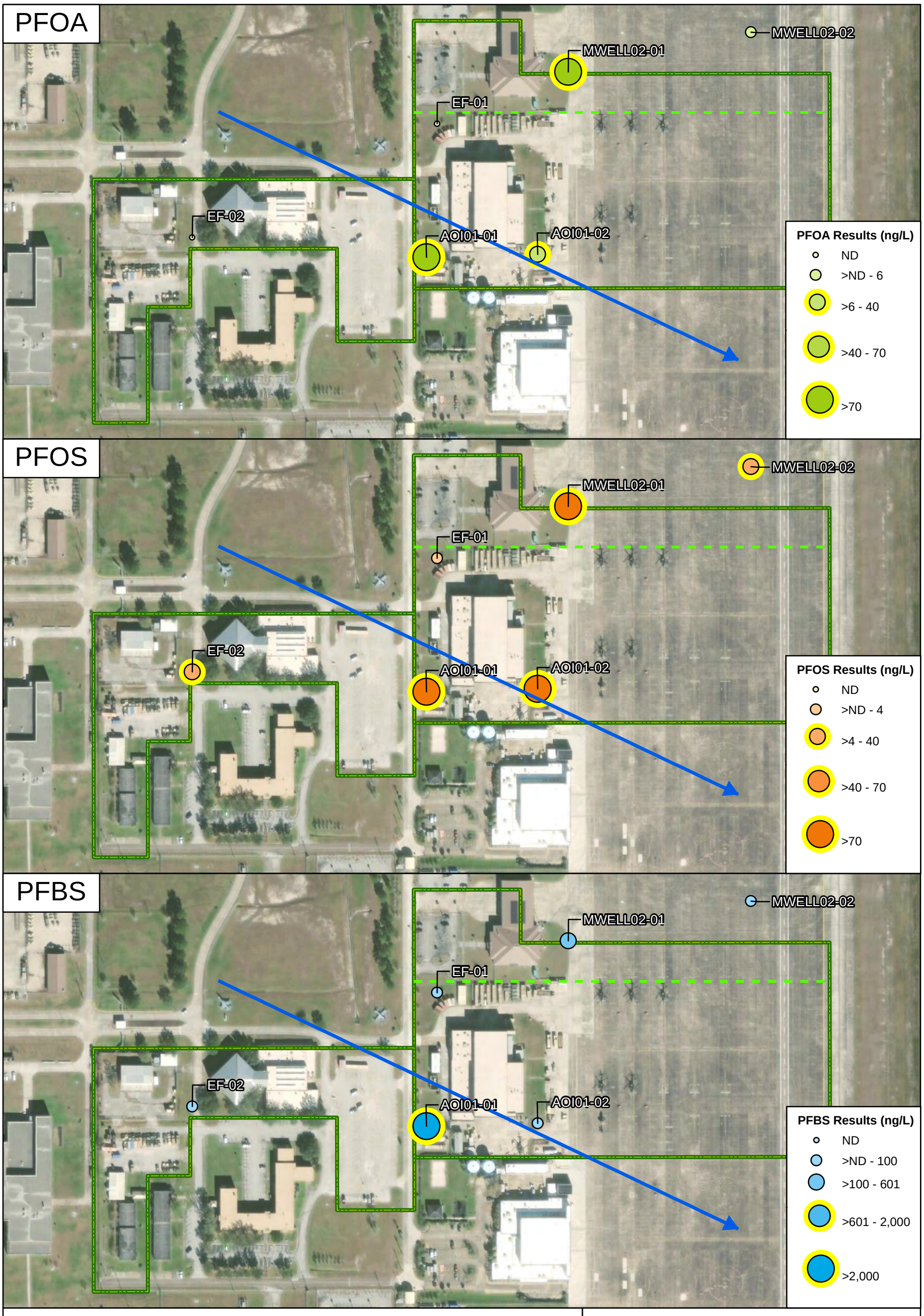
Exceedances of the OSD SL are depicted with a yellow halo.
Depth intervals shown represent respective sampling position within a given soil boring location.

PFNA Detections in Soil

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	2/14/2023	GIS BY	MS	2/14/2023
SCALE	1:3,000	CHK BY	SK	2/14/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	2/14/2023

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-5



Legend

- Approximate Corrected Facility Boundary
- Facility Boundary
- Groundwater Flow Direction

N

0 125 250 500 Feet

Exceedances of the OSD SL are depicted with a yellow halo.

PFOA, PFOS, and PFBS Detections in Groundwater

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	5/8/2023	GIS BY	MS	5/8/2023
SCALE	1:3,000	CHK BY	SW	5/8/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	5/8/2023

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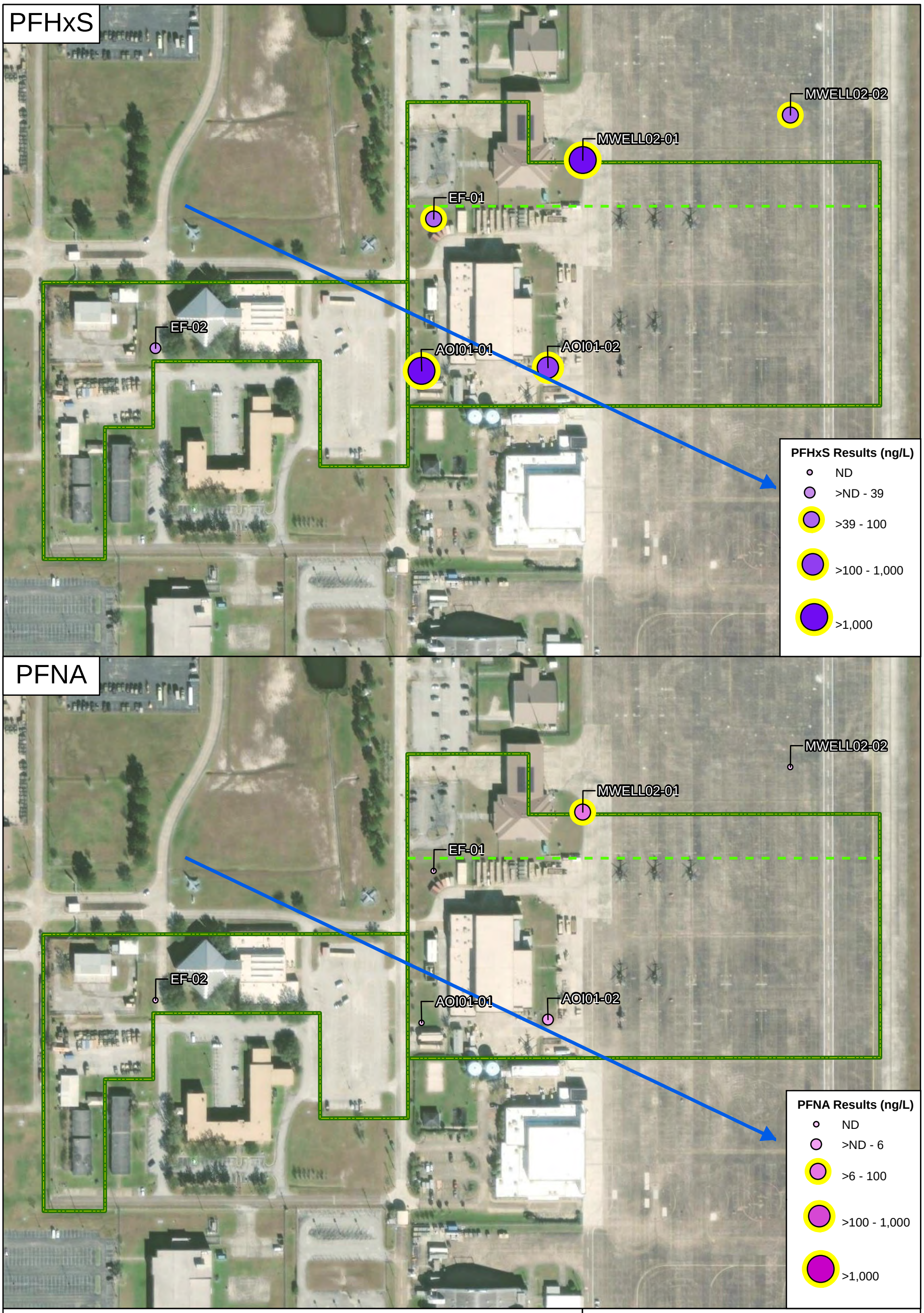
Figure 6-6

PFHxS



Legend

- Approximate Corrected Facility Boundary
- Facility Boundary
- Groundwater Flow Direction

N

0 110 220 440 Feet

Exceedances of the OSD SL are depicted with a yellow halo.

PFHxS and PFNA Detections in Groundwater

CLIENT	ARNG			
PROJECT	Site Inspection at Ellington Field, TX			
REVISED	5/8/2023	GIS BY	MS	5/8/2023
SCALE	1:2,640	CHK BY	SW	5/8/2023
Base Map: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community		PM	CM	5/8/2023

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Figure 6-7

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7. Exposure Pathways

The CSMs for each AOI, revised based on the SI findings, are 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; and
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 an incomplete pathway generally warrant no further action. However, the pathway is considered potentially complete if the relevant compounds are detected and the other four elements are satisfied, 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 to 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, residents outside the facility boundary, and recreational users outside of the facility boundary.

7.1 Soil Exposure Pathway

The SI results in soil were used to determine whether a potentially complete pathway exists between the source and potential receptors at AOI 1 and AOI 2 based on the aforementioned criteria.

7.1.1 AOI 1

AOI 1 is the Wash Rack, where TXARNG and TXANG personnel trained with Tri-Max™ units once a year from the early 1990s until around 2010 when AFFF at the facility was donated to the TXANG fire department, and Tri-Max™ units were replaced with Purple K units.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at AOI 1. Site workers, future construction workers (no current construction on the facility), and trespassers could contact constituents in surface soil via incidental ingestion and inhalation of dust. Therefore, the surface soil exposure pathways for these receptors are potentially complete. The nearest recreational area, Pasadena Municipal Golf Course is located approximately 620 feet west of the facility. The nearest residence is approximately 0.9 miles northeast of the facility. Therefore, the surface soil exposure pathways for off-facility residents and recreational users are considered incomplete. PFOA, PFOS, PFHxS, and PFBS were detected in subsurface soil at AOI 1. Construction workers could contact constituents in subsurface soil via incidental ingestion, and therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.1.2 AOI 2

AOI 2 is the Flight Line, where TXARNG and TXANG personnel trained with Tri-Max™ units once a year until around 2010 when AFFF at the facility was donated to the TXANG fire department, and Tri-Max™ units were replaced with Purple K units.

PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in surface soil at AOI 2. The potential receptors and pathways for surface soil are the same as described above for AOI 1. Though no subsurface soil samples were collected at AOI 2, the relevant compounds were detected in surface soil and these impacts could leach into subsurface soil via precipitation. Construction workers could contact constituents in subsurface soil via incidental ingestion, and therefore, the subsurface soil exposure pathway for future construction workers is potentially complete. The CSM for AOI 2 is presented on **Figure 7-1**.

7.2 Groundwater Exposure Pathway

The SI results in groundwater at AOI 1 were used to determine whether a potentially complete pathway exists between the source and potential receptors based on the aforementioned criteria. Though no groundwater samples were collected within AOI 2, the SI result in soil within AOI 2 and groundwater upgradient from AOI 2, were used to determine whether a potentially complete pathway exists between the source and potential receptors.

7.2.1 AOI 1

PFOA, PFOS, PFHxS, and PFBS were detected above their SLs in groundwater samples collected at AOI 1. Five public supply wells and 11 domestic wells were identified within a 4-mile radius of the facility; however, none of these wells are located downgradient of the facility. Therefore, the pathway for exposure to off-facility residents via ingestion of groundwater is considered incomplete. Drinking water at the facility is supplied by the City of Houston; therefore, the groundwater exposure pathway for site workers via direct ingestion of groundwater is considered incomplete. Depths to water measured at AOI 1 in June 2022 during the SI ranged from 5.00 to 8.67 feet bgs. Therefore, the incidental ingestion exposure pathway for future construction workers during construction activities is considered potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.2.2 AOI 2

Though no groundwater samples were collected within AOI 2 (the entire area is covered by concrete), PFOA, PFOS, PFHxS, and PFBS were detected above their SLs in groundwater samples collected upgradient and cross-gradient of AOI 2. While runoff from the Flight Line appears to be primarily directed to Stormwater Discharge Outfall 005, it is uncertain whether some runoff around the edges of the Flight Line could flow into nearby unpaved areas, especially in the

vicinity of MW-ELL02-01, potentially impacting groundwater. Five public supply wells and 11 domestic wells were identified within a 4-mile radius of the facility; however, none of these wells are located downgradient of the facility. Therefore, the pathway for exposure to off-facility residents via ingestion of groundwater is considered incomplete. Drinking water at the facility is supplied by the City of Houston; therefore, the groundwater exposure pathway for site workers via direct ingestion of groundwater is considered incomplete. Depths to water measured in wells nearby AOI 2 in June 2022 during the SI ranged from 4.14 to 5.62 feet bgs. Therefore, the incidental ingestion exposure pathway for future construction workers during construction activities is considered potentially complete. The CSM for AOI 2 is presented on **Figure 7-1**.

7.3 Surface Water and Sediment Exposure Pathway

The SI results in soil and groundwater, in combination with knowledge of the fate and transport properties of PFAS, were used to determine whether a potentially complete pathway exists between the source and potential receptors.

7.3.1 AOI 1

PFAS are water soluble and can migrate readily from soil to surface water via leaching and run-off. Because PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil and/or groundwater at AOI 1, it is possible that those compounds may have migrated from soil and groundwater to the facility's surface water drainage system which contains multiple ditches/channels for surface flow. Therefore, the surface water and sediment ingestion exposure pathways for site workers, future construction workers, and trespassers are considered potentially complete. Stormwater moves by open channel flow and underground drainage pipes until the runoff reaches Horsepen Bayou, eventually combining with Armand Bayou. Therefore, the surface water and sediment ingestion exposure pathway for off-facility recreational users is considered potentially complete. The CSM for AOI 1 is presented on **Figure 7-1**.

7.3.2 AOI 2

Because PFOA, PFOS, PFHxS, PFNA, and PFBS were detected in soil at AOI 2, it is possible that those compounds may have migrated from soil and groundwater to the facilities surface water drainage system which contains multiple ditches/channels for surface flow. Therefore, the receptors and pathways described above for AOI 1 are also possible at AOI 2. The CSM for AOI 2 is presented on **Figure 7-1**.

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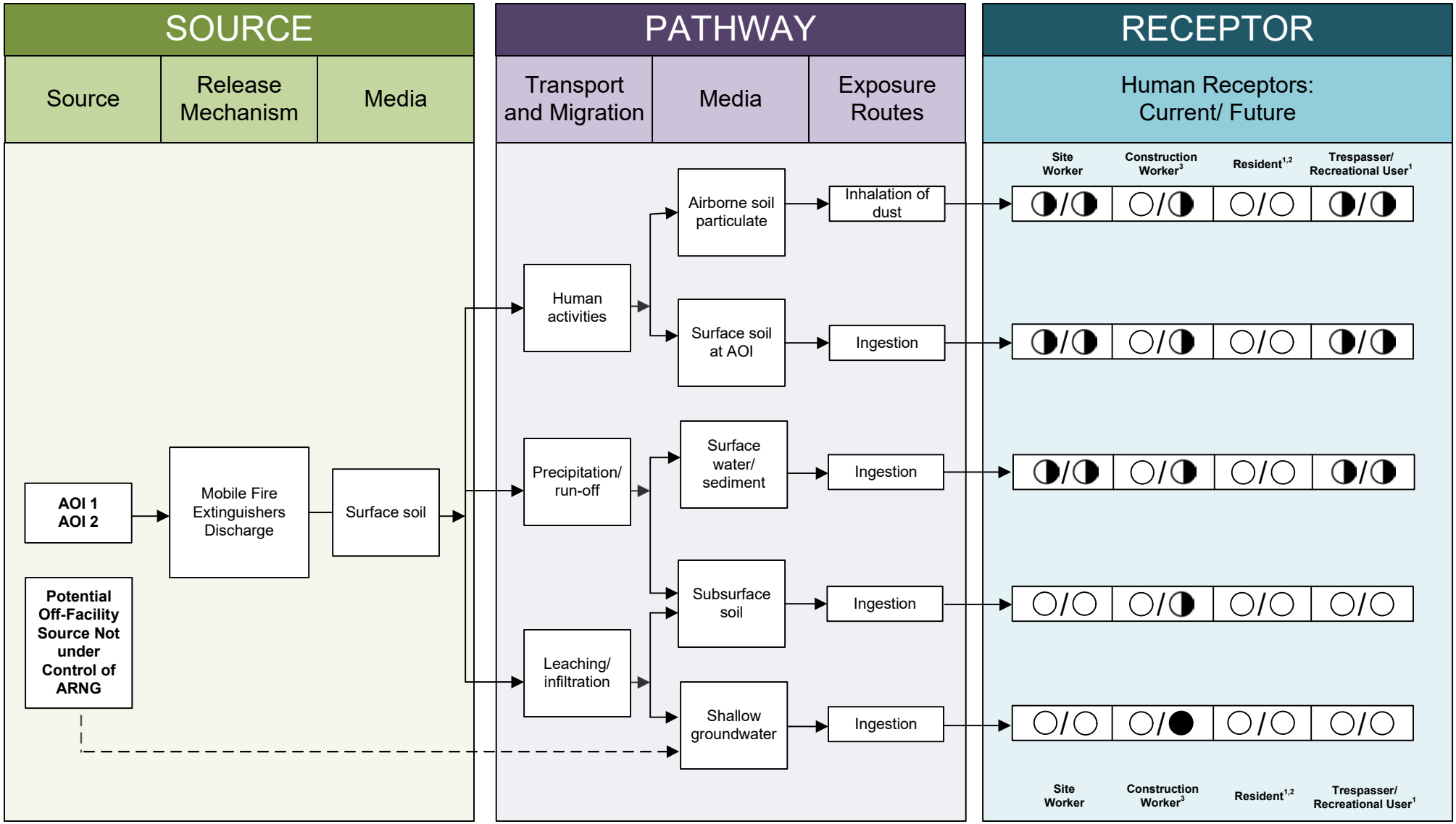

LEGEND

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

Notes:

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

Figure 7-1
Conceptual Site Model, AOI 1 and AOI 2
Ellington Field AASF

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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 SI Activities

The SI field activities were conducted from 1 to 9 June 2022 and consisted of utility clearance, direct push boring, soil sample collection, temporary monitoring well installation, grab groundwater sample collection, and land surveying. Field activities were conducted in accordance with the SI QAPP Addendum (AECOM, 2022b), except as previously noted in **Section 5.8**.

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2022b), samples were collected and analyzed for a subset of 18 compounds by LC/MS/MS compliant with QSM 5.3 Table B-15 as follows.

- Sixteen (16) soil samples from four boring locations and four hand auger locations;
- Four grab groundwater samples from four temporary wells and two groundwater samples from two existing permanent wells;
- Twelve (12) quality assurance QA/QC 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 AOIs 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 CSMs were refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure at the AOIs, which are described in **Section 7**.

8.2 Outcome

Based on the results of this SI, further evaluation under CERCLA is warranted in an RI for AOI 1 and AOI 2 (see **Table 8-1**). Based on the CSMs developed and revised in light of the SI findings, there is no potential for exposure to drinking water receptors from AOI 1 and AOI 2 from sources on the facility resulting from historical DoD activities. Sample analytical concentrations collected during the SI were compared to the project SLs in soil and groundwater, as described in **Table 6-1**. A summary of the results of the SI data relative to the SLs is as follows:

- At AOI 1:
    - The detected concentrations of PFOA, PFOS, PFHxS, PFNA and PFBS in soil at AOI 1 were below their SLs.
    - PFOA, PFOS, PFHxS, and PFBS exceeded their SLs in groundwater with the following maximum concentrations: PFOA at 151 J ng/L, PFOS at 2,150 J ng/L, PFHxS at 17,700 J ng/L, and PFBS at 2,750 J ng/L. PFNA was detected below the SL in groundwater. The PFOS exceedance detected in the sample collected from upgradient well EF-02 may indicate a potential unknown off-facility source.
    - Based on the exceedances of the SLs in groundwater, further evaluation of AOI 1 is warranted in an RI.

- At AOI 2:
    - The detected concentrations of PFOA, PFOS, PFHxS, PFNA and PFBS in soil at AOI 2 were below their SLs.
    - PFOA, PFOS, PFHxS, and PFNA exceeded their SLs in groundwater with the following maximum concentrations: PFOA at 206 J ng/L, PFOS at 4,010 J ng/L, PFHxS at 3,260 J ng/L, and PFNA at 30.3 J ng/L. PFBS was detected below the SL in groundwater. These exceedances were detected in samples collected upgradient of AOI 2 and may indicate a potential unknown off-facility source.
    - Based on the exceedances of the SLs in groundwater surrounding AOI 2 in combination with the detections in soil at AOI 2, further evaluation at AOI 2 is warranted.

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 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 MIL-SPEC 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 Release Area	Soil – Source Area	Groundwater – Source Area	Groundwater – Facility Boundary	Future Action
1	Wash Rack	◐	●	●	Proceed to RI
2	Flight Line	◐	N/A	●	Proceed to RI

Legend:
N/A = not applicable
● = detected; exceedance of the screening levels
◐ = detected; no exceedance of the screening levels
○ = not detected

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