FINAL
Site Inspection Report
Rio Rancho Training Site
Rio Rancho, New Mexico

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

February 2023

Prepared for:

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

Contract No. W912DR-19-D-0005

UNCLASSIFIED

This page intentionally left blank

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/kg	Microgram(s) per kilogram
%	Percent
AECOM	AECOM Technical Services, Inc.
AFFF	Aqueous film-forming foam
AOI	Area of Interest
ARNG	Army National Guard
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of Rio Rancho
CSM	Conceptual site model
CST	Civil Support Team
DoD	Department of Defense
DPT	Direct-push technology
DQO	Data Quality Objectives
DUA	Data Usability Assessment
EA	EA Engineering, Science, and Technology, Inc., PBC
EDR	Environmental Data Report™
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EB	Equipment blank
FB	Field blank
FD	Field duplicate
FedEx	Federal Express
FMS	Facility Maintenance Shop
ft	Foot (feet)
gal	Gallon(s)
GPS	Global positioning system
HDPE	High-density polyethylene
HFPO-DA	Hexafluoropropylene oxide dimer acid
IDW	Investigation-derived waste
in.	Inch(es)
ITRC	Interstate Technology Regulatory Council

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

LC/MS/MS	Liquid chromatography with tandem mass spectrometry
MS	Matrix spike
MSD	Matrix spike duplicate
NEtFOSAA	N-ethyl perfluorooctane sulfonamidoacetic acid
ng/L	Nanogram(s) per liter
NMARNG	New Mexico Army National Guard
NMeFOSAA	N-methyl perfluorooctane sulfonamidoacetic acid
No.	Number
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutanesulfonic acid
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PID	Photoionization detector
POD	Point of diversion
QAPP	Quality Assurance Project Plan
QSM	Quality Systems Manual
RI	Remedial investigation
SI	Site Inspection
SL	Screening level
TOC	Total organic carbon
TPP	Technical Project Planning
TS	Training Site
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

This page intentionally left blank

EXECUTIVE SUMMARY

The Army National Guard (ARNG) G9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at ARNG facilities nationwide based on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on the six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) (Assistant Secretary of Defense) dated 6 July 2022. The six compounds listed in the OSD memorandum include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and hexafluoropropylene oxide dimer acid (HFPO-DA). These compounds are collectively referred to as "relevant compounds" throughout the document and the applicable screening levels (SL) are provided below in **Table ES-1**.

The PA identified one Area of Interest (AOI) where PFAS-containing materials may have been used, stored, disposed, or released historically (see **Table ES-2**). The objective of the SI is to identify whether there has been a release to the environment from the 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 a comparison of SI results to SLs for the relevant compounds. This SI was completed at the Rio Rancho Training Site (TS) in Rio Rancho, New Mexico, and determined further investigation is not warranted for Rio Ranch TS. Rio Rancho TS will be referred to as the "Facility" throughout this document.

The Facility, operated by the New Mexico ARNG (NMARNG), encompasses approximately 120 acres in the north-central portion of the Albuquerque Metropolitan Statistical Area of New Mexico in Sandoval County. The land was acquired by the State Armory Board in 1987 through a special warranty deed with the NMARNG. The Readiness Center and FMS-3 buildings were constructed and opened in 1994. Rio Rancho TS is located in the Albuquerque Basin, within the Santa Fe Group aquifer system.

The PA identified one AOI for investigation during the SI phase. SI sampling results from the AOI were compared to OSD SLs. **Table ES-2** summarizes the SI results for the AOI. Based on the results of this SI, no further evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is warranted for the identified AOI.

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

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

Notes:
1. Office of the Assistant Secretary of Defense. July 2022. Risk Based Screening Levels Calculated for Groundwater and Soil using U.S. Environmental Protection Agency's Regional Screening Level Calculator. Hazard Quotient =0.1. May 2022.
2. Screening values for HFPO-DA were established after SI planning and execution and thus not included as an analyte. Future CERCLA phases will include HFPO-DA if warranted.

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

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	Hazardous Materials Storage Lockers/Wash Racks/Evaporation Lagoon	◑	Not Applicable	Not Applicable	No Further Action

Legend:
● = Detected; exceedance of SLs
◑ = Detected; no exceedance of SLs
○ = Not detected

1. INTRODUCTION

1.1 PROJECT AUTHORIZATION

The Army National Guard (ARNG) G9 is the lead agency in performing Preliminary Assessments (PAs) and Site Inspections (SIs) at ARNG facilities nationwide based on the current or potential historical use of per- and polyfluoroalkyl substances (PFAS) with a focus on six compounds presented in the memorandum from the Office of the Secretary of Defense (OSD) dated 6 July 2022 (Assistant Secretary of Defense 2022). The six compounds listed in the OSD memorandum will be referred to as "relevant compounds" throughout this document and include perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), and hexafluoropropylene oxide-dimer acid (HFPO-DA)[1] at ARNG facilities nationwide. The ARNG performed this SI at the Rio Rancho Training Site (TS) in Rio Rancho, New Mexico. The Rio Rancho TS will be referred to as the "Facility" throughout this report.

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

1.2 SITE INSPECTION PURPOSE

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

[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, as screening values were established after SI planning and execution. However, ARNG will add HFPO-DA to the list of constituents sampled during the next phase of CERCLA if warranted.

This page intentionally left blank

2. FACILITY BACKGROUND

2.1 FACILITY LOCATION AND DESCRIPTION

The New Mexico Army National Guard NMARNG) Rio Rancho TS facility encompasses approximately 120 acres of land located in the north-central portion of Albuquerque, approximately 25 miles north of downtown Albuquerque, in Sandoval County, which is near the center of New Mexico. The land was acquired in 1987 by the State Armory Board through a special warranty deed with the NMARNG and was used as a training site and Hawk Battalion between 1987 and 1995. Additional structures (the Readiness Center and FMS-3 buildings) were constructed and opened in 1994, as the HAWK Missile System was phased out (**Figure 2-1**). The facility contains the Facility Maintenance Shop (FMS)-3, a readiness center, the 64th Civil Support Team (CST), and areas used for tactical training (AECOM 2020).

2.2 FACILITY ENVIRONMENTAL SETTING

The Rio Rancho TS is approximately 5,300 feet (ft) above mean sea level (amsl) (**Figure 2-2**). The Facility consists of three buildings, a readiness center, the FMS-3 building, the CST, a training area, and a ROPES obstacle course (AECOM 2020). The ground surface within the facility is covered by buildings, asphalt, or concrete in some areas, while other areas are gravel-covered dirt lots or unpaved desert.

2.2.1 Geology

The facility lies in the Albuquerque Basin, one of the largest and deepest basins in the Rio Grande rift. The fill material in the Albuquerque Basin is mostly Cenozoic fill deposits of the Santa Fe Group. The Santa Fe Group was deposited during the middle Miocene to early Pleistocene epochs. During that time, the Albuquerque Basin received alluvial sediment from the adjacent highlands and fluvial sediments from Northern New Mexico and southern Colorado. For the Albuquerque area, alluvial deposits came from the Sandia Mountains providing weathered granitic and limestone material. The fluvial deposits from the north consisted of volcanic rock fragments. Volcanic material was also deposited by wind and basalt flows from nearby volcanoes, just to the west of Albuquerque, in late the Pleistocene and Holocene epochs. These processes resulted in thousands of feet of sediment that lay under Albuquerque, providing a porous space for water to accumulate (AECOM 2020).

Observations from drilling at the Facility are consistent with regional geology. Soils were observed to be dominated by poorly graded sand and silty sand. Samples for grain size analyses were collected at two locations, AOI101-01 and AOI01-02, and analyzed via American Society for Testing and Materials (ASTM) Method D-422. The results indicate that the soil samples are comprised primarily of sand (30.5% to 50.3%) and silt (57.3% to 41.3%). These results and facility observations are consistent with the reported depositional environment of the region. Soil pH was analyzed at one location, AOI01-02, and had a pH of 9.2.

2.2.2 Hydrogeology

The Rio Rancho TS resides within the Santa Fe Group aquifer system of the Albuquerque Basin. The groundwater has been deposited in three main phases. The lower Santa Fe group was created by dune fields and small streams draining into playa lakes and mud flats. The sediments in this group yield low volumes of poor-quality water. Deposits in the upper Santa Fe group come from drainage of the ancestral Rio Grande and its tributaries. Most of the potable water in the region comes from these later deposits, which lie within 1.2 miles of the eastern boundary of the basin. Finally, the modern Rio Grande cuts down into the Santa Fe group sediments to create the present river valley. Groundwater depth in the area is approximately 1,000 ft below ground surface (bgs). Groundwater flow direction is generally to the southeast (AECOM 2020). An Environmental Data Resources (EDR)™ report, along with other resources, was used to conduct a well search for a 1-mile radius surrounding the facility. Using additional online resources, such as state and local geographic information system databases, wells were researched to a 4-mile radius of the facility. Wells are displayed on **Figure 2-3**. No groundwater wells have been installed at the Rio Rancho TS.

The City of Rio Rancho (City) water supply consists entirely of groundwater withdrawn from the Santa Fe Group aquifer and has 17 wells currently in operation and diverts about 13,000 acre-ft per year. Three of these municipal wells are located within 1-mile west and upgradient of the facility. The city wells are considered points of diversion (PODs) by the New Mexico Office of the State Engineer (NMOSE), and have been designated as POD 38, POD 39, and POD 40. They are drilled into the Rio Grande POD Basin, and Middle Rio Grande POD Subbasin; no information about their total depths was available in the EDR™ report or the online well database maintained by the NMOSE (NMOSE 2021). The remaining city wells used for municipal water are located several miles south of the facility. Because the City pulls the water from deep wells, the supply is not as susceptible to climate change, drought, or human-caused degradation as a surface water supply. The City of Rio Rancho has been working to expand its water resources since 2001. The Aquifer Injection Project, the first of its kind in New Mexico, allows the city to inject purified water back into the aquifer and store it for future use. This water recharges the aquifer to maintain it as a drinking water source now and for future generations. The City has an emergency water shortage ordinance for times of drought or limited supply and can presently store up to 41 million gallons of water. The City has a 26,039 acre-ft per year water rights diversion permit. As part of the pumping permit, the City is required to purchase 728 acre-ft of water per 5-year period. To date, the City has purchased more water rights than required for the current timeframe (AECOM 2020).

2.2.3 Hydrology

The Rio Grande is the largest water body in the region and is approximately 8 miles east of the Facility. The inner valley of the Rio Grande contains a complex network of irrigation canals, ditches, and drains. In general, the Rio Grande flows from north to south through Sandoval County. The cities of Bernalillo, Rio Rancho, Albuquerque, Los Lunas, and Belen discharge treated effluent directly into the river. Surface water features at and near the Facility are shown in **Figure 2-4** (AECOM 2020).

At Rio Rancho TS, a drainage channels runoff from nearby paved surfaces to a stormwater retention pond. Additionally, there is an evaporation lagoon which receives discharge from the facility wash racks.

2.2.4 Climate

The climate in north-central New Mexico is categorized as semi-arid, receiving about 12 inches (in.) of precipitation per year. The highest rainfall (about 2 in. per month) usually occurs in August. Most of the moisture that Rio Rancho receives comes from the Gulf of Mexico during the North American Monsoon season. July is the hottest month averaging 78.1 degrees Fahrenheit (°F), while January is the coldest month, averaging 34.3°F. There is a diurnal temperature difference greater than 25°F for every month of the year. The immediate Albuquerque metro area receives an average of 9.6 in. of snowfall per winter, which can increase considerably in surrounding higher elevations (AECOM 2020).

2.2.5 Current and Future Land Use

Presently, the Rio Rancho TS is a NMARNG facility consisting of three buildings: a readiness center, the FMS-3 building, and CST, as well as a training area and a ROPES obstacle course. A fence surrounds the facility. The area is zoned as rural residential/agricultural (Sandoval County 2021). Future land use is not anticipated to change (AECOM 2020). Additionally, there are not any proposed significant changes to the mission of the Rio Rancho TS in the foreseeable future (EA Engineering, Science, and Technology, Inc., PBC [EA] 2021a).

2.2.6 Sensitive Habitat and Threatened/Endangered Species

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

The following species are listed as federally endangered, threatened, proposed, and/or candidate species in Sandoval County, New Mexico (U.S. Fish and Wildlife Service 2022):

- Birds: Mexican Spotted Owl (*Strix occidentalis lucida*) – Federally Threatened; Southwestern Willow Flycatcher (*Empidonax traillii extimus*) – Federally Endangered; Yellow-billed Cuckoo (*Coccyzus Americanus*) – Federally Threatened

- Amphibians: Jemez Mountains Salamander (*Plethodon neomexicanus*) – Federally Endangered

- Fishes: Rio Grande Cutthroat Trout (*Oncorhynchus clarkia virginalis*) – Federal Candidate; Rio Grande Silvery Minnow (*Hybognathus amarus*) – Federally Endangered

- Insects: Monarch Butterfly (*Danaus plexippus*) – Federal Candidate

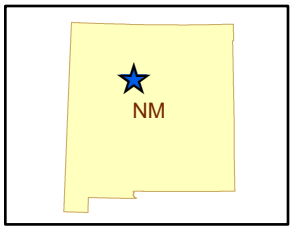
- Mammal: New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*) – Federally Endangered.

2.3 HISTORY OF PFAS USE

Interviews and records obtained during the PA/SI indicate that aqueous film-forming foam (AFFF) has been stored at the Facility within the Hazardous Materials Storage Lockers (AECOM 2020). Additionally, a Tri-Max™ 30 extinguisher was stored at the FMS-3 building in an office (Room 110) that functioned as a storage space, but interviews indicate the extinguisher was never used or serviced and it was taken off-facility for decommissioning and disposal in Summer 2020 (EA 2021a). Prior PFAS sampling results indicate there has been a release of PFAS at the Rio Rancho TS. A description of the AOI and its potential release areas are presented in **Section 3**.

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 2-1
Facility Location



Path: G:\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\RioRancho\RioRanchoSIReport.aprx

Facility Data

Facility Boundary

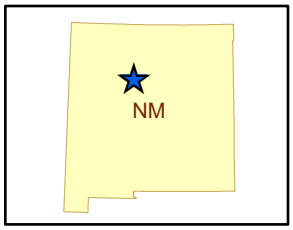
Data Sources:
ESRI 2020
AECOM 2020

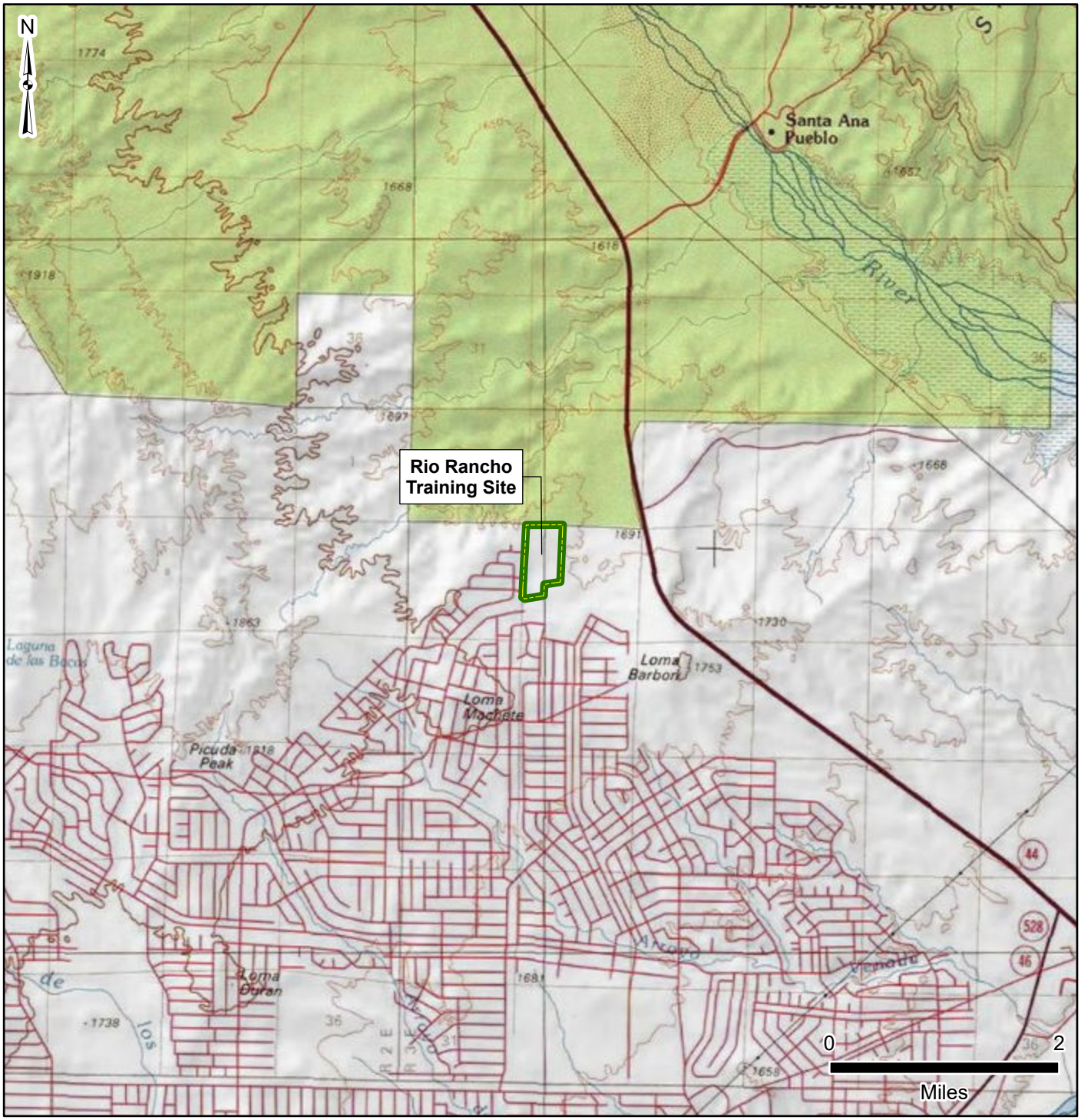
Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 2-2
Topography





Path: G:\Federal\Nationwide\PFAS\MAES_6342503831\PROJECTS\SI Report\RioRancho\RioRanchoSIReport.aprx

Facility Data

Facility Boundary

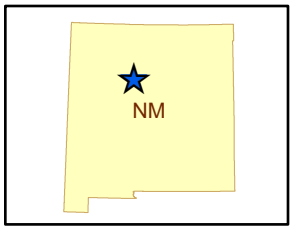
Data Sources:
ESRI 2020
AECOM 2020

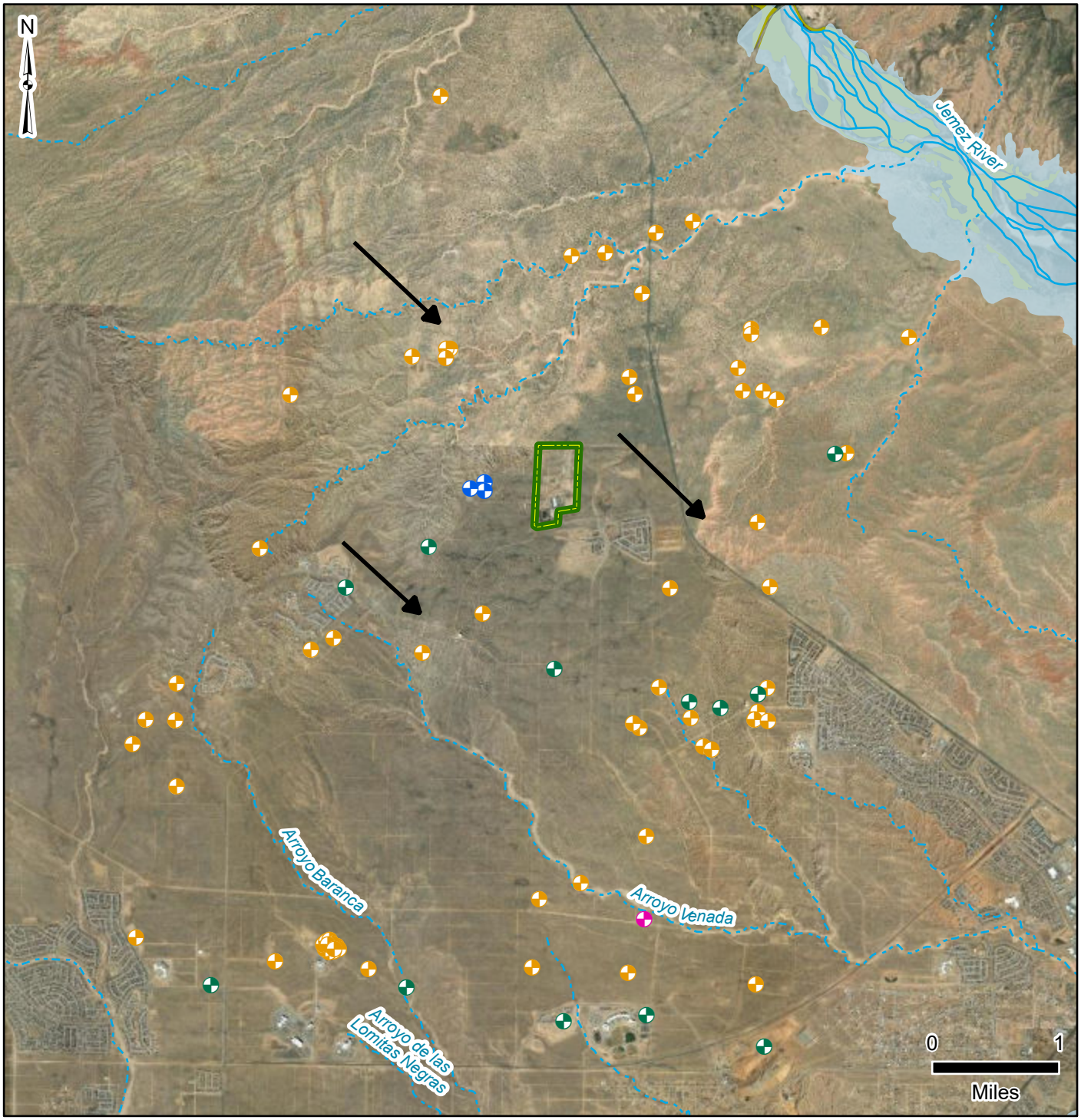
Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 2-3
Groundwater Features





Facility Data
- Facility Boundary

Well Type
- Domestic
- Public Water Supply
- Sanitary
- Unknown/Other

Hydrology/Hydrogeology
- Inferred Groundwater Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody
- Wetlands

Data Sources:
ESRI 2020
AECOM 2020

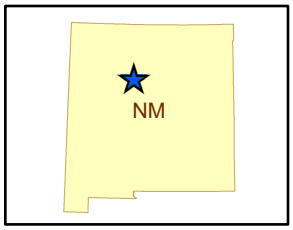
Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

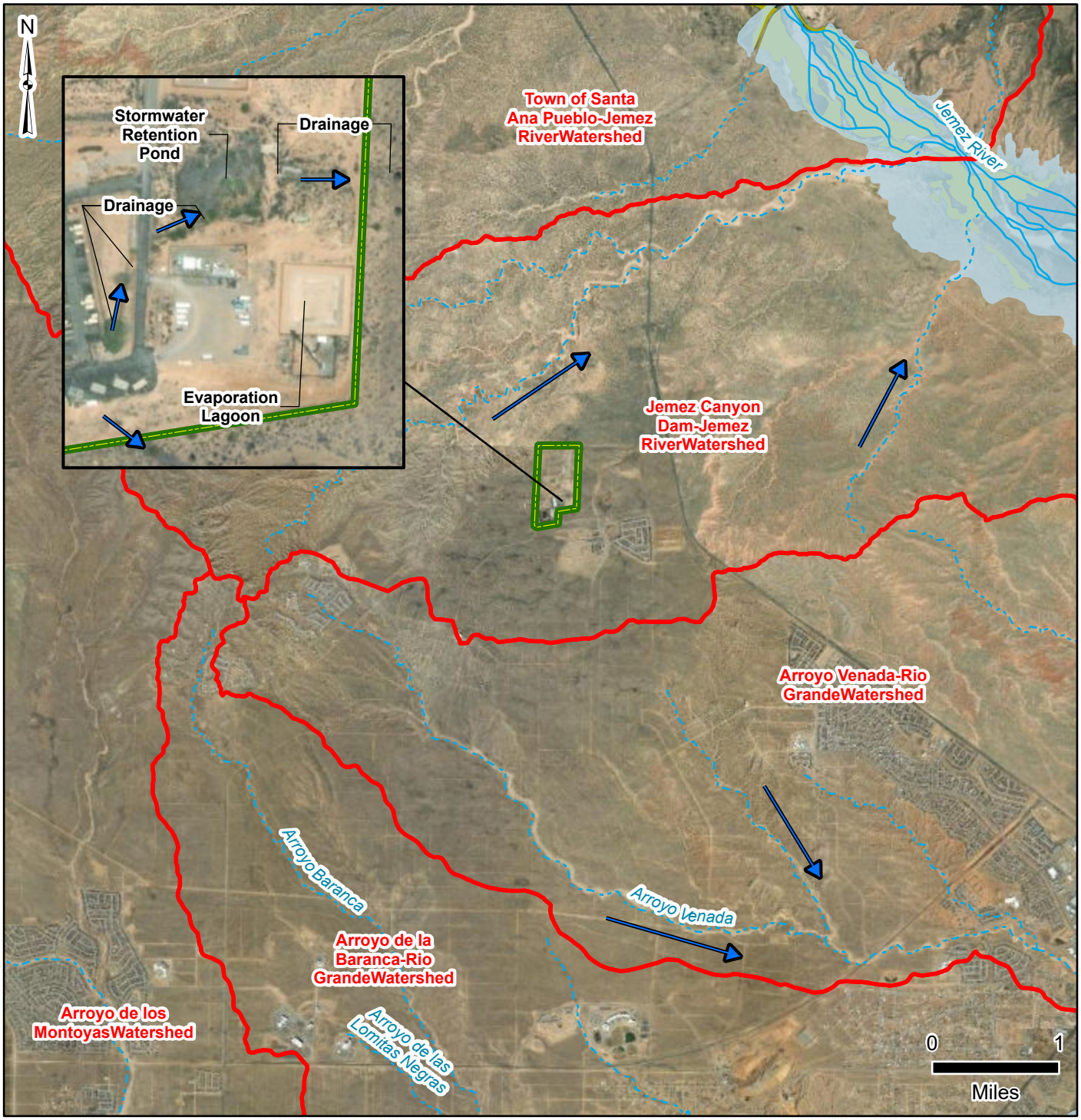
Path: G:\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\RioRancho\RioRanchoSIReport.aprx

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 2-4
Surface Water Features





Path: G:\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\RioRancho\RioRanchoSIReport.aprx

Facility Data
- Facility Boundary

Hydrology
- Surface Water Flow Direction
- Perennial Creek/Stream
- Intermittent Creek/Stream
- Waterbody
- Wetlands
- Watershed Boundary

Data Sources:
ESRI 2020
AECOM 2020

Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

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, three potential release areas were identified at the Rio Rancho TS and grouped into one AOI identified as AOI 1 Hazardous Materials Storage Lockers 2 and 3/Wash Racks/Evaporation Lagoon. The potential AOIs are shown on **Figure 3-1**.

3.1 AOI 1 – HAZARDOUS MATERIALS STORAGE LOCKERS 2 AND 3/WASH RACKS/EVAPORATION LAGOON

The AOI encompasses the hazardous materials lockers, adjacent wash racks, and evaporation lagoon (**Figure 3-1**). These features are located in the southern portion of the Facility and are described below.

3.1.1 Hazardous Materials Storage Lockers 2 and 3

The hazardous materials storage lockers, located in the southern portion of the facility, housed two 10-gallon (gal) containers of an unknown type of AFFF for an unknown period of time. The lockers are located in the segment of the facility designated as FMS-3. According to personnel interviews, two 10-gal containers of AFFF were found in Hazardous Waste Storage Locker 2 sometime in early 2019. The containers were found half-empty with evidence of a small amount of product around the cap. No leaks or spills of AFFF have been reported. The containers were described as small high-density polyethylene (HDPE) "poly" 10-gal closed head drums by interviewed personnel and were noted to be stored in a hazardous materials storage locker that was in good condition, with no evidence of corrosion or damage that would compromise the integrity of the locker. After these containers were discovered, they were moved to an adjacent hazardous materials storage locker (Hazardous Waste Storage Locker 3) designated for transport through the Defense Logistics Agency as non- Resource Conservation and Recovery Act non-hazardous waste. This secondary storage locker was also in good condition, with no evidence of corrosion or damage that would compromise the integrity of the locker. The containers of AFFF were dispatched via a third-party carrier (Envirokleen – USEPA ID No. TXR000084068), with the waste code N/H Out54091, on 8 April 2019. Both containers were classified as fiberboard or plastic drums, barrels, or kegs in the Uniform Hazardous Waste Manifest. The weight of the product listed on the Uniform Hazardous Waste Manifest is 60 pounds.

3.1.2 Wash Racks and Evaporation Lagoon

Wash racks are located adjacent to, and to the north of, the hazardous waste storage sheds. The wash racks discharge to an oil/water separator and eventually to a concrete evaporation lagoon. As noted in **Section 2.4**, a water sample was collected from the lagoon in March 2021 and was analyzed for PFAS in accordance with the discharge permit issued by the State of New Mexico. Several PFAS chemicals were detected and PFOA was detected at a concentration of 41.2 ng/L. As a result, the wash racks and lagoon were added as potential PFAS release areas during the SI scoping process and are considered potential PFAS release areas (EA 2021a).

3.1.3 Tri-MaxTM 30

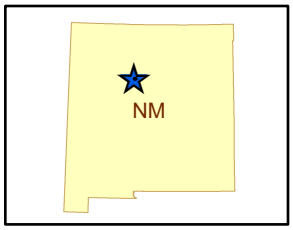
A Tri-Max™ 30 extinguisher was stored at the FMS-3 building in an office (Room 110) that functioned as storage space. There was no evidence of PFAS-containing substances ever having been used within the building. The FMS-3 building is not included as an AOI due to a lack of a complete exposure pathway. According to staff interviews, the Tri-Max™ was not used or serviced, and evidence of a leak was not observed. The unit was found with a full tank. As determined during reconnaissance, the storage location does not have floor drains, eliminating the potential transport of AFFF from the storage area to the environment. In Summer 2020, the Tri-Max™ unit was taken off-facility for decommissioning and proper disposal (EA 2021a).

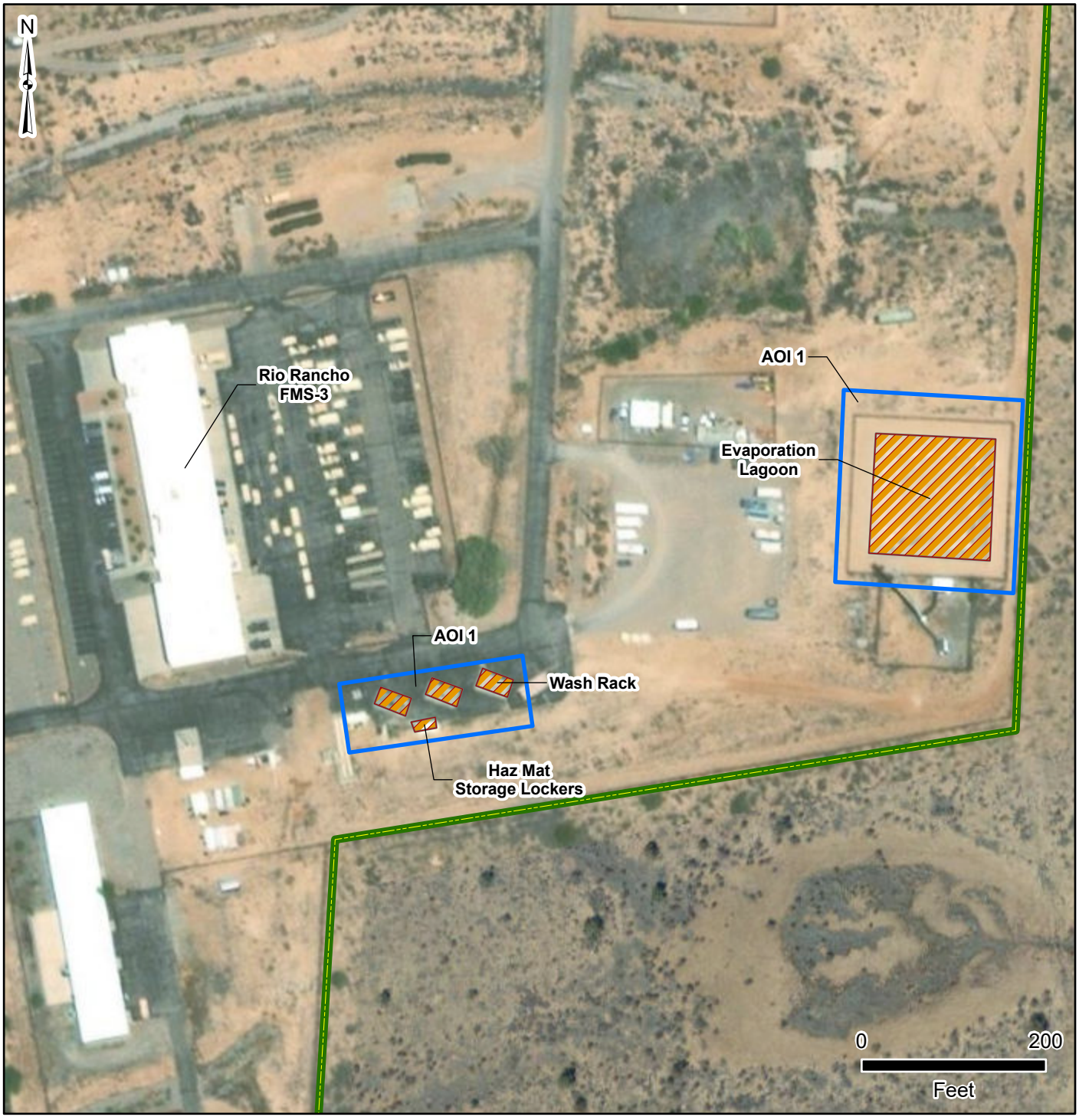
3.2 ADJACENT SOURCES

No potential Facility-adjacent sources were identified.

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 3-1
Area of Interest





Path: G:\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\RioRancho\RioRanchoSIReport.aprx

Facility Data

- Facility Boundary
- Area of Interest
- Potential PFAS Release Area

Data Sources:
ESRI 2020
AECOM 2020

Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

4. PROJECT DATA QUALITY OBJECTIVES

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

4.1 PROBLEM STATEMENT

ARNG will recommend AOIs for remedial investigation (RI) if Facility-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 for the SI include the following:

- The PA Report for the Rio Rancho TS
- Analytical data collected during other environmental sampling efforts at each ARNG installation
- Analytical data from soil samples collected as part of this SI in accordance with the Facility specific UFP-QAPP Addendum (EA 2021a).

4.3 STUDY BOUNDARIES

The scope of the SI was bounded horizontally by the property limits of the Facility (**Figure 2-2**). Off-facility sampling was not included in the scope of this SI. The scope of the SI was vertically bounded as follows: soil from direct-push technology (DPT) borings installed to 15 ft bgs. Temporal boundaries were limited to the earliest available time field resources were available to complete the study.

4.4 ANALYTICAL APPROACH

Samples were analyzed in accordance with the Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.3 by Eurofins Lancaster Laboratories Env, LLC, accredited under the DoD Environmental Laboratory Accreditation Program (DoD Environmental Laboratory Accreditation Program (ELAP), Accreditation No. 1.01. PFAS data underwent 100 percent (%) Stage 2B validation in accordance with the DoD General Data Validation Guidelines (2019) and DoD Data Validation Guidelines Module 3: Data Validation Procedure of Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (2020).

Data were compared to applicable SLs and decision rules as defined in the UFP-QAPP Addendum (EA 2021a).

4.5 DATA USABILITY ASSESSMENT

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

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

5. SITE INSPECTION ACTIVITIES

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

- *Final Preliminary Assessment Report, Rio Rancho, Rio Rancho, New Mexico*, dated August 2020 (AECOM 2020)

- *Final Programmatic Uniform Federal Policy-Quality Assurance Project Plan, Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide*, dated December 2020 (EA 2020a)

- *Final Site Inspection Uniform Federal Policy-Quality Assurance Project Plan Addendum, Rio Rancho Training Site, Rio Rancho, New Mexico,* dated November 2021 (EA 2021a)

- *Final Programmatic Accident Prevention Plan, Revision 1*, dated November 2020 (EA 2020b)

- *Accident Prevention Plan / Site Safety and Health Plan Addendum, Revision 0, Rio Rancho Training Site, New Mexico*, dated August 2021 (EA 2021b).

The SI field activities were conducted from 20 to 21 December 2021 and consisted of hand auger surface soil sample collection and DPT boring and subsurface soil sample collection. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021a), except as noted in **Section 5.9**.

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

- Six (6) surface soil samples from five locations including a duplicate sample (hand auger boring locations)

- Twenty-one (21) soil samples from six locations including three duplicate samples (DPT boring locations).

- One (1) field blank sample (FB).

- Two (2) equipment rinsate samples.

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

B3. Field change request forms are 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 of these activities are presented below.

5.1.1 Technical Project Planning

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

A combined TPP Meeting 1 and 2 was held on 10 August 2021, prior to SI field activities. Meeting minutes are provided in **Appendix D**. The combined TPP Meeting 1 and 2 was conducted in general accordance with EM 200-1-2.

The stakeholders for this SI include ARNG, USACE, and the New Mexico Environment Department, representatives familiar with the facility, the regulations, and the community. 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 UFP-QAPP Addendum (EA 2021a). Future TPP meetings will provide an opportunity to discuss results and findings, and future actions, where warranted.

5.1.2 Utility Clearance

EA contracted MT Private Utility Locating Services, LLC, a private utility location service, to perform utility clearance at the facility. Utility clearance was performed at each of the proposed boring locations on 13 December 2021 with input from the EA field team, New Mexico Environment Department, and ARNG. General locating services and ground-penetrating radar were used to complete the clearance. Additionally, the first 5 ft of each boring were pre-cleared by EA's drilling subcontractor, JR Drilling, using a hand auger to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.3 Source Water and PFAS Sampling Equipment Acceptability

The potable water source used for decontamination of drilling equipment was confirmed to be PFAS-free prior to the start of field activities. A sample from the yard hydrant located adjacent to the middle wash rack at the Rio Rancho TS was collected on 22 October 2021, prior to mobilization, and analyzed for PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15. The yard hydrant is connected to the City of Rio Rancho public water supply.

Materials that were used within the sampling zone were confirmed as acceptable for use in the PFAS sampling environment. The checklist of acceptable materials for use in the PFAS sampling environment was provided in the Standard Operating Procedures provided as Appendix B to the Programmatic UFP-QAPP (EA 2020a).

5.2 HAND AUGER SOIL SAMPLING

Six soil samples were collected from five locations near the wash racks for chemical analysis from 0 to 2 ft bgs using a hand auger. Asphalt and/or concrete were cut to allow hand auger access. All soil sample locations are shown on **Figure 5-1**. The hand auger location was selected based on the AOI information provided in the PA (AECOM 2020) and as agreed upon by stakeholders during the TPP and review of the UFP-QAPP Addendum (EA 2021a). Non-dedicated sampling equipment (i.e., hand auger) was decontaminated between sampling locations.

Each sample was collected into a laboratory-supplied PFAS-free HDPE bottle and labeled using a PFAS-free marker or pen. Samples were packaged on ice and transported via Federal Express (FedEx) under standard chain-of-custody procedures to the laboratory and analyzed for PFAS (LC/MS/MS compliant with QSM Version 5.3 Table B-15) in accordance with the UFP-QAPP Addendum. Quality control samples and analysis were performed as described in the UFP-QAPP Addendum (EA 2021a).

5.3 SOIL BORINGS AND SOIL SAMPLING

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

Three discrete soil samples were collected for chemical analysis from six soil borings: one sample at the surface (0 to 2 ft bgs) and two subsurface soil samples. One shallow subsurface soil sample was collected at 6–8 ft bgs, and one deep subsurface sample was collected at 13–15 ft. Additionally, three field duplicates were collected. Borings were drilled to a total depth of 15 ft bgs. Groundwater is present at an estimated depth of 1,000 ft bgs, and as a result was not encountered during drilling.

All soil sample locations are shown on **Figure 5-1**, and boring sample depths are provided in **Table 5-2**. The soil boring locations were selected based on the AOI information provided in the PA (AECOM 2020) and as agreed upon by stakeholders during the TPP and review of the UFP-QAPP Addendum (EA 2021a).

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

relative density, Munsell color, and Unified Soil Classification System texture were recorded. Boring logs are provided in **Appendix E**.

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

Field duplicate (FD) samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. Matrix spike (MS)/matrix spike duplicates (MSDs) were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. In instances when non-dedicated sampling equipment was used, such as a hand auger for the shallow soil samples, one equipment blank (EB) was collected per day and analyzed for the same parameters as the soil samples. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 6 degrees Celsius (°C) during shipment. After removal of the drilling equipment, boreholes were abandoned using bentonite chips. In borings installed on paved surfaces, the borings were abandoned by backfilling with bentonite chips to approximately 6 in. bgs and by filling the remainder of the borehole with concrete or asphalt to match the surrounding area.

5.4 MONITORING WELL INSTALLATION AND GROUNDWATER GRAB SAMPLING

Existing wells were not present at Rio Rancho TS. Given the depth to groundwater (greater than 1,000 ft bgs) wells were not installed at the Rio Rancho TS in accordance with the UFP-QAPP (EA 2021a). No groundwater grab samples were collected.

5.5 SYNOPTIC WATER LEVEL MEASUREMENTS

Temporary wells were not installed, and no existing wells were present at the Facility. As a result, water level measurements were not taken.

5.6 SURVEYING

Soil boring locations were recorded with a Trimble Geo 7x global positioning system (GPS) unit. Positions were collected in the applicable Universal Transverse Mercator zone projection with World Geodetic System 1984 datum (horizontal) and North American Vertical Datum 1988 (vertical). Surveying data were collected on 25 March 2022 and are provided in **Appendix B3**.

5.7 INVESTIGATION-DERIVED WASTE

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

Soil IDW (i.e., soil cuttings) generated during the SI activities were contained in labeled, 55-gallon Department of Transportation (DOT)-approved steel drums and left at the Facility in the designated hazardous waste storage lockers. The soil IDW was not sampled and assumes the characteristics of the associated soil samples collected from that source location.

Liquid IDW generated during SI activities (i.e., decontamination fluids) were contained in labeled, 55-gallon DOT-approved steel drums, and left at the Facility in the designated hazardous waste storage lockers. The liquid IDW was not sampled.

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.

5.8 LABORATORY ANALYTICAL METHODS

Soil samples were also analyzed for TOC using USEPA Method 9060A and pH by USEPA Method 9045D.

5.9 DEVIATIONS FROM UFP-QAPP ADDENDUM

The following deviations from the UFP-QAPP Addendum occurred based on conditions encountered during the field investigation activities. These deviations were discussed between EA, ARNG, USACE, and the New Mexico Environment Department and are documented in a Field Change Request Form (**Appendix B4)**. Deviations from the UFP-QAPP Addendum (EA 2021a) are noted below:

- Soil boring AOI1-06 was moved approximately 70 ft to the northeast so that it would be in closer proximity to the evaporation lagoon and the drain line discharge for the wash racks/oil water separator.

- Soil boring AOI1-02 was moved approximately 30 ft to the southeast so that it would be in closer proximity to the evaporation lagoon.

Additional deviations from the UFP-QAPP not included in the Field Change Request Form (**Appendix B.3**) are described below:

- The UFP-QAPP Addendum (EA 2021a) outlined that one pH/TOC sample, and one duplicate would be collected for the SI; however, the laboratory did not analyze the duplicate sample that was submitted. This inconsistency was noted after the sample holding time had passed. Because of likely biodegradation and the availability of data from the parent sample, the duplicate sample was not analyzed. This deviation does not affect the conclusions of the SI.

- The UFP-QAPP Addendum (EA 2021a) contained an inconsistency regarding the collection of field blanks (FBs). Worksheet #17 specifies that one FB will be collected per day, but Worksheet #20 indicates that no FBs will be collected. The discrepancy was discovered during sampling. One FB was collected instead of two due to a shortage of

available sample bottles. An EB can perform the same function as an FB, though with less specificity regarding the source of contamination. Because analytes were not detected in the EB, this deviation does not affect the conclusions of the SI.

- Percent recovery was not recorded for soil borings. PID measurements were not recorded for 0 to 2 ft soil borings. Though the PID was brought to the Facility the area was not a former fire training area and there was no evidence of staining or olfactory indication of a release. This deviation does not affect the conclusions of the SI.

Table 5-1. Samples by Medium
Rio Rancho Training Site, New Mexico
Site Inspection Report

Sample Identification	Sample Collection Date	Sample Depth (ft bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Grain Size (ASTM D422)	Comments
Soil Samples							
AOI01-01-SB-0-2	12/21/2021	0-2	X				
AOI01-01-SB-0-2-Dup	12/21/2021	0-2	X				FD
AOI01-01-SB-6-8	12/21/2021	6-8	X				
AOI01-01-SB-13-15	12/21/2021	13-15	X				
AOI01-02-SB-0-2	12/20/2021	0-2	X				
AOI01-02-SB-6-8	12/20/2021	6-8	X	X	X	X	
AOI01-02-SB-6-8-Dup*	12/20/2021	6-8			X		FD
AOI01-02-SB-13-15	12/20/2021	13-15	X				
AOI01-03-SB-0-2	12/20/2021	0-2	X				
AOI01-03-SB-6-8	12/20/2021	6-8	X				
AOI01-03-SB-13-15	12/20/2021	13-15	X				
AOI01-04-SB-0-2	12/20/2021	0-2	X				
AOI01-04-SB-6-8	12/20/2021	6-8	X				
AOI01-04-SB-13-15	12/20/2021	13-15	X				
AOI01-05-SB-0-2	12/20/2021	0-2	X				
AOI01-05-SB-6-8	12/20/2021	6-8	X				
AOI01-05-SB-6-8-Dup	12/20/2021	6-8	X				FD
AOI01-05-SB-13-15	12/20/2021	13-15	X				
AOI01-06-SB-0-2	12/20/2021	0-2	X				
AOI01-06-SB-6-8	12/20/2021	6-8	X				
AOI01-06-SB-13-15	12/20/2021	13-15	X				
AOI01-07-SB-0-2	12/21/2021	0-2	X				
AOI01-08-SB-0-2	12/21/2021	0-2	X				
AOI01-09-SB-0-2	12/21/2021	0-2	X				
AOI01-09-SB-0-2-Dup	12/21/2021	0-2	X				FD
AOI01-10-SB-0-2	12/21/2021	0-2	X				
AOI01-11-SB-0-2	12/21/2021	0-2	X				
Blank Samples							
RANCHO-EB-01	12/20/2021	-	X				EB
RANCHO-EB-02	12/21/2021	-	X				EB
RANCHO-FB-01	12/20/2021	-	X				FB

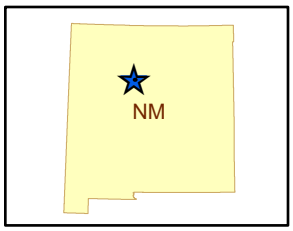
Notes:
* Sample was collected but not analyzed by laboratory. See deviations from UFP-QAPP addendum listed in **Section 5.9.**

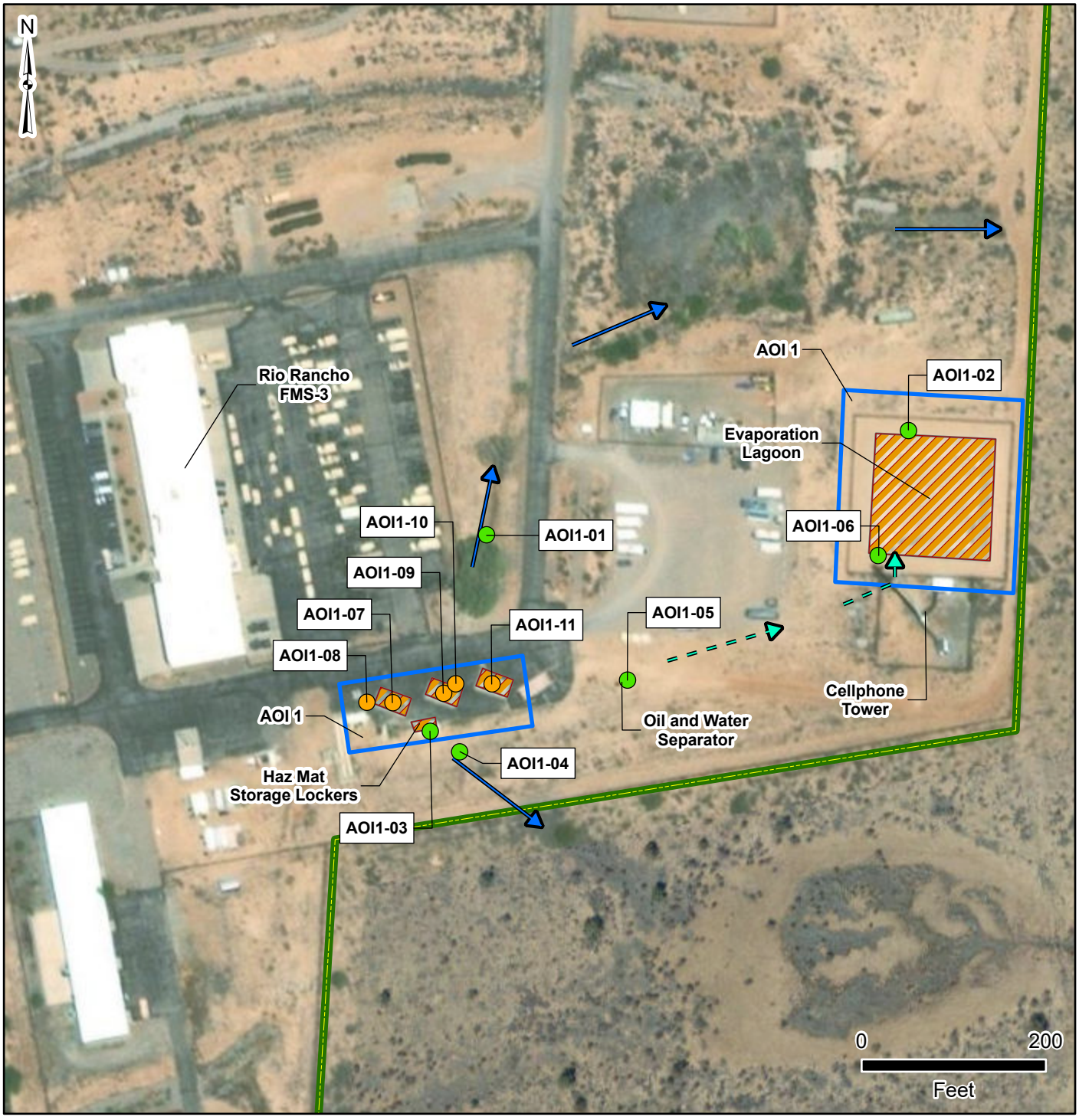
Table 5-2. Soil Boring Depths and Temporary Well Screen Intervals
Rio Rancho Training Site, New Mexico
Site Inspection Report

Area of Interest	Boring ID	Soil Boring Depth (ft bgs)	Temporary Well Screen Interval (ft bgs)
1	AOI01-01	15.0	-
	AOI01-02	15.0	-
	AOI01-03	15.0	-
	AOI01-04	15.0	-
	AOI01-05	15.0	-
	AOI01-06	15.0	-
	AOI01-07	2.0	-
	AOI01-08	2.0	-
	AOI01-09	2.0	-
	AOI01-10	2.0	-
	AOI01-11	2.0	-

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 5-1
Site Inspection Sample Locations





Path: G:\Federal\Nationwide\PFAS\MAES_634250383\PROJECTS\SIReport\RioRancho\RioRanchoSIReport.aprx

Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release Area

Sample Locations
- Soil Boring 0 to 15 Feet
- Soil Boring 0 to 2 Feet

Hydrology
- Surface Water Flow Direction
- OWS Drainage Flow Direction

Data Sources:
ESRI 2020
AECOM 2020

Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

6. SITE INSPECTION RESULTS

This section presents the analytical results of the SI for each AOI. The analytical results are reported and evaluated in the subsequent sections. The SLs used in this evaluation are presented in **Section 6.1**. A discussion of the results for the AOI is provided in **Section 6.3**. **Table 6-1** provides applicable SLs. **Tables 6-2 through 6-5** present relevant compound results for samples with detections in soil; only constituents detected in one or more samples are included. Tables that contain all results are provided in **Appendix F.** Laboratory reports for source water and SI samples 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 concentration for sampled media exceed the SLs established in the OSD memorandum, the AOI will proceed to the next phase under CERCLA. The SLs established in the OSD memorandum apply to the five compounds presented on **Table 6-1**.

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

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

Notes:
1. Assistant Secretary of Defense. July 2022. Risk-Based Screening Levels in Groundwater and Soil using USEPA's Regional Screening Level Calculator. Hazard Quotient=0.1. May 2022.
2. The Assistant Secretary of Defense established screening criteria for HFPO-DA also known as GenX. However, HFPO-DA was not included in the analysis as it was not used or stored at the Facility (AECOM 2020).

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

The data in the subsequent sections are compared against the SLs presented in **Table 6-1**. The SLs for groundwater are based on direct ingestion. The SLs for soil are based on incidental ingestion and are applied to the depth intervals reasonably anticipated to be encountered by the receptors identified at the facility: the residential scenario is applied to surface soil results (0 to 2 ft bgs). The industrial/commercial worker scenario is applied to shallow and deep subsurface soil results (2 to 15 ft bgs), which is the reasonable extent of construction that may occur at the Facility. No soil samples were collected from depths exceeding 15 ft bgs.

6.2 SOIL PHYSICOCHEMICAL ANALYSES

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

The data collected in this investigation will be used in subsequent investigations, where appropriate, to assess fate and transport of PFAS contaminants. According to the Interstate Technology Regulatory Council (ITRC), several important PFAS partitioning mechanisms include hydrophobic and lipophobic effects, electrostatic interactions, and interfacial behaviors. At relevant environmental pH values, certain PFAS are present as organic anions, and are therefore relatively mobile in groundwater (Xiao et al. 2015) but tend to associate with the organic carbon fraction that may be present in soil or sediment (Higgins and Luthy 2006; Guelfo and Higgins 2013). When sufficient organic carbon is present, organic carbon normalized distribution coefficients 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 – HAZARDOUS WASTE STORAGE SHEDS 2 AND 3/WASH RACKS/CONCRETE LAGOON

This section presents the analytical results for soil in comparison to SLs for AOI 1, which includes Hazardous Waste Storage Sheds 2 and 3, the adjacent wash racks, and the concrete evaporation lagoon. The detected compounds are summarized in **Tables 6-2, through 6-4**. **Figures 6-1 through 6-5** present detections for PFOS, PFOA, PFBS, PFHxS, and PFNA in soil.

6.3.1 AOI 1 – Soil Analytical Results

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

Soil was sampled in 11 boring locations associated with potential release areas at AOI 1. Soil was sampled from 0 to 2 ft bgs at locations in the vicinity of the wash rack drains (five locations); and in three intervals (0–2 ft bgs, 6–8 ft bgs, and 13–15 ft bgs) at the remaining six soil boring locations.

PFOA was detected in surface soil samples from six soil borings at concentrations up to an estimated 0.40 µg/kg, which was detected at AOI01-08. PFOA was also detected in shallow subsurface soil[2] at one location, AOI01-01, at an estimated concentration of 0.26 µg/kg at a depth of 6–8 ft bgs. Although PFOA was detected in the vicinity of the wash racks, in the drainage north of the wash racks, and on the unpaved area south of the wash racks, all detected concentrations of PFOA were below the SLs.

PFOS was detected in surface soil samples from five soil borings with a maximum estimated concentration of 8.3 µg/kg at AOI01-09. PFOS was also detected in shallow subsurface soils at

[2] Shallow subsurface soil is referred to as intermediate depth in figures.

6-8 ft bgs and deep subsurface soils at 13-15 ft bgs at AOI01-01 with a maximum concentration of 1.2 µg/kg in the deep subsurface. Although PFOS was detected in the vicinity of the wash racks, in the drainage north of the wash racks, and north of the evaporation lagoon, all detected concentrations of PFOS were below the SLs.

PFHxS was detected below the SL in surface soil samples from two locations near the wash racks. It was detected at an estimated concentration of 0.31 µg/kg and a concentration of 0.9 µg/kg at AOI01-07 and AOI01-08, respectively.

PFBS and PFNA were not detected in soil samples at the Facility.

6.3.2 AOI 1 – Groundwater Analytical Results

Groundwater was not sampled during this SI.

6.3.3 AOI 1 – Conclusions

Based on the results of the SI, PFOA, PFOS, and PFHxS were detected in soil below their respective SLs. Based on the lack of exceedances of the SLs in soil, further evaluation at AOI 1 is not warranted.

This page intentionally left blank

Table 6-2. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil, Site Inspection Report, Rio Rancho Training Site

		Location ID	AOI01-01		AOI01-01		AOI01-02		AOI01-03		AOI01-04		AOI01-05	
		Sample Name	AOI01-01-SB-0-2		AOI01-SB-01-SB-0-2-Dup		AOI01-02-SB-0-2		AOI01-03-SB-0-2		AOI01-04-SB-0-2		AOI01-05-SB-0-2	
		Parent Sample ID			AOI01-01-SB-0-2									
		Sample Date	12/21/2021		12/21/2021		12/20/2021		12/20/2021		12/20/2021		12/20/2021	
		Depth (ft bgs)	0-2		0-2		0-2		0-2		0-2		0-2	
Analyte[1,2]	**Screening Level[1,2]**	**Unit**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15														
Perfluorobutanesulfonic acid (PFBS)	1900	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid (PFHxS)	130	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid (PFNA)	19	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	13	µg/kg	1.1		1.4		0.43	J	ND	U	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	19	µg/kg	0.21	J	0.24	J	ND	U	ND	U	0.2	J	ND	U

Notes:
1. Assistant Secretary of Defense. July2022. Risk-Based Screening Levels in Groundwater and Soil U.S. Environmental Protection Agency's Regional Screening Level Calculator. Hazard Quotient =0.1. May 2022.

2. The Screening Levels for soil are based on incidental ingestion of soil in a residential scenario for direct ingestion of contaminated soil.

J = Estimated concentration.
U = Analyte was not detected at or above the quantitation limit.
µg/kg = Microgram(s) per kilogram.
ft bgs = Feet below ground surface.
ND = Analyte not detected above the limit of detection.
Qual = Qualifier.

Table 6-2. PFOA, PFOS, PFBS, PFNA, and PFHxS Results in Surface Soil, Site Inspection Report, Rio Rancho Training Site

		Location ID	AOI01-06		AOI01-07		AOI01-08		AOI01-09		AOI01-09		AOI01-10		AOI01-11	
		Sample Name	AOI01-06-SB-0-2		AOI01-07-SB-0-2		AOI01-08-SB-0-2		AOI01-09-SB-0-2		AOI01-09-SB-0-2-Dup		AOI01-10-SB-0-2		AOI01-11-SB-0-2	
		Parent Sample ID									AOI01-09-SB-0-2					
		Sample Date	12/20/2021		12/21/2021		12/21/2021		12/21/2021		12/21/2021		12/21/2021		12/21/2021	
		Depth (ft bgs)	0-2		0-2		0-2		0-2		0-2		0-2		0-2	
Analyte[1,2]	**Screening Level[1,2]**	**Unit**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15																
Perfluorobutanesulfonic acid (PFBS)	1900	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid (PFHxS)	130	µg/kg	ND	U	0.31	J	0.9		ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid (PFNA)	19	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	13	µg/kg	ND	U	3.7		0.28	J	3.3	J	8.3	J	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	19	µg/kg	ND	U	0.31	J	0.4	J	0.22	J	0.36	J	ND	U	0.22	J

Notes:
1. Assistant Secretary of Defense. July 2022. Risk-Based Screening Levels in Groundwater and Soil U.S. Environmental Protection Agency's Regional Screening Level Calculator. Hazard Quotient =0.1. May 2022.

2. The Screening Levels for soil are based on incidental ingestion of soil in a residential scenario for direct ingestion of contaminated soil.

J = Estimated concentration.
U = Analyte was not detected at or above the quantitation limit.
µg/kg = Microgram(s) per kilogram.
ft bgs = Feet below ground surface.
ND = Analyte not detected above the limit of detection.
Qual = Qualifier.

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

		Location ID	AOI01-01		AOI01-02		AOI01-03		AOI01-04		AOI01-05		AOI01-05		AOI01-06	
		Sample Name	AOI01-01-SB-6-8		AOI01-02-SB-6-8		AOI01-03-SB-6-8		AOI01-04-SB-6-8		AOI01-05-SB-6-8		AOI01-05-SB-6-8-Dup		AOI01-06-SB-6-8	
		Parent Sample ID											AOI01-05-SB-6-8			
		Sample Date	12/21/2021		12/20/2021		12/20/2021		12/20/2021		12/20/2021		12/20/2021		12/20/2021	
		Depth (ft bgs)	6-8		6-8		6-8		6-8		6-8		6-8		6-8	
Analyte[1,2]	**Screening Level[1,2]**	**Unit**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15																
Perfluorobutanesulfonic acid (PFBS)	25000	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid (PFHxS)	1600	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid (PFNA)	250	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	160	µg/kg	0.66	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	250	µg/kg	0.26	J	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U

Notes:
1. Assistant Secretary of Defense. July 2022. Risk-Based Screening Levels in Groundwater and Soil U.S. Environmental Protection Agency's Regional Screening Level Calculator. Hazard Quotient =0.1. May 2022.

2. The Screening Levels for soil are based on incidental ingestion of soil in a industrial/commercial worker scenario.

J = Estimated concentration.
U = Analyte was not detected at or above the quantitation limit.
µg/kg = Microgram(s) per kilogram.
ft bgs = Feet below ground surface.
ND = Analyte not detected above the limit of detection.
Qual = Qualifier.

This page intentionally left blank

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

		Location ID	AOI01-01		AOI01-02		AOI01-03		AOI01-04		AOI01-05		AOI01-06	
		Sample Name	AOI01-01-SB-13-15		AOI01-02-SB-13-15		AOI01-03-SB-13-15		AOI01-04-SB-13-15		AOI01-05-SB-13-15		AOI01-06-SB-13-15	
		Parent Sample ID												
		Sample Date	12/21/2021		12/20/2021		12/20/2021		12/20/2021		12/20/2021		12/20/2021	
		Depth (ft bgs)	13-15 ft		13-15 ft		13-15 ft		13-15 ft		13-15 ft		13-15 ft	
Analyte[1,2]	**Screening Level[1,2]**	**Unit**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
PFAS by LC/MS/MS compliant with QSM Version 5.3 Table B-15														
Perfluorobutanesulfonic acid (PFBS)	25000	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorohexanesulfonic acid (PFHxS)	1600	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorononanoic acid (PFNA)	250	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanesulfonic acid (PFOS)	160	µg/kg	1.2		ND	U	ND	U	ND	U	ND	U	ND	U
Perfluorooctanoic acid (PFOA)	250	µg/kg	ND	U	ND	U	ND	U	ND	U	ND	U	ND	U

Notes:
1. Assistant Secretary of Defense. July 2022. Risk-Based Screening Levels in Groundwater and Soil U.S. Environmental Protection Agency's Regional Screening Level Calculator. Hazard Quotient =0.1. May 2022.

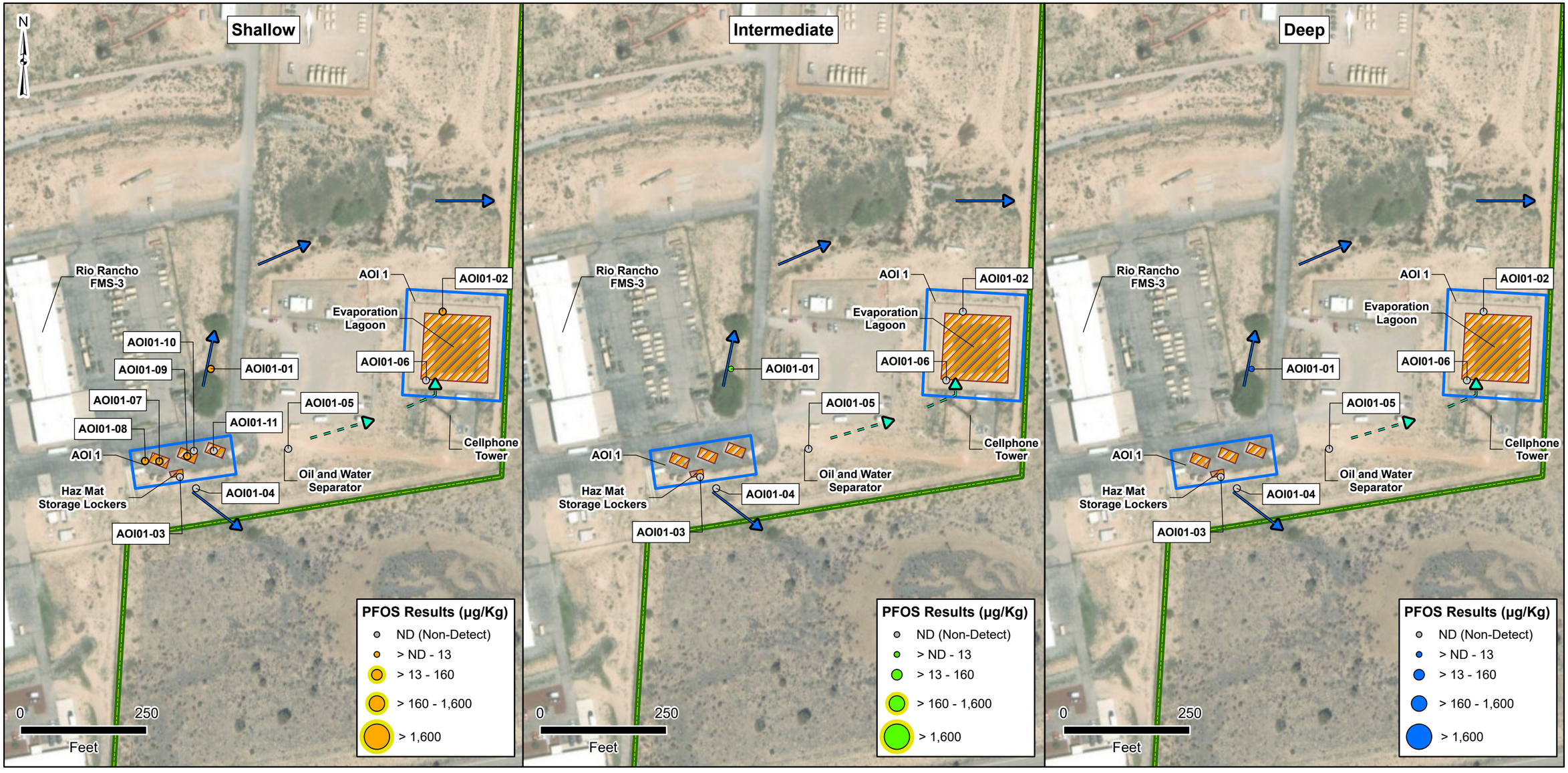
2. The Screening Levels for soil are based on incidental ingestion of soil in a industrial/commercial worker scenario.

J = Estimated concentration.
U = Analyte was not detected at or above the quantitation limit.
µg/kg = Microgram(s) per kilogram.
ft bgs = Feet below ground surface.
ND = Analyte not detected above the limit of detection.
Qual = Qualifier.

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 6-1
AOI 1
PFOS Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release Area

Hydrogeology
- Surface Water Flow Direction
- OWS Drainage Flow Direction

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

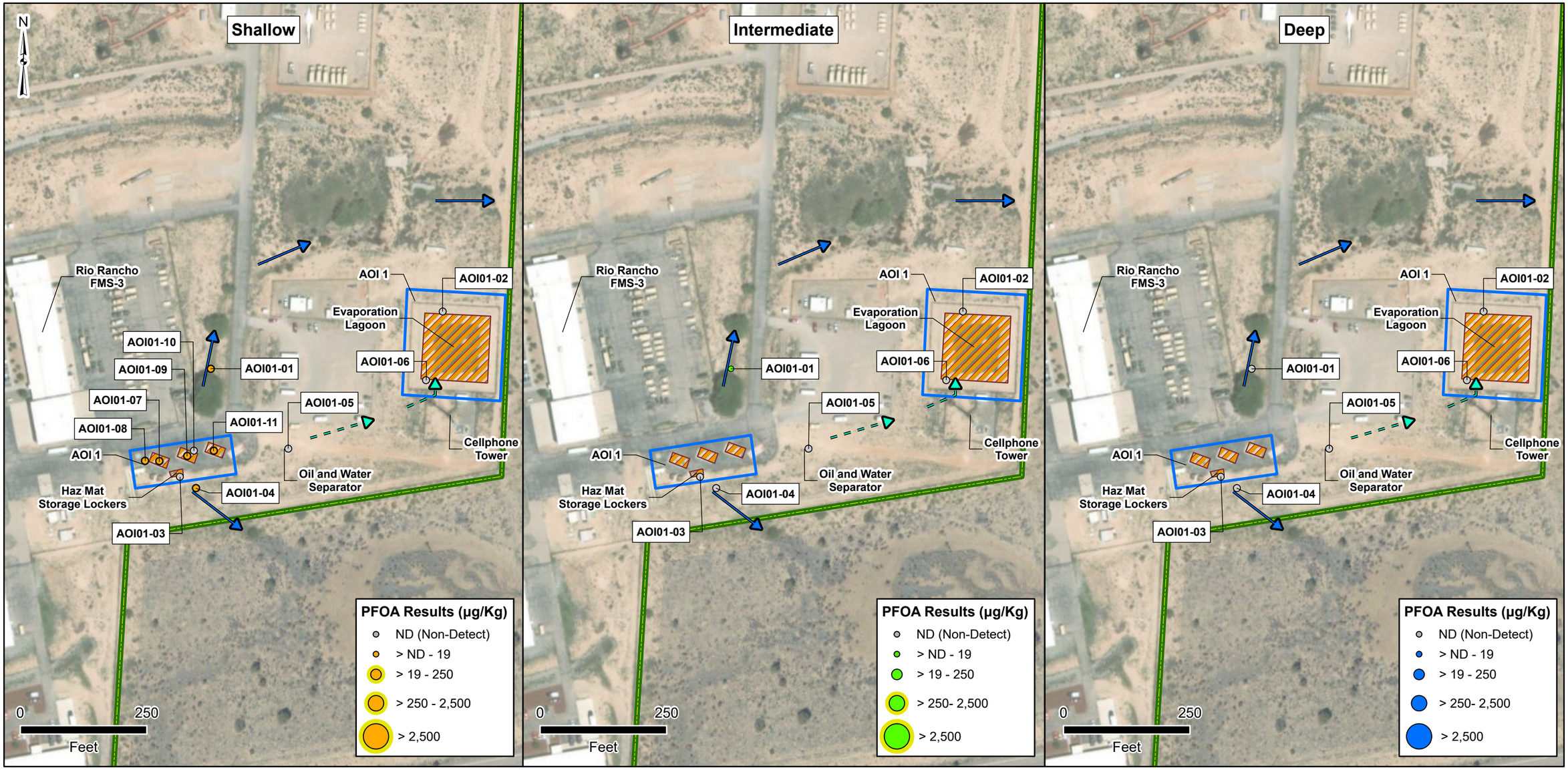
Data Sources:
ESRI 2022
AECOM 2019

Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 6-2
AOI 1
PFOA Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release Area

Hydrogeology
- Surface Water Flow Direction
- OWS Drainage Flow Direction

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

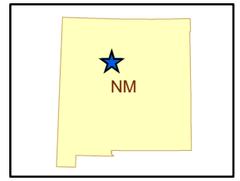
Data Sources:
ESRI 2022
AECOM 2019

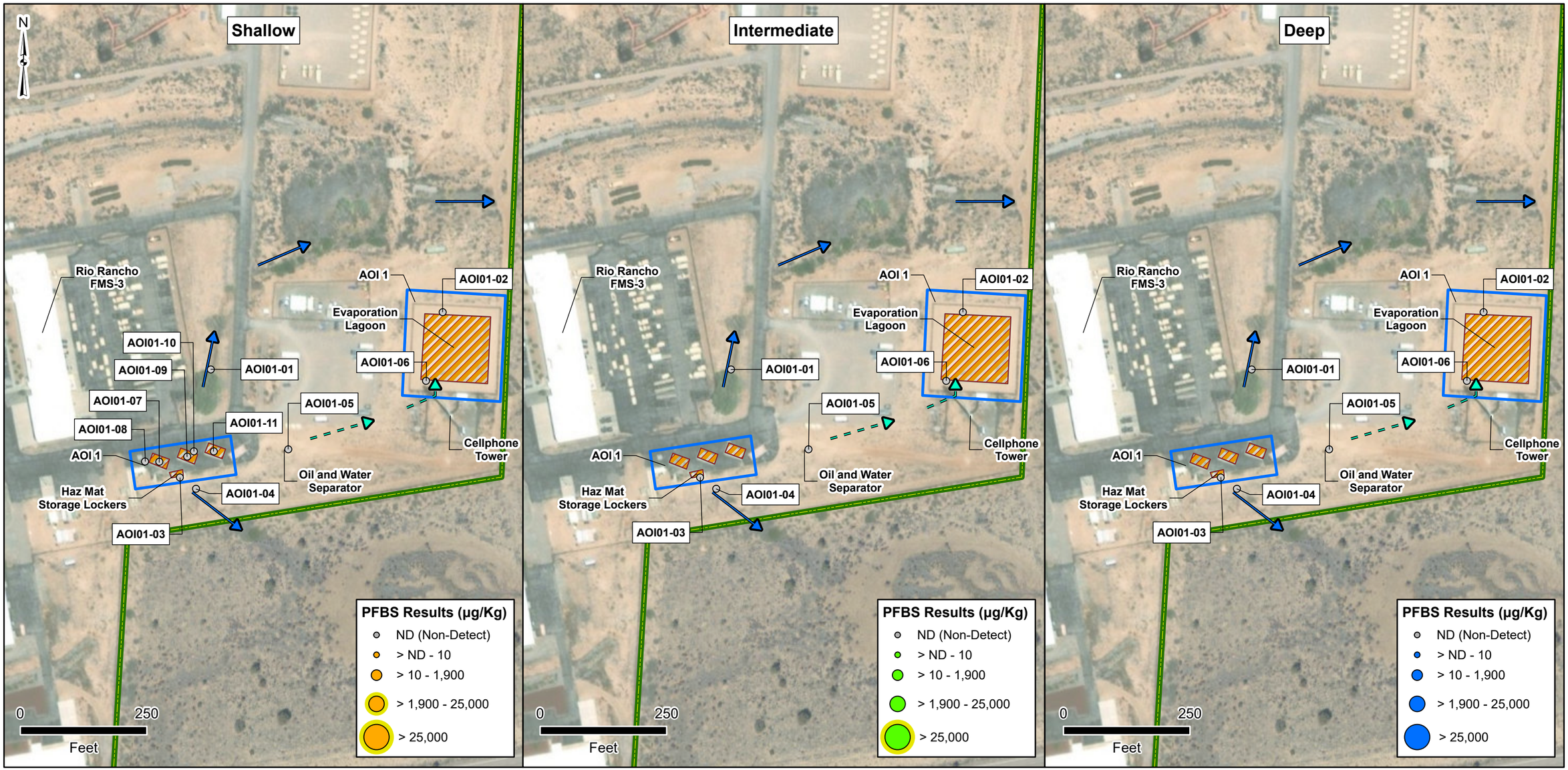
Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 6-3
AOI 1
PFBS Detections in Soil





Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release Area

Hydrogeology
- Surface Water Flow Direction
- OWS Drainage Flow Direction

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

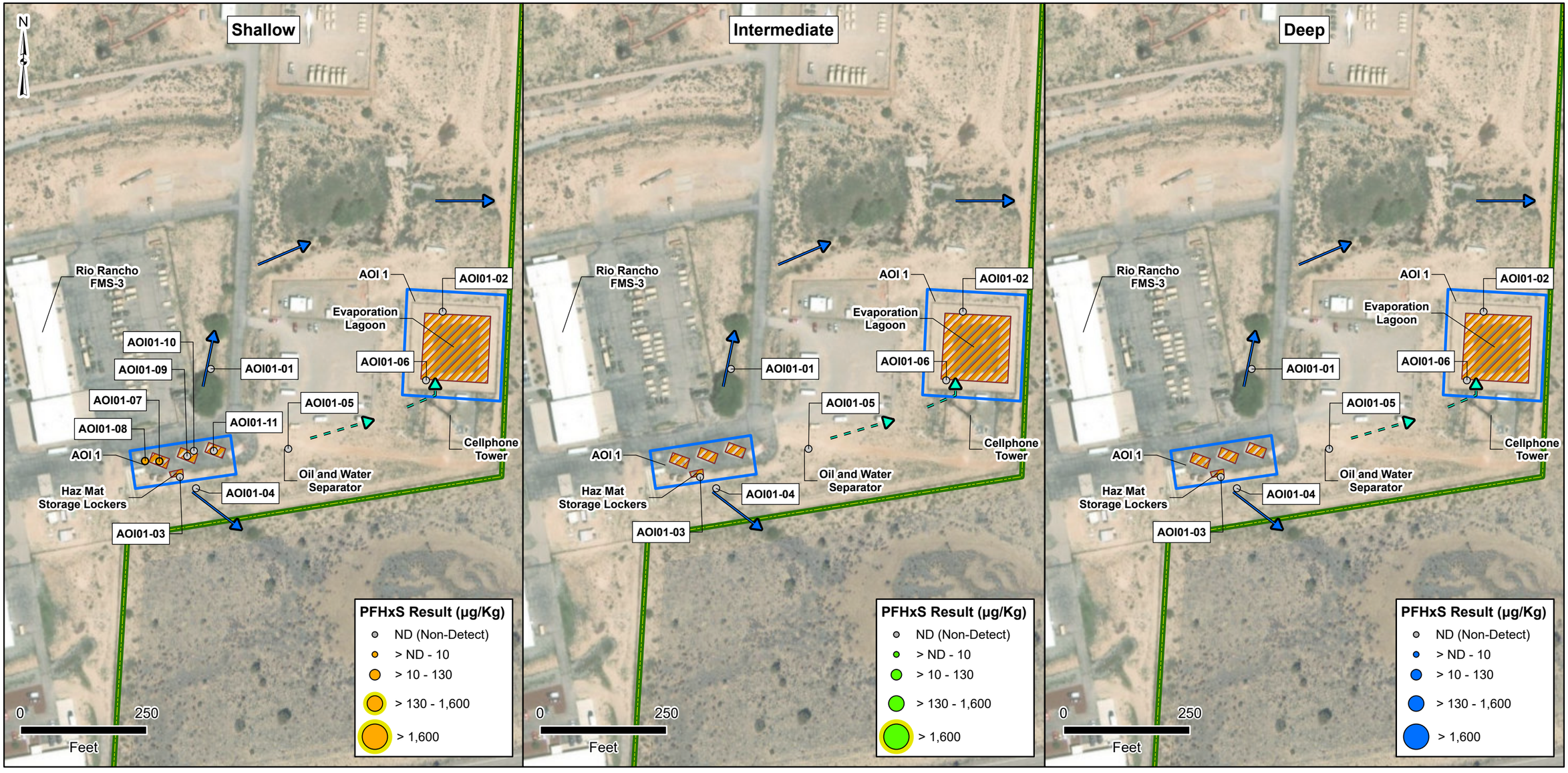
Data Sources:
ESRI 2022
AECOM 2019

Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 6-4
AOI 1
PFHxS Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release Area

Hydrogeology
- Surface Water Flow Direction
- OWS Drainage Flow Direction

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

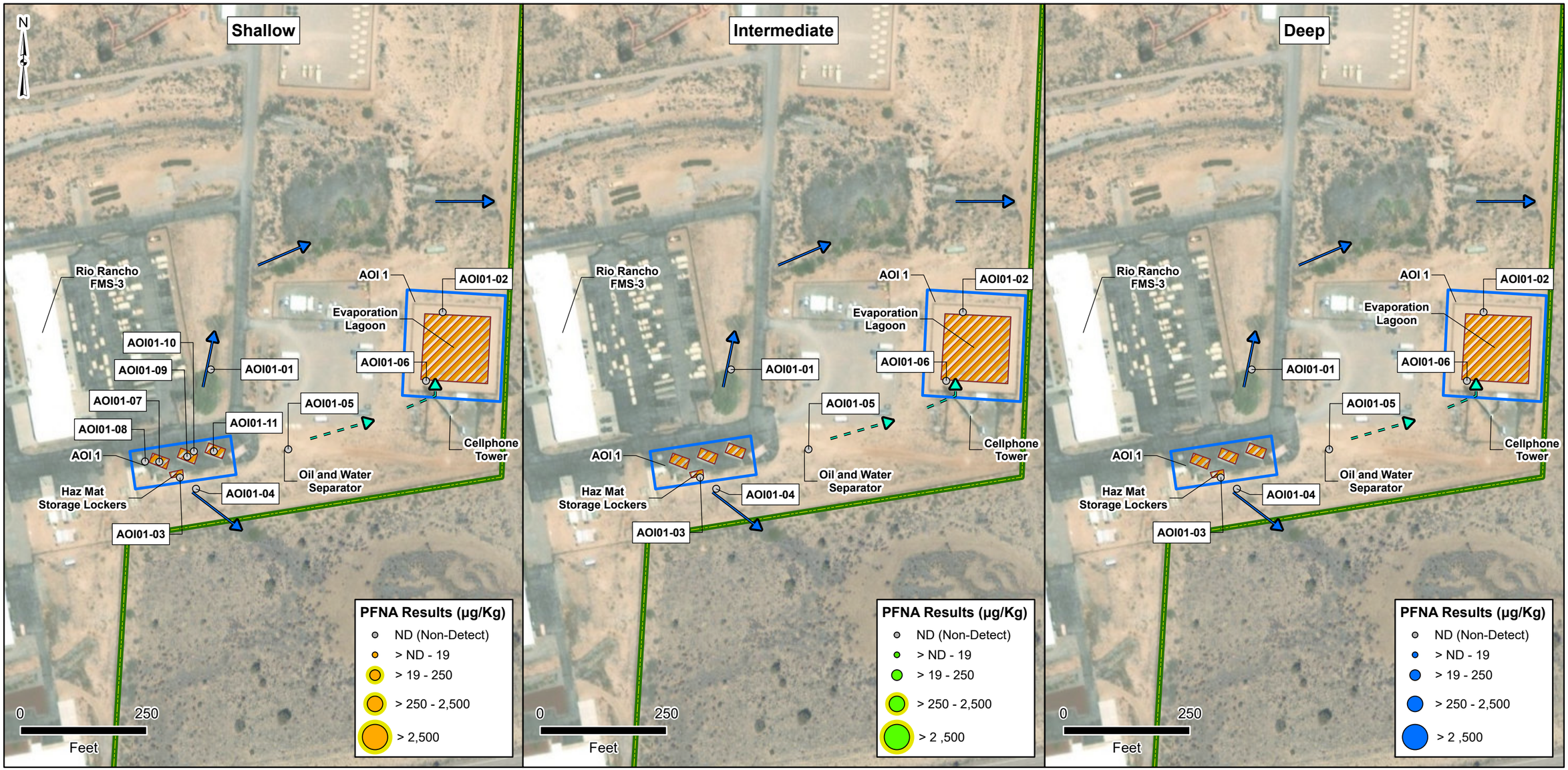
Data Sources:
ESRI 2022
AECOM 2019

Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

Army National Guard Site Inspections
Site Inspection Report
Rio Rancho, New Mexico

Figure 6-5
AOI 1
PFNA Detections in Soil



Facility Data
- Facility Boundary
- Area of Interest
- Potential PFAS Release Area

Hydrogeology
- Surface Water Flow Direction
- OWS Drainage Flow Direction

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

Data Sources:
ESRI 2022
AECOM 2019

Date:.....August 2022
Prepared By:.....EA
Prepared For:.....USACE
Projection:.....WGS 84 UTM 13N

This page intentionally left blank

7. EXPOSURE PATHWAYS

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

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

If any of these elements are missing, the pathway is incomplete. The CSM figures use an empty circle symbol to represent an incomplete exposure pathway. Areas with no identified complete pathway generally warrant no further action. However, the pathway is considered potentially complete if the relevant compounds are detected, in which case the CSM figure uses a half-filled circle symbol to represent a potentially complete exposure pathway. Additionally, a completely filled circle symbol is used to indicate when a potentially complete exposure pathway has detections of relevant compounds above the SLs. Areas with an identified potentially complete pathway that have detections of the relevant compounds above the SLs may warrant further investigation. Although the CSMs indicate whether potentially complete exposure pathways may exist, the recommendation for future study in a 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 PFAS exposure pathways 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 PFAS toxicological study. The receptors evaluated are consistent with those listed in USEPA guidance for risk screening (USEPA 2001). Receptors at Rio Rancho TS include Facility workers, construction workers, and trespassers.

7.1 SOIL EXPOSURE PATHWAY

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

7.1.1 AOI 1 – Hazardous Waste Storage Sheds 1 and 2/Wash Racks/Evaporation Lagoon

Potential PFAS release areas associated with AOI 1 include the hazardous waste storage lockers where AFFF was stored, adjacent wash racks, and the concrete evaporation lagoon. PFOA and/or PFOS were detected at seven boring locations, providing evidence of a potential AFFF release at the wash racks or nearby paved area. Based on previous sampling of wastewater from the

evaporation lagoon, PFAS appear to have been discharged to the lagoon via plumbing from the wash racks. Additionally, runoff from the wash rack area may have resulted in PFAS detections (PFOS and PFOA at concentrations below SLs) reported in soil to the north and south of the wash racks. A PFAS detection (PFOS at a concentration below the SL) was also reported in the soil boring located adjacent to and north of the evaporation lagoon.

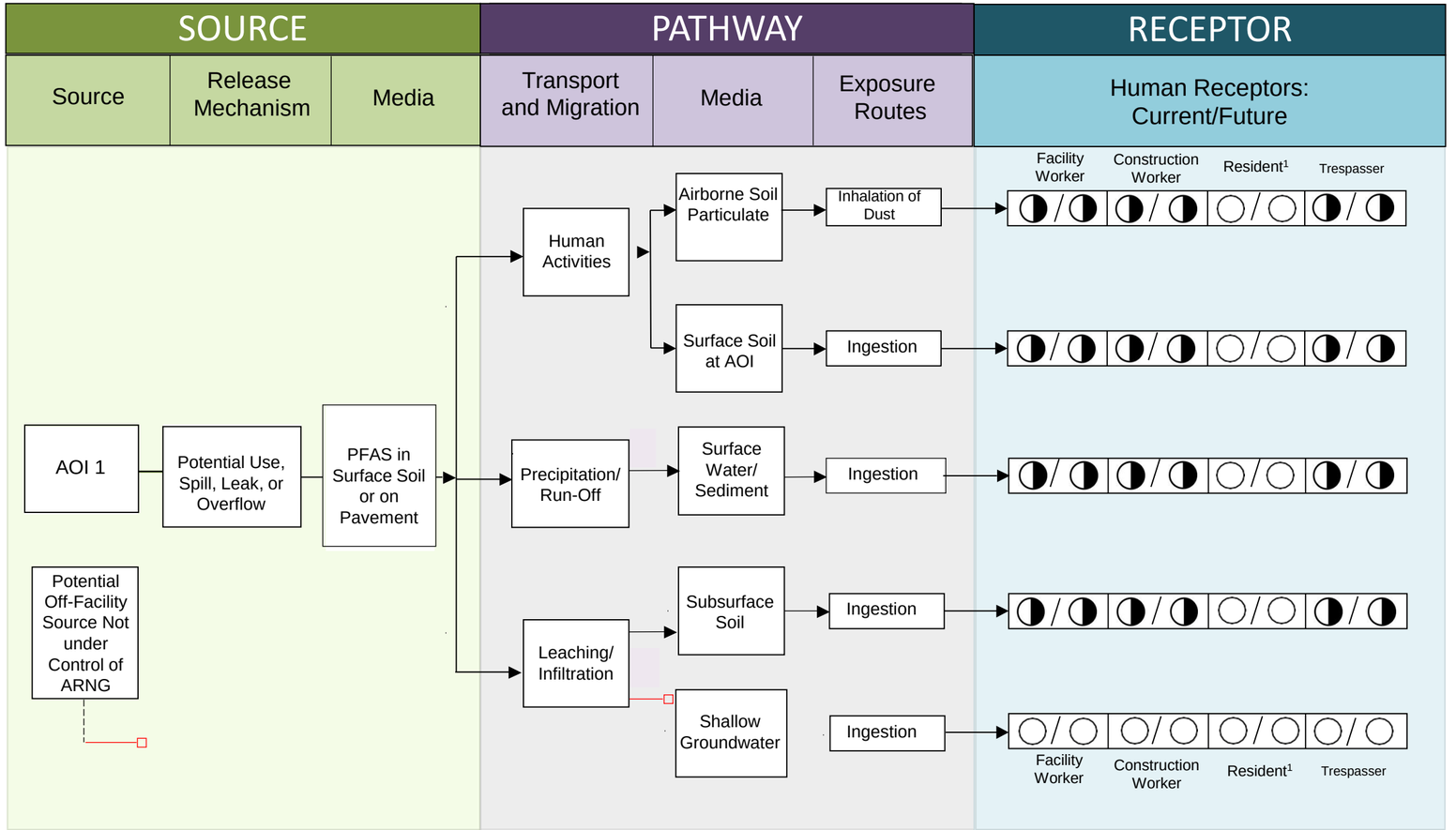
Based on the results of the SI for AOI 1, ground-disturbing activities to surface soil could result in Facility worker and construction worker exposure to PFOA and PFOS via inhalation of dust. Ground-disturbing activities to surface and subsurface soil could result in construction worker exposure to PFOA and PFOS via ingestion. Therefore, the exposure pathways for inhalation and ingestion are potentially complete for these receptors. The CSM is presented in **Figure 7-1**.

7.2 GROUNDWATER EXPOSURE PATHWAY

Due to the depth to groundwater at 1,000 ft bgs, groundwater is not considered a potentially complete pathway for migration of PFAS compounds to groundwater.

7.3 SURFACE WATER/ SEDIMENT EXPOSURE PATHWAY

Due to the presence of PFAS compounds detected in historical evaporation lagoon samples, the surface water/sediment exposure pathway is considered potentially complete.



LEGEND

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

Notes:

1. The resident and recreational users refer to off-facility receptors.

Figure 7-1
Conceptual Site Model
AOI 1 Rio Rancho Training Site

This page intentionally left blank

8. SUMMARY AND OUTCOME

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

8.1 SITE INSPECTION ACTIVITIES SUMMARY

The SI field activities at the facility were conducted from 20 to 21 December 2021. The SI field activities included soil sampling only, due to a groundwater depth of approximately 1,000 ft bgs. Field activities were conducted in accordance with the UFP-QAPP Addendum (EA 2021a), except as previously noted in **Section 5.9**.

To fulfill the project DQOs set forth in the approved SI UFP-QAPP Addendum (EA 2021a), samples were collected and analyzed for a subset of 24 compounds by LC/MS/MS compliant with QSM Version 5.3 Table B-15 as follows:

- Six (6) surface soil samples from five locations including a duplicate sample (hand auger boring locations)
- Twenty-one (21) soil samples from six locations including three duplicate samples (DPT boring locations).
- One (1) field blank sample (FB).
- Two (2) equipment rinsate 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 CSM was refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure at the AOI, which is described in **Section 7**.

8.2 OUTCOME

Based the results of this SI, further evaluation is not warranted for AOI 1 (see **Table 8.1**). Based on the CSMs developed and revised in light of the SI findings, there is potential for exposure to soil receptors from AOI 1 from sources on the facility resulting from historical DoD activities. Sample analytical concentrations collected during the SI were compared against the project SLs in soil, as described in **Table 6-1**.

A summary of the results of the SI data relative to the SLs is as follows:

- AOI 1:
  - PFOA, PFOS, and PFHxS were detected in soil below SLs at AOI 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, as screening values were established after SI planning and execution. However, ARNG will add HFPO-DA to the list of constituents sampled during the next phase of CERCLA if warranted.

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	Hazardous Materials Storage Lockers/Wash Racks/Evaporation Lagoon	◑	Not Applicable	Not Applicable	No Further Action

Legend:
● = Detected; exceedance of SLs
◑ = Detected; no exceedance of SLs
○ = Not detected

9. REFERENCES

AECOM Technical Services, Inc. (AECOM). 2020. *Final Preliminary Assessment Report, Rio Rancho, Rio Rancho, New Mexico*. August.

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

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

Department of Defense (DoD). 2019a. *Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3*. May.

———. 2019b. *General Data Validation Guidelines*. November.

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

EA Engineering, Science, and Technology, PBC (EA). 2020a. *Final Programmatic Uniform Federal Policy Quality Assurance Project Plan, Site Inspections for Per- and Polyfluoroalkyl Substances Impacted Sites, ARNG Installations, Nationwide*. December.

———. 2020b. *Final Programmatic Accident Prevention Plan, Revision 1.* November.

———. 2021a. *Final Site Inspection Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Addendum, Rio Rancho Training Site, Rio Rancho, New Mexico, Per- and Polyfluoroalkyl Substances Impacted Sites ARNG Installations, Nationwide*. November.

———. 2021b. *Accident Prevention Plan/Site Safety and Health Plan Addendum, Rio Rancho Training Site, New Mexico, Revision 0.* August.

Guelfo, J.L. and C.P. Higgins. 2013. Subsurface transport potential of perfluoroalkyl acids and aqueous film-forming foam (AFFF)-impacted sites. *Environ. Sci. Technol.* 47(9):4164-71.

Higgins, C.P., and R.G. Luthy. 2006. Sorption of perfluorinated surfactants on sediments. *Environ. Sci. Technol.* 40(23):7251-7256.

Interstate Technology Regulatory Council (ITRC). 2018. *Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances*. March.

New Mexico Office of the Engineer (NMOSE). 2021. Point of Diversion Locations. https://gis.ose.state.nm.us/gisapps/ose_pod_locations/. Accessed February 15.

Sandoval County, State of New Mexico. Zoning Lookup by Address Interactive Web Map. https://sandovalgis.maps.arcgis.com/apps/InformationLookup/index.html?appid=3e2a1dfb3c774b5c98e4c57e10f48212 Accessed June 1, 2021.

U.S. Environmental Protection Agency (USEPA). 1980. *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*. 11 December.

———. 1994. *National Oil and Hazardous Substances Pollution Contingency Plan (Final Rule).* 40 Code of Federal Regulations Part 300; 59 Federal Register 47384. September.

———. 2001. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments)*. December.

———. 2017a. UCMR 3 (2013-2015) Occurrence Data by State. Occurrence Data for the Unregulated Contaminant Monitoring Rule. Accessed 9 July 2019 at https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule. January.

———. 2017b. National Functional Guidelines for Organic Superfund Data Review. OLEM 9355.0-136, EPA-540-R-2017-002. Office of Superfund Remediation and Technology Innovation. January.

U.S. Fish and Wildlife Service (USFWS). 2022. *Endangered Species.* http://ecos.fws.gov/ipac/. Accessed on 7 January.

Xiao, F., M. F. Simcik, T.R. Halbach, and J.S Gulliver. 2015, *Perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) in soils and groundwater of a U.S. metropolitan area: Migration and implications for human exposure*. Water Research 72:64-74.