Final
Site Inspection Report
Range 30 Complex and MATES
Camp Grayling JMTC, MI

Perfluorooctanesulfonic Acid (PFOS) and
Perfluorooctanoic Acid (PFOA) Impacted Sites
ARNG Installations, Nationwide

October 2020

Prepared for:

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

UNCLASSIFIED

THIS PAGE INTENTIONALLY BLANK

Table of Contents

Figures

Tables

Appendices

Acronyms and Abbreviations

AECOM	AECOM Technical Services, Inc.
AFFF	aqueous film forming foam
AOI	Area of Interest
ARNG	Army National Guard
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
°C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CoC	chain of custody
CSM	conceptual site model
DA	United States Department of the Army
DoD	Department of Defense
DPT	Direct-Push Technology
DQI	Data Quality Indicators
DQO	Data Quality Objective
DUA	Data Usability Assessment
DVR	Data Validation Report
EAHA	Eugene A. Hickok and Associates
EGLE	Michigan Department of the Environment, Great Lakes, and Energy
ELAP	Environmental Laboratory Accreditation Program
ERB	equipment rinsate blank
FRB	field reagent blank
GCAL	Gulf Coast Analytical Laboratories, LLC
gpm	gallons per minute
HA	Health Advisory
HDPE	high-density polyethylene
IDW	investigation-derived waste
ITRC	Interstate Technology and Regulatory Council
JMTC	Joint Maneuver Training Center
LC/MS/MS	liquid chromatography with tandem mass spectrometry
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
LOD	limit of detection
LOQ	limit of quantification
MATES	Maneuver Area Training Equipment Site
MDEQ	Michigan Department of Environmental Quality
MDL	method detection limit
MDMVA	Michigan Department of Military and Veteran Affairs
MDNR	Michigan Department of Natural Resources
µg/kg	micrograms per kilogram

mph	miles per hour
MPRC	Multi-Purpose Range Complex
MS/MSD	matrix spike/ matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
NEtFOSAA	perfluorooctanesulfonamidoacetic acid
ng/l	nanograms per liter
NMeFOSAA	N-methyl perfluorooctanesulfonamidoacetic acid
NOAA	National Oceanic and Atmospheric Administration
ORA	Operational Range Assessment
ORP	oxidation-reduction potential
OSD	Office of the Secretary of Defense
PA	Preliminary Assessment
PFAS	per- and polyfluoroalkyl substances
PFC	perfluorinated compound
PFHxS	perfluorohexanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFTrDA	perfluorotridecanoic acid
PID	photoionization detector
PM	project manager
PQAPP	Programmatic UFP-QAPP
PVC	poly-vinyl chloride
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI/FS	Remedial Investigation/ Feasibility Study
RPD	relative percent difference
RSL	Regional Screening Level
S	sampling
SI	Site Inspection
SOP	standard operation procedure
TCRA	Time Critical Removal Action
TOC	total organic carbon
TPP	Technical Project Planning
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
UTM	Universal Transverse Mercator
WHPA	Well Head Protection Area

THIS PAGE INTENTIONALLY BLANK

Executive Summary

The Army National Guard (ARNG) G9 is performing Preliminary Assessments (PAs) and Site Inspections (SIs) at per- and polyfluoroalkyl substances (PFAS)-impacted sites at ARNG facilities nationwide. The objective of the SI at each facility is to identify whether there has been a release to the environment from the Areas of Interest (AOIs) identified in the PA and determine the presence or absence of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and perfluorobutanesulfonic acid (PFBS) at or above screening levels (SLs). A SI was completed at Range 30 Complex and Maneuver Area Training Equipment Site (MATES), a portion of Camp Grayling Joint Maneuver Training Center (JMTC) (Camp Grayling) in Michigan. Range 30 Complex and MATES will be referred to as the "Site" throughout this document.

Camp Grayling is divided into two geographic areas: the North Post and South Post. The Range 30 Complex and MATES are located in the southern part of North Post in Camp Grayling. The site includes a fenced area of approximately 5,260 acres that contains the Multi-Purpose Range Complex. During the PA for PFAS, the Range 30 Complex was identified as a single area of interest (AOI), referred to as AOI 8.

The MATES area was not identified as a potential PFAS release area during the PA; however, it was investigated further based on the results of Mobilization 1 and is now included as part of AOI 8. The MATES is approximately 60-acres and was designed to provide materials storage and maintenance and repair areas for ARNG equipment. MATES consists of seven buildings ranging in use from hazardous waste and compressed gas storage to tank washing platforms, a wash water treatment area including rapid sand filters, and two gravel and concrete motor pool areas (Michigan Department of Military and Veteran Affairs [MDMVA], 2007). Spent vehicle wash water at the wash rack is directed to an oil water separator. Gray water from maintenance operations within MATES is also passed through a pre-treatment system consisting of activated carbon and organo-clay carbon before releasing into the oil water separator. The oil water separator discharges into a 172-feet by 52-feet settling pond, and the treated water is discharged to an adjacent 140-feet by 114-feet Rapid Infiltration Bed under Groundwater Discharge Permit number GW1810156. Based on the *Integrated Contingency Plan*, no fire suppression systems exist in any of the MATES buildings (MDMVA, 2007). No known releases of AFFF have occurred in this area.

To fulfill the project data quality objectives set forth in the approved SI Quality Assurance Project Plan Addendum (AECOM, 2018b; AECOM, 2018f), samples were collected and analyzed for a subset of 18 PFAS by liquid chromatography with tandem mass spectrometry (LC/MS/MS) compliant with Quality Systems Manual (QSM) 5.1 Table B-15. The 18 PFAS analyzed as part of the ARNG SI program are specified in **Section 5.9** of this Report.

The Department of Defense (DoD) has adopted a policy to retain facilities in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process based on risk-based SLs for soil and groundwater, as described in a memorandum from the Office of the Secretary of Defense (OSD) dated 15 October 2019 (Assistant Secretary of Defense, 2019). The ARNG PFAS SIs follow this DoD policy and, when the maximum site concentration for sampled media exceed the SLs, the AOI will proceed to a Remedial Investigation (RI), the next phase under CERCLA. The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table ES-1**. All other results presented in this report are considered informational in nature and serve as an indication as to whether soil, groundwater, sediment, and surface water contain or do not contain the 18 PFAS analyzed within the boundaries of the facility.

Sample chemical analytical concentrations were compared against the project SLs as described in **Table ES-1**. A summary of the results of the SI data relative to the SLs is as follows:

- PFOA, PFOS, and PFBS were not detected in groundwater at any wells surrounding the Range 30 Complex (i.e., excluding MATES).
- PFOA and/or PFOS in groundwater exceeded the individual SLs of 40 nanograms per liter (ng/L) in groundwater at MATES and at the facility boundary. The maximum PFOA and PFOS concentrations were 60.7 ng/L and 7,810 ng/L, respectively, at temporary well AOI 8-2, located on the western MATES boundary. Based on the results of the SI, further evaluation of MATES is warranted in the RI.
- The detected concentrations of PFOA in soil samples from MATES were below the SLs. PFOS and PFBS were not detected in soil. Although there were no exceedances, PFAS in soil will be evaluated further in an RI.
- Based on the SI findings, exceedances of the SLs were observed in groundwater for PFOA and PFOS at MATES. Camp Grayling collected samples from two potable wells located on MATES in 2017, 2018 and 2019. PFOS and/or PFOA were detected in these samples at very low concentrations (below 5 ng/L). Additionally, PFOA, PFOS, and PFBS were not detected in groundwater in the most upgradient location near the northern boundary, which suggests the release occurred on the MATES property in the vicinity of the wash rack and rapid sand filters.

Table ES-2 summarizes the SI results for soil and groundwater. Based on the conceptual site models developed and revised based on the SI findings, there is potential for exposure to residential drinking water receptors from AOI 8: MATES caused by DoD activities. However, ARNG performed drinking water sampling at downgradient and side-gradient drinking water receptors, and no exceedances over 70 ng/L for PFOA and/or PFOS were observed. Results of the residential sampling effort near the MATES were provided to residents via letter.

Table ES-3 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in the RI for AOI 8: MATES.

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

Analyte	Residential (Soil) (µg/kg)[a,b] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a,b] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a,b]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	130,000	1,600,000	40,000

Notes:
a.) Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. HQ=0.1. 15 October 2019.
b.) If only one PFAS is present, a Hazard Quotient (HQ) of 1 applies and the values presented would increase by a factor of x10.

Table ES-2: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil-Source Area	Groundwater-Source Area	Groundwater-Near Boundary
8	Range 30 Complex	NA	○	○
8	MATES	◐	●	●

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

Table ES-3: Site Inspection Recommendations

AOI	Description	Rationale	Future Action
8	Range 30 Complex	No exceedances of SLs in groundwater.	No further action
8	MATES	Exceedances of SLs in groundwater at the source area and facility boundary. No exceedances of SLs in soil.	Proceed to RI

THIS PAGE INTENTIONALLY BLANK

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) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) at Impacted Sites, ARNG Installations, Nationwide. This work is supported by the United States (US) Army Corps of Engineers (USACE) Baltimore District and their contractor, AECOM Technical Services, Inc. (AECOM), under Contract Number W912DR-12-D-0014, Task Order W912DR17F0192, issued 11 August 2017. The ARNG performed this SI at the Range 30 Complex and the Maneuver Area Training Equipment Site (MATES), a portion of Camp Grayling Joint Maneuver Training Center (JMTC) (Camp Grayling) in Michigan. Range 30 Complex and MATES will be referred to as the "Site" throughout this document.

The SI project elements were performed in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; United States 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 including specific requirements for sampling for PFOA, PFOS, and perfluorobutanesulfonic acid (PFBS), and the group of related compounds known in the industry as per- and poly-fluoroalkyl substances (PFAS). The term PFAS is used throughout this report to encompass all PFAS chemicals being evaluated, including PFOA, PFOS, and PFBS, which are the key components of the suspected releases being evaluated, and the other 15 related compounds listed in the task order.

1.2 SI Purpose

A PA was performed at Camp Grayling (AECOM, 2018e) that identified a potential PFAS release area at the Site, which is considered to be a single area of interest (AOI). The objective of the SI is to identify whether there has been a release to the environment from the AOIs and determine the presence or absence of PFOA, PFOS, and PFBS at or above screening levels (SLs).

As stated in the *Federal Facilities Remedial Site Inspection Summary Guide* (USEPA, 2005), an SI has five goals:

1) Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment;
2) Determine the potential need for a removal action;
3) Collect or develop data to evaluate potential release;
4) Collect data to better characterize the release for more effective and rapid initiation of a Remedial Investigation (RI); and
5) Collect data to determine whether the release is more than likely the result of activities associated with the Department of Defense (DoD).

In addition to the USEPA-identified goals of an SI, the ARNG SI also identifies whether there are potential off-facility PFAS sources.

THIS PAGE INTENTIONALLY BLANK

2. Site Background

2.1 Site Location and Description

Camp Grayling (also referred to as the “facility” or “camp”) is in the City of Grayling and Grayling Township, Michigan and covers portions of Crawford, Kalkaska, and Otsego counties (**Figure 2-1**). The camp is divided by Interstate Highway 75 and is approximately 200 miles northwest of Detroit and 80 miles south of Michigan's Upper Peninsula. The facility is located in the north-central portion of the Lower Peninsula and is bisected by the Au Sable River into two areas. Camp Grayling is the National Guard’s largest training post. It provides training facilities and support services for the ARNG, Air National Guard, U.S. Army, U.S. Army Reserve units, and allied forces for live-fire weapons training, field training activities, light maneuver exercises, and heavy maneuver exercises.

Camp Grayling is divided into North Post and South Post operational areas. The focus of this report will be the Range 30 Complex and MATES, located in the southern part of North Post. The Site includes a fenced area of approximately 5,260 acres that contains the Multi-Purpose Range Complex (MPRC). The MATES is located southwest of the Range 30 Complex. The site layout at the Range 30 Complex and MATES is shown on **Figure 2-2**.

2.2 Facility Environmental Setting

Camp Grayling is entirely within the Grayling Outwash Plain Regional Landscape Ecosystem of the Highplains District of Region II (Albert, 1995). This ecosystem is characterized as broad outwash plain, including sandy ice-disintegration ridges; jack pine barrens, some white pine-red pine forest, and northern hardwood forest. Due to its inland location, northern latitude, and relatively high elevations, the Highplains District experiences the most severe climate in Lower Michigan. The topography at the camp is shown on **Figure 2-3**. Surface water and groundwater features are presented on **Figures 2-4** and **2-5**, respectively.

Additionally, numerous residences that are occupied seasonally or permanently are present along the banks of the Au Sable River and Lake Margrethe. Both water bodies are heavily used for recreational activities, including swimming, canoeing, and fishing.

2.2.1 Geology

Camp Grayling is in the north-central portion of the Michigan Basin; a symmetrical, circular, sedimentary basin in the Central Interior Platform of the U.S. During the Pleistocene epoch, four successive continental glaciers moved across parts of the Michigan Basin. The movement of the glaciers scoured the bedrock surface, deepening valleys and rounding hills. Advancing glaciers transported large quantities of glacial sediments, and when the ice melted, it deposited the glacial drift to a maximum thickness of 1,400 feet in the basin.

Camp Grayling is underlain by unconsolidated glacial sediments (i.e., glacial drift) that overlie sedimentary bedrock consisting of Middle to Late Mississippian Age bedrock from the Coldwater and Michigan formations. These interbedded layers of shale, sandstone, and limestone range in total thickness from 500 to 600 feet. They were formed 325 to 350 million years ago from the deposition of marine sediments. The glacial deposits include lacustrine clay, sand, and gravel outwash plains, with glacial till providing highly variable discontinuous layers. The glacial drift is reported to extend to at least 600 feet below ground surface (bgs). The glaciers created two separate moraines on-installation.

Soils at Camp Grayling are largely derived from glaciofluvial parent materials. The surficial soils are predominantly sandy soils that are somewhat excessively to excessively drained. These soils

exhibit relatively low fertility and vegetation production potentials, but a high tolerance to the compaction and erosion impacts of tracked and wheeled vehicle use. The rest of the soils present on Camp Grayling range from very poorly drained to well-drained soils. These soils can be found on the outwash, as well as in the wetland and low areas (MDMVA, 2007).

There are three primary soil series and four soil groups within Camp Grayling. The three distinct soil series, which comprise approximately 70 percent (%) of the facility, are the Graycalm (28%), Grayling (23% of the facility and 15% in soil complexes), and Rubicon (4.8% of the facility and 4.9% in soil complexes) soil series. In general, the soils at Camp Grayling have a high wind erosion and low water erosion potential.

Soil borings completed during the SI found that soils at MATES[1] are dominated by poorly graded and well-graded sand with thin beds and lenses of gravel and clay clasts. These permeable sand intervals are widespread and commonly observed more than 30 feet thick. Intervening beds of gravelly sands and beds containing clay clasts range up to 3.0 feet thick. Isolated occurrences of silty sands (up to 1.5 feet thick) and fat clay (up to 3.0 feet thick) were also observed. These site observations are consistent with sedimentary deposition from a braided river network in a glaciofluvial depositional environment. The well-graded and poorly-graded sands represent the bulk of the sediment load transported and deposited in the braided river system which was supplied by melting ice downgradient of and proximal to the glacier terminus. The well-graded gravel intervals represent isolated point bar deposits, whereas the siltier and thin clayey intervals likely represent discontinuous floodplain deposits characteristic of braided rivers. Thicker clay deposits represent isolated, abandoned channel fill, as active braided channels migrated to new flow paths due to changing glacial melt discharge and sediment load.

2.2.2 Hydrogeology

Regional and local groundwater flow throughout the installation appears to generally follow surface water drainage patterns. Regional groundwater divides most likely correlate to the major surface water divides for the Manistee, Au Sable, and Muskegon rivers. Rainfall infiltration recharging groundwater likely follows a shallow flow system that discharges to lakes and streams supporting their water levels (MDMVA, 2007).

The North Post contains unconfined aquifers within the glacial outwash sediments consisting of sands, silts, and gravels. Predominant sediments consist of fine- to medium-grained sands that are moderately to excessively drained. Several domestic wells penetrate these sediments, indicating that the formation likely has good water yields. Depth to water varies in this area from 0 to 200 feet bgs. Groundwater in this area flows generally in a south to southeasterly direction at Range 30 Complex and south to southwesterly at MATES. Local variations in groundwater flow are the result of surface drainage and topographic features, including some north to northeast flow toward the North Branch Au Sable River in far northern portions of the North Post. Groundwater flow velocity in this area is approximately 1 to 1.5 feet per day (MDMVA, 2007).

The MATES Well Head Protection Area (WHPA) has two wells that serve as the potable water source for approximately 125 people who work at MATES. Both wells were drilled in the late 1980s to approximately 180 feet and are reported to be equipped with pumps capable of pumping at 500 gallons per minute (gpm). Also, the well screens are reported to be 143 to 183 feet bgs and 152 to 177 feet bgs (MDMVA, 2007). A Wellhead Protection Plan was implemented in 2001 in order to protect potable drinking water systems at Camp Grayling's MATES, located in the southern portion of the North Post (Parsons Engineering Science, Inc., 2001). Observed groundwater

[1] No soil borings were completed around Range 30 Complex.

elevations from the October 2018 synoptic gauging event and corresponding contours are displayed on **Figure 2-6**.

2.2.3 Hydrology

The Site is situated within three watersheds: the Kyle Lake Watershed, Shellenbarger Lake- Au Sable River Watershed, and the Wakeley Creek- Au Sable River Watershed. These watersheds intersect on the Site, with most of the area draining south-southeast, towards the Au Sable River.

The Au Sable River is a major tributary to Lake Huron. Approximately 88,800 acres of Camp Grayling lands are in the Au Sable River watershed, with most being on the North Post. This land area, about 60% of Camp Grayling, is drained by approximately 85 miles of streams. Mean discharge for the main branch of the Au Sable at Grayling is 76.1 cubic feet per second (cfs). Additionally, a wetlands area is present along the western boundary of the MATES area.

2.2.4 Climate

The Site's climate is predominantly continental in character as a result of its interior mid-Michigan location. The prevailing winds are westerly during the summer, as the Bermuda high pressure center pushes into the southeastern U.S. Secondary wind directions include the northwest through the southwest quadrants. Northeasterly winds are observed relatively infrequently. The annual mean wind speed is 9 miles per hour (mph); however, wind speeds of 40 mph have been observed during January, June, and November. The day-to-day weather is a result of the movement of pressure systems across the country; therefore, the Site and its vicinity does not often experience long periods of hot, humid summer weather or extreme cold weather. However, climatic effects of Lake Michigan and Lake Huron are still discernible in their influence on snowfall and cloud cover during the late fall and early winter months (National Guard Bureau & MDMVA, 1994).

The annual mean temperature at Camp Grayling is 42.4 degrees Fahrenheit. The average summer high temperature is 77.6 degrees Fahrenheit, and the average winter low temperature is 10.6 degrees Fahrenheit. The total mean annual precipitation is 33.61 inches, with approximately 10 inches of precipitation falling as snowfall. February is the driest month, with an average of 1.28 inches of precipitation, while August is the wettest month, with 3.78 inches. Afternoon showers and thunderstorms are the major sources of summer precipitation. The average annual snowfall at Grayling is 105.1 inches (National Oceanic and Atmospheric Administration [NOAA], 2018).

2.2.5 Current and Future Land Use

According to a 2001 Land Condition-Trend Analysis Facility Report for Camp Grayling (Envirologic Technologies, Inc., 2003), most of the Camp Grayling land is used for tracked and wheeled vehicle maneuvering. Numerous active live-fire training ranges, including Range 30 Complex, also occupy significant portions of the North and South Post. Non-Military land uses at Camp Grayling include Michigan Department of Natural Resources (MDNR) forestry activities, hunting, fishing, timber, and mineral extraction. Sand, gravel, and clay extraction is managed by MDNR with consultation of Camp Grayling (MDMVA, 2007). Extreme northern and southern areas within facility boundaries have been developed for oil and gas production. Administration of oil and gas development is provided by both MDNR and Michigan Department of Environmental Quality (MDEQ)[2] (MDNR, 2013). Active training areas (including ranges), the cantonment, and the site have controlled access while the remaining areas have open access to the public.

[2] Effective 22 April 2019, MDEQ underwent a reorganization into the Michigan Department of the Environment, Great Lakes, and Energy (EGLE).

The predominant land use outside the facility boundaries is public lands, especially public forest lands. Private lands and residences abut portions of the camp, including the City of Grayling and Grayling Township, located east and southeast of the Site and the north and eastern shores of Lake Margrethe. Numerous residences that are occupied seasonally and permanently are present along the banks of the Au Sable River and Lake Margrethe. Both water bodies are heavily used for recreational activities, including swimming, canoeing, and fishing. Light industrial and heavy industrial zoning are found in portions of the City of Grayling and Grayling Township. These zonings apply to various kinds of manufacturing or value-added activities (MDMVA, 2007).

Reasonably anticipated future land use is not expected to change from the current land use described above.

2.2.6 Critical Habitat and Threatened/Endangered Species

The following birds, plants, mammals and reptiles are federally endangered, threated, proposed and/or are listed as candidate species near the Site (U.S. Fish and Wildlife Service [USFWS], 2018).

- **Birds**: Kirtland's Warbler, *Setophaga kirtlandii* (endangered)
- **Plants**: Houghton's goldenrod, *Solidago houghtonii* (threatened)
- **Mammals**: Northern Long-Eared Bat, *Myotis septentrionalis* (threatened)
- **Reptiles**: Eastern Massasauga, *Sistrurus catenatus* (threatened)

2.3 History of AFFF Use

Prior to construction of the MPRC in 1997, the Range 30 Complex included a tank range and World War II era armor training range (MDMVA, 2007). Travel is restricted to roads within the range. Historically, training activities occasionally resulted in the ignition of wildfires within different portions of the Range 30 Complex. AFFF "wet water" may have been used by Camp Grayling to extinguish such fires caused by training during the active period of AFFF use in the 1970s and 1980s. MDNR assisted Camp Grayling with controlled burns to minimize the potential for wildfires and used a wetting agent to extinguish the fires. The wetting agent used in these instances was very similar in chemical composition to Class A Foam but does not have the foaming abilities of AFFF. The number of emergency responses to the complex is not known. No known uses of AFFF have been discovered at the MATES area.

A description of AOI 8 is presented in **Section 3**.

2.4 Drinking Water Sampling

As part of a facility-wide drinking water sampling effort, Camp Grayling collected samples from two potable wells located on MATES in 2017 (B01422 and backup well 01421). PFOS and/or PFOA were detected in these samples at concentrations below 5 nanograms per liter (ng/L), which is below the USEPA Health Advisory (HA) of 70 ng/L.

In November 2018, December 2018 and February 2019, ARNG collected off-facility drinking water samples due to the exceedance of the PFOS SL observed in groundwater during the August 2018 SI from MATE-MW03 (results presented in **Section 6.3**). Twenty-three (23) properties along South Headquarters Road, West North Down River Road, Siedell Way, Packer Place and Pine Oak Trail were selected to be sampled due to their proximity to MATES (see **Figure 2-7**). PFOS and/or PFOA were not detected in any of the drinking water samples collected. Estimated detections of PFBS and PFHxS were detected at three locations at concentrations less than 3.00 ng/L. The results of the drinking water sampling were provided in letters to the residents and are also

provided in **Table 2-1**. The results indicate that there are no down- or side-gradient impacts to drinking water attributable to ARNG activities at MATES.

THIS PAGE INTENTIONALLY BLANK

Table 2-1
PFAS Detections in Residential Drinking Water
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		POTABLE																	
Sample ID		POTABLE-01-110818		POTABLE-02-110818		POTABLE-03-110818		POTABLE-04-110818		POTABLE-05-110818		POTABLE-05-110818 DUP		POTABLE-06-110818		POTABLE-07-110918		POTABLE-08-110818	
Sample Date		11/08/2018		11/08/2018		11/08/2018		11/08/2018		11/08/2018		11/08/2018		11/08/2018		11/09/2018		11/08/2018	
Analyte	EPA HA [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS via EPA 537.1 (ng/L)																			
PFBS	-	ND		ND		ND		ND		ND		ND		ND		ND		ND	
PFHxS	-	ND		ND		ND		ND		ND		ND		ND		ND		1.71	J-

Grey Fill — Detected concentration exceeded EPA HA

References

a. United States Environmental Protection Agency (EPA). 2016. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-005. May 2016. / EPA. 2016. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-004. May 2016.

Interpreted Qualifiers

J = Estimated concentration

J- = Estimated concentration, biased low

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid

Acronyms and Abbreviations

DUP	Duplicate
EPA	United States Environmental Protection Agency
HA	Health Advisory
LOD	Limit of Detection
ND	Analyte not detected above the LOD
Qual	Interpreted Qualifier
ng/L	nanogram per liter
-	Not applicable

Table 2-1
PFAS Detections in Residential Drinking Water
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		POTABLE																	
Sample ID		POTABLE-09-110918		POTABLE-09-110918 DUP		POTABLE-10-110818		POTABLE-11-110818		POTABLE-12-110918		POTABLE-13-110918		POTABLE-14-110918		POTABLE-15-110818		POTABLE-16-110918	
Sample Date		11/09/2018		11/09/2018		11/08/2018		11/08/2018		11/09/2018		11/09/2018		11/09/2018		11/08/2018		11/09/2018	
Analyte	EPA HA [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS via EPA 537.1 (ng/L)																			
PFBS	-	ND		ND		ND		ND		2.33	J	ND		ND		ND		ND	
PFHxS	-	1.70	J	1.90	J	ND		ND		2.00	J	ND		ND		ND		ND	

Grey Fill — Detected concentration exceeded EPA HA

References

a. United States Environmental Protection Agency (EPA). 2016. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-005. May 2016. / EPA. 2016. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-004. May 2016.

Interpreted Qualifiers

J = Estimated concentration

J- = Estimated concentration, biased low

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid

Acronyms and Abbreviations

DUP	Duplicate
EPA	United States Environmental Protection Agency
HA	Health Advisory
LOD	Limit of Detection
ND	Analyte not detected above the LOD
Qual	Interpreted Qualifier
ng/L	nanogram per liter
-	Not applicable

Table 2-1
PFAS Detections in Residential Drinking Water
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		POTABLE																	
Sample ID		POTABLE-17-120718		POTABLE-18-022119		POTABLE-18-022119-DUP		POTABLE-19-120718		POTABLE-20-022119		POTABLE-21-120618		POTABLE-22-120618		POTABLE-23-120618		POTABLE-23-120618 DUP	
Sample Date		12/07/2018		2/21/2019		2/21/2019		12/07/2018		2/21/2019		12/06/2018		12/06/2018		12/06/2018		12/06/2018	
Analyte	**EPA HA [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Water, PFAS via EPA 537.1 (ng/L)																			
PFBS	-	ND		ND		ND		ND		ND		ND		ND		ND		ND	
PFHxS	-	ND		ND		ND		ND		ND		ND		ND		ND		ND	

Grey Fill — Detected concentration exceeded EPA HA

Chemical Abbreviations

PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid

References

a. United States Environmental Protection Agency (EPA). 2016. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-005. May 2016. / EPA. 2016. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). Office of Water (4304T). Health and Ecological Criteria Division, Washington, DC 20460. EPA Document Number: 822-R-16-004. May 2016.

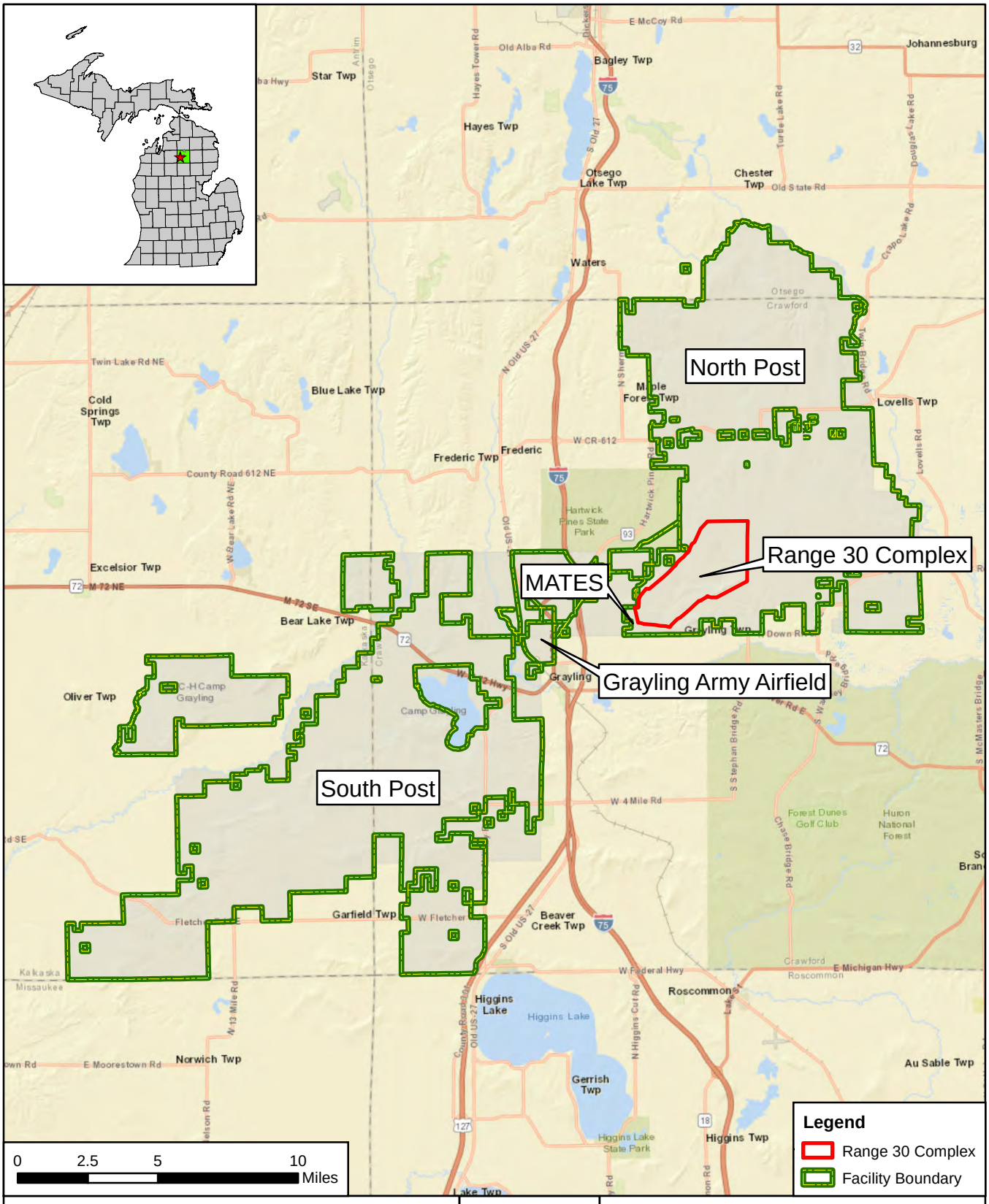
Acronyms and Abbreviations

DUP	Duplicate
EPA	United States Environmental Protection Agency
HA	Health Advisory
LOD	Limit of Detection
ND	Analyte not detected above the LOD
Qual	Interpreted Qualifier
ng/L	nanogram per liter
-	Not applicable

Interpreted Qualifiers

J = Estimated concentration

J- = Estimated concentration, biased low



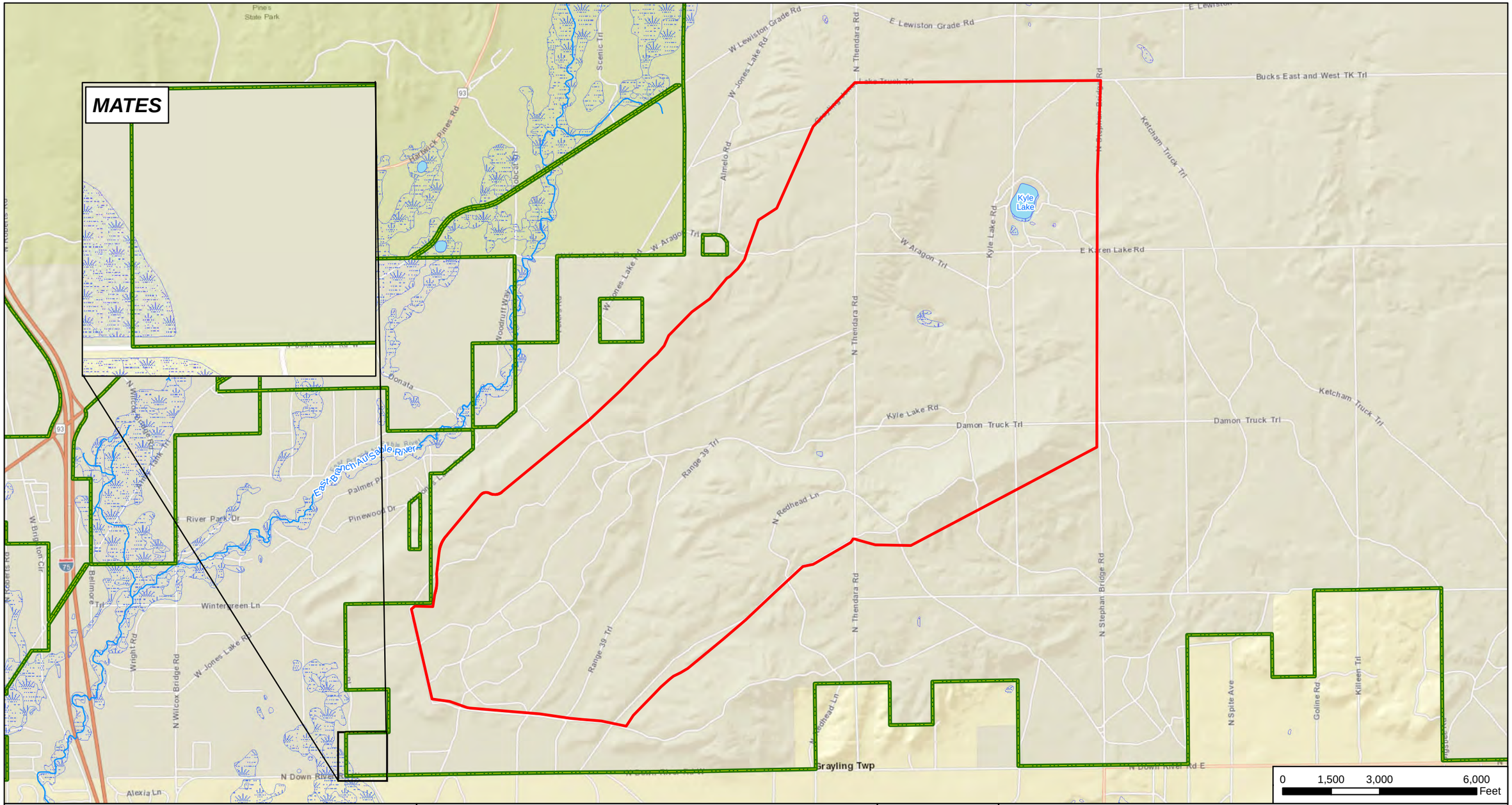
CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:316,800	CHK BY	SC	9/25/2019
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	RG	9/25/2019

Camp Grayling Site Location

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_2-1_Grayling_R30C_Location_Map.mxd



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:36,000	CHK BY	SC	9/25/2019
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	RG	9/25/2019

Legend

- Range 30 Complex
- Facility Boundary
- Water Body
- Wetland
- River/Stream

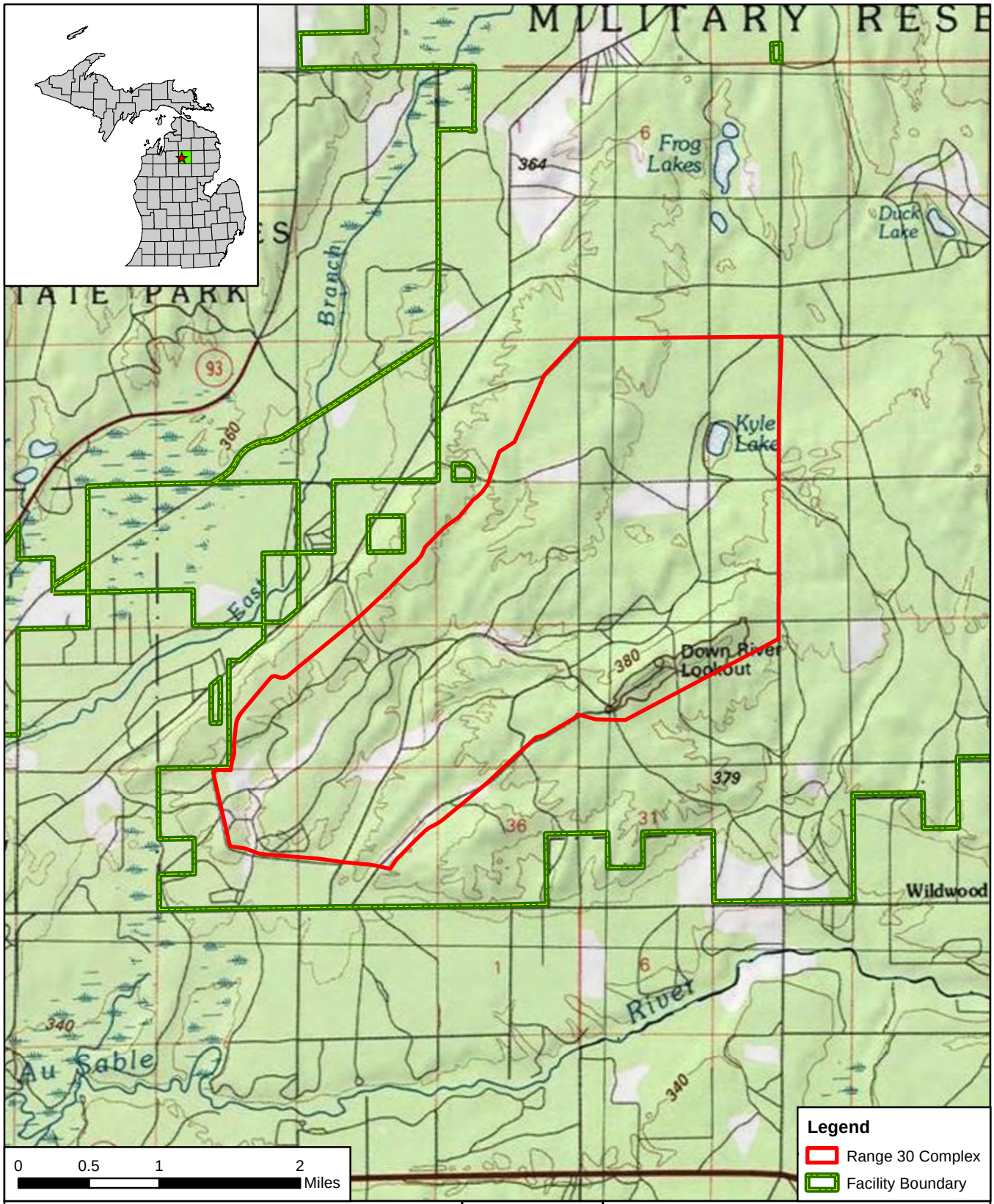
N

Site Layout

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_2-2_Grayling_R30C_Site_Layout.mxd



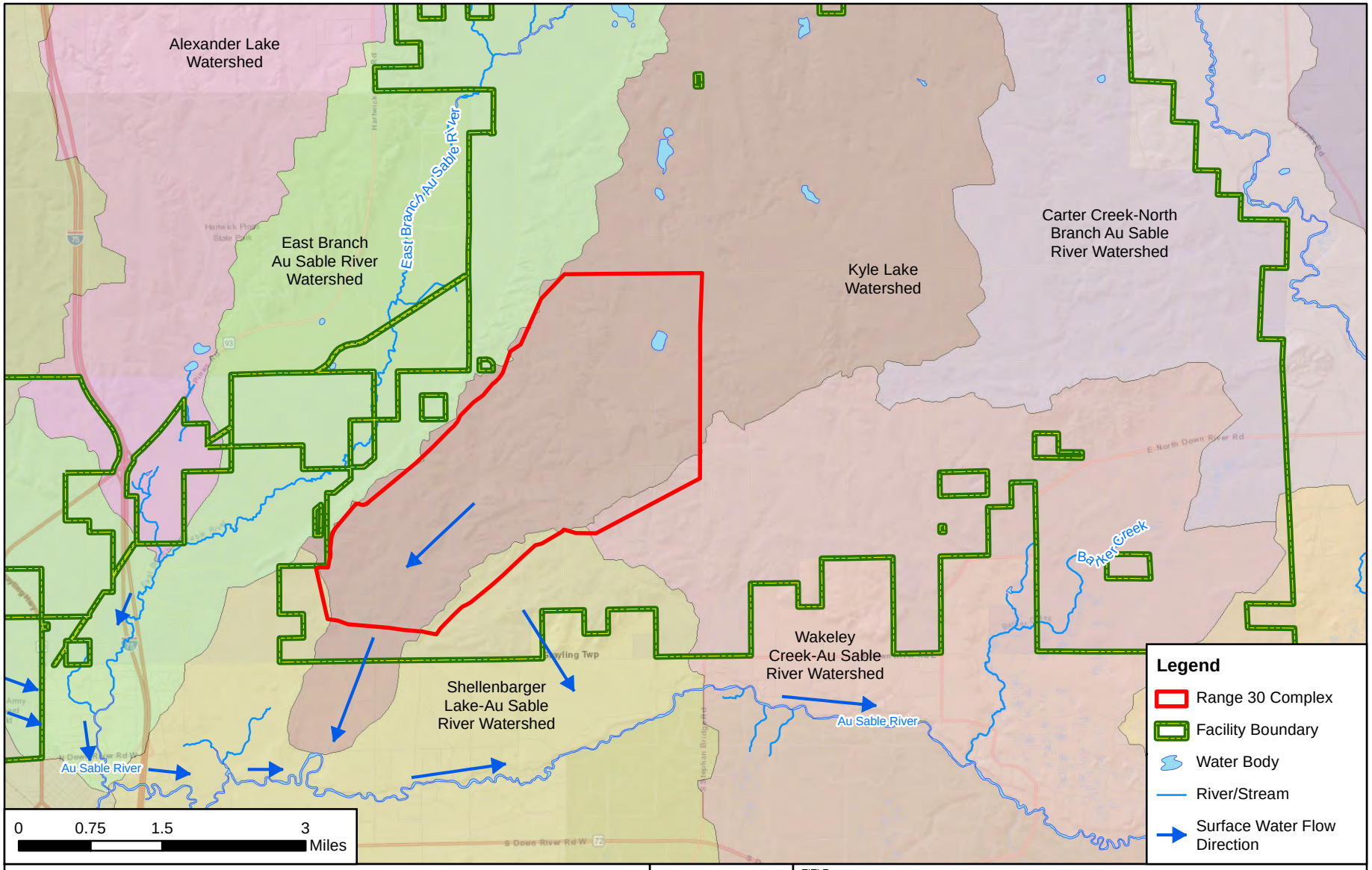
CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:63,360	CHK BY	SC	9/25/2019
Base Map: Copyright:© 2013 National Geographic Society, i-cubed		PM	RG	9/25/2019

Site Topography

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-3

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_2-3_Grayling_R30C_Site_Topography.mxd



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:95,040	CHK BY	SC	9/25/2019
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	RG	9/25/2019

TITLE

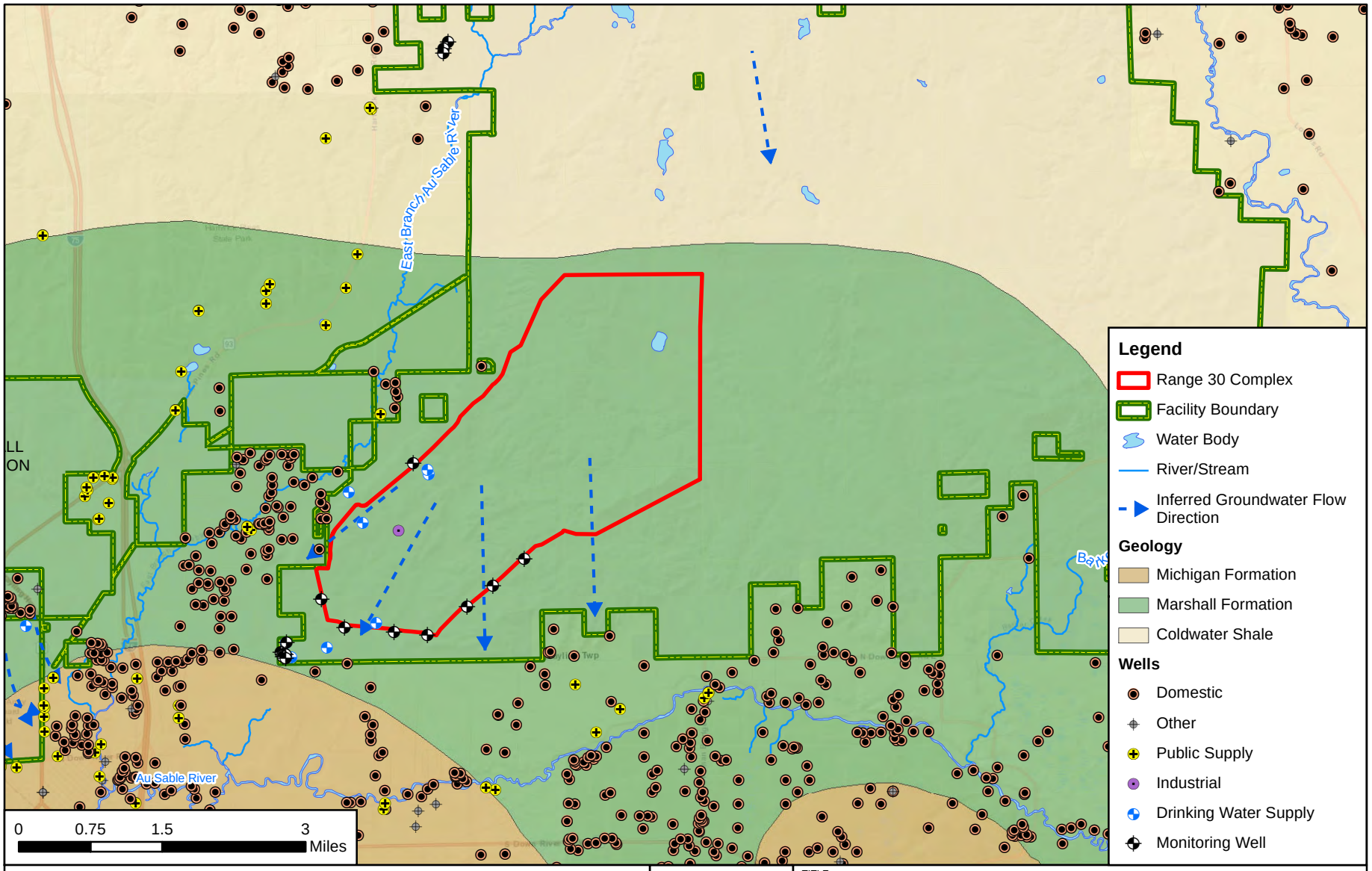
Surface Water Features

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-4

Q:\Projects\ENV\GEARS\GEO\MAES 2012 Unrestricted\Fort Meade\E. Data Management\GIS\MXDs\Chisholm_6th\March2017\ Fig_2-4_Grayling_R30C_Surfacewater_Features.mxd



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:95,040	CHK BY	SC	9/25/2019
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	RG	9/25/2019

TITLE

Groundwater Features

AECOM

12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-5

Q:\Projects\ENV\GEARS\GEO\MAES 2012 Unrestricted\Fort Meade\E. Data Management\GIS\MXDs\Chisholm_6th\March2017\ Fig_2-5_Grayling_R30C_Groundwater_Features.mxd

November 2018

MATE_MW-4
1138.27

PZ-1
1136.89

MATE_MW-11
1136.37

MATE_MW-3
1136.36

PZ-2
1135.71

MATE_MW-8
1135.69

PZ-3
1135.11

PZ-4
1135.59

PZ-5
1135.75

1138
1137
1136
1135

0 175 350 700 Feet

July 2018

RG30_MW4
1159.62

RG30_MW1
1143.31

RG30_MW3
1145.49

RG30_MW7
1140.85

MATE_MW-4
1138.17

MATE_MW-3
1135.43

MATE_MW-11
1136.03

MATE_MW-8
1135.39

RG30_MW6
1136.85

RG30_MW5
1130.96

RG30_MW2
1133.58

RG30_MW8
1135.75

1160
1155
1150
1145
1140
1135
1130

0 1,000 2,000 4,000 Feet

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:24,000	CHK BY	SC	9/25/2019
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	RG	9/25/2019

Facility Boundary
Monitoring Well
Piezometer
Groundwater Contour
Inferred Groundwater Contour
Groundwater Flow Direction

Note: July 2018 groundwater elevations were collected on 30 July 2018.

November 2018 groundwater elevations were collected on 30 November 2018.

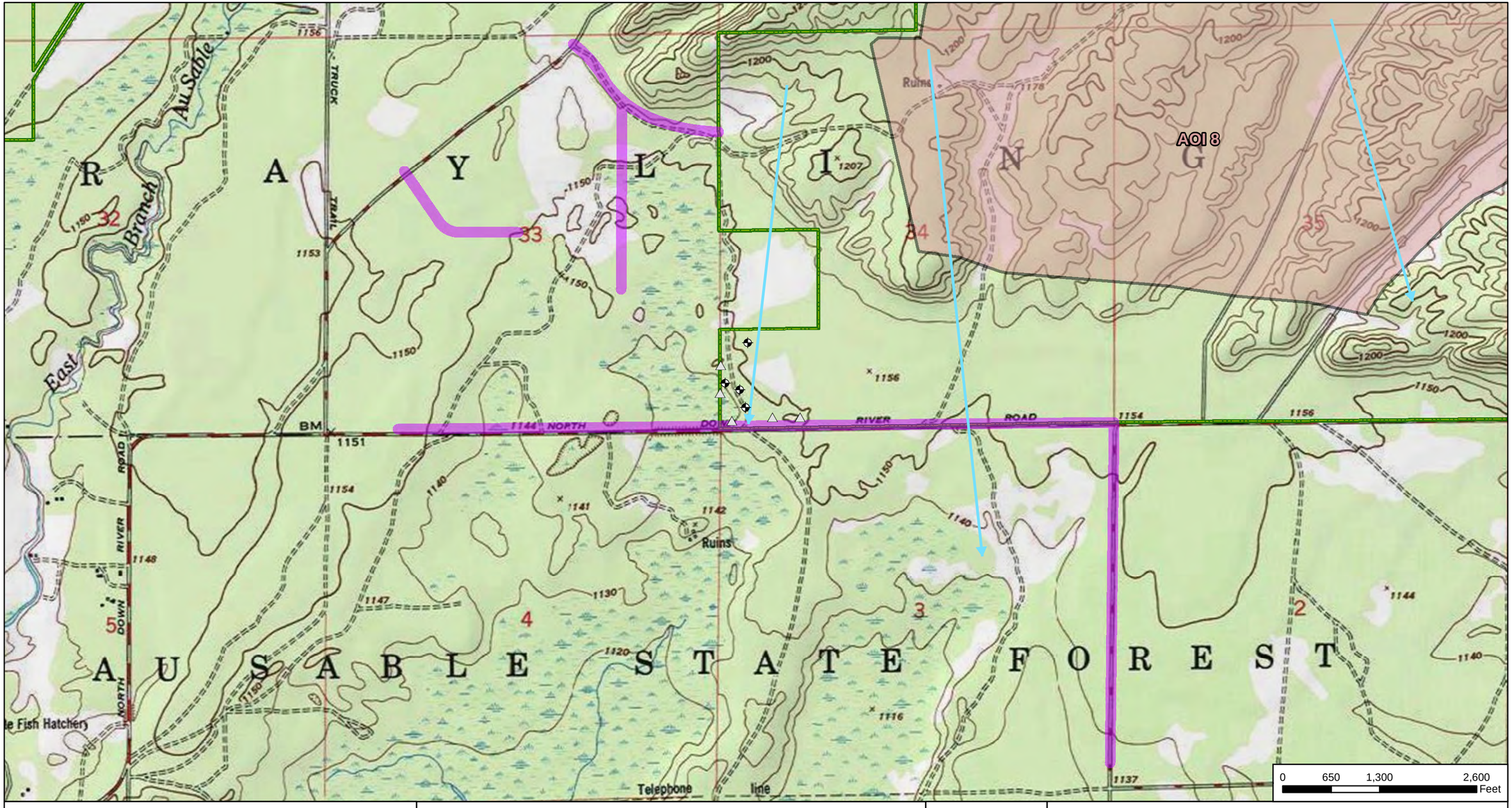
N

Groundwater Elevations, July and November 2018

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-6

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_2-6_Grayling_R30C_Groundwater_Elevation.mxd



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	4/16/2020	GIS BY	MS	4/16/2020
SCALE	1:15,600	CHK BY	CM	4/16/2020
Base Map: Copyright:© 2013 National Geographic Society, i-cubed		PM	RG	4/16/2020

- Monitoring Well
- Piezometer
- Area of Interest
- Private Drinking Water Well Sampling Target Zones
- Facility Boundary
- Groundwater Flow Direction

N

Residential Sampling Areas

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-7

C:\Users\stankevichm\OneDrive - AECOM Directory\ARNG_PFAS_GIS_60552172\MXDs\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_2-7_Grayling_R30C_Residential_Sampling_Areas.mxd

3. Summary of Areas of Interest

The potential source areas at Camp Grayling identified in the PA were grouped into AOIs based on proximity to one another as well as groundwater flow direction (AECOM, 2018e). In the PA, the Range 30 Complex was considered to be a single AOI, referred to as AOI 8[3]; however, based on the findings of the PA, AOI 8 has been expanded to now include MATES. Specific, detailed information regarding the frequency, volume, chemical composition, and concentration of any potential AFFF or "wet water"[4] used at Range 30 Complex are not known. The potential source areas at AOI 8 are shown on **Figure 3-1**.

3.1 AOI 8

3.1.1 Emergency Response Area - Range 30 Complex

The Range 30 Complex, located in the southern portion of North Post, includes a fenced area of approximately 5,260 acres that contains the MPRC. Prior to construction of the MPRC in 1997, the Range 30 Complex included a tank range and World War II era armor training range (MDMVA, 2007). Travel is restricted to roads within the range due to munitions concerns. Historically, training activities occasionally resulted in the ignition of wildfires within different portions of the Complex. AFFF "wet water" or the alternative wetting agent (i.e., Class A foam concentrate and dish washing soap used by MDNR) was used to extinguish wildfires during the active period of AFFF use in the 1970s and 1980s (AECOM, 2018e). The fire control activities were reported to have occurred near the Range 30 Complex boundary fence. The number of emergency responses to the complex is not known. Additionally, the type of wetting agent used in each emergency response and the formulation of the AFFF "wet water" are unknown.

3.1.2 MATES

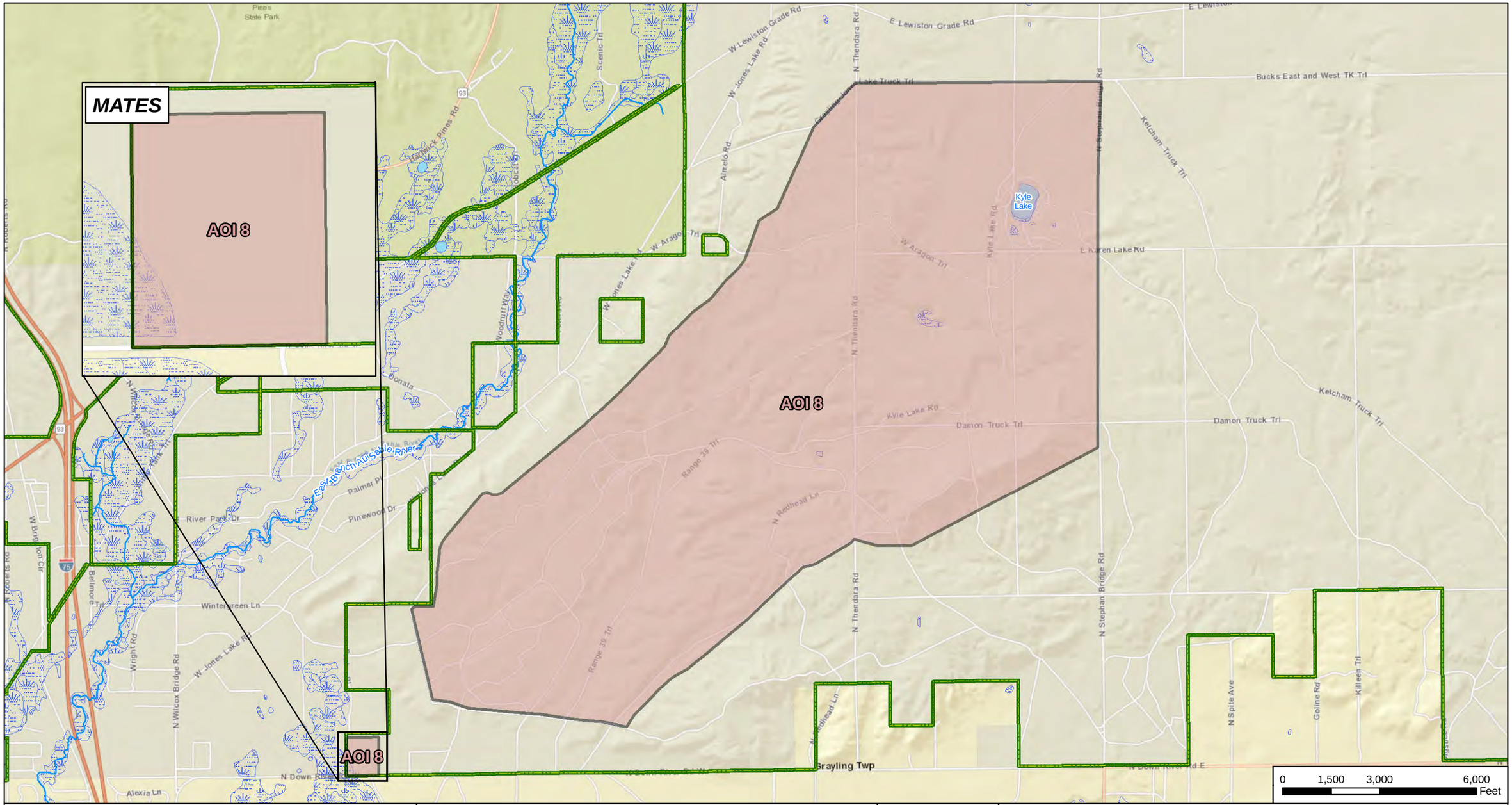
The MATES area was not identified as a potential PFAS release area during the PA; however, it was investigated further based on the results of the Mobilization 1 and is now included as part of AOI 8. Certain permanent wells at MATES were sampled in Mobilization 1 as they represented what was believed at the time to be downgradient, facility boundary locations. MATES is approximately 60-acres and was designed to provide materials storage, and maintenance and repair areas for ARNG equipment. MATES consists of seven buildings ranging in use from hazardous waste and compressed gas storage to tank washing platforms, a wash water treatment area including rapid sand filters, and two gravel and concrete motor pool areas (MDMVA, 2007). Based on the *Integrated Contingency Plan*, no fire suppression systems exist in any of the MATES buildings (MDMVA, 2007). No known releases of AFFF have occurred in this area.

There are two sources of grey water at the MATES complex. The first is from trench drains located in the floor of the maintenance bays inside a vehicle maintenance building. The trench drains flow by gravity through a grit chamber and an oil-water separator located inside the building, before feeding into a lift station. The lift station pumps the grey water through a series of treatment vessels located inside the treatment building, including a bag filter, flow meter, organo-clay

[3] The Range 30 Complex AOI was identified during the PA for Camp Grayling. Other areas of interest were also identified that may be investigated under separate SI tasks. Per the PA (AECOM, 2018), the Range 30 Complex is designated as AOI 8.
[4] The term "wet water" is a colloquial term used by firefighters and has reportedly been mixed using different formulations and wetting agents (e.g., AFFF concentrate, Class A foam concentrate, or dish washing soap) by different entities. Where appropriate, this report will make the distinction between "AFFF 'wet water'", where the formulation may have included the use of AFFF, and other wetting agents or foams. AFFF "wet water" ceased being stored in fire truck tanks in approximately 1988 due to leaking and the use of the truck's water tanks for nonfirefighting activities, after a new fire chief took over operations in 1986.

pressure vessels, and liquid phase carbon pressure vessels. Effluent from the treatment building is discharged to Pond #1 which performs sedimentation and oil-water separation functions.

The second source of grey water at MATES is the outdoor vehicle Wash Rack. Vehicle washing is performed on the concrete Wash Rack using water from an onsite potable well. The resulting grey water is collected in a sump and discharged to Pond #1, where it mingles with the grey water effluent from the treatment building. From Pond #1, the two combined grey water streams flow to Pond #2, which is a 172-feet by 52-feet settling pond. The water from Pond #2 is periodically pumped to an adjacent 140-feet by 114-feet Rapid Infiltration Bed under Groundwater Discharge Permit number GW1810156. A flow diagram of the grey water treatment system and wash rack is included as **Figure 3-2**.



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:36,000	CHK BY	SC	9/25/2019
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	RG	9/25/2019

Legend

- Area of Interest
- Facility Boundary
- Water Body
- Wetland
- River/Stream

N

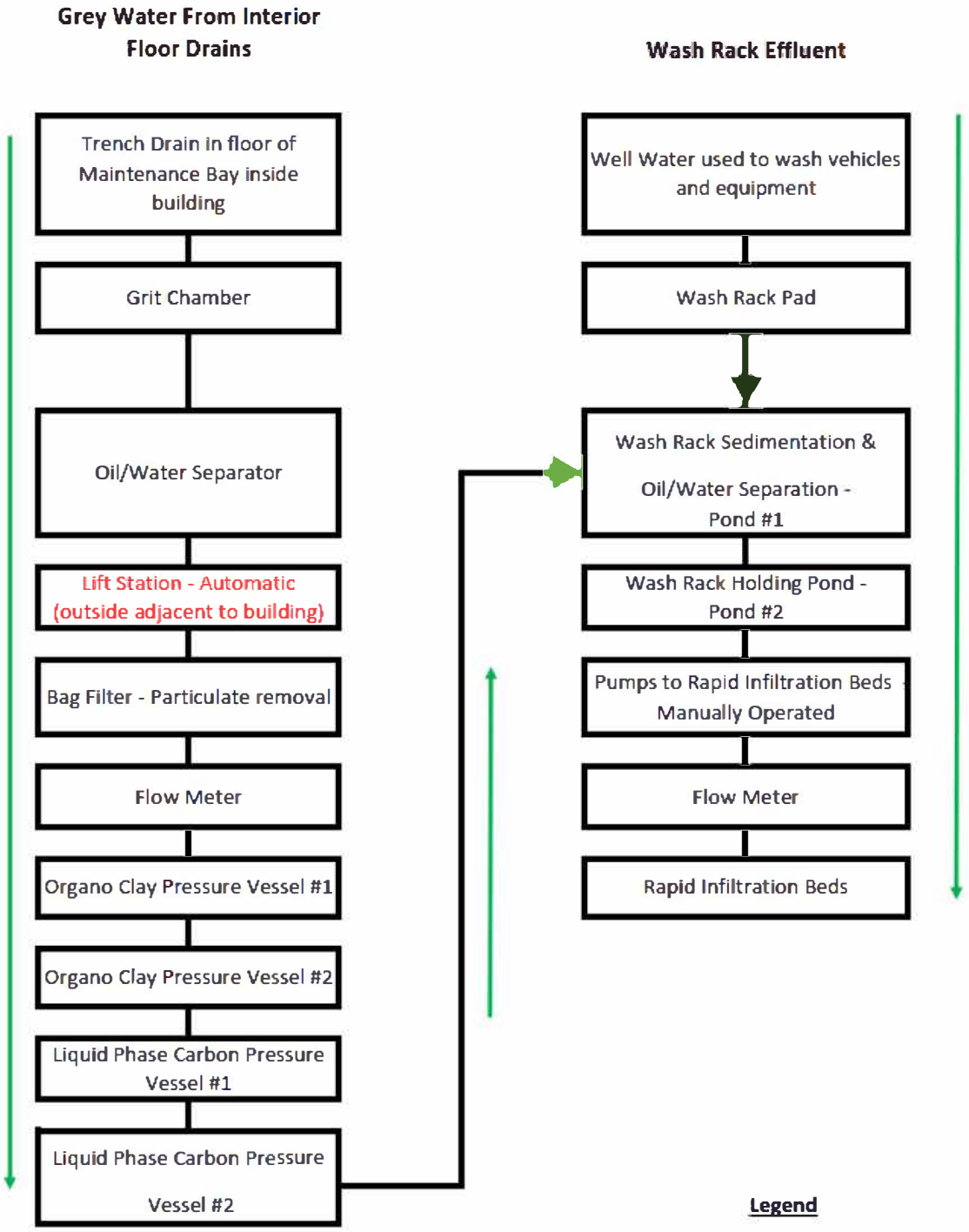
AOI 8, Range 30 Complex and MATES

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_3-1_Grayling_R30C_AOI.mxd

MATES Grey Water Treatment System and Wash Rack Flow



Source: MIARNG, 2020. "MATES Gray Water Treatment System and Wash Rack Flow."

CLIENT	ARNG			
NOTES	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:316,800	CHK BY	SC	9/25/2019
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,		PM	RG	9/25/2019

N

MATES Grey Water and Wash Rack Flow Diagram

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_2-1_Grayling_R30C_Location_Map.mxd

4. Project Data Quality Objectives

Project Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data and define the level of certainty required to support the project decision-making process. The specific DQOs established for this Site are described below. These DQOs were developed in accordance with the USEPA's seven-step iterative process (USEPA, 2006).

4.1 Problem Statement

The following problem statement was developed during project planning:

The presence of PFAS, which may pose a risk to human health or the environment, in environmental media at the facility is currently unknown. PFAS are classified as emerging environmental contaminants that are garnering increasing regulatory interest due to their potential risks to human health and the environment. The regulatory framework for managing PFAS at both the federal and state level continues to evolve.

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 Office of the Secretary of Defense (OSD) dated 15 October 2019 (Assistant Secretary of Defense, 2019). 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 three compounds: PFOS, PFOA, and PFBS. The SLs are presented in **Section 6.1** of this Report.

The following quotes from the DA policy documents form the basis for this project (DA, 2016; DA, 2018):

- "The Army will research and identify locations where PFOS- and/or PFOA-containing products, such as AFFF, are known or suspected to have been used. Installations shall coordinate with installation/facility fire response or training offices to identify AFFF use or storage locations. The Army will consider FTAs, AFFF storage locations, hangars/buildings with AFFF suppression systems, fire equipment maintenance areas, and areas where emergency response operations required AFFF use as possible source areas. In addition, metal plating operations, which used certain PFOS-containing mist suppressants, shall be considered possible source areas."
- "Based on a review of site records…determine whether a CERCLA PA is appropriate for identifying PFOS/PFOA release sites. If the PA determines a PFOS/PFOA release may have occurred, a CERCLA SI shall be conducted to determine presence/absence of contamination."
- "Identify sites where perfluorinated compounds are known or suspected to have been released, with the priority being those sites within 20 miles of the public systems that tested above USEPA HA levels" (USEPA, 2016a; USEPA, 2016b).

4.2 Goals of the Study

The following goals were established for this SI:

1) Determine the presence or absence of PFOA, PFOS, and PFBS at or above SLs.
2) Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.

3) Determine the potential need for a removal action.
4) Collect data to better characterize the release areas for more effective and rapid initiation of a RI.
5) Identify, within 4 miles of the installation, other potential PFAS sources (fire stations, major manufacturers, other DoD facilities) and receptors, including both groundwater and surface water receptors, to determine whether the ARNG is the likely source of PFAS or whether there is an off-facility source of PFAS responsible for installation detections of PFAS (USEPA, 2005).
6) Determine whether a potentially complete pathway exists between the source and potential receptors and whether ARNG is the likely source of the contamination.

4.3 Information Inputs:

Primary information inputs included:

- PA for Camp Grayling, Michigan (AECOM, 2018e);
- Groundwater and soil samples collected in accordance with the SI Quality Assurance Project Plan (QAPP) Addendum and Supplemental SI QAPP Addendum (AECOM, 2018b; AECOM, 2018f); and
- Field data collected during the SI, including groundwater elevation and water quality parameters measured using a multi-parameter water quality meter.

4.4 Study Boundaries

The scope of the SI was bounded by the property limits of the Site (**Figure 2-2**). Off-site sampling was not included in the scope of this SI; however, residential drinking water sampling water was performed down-gradient and side-gradient of MATES to confirm no complete drinking water pathway exists.

4.5 Analytical Approach

All samples were analyzed by Gulf Coast Analytical Laboratories, LLC (GCAL), a DoD Environmental Laboratory Accreditation Program (DoD ELAP; Accreditation Number 74960) and National Environmental Laboratory Accreditation Program (NELAP; Certificate Number 01955) certified laboratory. Data were compared to applicable screening criteria and decision rules as defined in the SI QAPP Addendum and Supplemental SI QAPP Addendum (AECOM, 2018b; AECOM, 2018f) were applied. Decision rules were developed for groundwater and soil, and they applied to all data collected. These rules governed response actions based on the results of the SI sampling effort.

The decision rules described in the **Worksheet #11** of the QAPP Addendum identify actions based on the following:

Groundwater:

- Is there a human receptor within 4 miles of the facility?
- What is the concentration of PFOA, PFOS, and PFBS at the potential release areas?
- What is the concentration of PFOA, PFOS, and PFBS at the facility boundary upgradient and downgradient of the potential release areas?

- What does the conceptual site model (CSM) suggest in terms of source, pathway and receptor?

Soil:

- What is the concentration of PFOA, PFOS, and PFBS in shallow surface soil (0 to 2 feet bgs)?
- What is the concentration of PFOA, PFOS, and PFBS in deep soil (i.e., capillary fringe)?
- What does the CSM suggest in terms of source, pathway, and receptor?

4.6 Data Usability Assessment

The Data Usability Assessment (DUA) 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, 2018a; DoD, 2018b; USEPA, 2017).

Data Quality Indicators (DQIs) (Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity) are important components in assessing data usability. These DQIs were evaluated in the subsequent sections and demonstrate that the data presented in this SI report are of high quality. Although the SI data are considered reliable, some degree of uncertainty can be associated with the data collected. Specific factors that may contribute to the uncertainty of the data evaluation are described below. The Data Validation Report (DVR) (**Appendix A**) presents explanations for all qualified data in greater detail.

4.6.1 Precision

Precision is the degree of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place. Field sampling precision is measured with the field duplicate relative percent differences (RPD); laboratory precision is measured with calibration verification, internal standard recoveries, laboratory control spike (LCS) and matrix spike (MS) duplicate RPD.

Extraction internal standards were added by the laboratory during sample extraction to measure relative responses of target analytes and used to correct for bias associated with matrix interferences and sample preparation efficiencies, injection volume variances, mass spectrometry ionization efficiencies, and other associated preparation and analytical anomalies. Several field samples displayed extraction internal standard percent recoveries associated with multiple analytes that were less than the quality control (QC) limits. The associated field sample results were non-detects and were qualified “UJ”. These anomalies are considered minor, and the results are usable as qualified but should be considered as an estimated value.

Calibration verifications were performed routinely to ensure that instrument responses for all calibrated analytes were within established QC criteria. One calibration verification displayed percent differences greater than the upper QC limit of 30% for N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA) and N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA). The associated field sample results were non-detect, therefore, no data qualifying action was required.

Laboratory control spike/laboratory control spike duplicate (LCS/LCSD) pairs were prepared by addition of known concentrations of each analyte in a matrix-free media known to be free of target

analytes. LCS/LCSD pairs were analyzed for every analytical batch to demonstrate the ability of the laboratory to detect similar concentrations of a known quantity in matrix-free media. Two LCS/LCSD pairs prepared in QC batches 647252 and 646940 displayed RPD greater than the upper QC limit of 20% for perfluorotridecanoic acid (PFTrDA). The associated field sample results were non-detect, therefore, no data qualifying action was required.

Matrix spike/matrix spike duplicate (MS/MSD) samples were prepared, analyzed, and reported for all preparation batches. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested. MS/MSD samples were submitted to the laboratory for analysis at a rate of 5%. The MS/MSDs for samples AOI8-MATE-MW-11-101818 and AOI-8-10-SB-9-10 displayed RPDs greater than the QC limit of 20% for PFTrDA and 6:2 fluorotelomer sulfonic acid (6:2 FTS). The associated parent sample results were non-detect, therefore, no data qualifying action was taken.

Field duplicate samples were collected at a rate of 10% to assess the overall sampling and measurement precision for this sampling effort. The field duplicate samples were analyzed for PFAS and general chemistry parameters. The field duplicate samples were within the project established precision limits presented in the QAPP Addendum (AECOM, 2018b).

4.6.2 Accuracy

Accuracy is a measure of confidence in a measurement. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement. The more precise or reproducible the result, the more reliable or accurate the result. Accuracy is measured through percent recoveries in the LCS/LCSD, MS/MSD, and surrogates.

LCS/LCSD samples were prepared by addition of known concentrations of each analyte in a matrix free media known to be free of target analytes. LCS/LCSD samples were analyzed for every analytical batch and demonstrated that the analytical system was in control during sample preparation and analysis, with one exception. Two LCS/LCSD pairs prepared in QC batches 647252 and 646940 displayed percent recoveries greater than the upper QC limit for PFTrDA. The associated field sample results were non-detect, therefore, no data qualifying action was required.

MS/MSD samples were prepared, analyzed, and reported at a rate of 5%. MS/MSD samples demonstrated that the analytical system was in control for the matrix being tested, with one exception. The MS/MSD for sample AOI8-MATE-MW-11-101818 displayed percent recoveries greater than the upper QC limit for PFTrDA. The associated parent sample results were non-detect, therefore, no data qualifying action was taken.

4.6.3 Representativeness

Representativeness qualitatively expresses the degree to which data accurately reflect site conditions. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences.

Relating to the use of standard analytical methods, the laboratory followed the method as established in PFAS by liquid chromatography with tandem mass spectrometry (LC/MS/MS) Compliant with Quality Systems Manual (QSM) 5.1 Table B-15, including the specific preparation requirements (i.e. ENVI-Carb or equivalent used), mass calibration, spectra, all the ion transitions identified in Table B-15 were monitored, standards that contained both branch and linear isomers when available were used, and isotopically labeled standards were used for quantitation.

Field QC samples were collected to assess the representativeness of the data collected. Field duplicates were collected at a rate of 10% for all field samples, while MS/MSD samples were collected at a rate of 5%. All preservation techniques were followed by the field staff, and all technical and analytical holding times were met by the laboratory. The laboratory used approved standard methods in accordance with the QAPP Addendum (AECOM, 2018b) for all analyses.

Instrument blanks and method blanks were prepared by the laboratory in each batch as a negative control. Several PFAS instrument blanks and method blanks displayed detections greater than the detection limit for multiple target analytes. In total, 46 field sample results were qualified "U" during data validation due to associated detections in instrument and/or method blanks. The reported field sample result values were adjusted to be equal to the level of detection (LOD); the LOD was elevated to the concentration of the blank detection in instances where the blank concentration was greater than the LOD. The results are usable as qualified but should be considered false positives and treated as non-detect.

One field reagent blank (FRB) was collected during each mobilization. Additionally, equipment rinsate blanks (ERBs) were collected for groundwater and soil samples. Several ERBs displayed detections for PFOS greater than the detection limit. All PFOS ERB detections were previously qualified due to instrument blank and method blank detections. Therefore, no data qualifying action was taken based on the "U" qualified PFOS ERB detections. ERB FQC-EB35563 displayed detections greater than the detection limits for 6:2 FTS and perfluorohexanesulfonic acid (PFHxS). In total, one field sample result was qualified "U" during data validation due to associated ERB and/or trip blank detections. The reported field sample result value was adjusted to be equal to the LOD, and the LOD was elevated to the concentration of the blank detection. The result is usable as qualified but should be considered a false positive and treated as non-detect.

A sample of the water used for decontamination of the drill rig was collected in advance of the field effort. The drill rig decontamination sample, AOI8-AIRFIELDSPIGOT-080318, displayed a detection for PFHxS greater than the detection limit at an estimated value of 1.48 J ng/L. All other PFAS were not detected. Field sample results for PFHxS were all greater than five times the detected concentration, therefore, no data qualifying action was required. Based on the sample results, the potable water source was deemed acceptable for use during the investigation for decontamination of drilling equipment and during well installation.

Overall, the data are usable for evaluating the presence or absence of PFAS at the Site. Sufficient usable data were obtained to meet the objectives of the SI and to complete the risk assessment.

4.6.4 Comparability

Comparability is the extent to which data from one study can be compared directly to either past data from the current project or data from another study. Using standardized sampling and analytical methods, units of reporting, and site selection procedures help ensure comparability. Standard field sampling and typical laboratory protocols were used during the SI and are considered comparable to ongoing investigations.

4.6.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data expected under normal conditions. The laboratory provided data meeting system QC acceptance criteria for all samples tested. Project completeness was determined by evaluating the planned versus actual quantities of data. Percent completeness per parameter is as follows:

- PFAS in groundwater by LC/MS/MS compliant with QSM 5.1 Table B-15 at 100%

- PFAS in soil by LC/MS/MS compliant with QSM 5.1 Table B-15 at 100%
- pH in soil by USEPA Method 9045D at 100%
- total organic carbon (TOC) by USEPA Method 9060 at 100%

4.6.6 Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory fortified blanks, a method detection limit (MDL) study, and calibration standards at the level of quantification (LOQ). In order to meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity and project LOQs specified in the QAPP Addendum (AECOM, 2018b). The laboratory provided the requested MDL studies and provided applicable calibration standards at the LOQ. In order to achieve the DQOs for sensitivity outlined in the QAPP Addendum (AECOM, 2018b), the laboratory reported all field sample results at the lowest possible dilution. Additionally, any analytes detected below the LOQ and above the MDL were reported and qualified “J” as estimated values by the laboratory.

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 Preliminary Assessment Report, Camp Grayling, Michigan,* dated August 2018 (AECOM, 2018e);
- *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan,* dated March 2018 (AECOM, 2018a);
- *Final Site Inspection Quality Assurance Project Plan Addendum, Camp Grayling Range 30 Complex, Michigan,* dated July 2018 (AECOM, 2018b);
- *Final Supplemental Site Inspection Quality Assurance Project Plan Addendum, Range 30 Complex and Maneuver Area Training Equipment Site, Camp Graying, Michigan,* dated October 2018 (AECOM, 2018f);
- *Final Programmatic Accident Prevention Plan,* dated July 2018 (AECOM, 2018c); and
- *Final Site Safety and Health Plan, Grayling Army Airfield and Range 30 Complex, Camp Grayling, Michigan* dated July 2018 (AECOM, 2018d).

SI field activities were conducted in two mobilizations. A component of Mobilization 1, which was preformed to investigate the Range 30 Complex, included sampling four existing wells at MATES. MATES is located southwest of the Range 30 Complex. The MATES wells were sampled during Mobilization 1 to serve as boundary wells, determining if PFAS were present in groundwater at the Site boundary. No exceedances in groundwater were observed around Range 30 Complex; however, there was an exceedance of the SL for PFOS at one MATES monitoring well, which suggested an additional potential PFAS release area. Based on the exceedance, the MATES was added as a potential PFAS release area within AOI 8, and a supplemental SI investigation was performed.

Mobilization 1 included groundwater sampling from 30 July to 3 August 2018; Mobilization 2 included grab soil and groundwater sampling from 18 to 30 October 2018. As part of a separate action, residential well sampling was performed by ARNG at 23 residencies west and south of MATES. PFOS and PFOA were not detected in any of the 23 samples. Residents were notified by letter of sampling results. Field activities were conducted in accordance with the QAPP Addendum dated August 2018 and the Supplemental QAPP Addendum dated October 2018, except as noted in **Section 5.10**.

The following samples were collected at the Site and analyzed for a subset of 18 PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15 to fulfill the project DQOs:

Mobilization 1 –

- 12 groundwater samples from existing permanent monitoring well locations.

Mobilization 2 –

- 6 grab soil samples from 2 boring locations;
- 10 grab groundwater samples from 10 temporary well locations; and
- 4 groundwater samples from existing permanent monitoring well locations.

Figures 5-1 and **5-2** provide the sample locations for all media across the site for Mobilization 1 and 2, respectively. Logs of Daily Notice of Field Activities were completed throughout Mobilization 1 and 2 activities and are provided in **Appendix B**. Additionally, a photographic log of field activities is provided in **Appendix C**.

5.1 Pre-Investigation Activities

The SI preplanning activities included the utility clearance and decontamination source water sampling, which are discussed in more detail below.

5.1.1 Utility Clearance

Prior to the intrusive work performed during Mobilization 2, utility clearance was conducted by Camp Grayling Department of Public Works, with input from the AECOM field team. AECOM's drilling subcontractor, Cascade Technical Services, LLC, contacted "Miss Digg" one-call utility clearance contractor to notify them of intrusive work. Additionally, the first 5 feet of each boring was advanced using hand augering methods to verify utility clearance in shallow subsurface where utilities would typically be encountered.

5.1.2 Source Water and PFAS Sampling Equipment Acceptability

A sample from the potable water source at the site was collected on 3 August 2018 and analyzed for PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15. The results of the potable well sample are provided in **Appendix I**. A discussion of the results is presented in **Section 4.6.3**.

All materials that were used within the sampling zone were confirmed as acceptable for use in the PFAS sampling environment. A summary of acceptable materials for use in the PFAS sampling environment is provided in PQAPP Appendix C, Table 1 (AECOM, 2018a). Prior to the start of field work each day, a PFAS Sampling Checklist was completed as an additional layer of control. The check list served as a daily reminder to each field team member regarding the allowable materials within the sampling environment.

5.2 Groundwater Sampling

Groundwater samples were collected from existing permanent monitoring wells as part of Mobilization 1 and Mobilization 2. Samples were collected in accordance with the QAPP Addendum (AECOM, 2018b) via low-flow sampling methods (using a QED Sample Pro® bladder pump with disposable tubing). Water levels were measured to the nearest 0.01 inch and recorded. The pump tubing used for each well was PFAS-free (e.g. HDPE) and placed at the center of the well screen. Groundwater samplers were decontaminated between boring locations. 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, transported via Federal Express under standard CoC procedures to the laboratory, and analyzed for PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15 in accordance with the QAPP Addendum (AECOM, 2018b). The locations of wells sampled during Mobilization 1 are provided in **Figure 5-1**. The monitoring well screen intervals are provided on **Table 5-3**.

Field duplicate samples were collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. MS/MSD were collected at a rate of 5% and analyzed for the same parameters as the accompanying samples. One FRB was collected for each mobilization and analyzed for select PFAS. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 4 degrees Celsius (°C) during shipment.

5.3 Soil Borings and Soil Sampling

Soil borings and soil sampling were completed as part of Mobilization 2, only. Soil borings were conducted via direct-push technology (DPT) in accordance with *Standard Operating Procedure (SOP) 3-17 Direct Push Sampling Techniques*. A Boart Longyear Minisonic LS250 drill rig was used to collect continuous soil cores to the target depth. Three soil samples were collected from each soil boring. A hand auger was used to collect shallow surface soil samples (0-2 ft bgs) in order to be compliant with utility clearance procedures. One subsurface soil sample approximately 1 foot above the groundwater table and one subsurface soil sample at the mid-point between the surface and the groundwater table were collected at each boring using DPT.

The soil boring locations are shown on **Figure 5-2** and depths in **Table 5-1**. The soil boring locations were chosen based on known AFFF uses at similar facilities. No information regarding AFFF use at MATES is available.

The soil cores were continuously logged for lithological descriptions by a field geologist using the Unified Soil Classification System (USCS) per *SOP 3-16 Soil and Rock Classification*. A photoionization detector (PID) was used to screen the breathing zone during boring activities. Observations and measurements were recorded on field forms 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. For cases in which a clay layer with a thickness in excess of 3 feet was observed, boring activities were terminated in order to avoid penetrating a competent clay layer. This occurred at MATES in soil boring 8-4, where a 3.0-foot thick clay layer was observed at 32 feet bgs. Other clay layers observed at MATES were found as very thin to thick beds up to 2.5 feet thick. The clay intervals are described as dark gray to brownish gray to dark grayish brown, stiff, with medium to high plasticity, and containing trace amounts of fine- to medium-grained sand disseminated throughout the clay interval or concentrated in thin laminations within the lower portions of the observed clay intervals. Beds of well-graded sand with minor gravel components and/or clay clasts typically overlie the clay intervals, which fits with the model of channel abandonment that was overridden by later high-energy flow conditions, as the braided channel network migrated and aggraded within its channel belt. The boring logs are provided in **Appendix E.**

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 Federal Express under standard chain of custody (CoC) procedures to the laboratory and analyzed for PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15, TOC (USEPA Method 9060A) and pH (USEPA Method 9045D) in accordance with the QAPP Addendum (AECOM, 2018b). For cases in which non-dedicated sampling equipment was used, such as a stainless-steel scoop and mixing bowl used for the 0 to 2 feet bgs soil samples, ERB samples were collected and analyzed for the same analytes as the soil samples.

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. A temperature blank was placed in each cooler to ensure that samples were preserved at or below 4°C during shipment.

DPT borings were converted to temporary wells, which were subsequently abandoned in accordance with the QAPP Addendum (AECOM, 2018b) using bentonite chips at completion of sampling activities. Borings were installed in grass areas to avoid disturbing concrete or asphalt surfaces.

5.4 Temporary Well Installation and Grab Groundwater Sampling

Temporary wells were installed as part of Mobilization 2. Once the borehole was advanced to the specified depth, as described in **Section 5.3**, the 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 was used for each sampling location to avoid cross contamination between locations.

In some cases, flowing sands were observed to the extent that the PVC well materials would not remain in the ground. As a result, seven temporary wells were set and sampled using the 2-inch stainless steel screen point groundwater sampling system (SP-16 system). The SP-16 system was used at temporary wells AOI 8-2, AOI 8-3, AOI 8-4, AOI 8-6, AOI 8-8, AOI 8-9, and AOI 8-10. The screen intervals for temporary wells are provided in **Table 5-2**. The screen point sampler was decontaminated between each location, and an ERB sample was collected and analyzed for the same parameters as the groundwater samples.

Groundwater samples were collected using a peristaltic pump with PFAS free HDPE tubing. Temporary wells were purged at a rate determined in the field in order to reduce turbidity and draw down prior to sampling. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, oxidation–reduction potential) were measured and recorded on the field sampling form after each grab sample was collected. Water quality parameters were measured using a water quality meter and flow-through cell. See *SOP 3-14 Monitoring Well Sampling* and *SOP 3-24 Water Quality Parameter Testing* in the 2018 QAPP Addendum for more details.

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. FRBs were collected in accordance with the PQAPP (AECOM, 2018b). A temperature blank was placed in each cooler to ensure that samples were preserved at or below 4°C during shipment.

Temporary wells were abandoned in accordance with the QAPP Addendum (AECOM, 2018b) by removing the PVC or the SP16 system and backfilling the hole with bentonite chips. All temporary wells were installed in grass areas to avoid disturbing concrete or asphalt.

5.5 Piezometer Installation

Five piezometers (PZ 1 through 5) were constructed of a 5-foot section of 1-inch Schedule 40 PVC screen with sufficient casing to reach ground surface. The piezometers were installed such that the screen straddled the top of the groundwater table. The piezometers were installed using the drill rig where access was not restricted and using a slide hammer in areas with restricted access. The locations of the piezometers are shown on **Figure 2-6**.

5.6 Synoptic Water Level Measurements

Two synoptic groundwater gauging events were performed: one on 30 July 2018, and one on 30 November 2018. Groundwater elevation measurements were collected from twelve (12) existing permanent monitoring wells on Range 30 and MATES in July 2018, and from five piezometers and four monitoring wells within MATES in November 2018. Water level measurements were taken from the northern side of the well casing. A groundwater flow contour map is provided in **Figure 2-6**. Groundwater elevation data is provided in **Table 5-4**.

5.7 Surveying

The northern side of each new piezometers and existing permanent well casing at MATES was surveyed by Michigan-Licensed land surveyors following guidelines provided in *SOP 3-07 Land Surveying*. Survey data from the newly installed piezometers and the existing permanent wells in the MATES area were collected on 15 November 2018 in the Universal Transverse Mercator (UTM) Zone 16 projection with WGS 84 datum. The surveyed well data is provided in **Appendix F**.

5.8 Investigation-Derived Waste

As of the date of this report, the disposal of PFAS investigation derived waste (IDW) is not regulated. PFAS IDW generated during Mobilization 1 and 2 is considered a non-hazardous waste and was managed in accordance with the QAPP Addendum (AECOM, 2018b) and QAPP Addendum, Worksheet #17g (rev. 1), approved by MDEQ on 8 October 2018 (AECOM, 2018f). The approach for IDW was modified between Mobilization 1 and 2 due to the issuance of Army Guidance for Addressing Releases of PFAS dated September 2018 (DA, 2018).

5.8.1 Mobilization 1

During Mobilization 1, all liquid (i.e., purge water and decontamination fluids) IDW generated during the SI activities was containerized in properly labeled 55-gallon drums. The IDW was stored within the fenced boundary of Camp Grayling at a location designated by ARNG. ARNG is responsible for waste profiling and arranging transportation and disposal of the IDW.

5.8.2 Mobilization 2

Solid IDW (i.e., soil cuttings) generated during the SI activities were left in place at the point of the source. The soil cuttings were distributed evenly around the borehole. This IDW was not sampled and assumes the PFAS characteristics of the associated soil samples collected from that source location.

Liquid IDW generated during Mobilization 2 SI activities (i.e., purge water, development water, and decontamination fluids) was discharged directly to the ground surface slightly downgradient of the source. This IDW was not sampled and assumes the PFAS characteristics of the associated groundwater samples collected from that source location.

AECOM collected global positioning system points (i.e., polygon) around each location where IDW was placed. The polygons are displayed on a figure in **Appendix G**.

Other solids such as spent PPE, 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.

5.9 Laboratory Analytical Methods

Samples were analyzed for PFAS by LC/MS/MS Compliant with QSM 5.1 Table B-15 at GCAL in Baton Rouge, Louisiana, a DoD ELAP and NELAP certified laboratory. The 18 PFAS analyzed as part of the ARNG SI program include the following:

- 6:2 fluorotelomer sulfonate (6:2 FTS)
- 8:2 fluorotelomer sulfonate (8:2 FTS)
- Perfluorohexanoic acid (PFHxA)
- Perfluorohexanesulfonic acid (PFHxS)

- N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
- N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutyrate (PFBA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluorodecanoic acid (PFDA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanoic acid (PFOA)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluoropentanoic acid (PFPeA)
- Perfluorotetradecanoic acid (PFTeDA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoroundecanoic acid (PFUdA)

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

5.10 Deviations from QAPP Addendum

Deviations from the QAPP Addendum occurred based on field conditions and discussion between AECOM and ARNG. Deviations from the QAPP Addendum are noted below:

- The QAPP erroneously listed monitoring well MATE-MW-6 as opposed to MATE-MW-3 as an existing monitoring well to be sampled. MATE-MW-6 had been abandoned prior to the Mobilization 1. The field forms and laboratory data have been updated to reflect the correct well ID.

Table 5-1
Samples by Medium
Range 30 Complex and MATES, Camp Grayling JMTC
Site Inspection Report

Sample Identification	Sample Collection Date	Sample Depth (feet bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
Phase 1 Groundwater Samples						
AOI8-MATE-MW3-080218	8/2/2018	15.32	x			
AOI8-MATE-MW4-080218	8/2/2018	19.5	x			
AOI8-MATE-MW8-080218	8/2/2018	18.9	x			
AOI8-MATE-MW11-080218	8/2/2018	8	x			
AOI8-RG30-MW1-080118	8/1/2018	96	x			
AOI8-RG30-MW2-080318	8/3/2018	63.5	x			
AOI8-RG30-MW2-080318DUP	8/3/2018	63.5	x			Field Duplicate
AOI8-RG30-MW3-073118	7/31/2018	51.5	x			
AOI8-RG30-MW3-073118 DUP	7/31/2018	51.5	x			Field Duplicate
AOI8-RG30-MW4-080118	8/1/2018	81.5	x			
AOI8-RG30-MW5-073118	7/31/2018	37	x			
AOI8-RG30-MW6-073118	7/31/2018	21	x			
AOI8-RG30-MW7-073118	7/31/2018	23	x			
AOI8-RG30-MW8-080118	8/1/2018	69	x			
Phase 2 Soil Samples						
AOI-8-9-SB-0-1	10/29/2018	0 - 1	x	x	x	
AOI-8-9-SB-5-6	10/29/2018	5 - 6	x	x	x	
AOI-8-9-SB-5-6 DUP	10/29/2018	5 - 6	x	x	x	Field Duplicate
AOI-8-9-SB-9-10	10/29/2018	9 - 10	x	x	x	
AOI-8-10-SB-0-1	10/29/2018	0 - 1	x	x	x	
AOI-8-10-SB-5-6	10/29/2018	5 - 6	x	x	x	
AOI-8-10-SB-9-10	10/29/2018	9 - 10	x	x	x	
Phase 2 Groundwater Samples						
AOI-8-1-GW-35-40	10/26/2018	39	x			
AOI-8-2-GW-15-20	10/25/2018	19	x			
AOI-8-3-GW-15-20	10/25/2018	19	x			
AOI-8-4-GW-30-35	10/24/2018	34	x			
AOI-8-5-GW-35-40	10/23/2018	39	x			
AOI-8-6-GW-45-50	10/23/2018	49	x			
AOI-8-7-GW-35-40	10/23/2018	39	x			
AOI-8-8-GW-20-25	10/23/2018	24	x			
AOI-8-8-GW-20-25 DUP	10/23/2018	24	x			Field Duplicate
AOI-8-9-GW-15-20	10/29/2018	19	x			
AOI-8-10-GW-15-20	10/30/2018	19	x			
AOI8-MATE-MW-3-101918	10/19/2018	13	x			
AOI8-MATE-MW-4-101818	10/18/2018	19	x			
AOI8-MATE-MW-4-101818 DUP	10/18/2018	19	x			Field Duplicate
AOI8-MATE-MW-8-101918	10/19/2018	20	x			
AOI8-MATE-MW-11-101818	10/18/2018	7	x			
Decontamination Samples						
AOI8-AIRFIELDSPIGOT-080318	8/3/2018	---	x			Decontamination Source
EB-101818	10/18/2018	---	x			Equipment Blank

Table 5-1
Samples by Medium
Range 30 Complex and MATES, Camp Grayling JMTC
Site Inspection Report

Sample Identification	Sample Collection Date	Sample Depth (feet bgs)	PFAS (USEPA Method 537 Modified)	TOC (USEPA Method 9060A)	pH (USEPA Method 9045D)	Comments
FB-101818	10/18/2018	---	x			Field Blank
FQC-EB8612	10/23/2018	---	x			Equipment Blank
FB-20181023	10/23/2018	---	x			Field Blank
EB-20181024-1220	10/24/2018	---	x			Equipment Blank
FQC-EB35563	10/24/2018	---	x			Equipment Blank
EB-20181025-0950	10/25/2018	---	x			Equipment Blank
EB-20181025-1000	10/25/2018	---	x			Equipment Blank

Notes:

ft = feet

MS/MSD = matrix spike/ matrix spike duplicate

PFAS = per- and polyfluoroalkyl substances

TOC =total organic carbon

USEPA = United States Environmental Protection Agency

Table 5-2
Soil Boring Depths and Temporary Well Screen Intervals (Mobilization 2)
Range 30 Complex and MATES, Camp Grayling JMTC
Site Inspection Report

Area of Interest	Boring Location	Soil Boring Depth (feet bgs)	Temporary Well Screen Interval (feet bgs)
8	8-1	40	35 - 40
	8-2	20	15 – 20
	8-3	20	15 – 20
	8-4	35	30 – 35
	8-5	40	35 - 40
	8-6	50	45 – 50
	8-7	40	35 - 40
	8-8	25	20 – 25
	8-9	20	15 – 20
	8-10	20	15 – 20

Notes:
bgs = below ground surface
* = sample collected using SP16 sampling tool

Table 5-3
Monitoring Well Screen Intervals
Range 30 Complex and MATES, Camp Grayling JMTC
Site Inspection Report

Monitoring Well ID	Screen Interval (feet bgs)
MATE-MW-3	26.75 - 31.75
MATE-MW-4	74 - 79
MATE-MW-8	16.6 - 21.6
MATE-MW-11	4.25 - 9.25
RG30-MW1	91 - 96
RG30-MW2	58 - 63
RG30-MW3	45 - 50
RG30-MW4	74 - 79
RG30-MW5	30 - 35
RG30-MW6	15 - 20
RG30-MW7	18 - 23
RG30-MW8	64 - 69

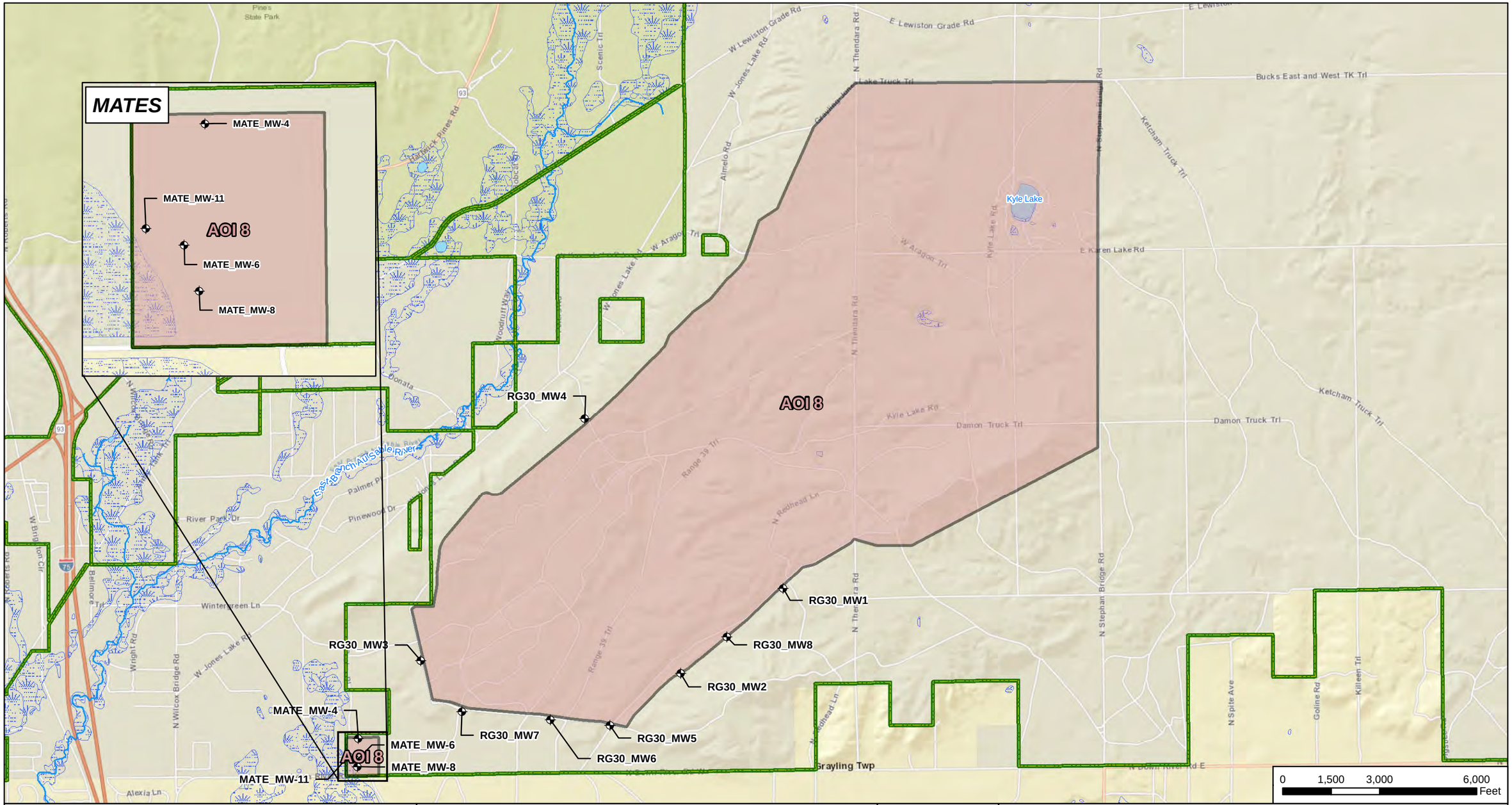
Notes:
bgs = below ground surface

Table 5-4
Groundwater Elevation
Range 30 Complex and MATES, Camp Grayling JMTC
Site Inspection Report

Monitoring Well ID	Top of Casing Elevation (ft amsl)	July 2018 Depth to Water (ft btoc)	July 2018 Groundwater Elevation (ft amsl)	November 2018 Depth to Water (ft btoc)	November 2018 Groundwater Elevation (ft amsl)
RG30-MW1	1235.17	91.86	1143.31	-	-
RG30-MW2	1194.72	61.14	1133.58	-	-
RG30-MW3	1195.20	49.71	1145.49	-	-
RG30-MW4	1238.81	79.19	1159.62	-	-
RG30-MW5	1165.31	34.35	1130.96	-	-
RG30-MW6	1155.17	18.32	1136.85	-	-
RG30-MW7	1161.89	21.04	1140.85	-	-
RG30-MW8	1202.33	66.58	1135.75	-	-
MATE-MW-3	1146.99	11.56	1135.43	10.63	1136.36
MATE-MW-4	1147.36	9.19	1138.17	9.09	1138.27
MATE-MW-8	1143.89	8.50	1135.39	8.20	1135.69
MATE-MW-11	1142.26	6.23	1136.03	5.89	1136.37
PZ-1	1142.77	-	-	5.88	1136.89
PZ-2	1137.21	-	-	1.50	1135.71
PZ-3	1138.16	-	-	3.05	1135.11
PZ-4	1143.69	-	-	8.10	1135.59
PZ-5	1146.14	-	-	10.39	1135.75

Notes:
amsl = above mean sea level
btoc = below top of casing
ft = feet
- = not measured

THIS PAGE INTENTIONALLY BLANK



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:36,000	CHK BY	CM	9/25/2019
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	RG	9/25/2019

Legend

- Area of Interest
- Facility Boundary
- Water Body
- Wetland
- River/Stream
- Monitoring Well

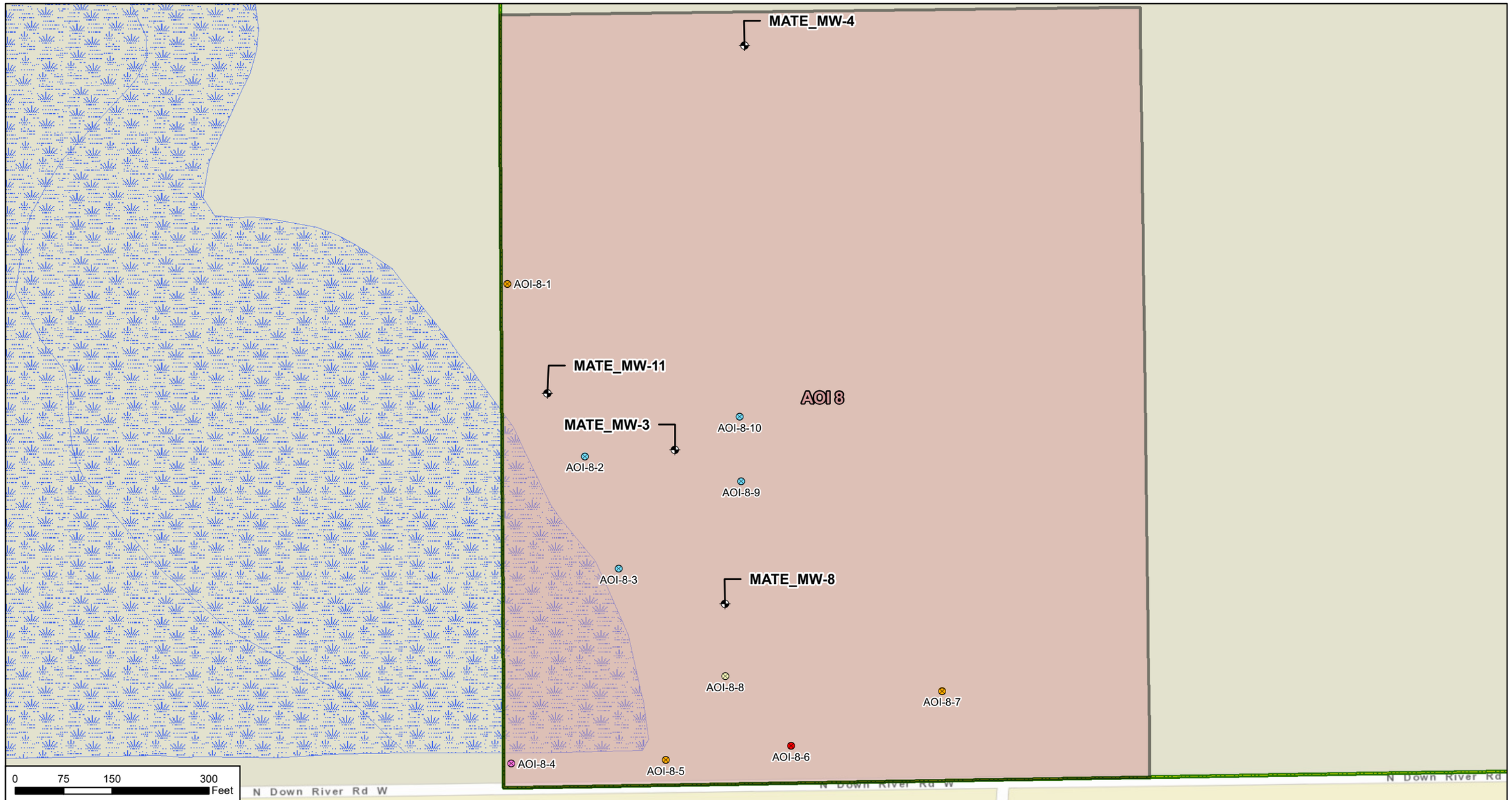
N

Mobilization 1 Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 5-1

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_5-1_Grayling_R30C_Phase_1_Sampling_Locations.mxd



CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	9/25/2019	GIS BY	MS	9/25/2019
SCALE	1:1,800	CHK BY	CM	9/25/2019
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	RG	9/25/2019

- Area of Interest
- Facility Boundary
- Water Body
- Wetland
- Monitoring Well
- 20 ft DPT Boring/Temporary well
- 25 ft DPT Boring/Temporary well
- 35 ft DPT Boring/Temporary well
- 40 ft DPT Boring/Temporary well
- 50 ft DPT Boring/Temporary well

N

Mobilization 2 Sample Locations

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 5-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_5-2_Grayling_R30C_Phase_2_Sampling_Locations.mxd

6. Site Inspection Results

This section presents the analytical results of the SI for each AOI. 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** through **Section 6.9**. **Table 6-2** through **Table 6-4** present PFAS results for samples with detections in soil and groundwater; only constituents detected in one or more samples are included. Tables that contain all results are provided in **Appendix H**, and the laboratory reports are provided in **Appendix I**.

6.1 Project Action 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 15 October 2019 (Assistant Secretary of Defense, 2019). 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 a RI, the next phase under CERCLA. The SLs apply to three compounds, PFOA, PFOS, and PFBS, for both soil and groundwater, as presented in **Table 6-1**.

All other results presented in this report are considered informational in nature and serve as an indication as to whether soil, groundwater, sediment, and surface water contain or do not contain PFAS within the boundaries of the facility.

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

Analyte	Residential (Soil) (µg/kg)[a,b] 0-2 feet bgs	Industrial/ Commercial Composite Worker (Soil) (µg/kg)[a,b] 2-15 feet bgs	Tap Water (Groundwater) (ng/L)[a,b]
PFOA	130	1,600	40
PFOS	130	1,600	40
PFBS	130,000	1,600,000	40,000

Notes:
a.) Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater and Soil using United States Environmental Protection Agency's (USEPA's) Regional Screening Level Calculator. HQ=0.1. 15 October 2019.
b.) If only one PFAS is present, a Hazard Quotient (HQ) of 1 applies and the values presented would increase by a factor of x10.

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 H** 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 (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 8

This section presents the analytical results for soil and groundwater for the Site. The detected compounds are presented in **Table 6-2** though **Table 6-4**. **Figures 6-1** through **6-4** present detections for PFOS and PFOA in soil and groundwater.

6.3.1 Soil Analytical Results

Soil samples were collected during Mobilization 2 from the MATES area, only. Soil was sampled from three intervals at AOI 8-9 and AOI 8-10. PFOA was detected in the two surface soil samples at concentrations 0.066 J micrograms per kilogram (µg/kg) and 0.051 J µg/kg, below the SL of 130 µg/kg. PFOA was detected in the shallow subsurface at concentrations 0.018 J µg/kg and 0.028 J µg/kg, below the SL of 1,600 µg/kg. PFOS and PFBS were not detected in any of the soil samples, and the highest detection of PFOA occurred at AOI 8-9, between 0 to 1 foot bgs.

The detected compounds from the soil sampling are summarized in **Table 6-2** and **Table 6-3**. . **Figures 6-1** and **6-2** present the ranges of detection for PFOS and PFOA for Mobilization 2.

6.3.2 Groundwater Analytical Results

During Mobilization 1, groundwater was sampled from 12 permanent monitoring wells. PFOS exceeded the SL of 40 ng/L at a concentration of 137 ng/L in one monitoring well, MATE-MW03, and was detected at a concentration of 17.3 ng/L in another monitoring well, MATE-MW8. PFOA was detected at concentrations ranging from 2.24 J ng/L to 13.5 ng/L, below the SL of 40 ng/L. PFBS was not detected in any of the groundwater samples. As described in **Section 2.4**, PFOS and PFOA were not detected in any of the downgradient potable wells surrounding the Range 30 Complex, and PFBS was detected in one well at a concentration of 2.33 J ng/L.

During Mobilization 2 at the MATES, groundwater sampled from 10 temporary wells and 4 permanent monitoring wells. PFOA exceeded the SL of 40 ng/L at a concentration of 60.7 ng/L in temporary well AOI 8-2. PFOS exceeded the SL of 40 ng/L at concentrations ranging from 41 ng/L to 7,810 ng/L in three temporary wells (AOI 8-2, AOI 8-3, and AOI 8-9) and one permanent monitoring well (MATE-MW03). The highest detections of PFOA and PFOS occurred at AOI 8-2, screened from 15-20 feet bgs, along the western boundary of MATES. PFBS was detected at concentrations 1.34 J ng/L and 2.96 J ng/L, below the SL of 40,000 ng/L. PFOA, PFOS, and PFBS were not detected in MATE-MW04, which is hydraulically upgradient of all locations with SL exceedances. The detected compounds from groundwater are summarized in **Table 6-4**. **Figures 6-3** and **6-4** present the ranges of detection for PFOS and PFOA for Mobilization 1 and 2, respectively.

6.3.3 Conclusions

Based on the results of the SI, PFOA was detected in soil at AOI 8; however, the detected concentrations were at least three orders of magnitude lower than the residential SL of 130 µg/kg for PFOA. PFOA and PFOS exceeded the individual SLs of 40 ng/L at MATES. PFOA, PFOS, and PFBS were not detected in groundwater around the Range 30 Complex. Based on knowledge of historical use and sources of PFAS, it is believed that the wash rack at MATES could represent the source of PFAS in the area.

Table 6-2
PFAS Detections in Surface Soil
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

	Area of Interest	AOI8			
	Sample ID	AOI-8-9-SB-0-1		AOI-8-10-SB-0-1	
	Sample Date	10/29/2018		10/29/2018	
	Depth	0 - 1 ft		0 - 1 ft	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual
Soil, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ug/Kg)					
PFHxA	-	ND		0.041	J
PFHxS	-	0.025	J	0.042	J
PFNA	-	0.022	J	ND	
PFOA	130	0.066	J	0.051	J
PFTrDA	-	0.032	J	ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on residential scenario for direct ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFTrDA	perfluorotridecanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography 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
ug/Kg	micrograms per Kilogram
-	Not applicable

Table 6-3
PFAS Detections in Shallow Subsurface Soil
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		AOI8									
Sample ID		AOI-8-9-SB-5-6		AOI-8-9-SB-5-6 DUP		AOI-8-9-SB-9-10		AOI-8-10-SB-5-6		AOI-8-10-SB-9-10	
Sample Date		10/29/2018		10/29/2018		10/29/2018		10/29/2018		10/29/2018	
Depth		5 - 6 ft		5 - 6 ft		9 - 10 ft		5 - 6 ft		9 - 10 ft	
Analyte	**OSD Screening Level [a]**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
Soil, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ug/Kg)											
8:2 FTS	-	0.014	J	0.00919	J	0.011	J	0.012	J	0.015	J
PFDA	-	ND		0.022	J	ND		ND		ND	
PFHxS	-	0.024	J	ND		0.016	J	0.027	J	0.022	J
PFOA	1600	ND		0.028	J	0.018	J	ND		ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Soil screening levels based on industrial/commercial composite worker scenario for incidental ingestion of contaminated soil.

Interpreted Qualifiers

J = Estimated concentration

Chemical Abbreviations

8:2 FTS	8:2 fluorotelomer sulfonate
PFDA	perfluorodecanoic acid
PFHxS	perfluorohexanesulfonic acid
PFOA	perfluorooctanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
DUP	Duplicate
ft	feet
HQ	Hazard quotient
LCMSMS	Liquid Chromatography 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
ug/Kg	micrograms per Kilogram
-	Not applicable

Table 6-4
PFAS Detections in Groundwater
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		AOI8																	
Sample ID		AOI-8-1-GW-35-40		AOI-8-2-GW-15-20		AOI-8-3-GW-15-20		AOI-8-4-GW-30-35		AOI-8-5-GW-35-40		AOI-8-6-GW-45-50		AOI-8-7-GW-35-40		AOI-8-8-GW-20-25		AOI-8-8-GW-20-25-DUP	
Screen Interval (feet bgs)		35-40		15-20		15-20		30-35		35-40		45-50		35-40		20-25		20-25	
Sample Date		10/26/2018		10/25/2018		10/25/2018		10/24/2018		10/24/2018		10/23/2018		10/23/2018		10/23/2018		10/23/2018	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ng/L)																			
6:2 FTS	-	ND		1980		32.4		ND		ND		ND		ND		ND		ND	
8:2 FTS	-	ND		139		3.12	J	ND		ND		ND		ND		ND		ND	
PFBA	-	ND		26.8		ND		ND		ND		123		ND		ND		ND	
PFBS	40000	ND		2.96	J	ND		ND		ND		ND		ND		ND		ND	
PFHpA	-	ND		46.9		ND		ND		ND		ND		ND		ND		ND	
PFHxA	-	ND		99.4		ND		ND		ND		ND		ND		ND		ND	
PFHxS	-	ND		192		29.6		ND		ND		3.51	J	ND		3.47	J	3.46	J
PFNA	-	ND		9.71	J	ND		ND		ND		ND		ND		ND		ND	
PFOA	40	ND		60.7		5.08	J	ND		ND		ND		ND		ND		ND	
PFOS	40	ND		7810		397		13.1		ND		ND		ND		ND		ND	
PFPeA	-	ND		113		4.72	J	ND		ND		ND		ND		ND		ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. 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.

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
bgs	below ground surface
DUP	Duplicate
GW	Groundwater
HQ	Hazard quotient
LCMSMS	Liquid Chromatography 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
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable

Table 6-4
PFAS Detections in Groundwater
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		AOI8															
Sample ID		AOI-8-9-GW-15-20		AOI-8-10-GW-15-20		AOI8-MATE-MW3-080218		AOI8-MATE-MW-3-101918		AOI8-MATE-MW4-080218		AOI8-MATE-MW-4-101818		AOI8-MATE-MW-4-101818 DUP		AOI8-MATE-MW8-080218	
Screen Interval (feet bgs)		15-20		15-20		26.75-31.75		26.75-31.75		74-79		74-79		74-79		16.6-21.6	
Sample Date		10/29/2018		10/30/2018		08/02/2018		10/19/2018		08/02/2018		10/18/2018		10/18/2018		08/02/2018	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ng/L)																	
6:2 FTS	-	ND		ND		33.5		3.92	J	ND		ND		ND		ND	
8:2 FTS	-	ND		ND		ND		ND		ND		ND		ND		ND	
PFBA	-	3.35	J	3.85	J	8.20	J	5.05	J	ND		ND		ND		2.20	J
PFBS	40000	ND		ND		ND		1.34	J	ND		ND		ND		ND	
PFHpA	-	5.31	J	ND		12.9		5.61	J	ND		ND		ND		3.01	J
PFHxA	-	8.72	J	ND		26.4		6.27	J	ND		ND		ND		5.42	J
PFHxS	-	21.5		1.77	J	116		35.3		ND		ND		ND		27.6	
PFNA	-	ND		ND		ND		ND		ND		ND		ND		ND	
PFOA	40	5.24	J	ND		13.5		7.38	J	ND		ND		ND		2.58	J
PFOS	40	41		18.3		137		142		ND		ND		ND		17.3	
PFPeA	-	10.9		ND		23.9		6.26	J	ND		ND		ND		5.65	J

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. 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.

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
bgs	below ground surface
DUP	Duplicate
GW	Groundwater
HQ	Hazard quotient
LCMSMS	Liquid Chromatography 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
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable

Table 6-4
PFAS Detections in Groundwater
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		AOI8															
Sample ID		AOI8-MATE-MW-8-101918		AOI8-MATE-MW11-080218		AOI8-MATE-MW-11-101818		AOI8-RG30-MW1-080118		AOI8-RG30-MW2-080318		AOI8-RG30-MW2-080318DUP		AOI8-RG30-MW3-073118		AOI8-RG30-MW3-073118 DUP	
Screen Interval (feet bgs)		16.6-21.6		4.25-9.25		4.25-9.25		91-96		58-63		58-63		45-50		45-50	
Sample Date		10/19/2018		08/02/2018		10/18/2018		08/01/2018		08/03/2018		08/03/2018		07/31/2018		07/31/2018	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ng/L)																	
6:2 FTS	-	ND		13.8		ND		ND		ND		ND		2.49	J	3.73	J
8:2 FTS	-	ND		ND		ND	UJ	ND		ND		ND		ND		ND	
PFBA	-	6.07	J	7.24	J	ND		6.53	J	ND		ND		ND		ND	
PFBS	40000	ND		ND		ND		ND		ND		ND		ND		ND	
PFHpA	-	8.98		4.39	J	ND		ND		ND		ND		ND		ND	
PFHxA	-	14.1		3.44	J	ND		ND		ND		ND		ND		ND	
PFHxS	-	48.6		11.9		4.17	J	ND		ND		ND		ND		ND	
PFNA	-	ND		ND		ND		ND		ND		ND		ND		ND	
PFOA	40	6.36	J	2.24	J	ND		ND		ND		ND		ND		ND	
PFOS	40	32.0		ND		ND		ND		ND		ND		ND		ND	
PFPeA	-	22.6		ND		ND		ND		ND		ND		ND		ND	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. 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.

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
bgs	below ground surface
DUP	Duplicate
GW	Groundwater
HQ	Hazard quotient
LCMSMS	Liquid Chromatography 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
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable

Table 6-4
PFAS Detections in Groundwater
Site Inspection Report, Range 30 Complex and MATES, Camp Grayling JMTC

Area of Interest		AOI8									
Sample ID		AOI8-RG30-MW4-080118		AOI8-RG30-MW5-073118		AOI8-RG30-MW6-073118		AOI8-RG30-MW7-073118		AOI8-RG30-MW8-080118	
Screen Interval (feet bgs)		74-79		30-35		15-20		18-23		64-69	
Sample Date		08/01/2018		07/31/2018		07/31/2018		07/31/2018		08/01/2018	
Analyte	OSD Screening Level [a]	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Water, PFAS by LCMSMS Compliant with QSM 5.1 Table B-15 (ng/L)											
6:2 FTS	-	ND		ND		ND		ND		ND	
8:2 FTS	-	ND		ND		ND		ND		ND	
PFBA	-	ND		ND		12.8		2.85	J	11.7	
PFBS	40000	ND		ND		ND		ND		ND	
PFHpA	-	ND		ND		ND		ND		2.13	J
PFHxA	-	ND		ND		ND		ND		2.85	J
PFHxS	-	ND		ND		ND		ND		ND	
PFNA	-	ND		ND		ND		ND		ND	
PFOA	40	ND		ND		ND		ND		ND	
PFOS	40	ND		ND		ND		ND		ND	
PFPeA	-	ND		ND		ND		ND		13.6	

Grey Fill — Detected concentration exceeded OSD Screening Levels

References

a. Assistant Secretary of Defense, 2019. Risk Based Screening Levels Calculated for PFOS, PFOA, PFBS in Groundwater or Soil using USEPA's Regional Screening Level Calculator. HQ=0.1. 15 October 2019. Groundwater screening levels based on residential scenario for direct ingestion of groundwater.

Interpreted Qualifiers

J = Estimated concentration

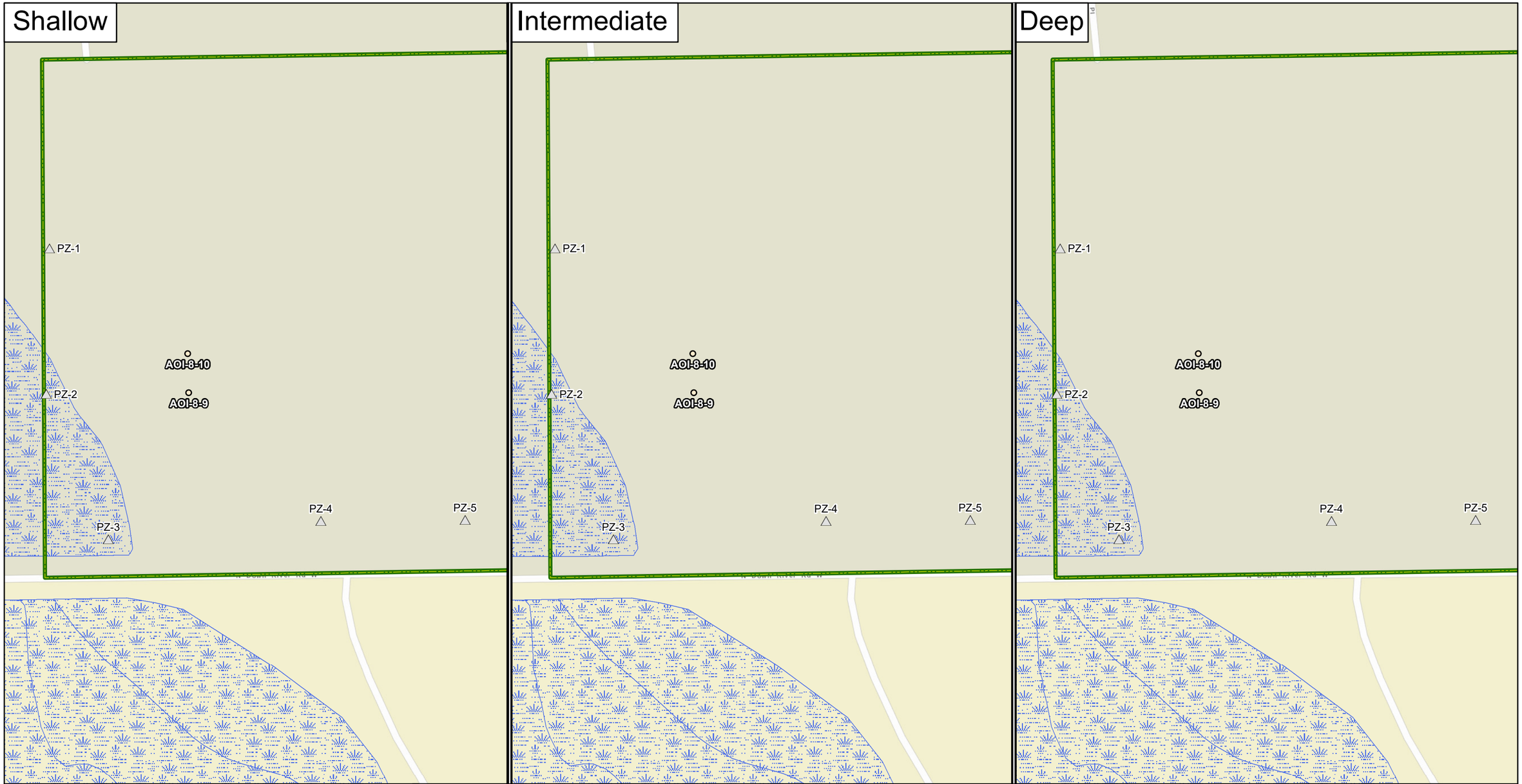
UJ = The analyte was not detected at a level greater than or equal to the adjusted DL. However, the reported adjusted DL is approximate and may be inaccurate or imprecise.

Chemical Abbreviations

6:2 FTS	6:2 fluorotelomer sulfonate
8:2 FTS	8:2 fluorotelomer sulfonate
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFPeA	perfluoropentanoic acid

Acronyms and Abbreviations

AOI	Area of Interest
bgs	below ground surface
DUP	Duplicate
GW	Groundwater
HQ	Hazard quotient
LCMSMS	Liquid Chromatography 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
USEPA	United States Environmental Protection Agency
ng/L	nanogram per liter
-	Not applicable



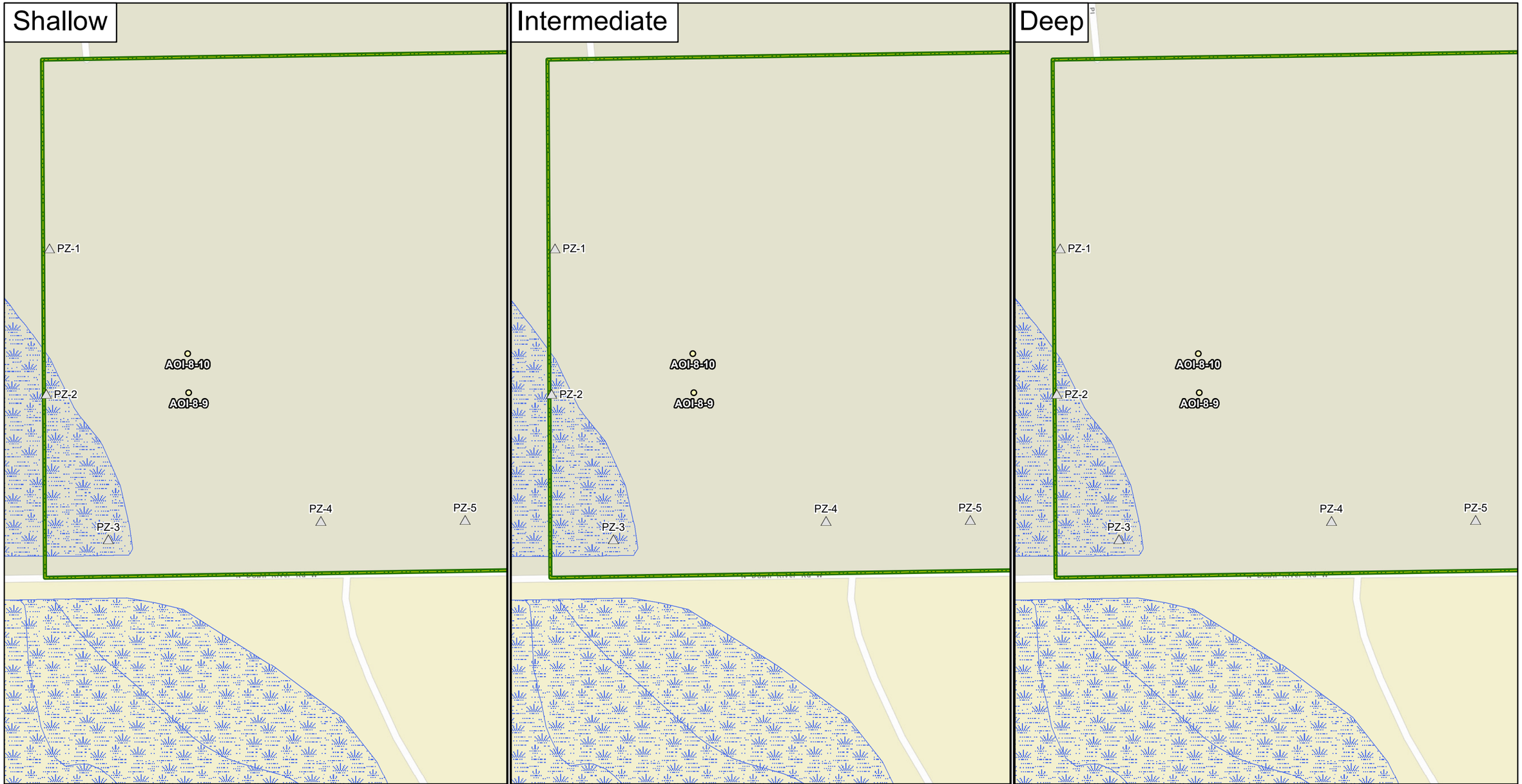
CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	1/2/2020	GIS BY	MS	1/2/2020
SCALE	1:3,000	CHK BY	CM	1/2/2020
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)		PM	RG	1/2/2020

PFOS Detections in Soil (AOI 1, Mobilization 2)

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-1

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_6-1_Grayling_R30_SI_PFOS_Soil_Results_Shallow_Inter_Deep.mxd



CLIENT	ARNG
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI

REVISED	1/2/2020	GIS BY	MS	1/2/2020
SCALE	1:3,000	CHK BY	CM	1/2/2020
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	RG	1/2/2020

Facility Boundary
Wetland
Piezometer

PFOA results (µg/Kg)

- ND-0.1
- >0.1-10
- >10-130
- >130-1,600
- >1,600

0 125 250 500 Feet

N

PFOA Detections in Soil (AOI 8, Mobilization 2)

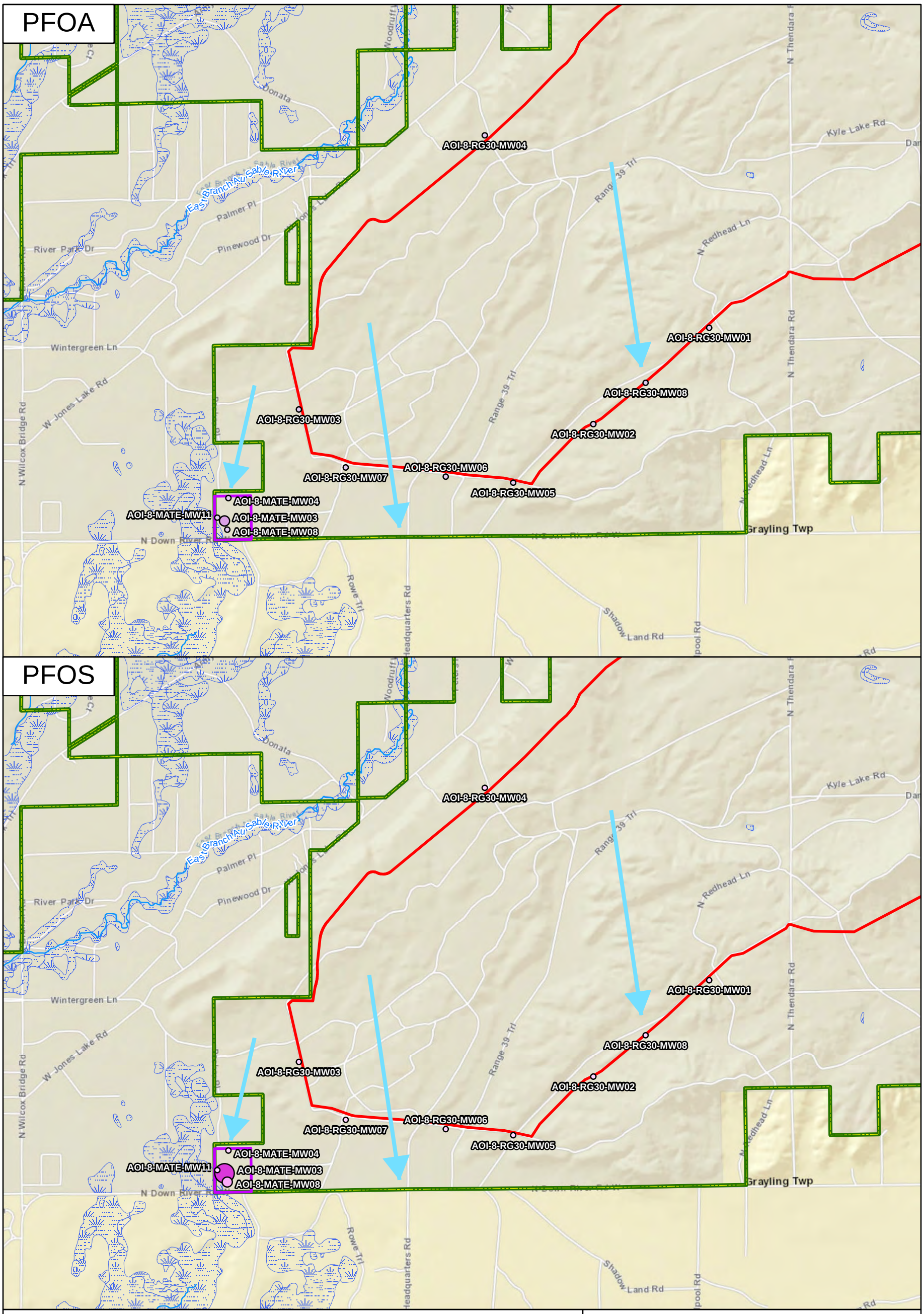
AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-2

Q:\Projects\ENV\GEARS\GEO\ARNG PFAS\900-CAD-GIS\920-GIS or Graphics\MXD\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_6-2_Grayling_R30_SI_PFOA_Soil_Results_Shallow_Inter_Deep.mxd

PFOA

PFOS



MATES
Range 30 Complex
Facility Boundary
Water Body
Wetland
River/Stream
Groundwater Flow Direction

PFOA Results (ng/L)	PFOS Results (ng/L)
ND - 10	ND - 10
>10 - 40	>10 - 40
>40 - 70	>40 - 70
>70 - 400	>70 - 400
>400	>400

ng/L = nanograms per liter

0 0.25 0.5 1 Miles

PFOS and PFOA Detections in Groundwater (AOI 8, Mobilization 1)

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	10/14/2020	GIS BY	MS	10/14/2020
SCALE	1:31,680	CHK BY	CM	10/14/2020
Base Map: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong		PM	RG	10/14/2020

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-3

C:\Users\stankevichm\OneDrive - AECOM Directory\ARNG_PFAS_GIS_60552172\MXDs\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_6-3_Grayling_R30_SI_PFOS+PFOA_Combined_P1_GW_Portrait.mxd

PFOA

PFOS

AOI-8-MATE-MW04
AOI-8-1
AOI-8-MATE-MW11
AOI-8-10
AOI-8-MATE-MW03
AOI-8-2
AOI-8-9
AOI-8-3
AOI-8-MATE-MW08
AOI-8-8
AOI-8-7
AOI-8-5
AOI-8-6
AOI-8-4
N Down River Rd W

0 100 200 400 Feet

CLIENT	ARNG			
PROJECT	Site Inspection for PFAS at Camp Grayling, Range 30 Complex, MI			
REVISED	10/15/2020	GIS BY	MS	10/15/2020
SCALE	1:2,400	CHK BY	CM	10/15/2020
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	RG	10/15/2020

Facility Boundary
Water Body
Wetland
River/Stream
Groundwater Flow Direction

PFOA Results (ng/L)
ND-10
>10-40
>40-70
>70-400
>400

PFOS Results (ng/L)
ND-10
>10-40
>40-70
>70-400
>400

ng/L = nanograms per liter

N

PFOS and PFOA Detections in Groundwater (AOI 8, Mobilization 2)

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 6-4

C:\Users\stankevichm\OneDrive - AECOM Directory\ARNG_PFAS_GIS_60552172\MXDs\MI\Grayling\SI_Figures\Range_30_Complex_SI_Figures\Range_30_SI_Report\Fig_6-4_Grayling_R30_SI_PFOS+PFOA_Combined_P2_GW.mxd

7. Exposure Pathways

The CSMs for each AOI, revised based on the SI findings, are presented on **Figure 7-1** and **Figure 7-2**. 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 PFOA, PFOS, or PFBS 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 PFOA, PFOS, or PFBS above the SLs. Areas with an identified potentially complete pathway may warrant further investigation.

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 is sparse and continues 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 the Site include site workers (e.g., Camp Grayling staff and visiting soldiers), construction workers, fulltime and part time residents outside the facility boundary, trespassers, and recreational users.

7.1 Soil Exposure Pathway

The SI results for PFOA, PFOS, and PFBS in 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 8- Range 30 Complex

Historically, training activities occasionally resulted in the ignition of wildfires within different portions of the Range 30 Complex. AFFF “wet water” or the alternative wetting agent (i.e., used by MDNR) was used to extinguish wildfires during the active period of AFFF use in the 1970s and 1980s. The number of emergency responses to the complex is not known. Additionally, the chemical composition of the AFFF “wet water” and the wetting agent is unknown. No soil samples were collected within the Range 30 Complex due to issues related to military munitions; however, if AFFF were to be released to soil, due to the chemical and physical properties of PFAS, it would be expected to see contamination in groundwater. Based on the groundwater data collected around the Range 30 Complex, the soil exposure pathway for all evaluated receptors is considered incomplete. The CSM is presented on **Figure 7-1**.

7.1.2 AOI 8- MATES

Although there are no documented releases or uses of AFFF at the MATES, PFOA was detected in soil below the SLs at the MATES and confirm the release of PFAS to soil in MATES. Additionally, the groundwater results support the conclusion that a release occurred at MATES. As such, ground disturbing activities could potentially result in site worker and future construction worker exposure to PFOA via inhalation of dust or ingestion of soil. No current construction is occurring at MATES. Additionally, off-facility residents and recreational users may be potentially exposed to PFOA via inhalation of dust caused by on-facility ground disturbing activities, although this exposure is likely insignificant. The CSM is presented on **Figure 7-2**.

7.2 Groundwater Exposure Pathway

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

7.2.1 AOI 8- Range 30 Complex

PFOA, PFOS, and PFBS were detected in groundwater at MATES, downgradient of the source area at the Range 30 Complex. However, PFOA, PFOS, and PFBS were not detected in any groundwater samples surrounding the Range 30 Complex, downgradient of potential PFAS release area (i.e., AOI8-RG30-MW01 through 03, AOI08-RG30-MW05 through 08). The groundwater results suggest that the source area is originating from MATES and not the Range 30 Complex. Therefore, the ingestion pathway for all receptors is incomplete. The CSM is presented on **Figure 7-1**.

7.2.2 AOI 8- MATES

PFOA, PFOS, and PFBS were detected in groundwater at the source area and facility boundary at the MATES including exceedances of the individual SLs for PFOS and PFOA. As described in **Section 2.4**, Camp Grayling collected samples from two potable wells located on MATES in 2017, 2018 and 2019 (B01422 and backup well 01421). PFOS and/or PFOA were detected in these samples at concentrations below 5 ng/L which is below the HA of 70 ng/L. Additionally, PFOA, PFOS, and PFBS were not detected in groundwater in the most upgradient location near the northern boundary, MATE-MW04, which suggests the release occurred on the MATES property in the vicinity of the wash rack and rapid sand filters.

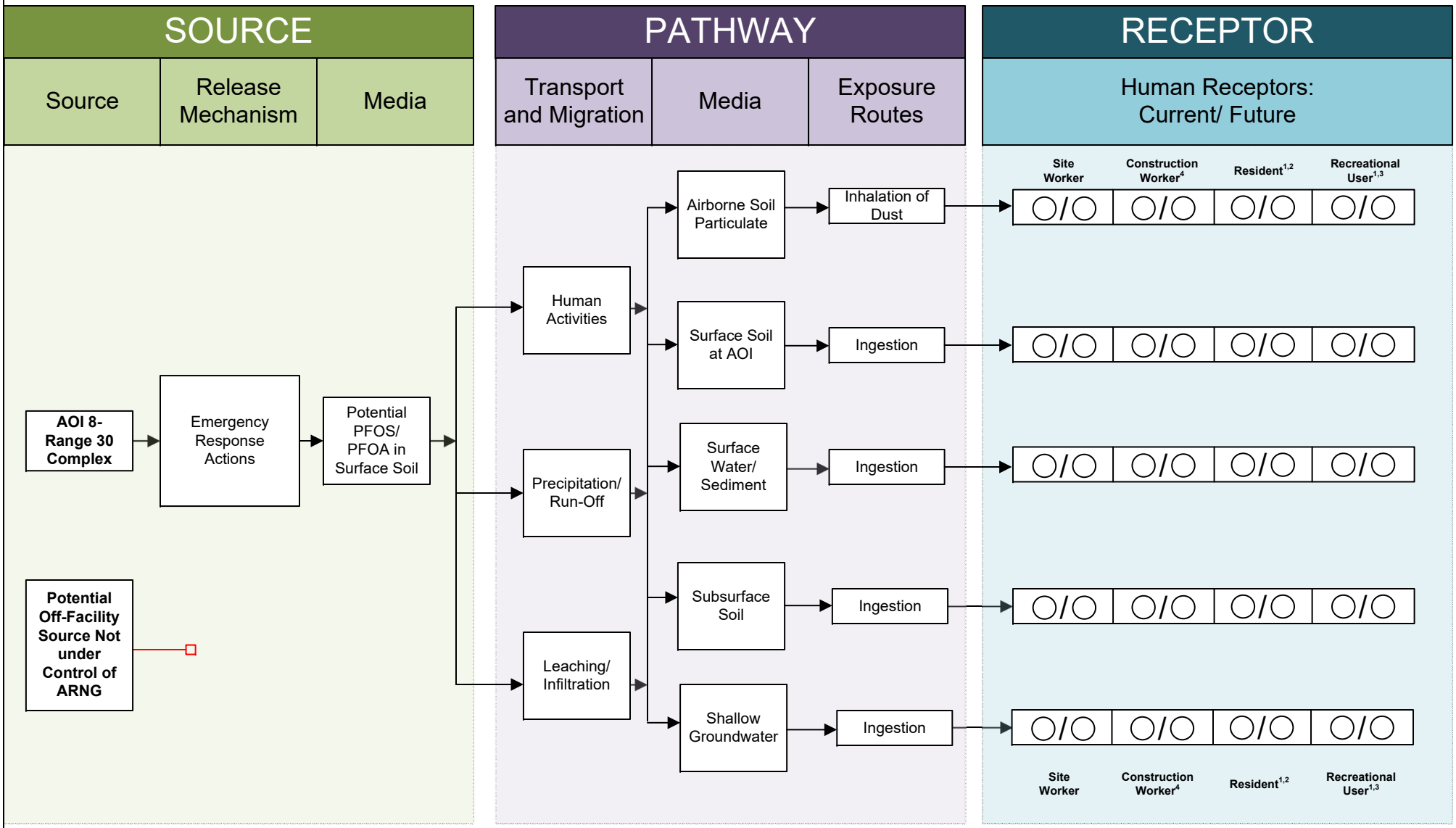
Based on the groundwater results and the on-facility potable well sampling performed in 2017, 2018 and 2019, the ingestion exposure pathway is potentially complete for current and future site workers, and complete for future construction workers. Private residential drinking water well sampling, downgradient of MATES confirmed PFOS and PFOA are not present in drinking water, therefore, the exposure pathway for current residents or recreational users is incomplete. Because the mechanism and timing of PFAS release to the environment at MATES is unknown, the drinking water pathway is considered potentially complete for future residents and recreational users due to the potential migration of groundwater towards the receptors. The CSM is presented on **Figure 7-2**.

7.3 Surface Water and Sediment Exposure Pathway

The ingestion exposure pathways for surface water and sediment are potentially complete for residents and recreational users of the Au Sable River based on the groundwater concentrations from MATES, only. The ingestion exposure pathway is relevant to incidental ingestion during

recreational use of the Au Sable River, only, as surface water is not used as a drinking water source from this water body. Surface water and sediment in the Au Sable River were not sampled as part of this SI, as the scope of sampling was limited to the presence or absence of PFOS, PFOA, and PFBS within the Site boundary. Therefore, the ingestion exposure pathways for surface water and sediment are potentially complete for off-facility residents and recreational users outside the facility of the Au Sable.

THIS PAGE INTENTIONALLY BLANK



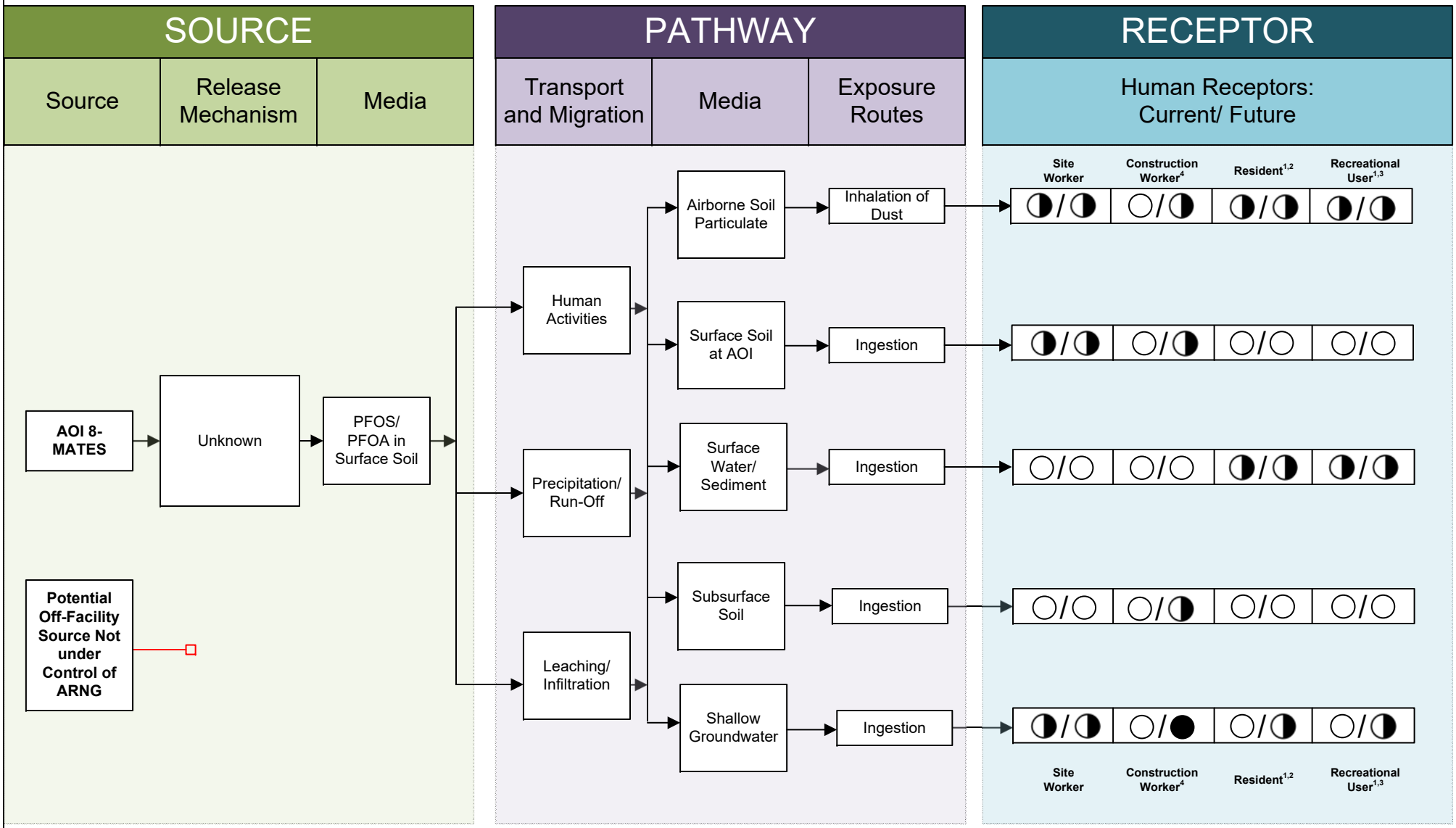
LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Complete Pathway

NOTES

1. The resident and recreational users refer to off-site receptors.
2. Inhalation of dust for off-site receptors is likely insignificant.
3. Human consumption of fish potentially affected by PFAS is possible.
4. No current active construction at Range 30 Complex.

Figure 7-1
Conceptual Site Model
AOI 8 Range 30 Complex



LEGEND

- Flow-Chart Stops
- Flow-Chart Continues
- Partial / Possible Flow
- Incomplete Pathway
- Potentially Complete Pathway
- Complete Pathway

NOTES

1. The resident and recreational users refer to off-site receptors.
2. Inhalation of dust for off-site receptors is likely insignificant.
3. Human consumption of fish potentially affected by PFAS is possible.
4. No current active construction at MATES.

Figure 7-2
Conceptual Site Model
AOI 8 MATES

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 Summary

SI field activities were conducted in two mobilizations. Mobilization 1 was groundwater sampling from 30 July to 3 August 2018; Mobilization 2 was grab soil and groundwater sampling from 18 to 30 October 2018. Field activities were conducted in accordance with the QAPP Addendum (AECOM, 2018b), except as previously noted in **Section 5.9**.

To fulfill the project DQOs set forth in the approved SI QAPP Addendum (AECOM, 2018b), samples were collected and analyzed for PFAS by LC/MS/MS QSM 5.1 Table B-15 as follows:

Mobilization 1 –

- 12 groundwater samples from permanent monitoring well locations.

Mobilization 2 –

- 6 grab soil samples from 2 boring locations;
- 10 grab groundwater samples from 10 temporary well locations; and
- 4 groundwater samples from permanent monitoring well locations.

The information gathered during this investigation was used to determine if PFOA, PFOS, and/or PFBS were present at or above SLs. Additionally, the CSMs were refined to assess whether a potentially complete pathway exists between the source and potential receptors for potential exposure to PFOA, PFOS, and PFBS at the AOIs, which are described in **Section 7**.

8.2 SI Goals Evaluation

As described in **Section 4.2**, the SI activities were designed to achieve six main goals or DQOs. This section describes the SI goals and the conclusions that can be made for each based on the data collected during this investigation.

1) *Determine the presence or absence of PFAS contamination at the Site.*

   PFOA, PFOS, and/or PFBS were detected in both soil and groundwater at AOI 8: MATES but not in groundwater at AOI 8: Range 30 Complex. PFOA, PFOS, and/or PFBS were also detected at the facility boundary between source areas and potential drinking water receptors. Detections in groundwater at MATES exceeded the SL or 40 ng/L for PFOA and PFOS. The detected concentrations of PFOA, PFOS, and PFBS in all soil samples were below the SLs.

2) *Develop information to potentially eliminate a release from further consideration because it is determined that it poses no significant threat to human health or the environment.*

   Based on exceedances of PFOA and PFOS in groundwater at MATES, only, this area has the potential to pose a significant threat to human health or the environment. PFOA, PFOS, and PFBS were not detected in groundwater at Range 30 Complex, so this potential source area was removed from further consideration.

3) *Determine the potential need for a removal action.*

As described in **Section 2.4**, in November 2018, December 2018 and February 2019, ARNG collected off-facility drinking water samples due to the exceedance of PFOS SL observed in groundwater during the August 2018 SI from MATE-MW03. Twenty-three (23) properties along South Headquarters Road, West North Down River Road, Siedell Way, Packer Place and Pine Oak Trail were selected to be sampled due to their proximity to MATES. PFOS and PFOA were not detected in any of the drinking water samples collected. Therefore, the need for a removal action due to an impacted drinking water receptor does not exist.

4) *Collect data to better characterize the release areas for more effective and rapid initiation of a RI.*

   The geological data collected as part of the SI indicate a highly permeable and conductive environment, with soils dominated by well-graded sand with thin beds and lenses of gravel and mud clasts. These site observations are consistent with sedimentary deposition from a braided river in a glaciofluvial environment. The well-graded sands represent the bulk of the sediment load transported and deposited in the braided river system, supplied by melting ice at the glacier terminus. The well-graded gravel intervals represent isolated point bar deposits, whereas the siltier and thin clayey intervals likely represent discontinuous floodplain deposits characteristic of braided rivers. Thicker clay deposits represent isolated channel fill, as the braids migrated and abandoned former channel flow paths.

   Depth to water at the Site ranges from approximately 6 to 11 feet bgs, and groundwater flow is in a north-south trending direction. These geologic and hydrogeologic observations inform development of technical approach for the RI.

5) *Identify within 4 miles of the installation other potential PFAS sources (fire stations, major manufacturers, other DoD facilities) and receptors, including both groundwater and surface water receptors, to determine whether the ARNG is the likely source of PFAS, or whether there is an off-facility source of PFAS responsible for installation detections of PFAS (USEPA, 2005).*

   Based upon the qualitative evaluation of soil results in combination with quantitative groundwater results and groundwater flow direction analysis, the source of PFAS contamination is likely the result of historical DoD activities.

6) *Determine whether a potentially complete pathway exists between the source and potential receptors and whether the contamination is attributable to ARNG activities.*

   As determined through drinking water sampling described under goal #3, a complete pathway does not exist between the source and drinking water receptors.

8.3 Outcome

Based on the CSM developed and revised based on SI findings, and off-facility drinking water sampling, there is no current exposure to residential drinking water receptors from sources on the Site from AFFF releases resulting from ARNG activities. Off-facility drinking water sampling performed by ARNG at 23 residences west and south of MATES indicates downgradient drinking water receptors are not impacted.

Sample chemical analytical concentrations collected during the SI were compared against the project SLs for PFOA, PFOS, and PFBS in soil and groundwater, as described in **Table 6-1**. The following bullets summarize the SI results:

- PFOA, PFOS, and PFBS were not detected in groundwater at any wells surrounding the Range 30 Complex (i.e., excluding MATES).

- PFOA and/or PFOS in groundwater exceeded the individual SLs of 40 ng/L in groundwater at MATES and at the facility boundary. The maximum PFOA and PFOS concentrations were 60.7 ng/L and 7,810 ng/L, respectively, at temporary well AOI 8-2, located on the western MATES boundary. Based on the results of the SI, further evaluation of MATES is warranted in the RI.

- The detected concentrations of PFOA in soil samples from MATES were below the SLs. PFOS and PFBS were not detected in soil. Although there were no exceedances, PFAS in soil will be evaluated further in an RI.

- Based on the SI findings, exceedances of the SLs were observed in groundwater for PFOA and PFOS at MATES. Camp Grayling collected samples from two potable wells located on MATES in 2017, 2018 and 2019. PFOS and/or PFOA were detected in these samples at very low concentrations (below 5 ng/L). Additionally, PFOA, PFOS, and PFBS were not detected in groundwater in the most upgradient location near the northern boundary, which suggests the release occurred on the MATES property in the vicinity of the wash rack and rapid sand filters.

Table 8-2 summarizes the SI results for soil and groundwater. Based on the CSMs developed and revised based on the SI findings, there is potential for exposure to residential drinking water receptors from AOI 8: MATES caused by DoD activities. However, ARNG performed drinking water sampling at downgradient and side-gradient drinking water receptors, and no exceedances over 70 ng/L for PFOA and/or PFOS were observed. Results of the residential sampling effort near the MATES were provided to residents via letter.

Table 8-3 summarizes the rationale used to determine if an AOI should be considered for further investigation under CERCLA and undergo an RI. Based on the results of this SI, further evaluation is warranted in the RI for AOI 8: MATES.

Table 8-1: Summary of Site Inspection Findings

AOI	Potential PFAS Release Area	Soil-Source Area	Groundwater-Source Area	Groundwater-Near Boundary
8	Range 30 Complex	NA	○	○
8	MATES	◐	●	●

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

Table 8-2: Site Inspection Recommendations

AOI	Description	Rationale	Future Action
8	Range 30 Complex	No exceedances of SLs in groundwater.	No further action
8	MATES	Exceedances of SLs in groundwater at the source area and facility boundary. No exceedances of SLs in soil.	Proceed to RI

9. References

AECOM. 2018a. *Final Site Inspection Programmatic Uniform Federal Policy-Quality Assurance Project Plan, Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/W912DR17F0192*. 9 March.

AECOM. 2018b. *Final Site Inspection Quality Assurance Project Plan Addendum, Camp Grayling Range 30 Complex, Michigan, Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/W912DR17F0192*. July.

AECOM. 2018c. *Final Programmatic Accident Prevention Plan, Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide. Contract No. W912DR-12-D-0014/W912DR17F0192*. July.

AECOM. 2018d. *Final Site Safety and Health Plan, Camp Grayling, Michigan, Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/W912DR17F0192*. July.

AECOM. 2018e. *Final Preliminary Assessment Report, Camp Grayling, Michigan, Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/W912DR17F0192*. August.

AECOM. 2018f. *Final Supplemental Site Inspection Quality Assurance Project Plan Addendum, Range 30 Complex and Maneuver Area Training Equipment Site, Camp Grayling, Michigan, Perfluorooctanesulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) Impacted Sites ARNG Installations, Nationwide Contract No. W912DR-12-D-0014/W912DR17F0192*. October.

ATSDR. 2018. *An Overview of Perfluoroalkyl and Polyfluoroalkyl Substances and Interim Guidance for Clinicians Responding to Patient Exposure Concerns.* 7 May.

Albert, Dennis A. 1995. Regional landscape ecosystems of Michigan, Minnesota, and Wisconsin: a working map and classification. Gen. Tech. Rep. NC-178. Accessed March 2018 at https://www.nrs.fs.fed.us/pubs/gtr/other/gtr-nc178/index.html..

Assistant Secretary of Defense. 2019. *Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program*. 15 October.

DA. 2016. *EM-200-1-2, Environmental Quality, Technical Project Planning Process.* 29 February.

DA. 2018. *Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances.* 4 September.

Envirologic Technologies, Inc. 2003. *Land Condition Trend Analysis Facility Report, 1992-2001 of Camp Grayling Maneuver Training Center*.

EAHA. 1986. *Camp Grayling Environmental Management Analysis and Phase II Environmental Baseline*.

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

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

ITRC. 2018. *Environmental Fate ant Transport for Per- and Polyfluoroalkyl Substances*. March.

MDMVA. 2007. *Camp Grayling Maneuver Training Center Integrated Natural Resources Management Plan (2007-2011).* January 2007.

National Guard Bureau & MDMVA. 1994. *Mission Expansion/Multiple Construction: Camp Grayling Army National Guard Training Site, Michigan. Final Environmental Impact Statement.*

MDNR. 2013. *Northern Lower Peninsula Regional State Forest Management Plan. Forest Resources Division and Wildlife Division.* December.

NOAA. 2018. *Climate Data Online.* Accessed March 2018 at https://www.ncdc.noaa.gov/cdo-web/.

Parsons Engineering Science, Inc. 2001. *Final Wellhead Protection Plan, Camp Grayling Maneuver Training Center, Grayling, Michigan*.

URS Group, Inc. 2013. *Operational Range Assessment, Phase II Report, Camp Grayling, Michigan.* June 2013.

USEPA. 1980. *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*.

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

USEPA. 2005*. Federal Facilities Remedial Site Inspection Summary Guide.*

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

USEPA. 2012. *Third Unregulated Contaminant Monitoring Rule (UCMR-3)*. Accessed March 2018 at https://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule. May.

USEPA. 2016a. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). Office of Water (4304T).* Health and Ecological Criteria Division, Washington, DC 20460. US EPA Document Number: 822-R-16-005. May.

USEPA, 2016b. *Drinking Water Health Advisory for Perfluorooctane Sulfonate Acid (PFOS). Office of Water (4304T).* Health and Ecological Criteria Division, Washington, DC 20460. US EPA Document Number: 822-R-16-004. May.

USEPA. 2018. *Regional Screening Levels – Generic Tables (May 2018). Residential – Direct Contact Soil.* Accessed 8 May 2018 at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

USFWS. 2018. *Environmental Conservation Online System.* Accessed 14 February 2019 at https://ecos.fws.gov/ecp/.

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.