FINAL

AREA 2 FIELD SAMPLING PLAN

ADDENDUM TO REMEDIAL INVESTIGATION WORK PLAN

FOR PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

FORMER FORT DEVENS ARMY INSTALLATION, DEVENS, MA

DECEMBER 2018

Prepared for:
U.S. Army Corps of Engineers
New England District
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Contract No.: W912WJ-18-C-0011

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The United States Department of Defense, Department of Army, funded wholly or in part the preparation of this document and work described herein under Contract No. W912WJ-18-C-0011. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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for Per- and Polyfluoroalkyl Substances (PFAS)

Former Fort Devens Army Installation

Devens, Massachusetts

December 2018

CERTIFICATION:

I hereby certify that the enclosed Report, shown and marked in this submittal, is that proposed to be incorporated with Contract Number W912WJ-18-C-0011. This document was prepared in accordance with the U.S. Army Corps of Engineers (USACE) Scope of Work and is hereby submitted for Government approval.

Reviewed By:

12/6/18

KGS Project Manager **Date**

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USACE Project Manager **Date**

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AAFES	Army Air Force Exchange Service
AFFF	aqueous film-forming foam
AOC	Area of Contamination
bgs	below ground surface
cm/sec	centimeter per second
CSM	conceptual site model
Devens	former Fort Devens Army Installation
DOC	dissolved organic carbon
DPT	direct push technology
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
FSP	Field Sampling Plan
ft	feet/foot
HERA	Draft Baseline Human Health Risk Assessment and Screening Level Ecological Risk Assessment
IDW	investigation derived waste
KGS	KOMAN Government Solutions
LHA	lifetime health advisory
LTM	long-term monitoring
MassDEP	Massachusetts Department of Environmental Protection
MNA	monitored natural attenuation
ng/L	nanograms per liter
NIA	North Impact Area
ORSG	Office of Research and Standards Guideline
PA	Preliminary Assessment
PFAS	per-and polyfluoroalkyl substances
PFHpA	perfluoroheptanoic acid
PFHxS	perfluorohexane sulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
POL	Petroleum, Oil, and Lubricants
QC	quality control
RI	Remedial Investigation
ROD	Record of Decision
RQD	rock quality designations
SHL	Shepley’s Hill Landfill

ACRONYMS AND ABBREVIATIONS

SI	Site Inspection
SOP	standard operating procedure
SSL	site-specific screening level
TOC	total organic carbon
TOP	total oxidizable precursor
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
USACE	United States Army Corps of Engineers, New England District
USEPA	United States Environmental Protection Agency
UST	underground storage tank

1.0 INTRODUCTION AND BACKGROUND

This Field Sampling Plan (FSP) for Area 2 at Former Fort Devens Army Installation (Devens) located in Devens, Massachusetts has been prepared by KOMAN Government Solutions (KGS) on behalf of the United States Army Corps of Engineers, New England District (USACE) and has been generated as an addendum to the *Draft Remedial Investigation Work Plan for Per- and Polyfluoroalkyl Substances (PFAS)* (KGS, 2018a). Area 2 consists of Areas of Contamination (AOC) 05, 32/43A, 43G, 43J, and 76 at Devens as well as the MacPherson water supply well investigation area (Figure 1). The other AOCs and areas of investigation for the Remedial Investigation (RI) will be addressed as part of Area 1 and Area 3 FSPs. Areas 1, 2, and 3 were designated for sequencing of field activities and do not represent prioritization.

A base-wide Preliminary Assessment (PA) for per- and polyfluoroalkyl substances (PFAS) was completed in 2017 (KGS, 2017) that identified several AOCs at Devens where aqueous film-forming foam (AFFF), which is a source of PFAS, was stored, used, or released. A Site Inspection (SI) (BERS-Weston, 2018b), a one-time sampling of existing long-term monitoring (LTM) wells (KGS, 2018b), and SI Addendum (BERS-Weston, 2018a) were subsequently completed and concluded that PFAS are present in groundwater and soil at several AOCs in Area 2. In addition, PFAS have been detected in the MacPherson water supply well, which is located on Devens (Figure 1). Therefore, the Army is conducting an RI under the Comprehensive Environmental Response, Compensation, and Liability Act to determine the nature and extent of PFAS in groundwater, soil, surface water, and sediment at AOCs 05, 32/43A, 43G, 43J, and 76 at Devens, to determine whether sources at Devens are impacting public water supply wells, and to evaluate whether PFAS are present in environmental media at Devens at concentrations that pose an unacceptable risk to human health or the environment.

2.0 OBJECTIVES

The purpose of this FSP is to provide the sampling design and rationale associated with each AOC for Area 2 and is intended to be used in conjunction with the RI Work Plan (KGS, 2018a) and the project Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) [Appendix A of the RI Work Plan (KGS, 2018a)]. This FSP has been developed to support the study goals, questions and decision statements summarized in Worksheet #11 (Data Quality Objectives) of the UFP-QAPP. All of the PFAS UFP-QAPP worksheets referenced in this FSP are provided in Appendix A of this FSP. A conceptual site model (CSM) for the presence of PFAS in the environment at Devens and potential exposure pathways are provided in Section 3 of the RI Work Plan. AOC-specific CSM details are provided in Section 5.0 of this FSP.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The organizational structure for the PFAS RI at Devens is provided in combined Worksheet #3 and #5 (Project Organization and UFP-QAPP Distribution) of the UFP-QAPP. Personnel qualifications for key project personnel are summarized on combined Worksheet #4, #7, and #8 (Personnel Qualifications) of the UFP-QAPP. Communication pathways are provided in Worksheet #6 (Communication Pathways) of the UFP-QAPP (Appendix A).

4.0 GENERAL REMEDIAL INVESTIGATION APPROACH

This section provides a general overview of the RI approach at Area 2. A discussion of the CSM and data quality objectives (DQO) for PFAS at each AOC as well as figures and tables that provide the sampling plan for each AOC, are provided in Section 5.0 of this FSP. Requirements for collection of field quality control samples are discussed in Section 6.0. A listing of field standard operating procedures (SOP) applicable to the Area 2 investigation is provided in Section 7.0. Sample packaging and shipping requirements are summarized in Section 8.0. Management of investigation-derived waste (IDW) is summarized in Section 9.0 and processes for field assessment and corrective actions are presented in Section 10.0.

Field work in RI Area 2 will be conducted using an approach that will allow for timely collection, receipt, and review of data that will be incorporated into the CSM for each AOC and that will help guide additional field activities, if needed. The investigation program is intended to be dynamic such that the initial proposed activities will be completed, and the results provided and discussed with the U.S. Environmental Protection Agency (USEPA) and Massachusetts Department of Environmental Protection (MassDEP) to expedite selection and implementation of additional activities needed to achieve the study goals and DQOs specified in UFP-QAPP Worksheet #11 (Data Quality Objectives) at Area 2 (Appendix A). A scoping meeting was conducted on August 29, 2018 to discuss sampling locations with the base closure team and stakeholders for Area 2.

4.1 Evaluation of Previous PFAS Results

The PFAS groundwater and soil data obtained during the SI (BERS-Weston, 2018b), a one-time sampling of existing LTM wells (KGS, 2018b), and SI Addendum (BERS-Weston, 2018a) were used to develop the sampling plan for Area 2. No surface water or sediment samples were collected from Area 2 surface water bodies during the SI or SI addendum (BERS-Weston, 2018b and 2018a) or the LTM sampling (KGS, 2018b).

Historic PFAS groundwater results at Area 2 AOCs are compared to the USEPA Lifetime Health Advisory (LHA) of 70 nanograms per liter (ng/L) for the sum of perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA).

4.2 Groundwater Investigation

An extensive groundwater monitoring well network is available at many of the AOCs being investigated at Area 2. Whenever possible, existing monitoring wells will be sampled for PFAS analysis to provide data regarding the extent of PFAS in groundwater at Devens. The existing groundwater monitoring well network will be augmented with groundwater vertical profile sampling (“profiling”) involving direct push technology (DPT) and/or possibly sonic drilling technology, both of which are proven to provide representative groundwater samples that will support the objectives of this RI, as outlined in Section 2.0 of the RI Workplan (KGS, 2018a). The groundwater vertical profiling will be conducted in conjunction with sampling of existing monitoring wells to delineate PFAS groundwater contamination vertically and laterally in the aquifer.

4.3 Soil Investigation

Surface and subsurface soil samples will be collected for PFAS analysis from the unsaturated zone to identify and/or confirm the location of potential PFAS source areas that have been tentatively identified at AOC 76 in the SI Addendum (BERS-Weston, 2018a). While PFAS have been reported in groundwater at AOCs 32/43A, 43G, 43J and at the MacPherson municipal water supply well, a potential source for PFAS groundwater contamination was not identified. For these AOCs where groundwater contamination has been reported but no known source has been identified, the additional groundwater data collected during this RI will be reviewed to identify unknown source areas that may potentially be located at Devens. If the groundwater data indicate a previously unidentified source area at Area 2, additional soil sampling may be completed to define the nature and extent in soil and provide data that can be used in support of the Risk Assessment.

At AOC 05, based on the lack of known use of AFFF at SHL and a review of the groundwater results obtained during the SI (BERS-Weston, 2018b) and LTM sampling (KGS, 2018b) the presence of low concentration PFAS in groundwater within SHL is not attributed to a specific point sources involving past activities associated with the use of AFFF (i.e., fire training, hose cleaning, etc.). Therefore, soil sampling at AOC 05 is not planned at this time. However, if groundwater data indicate that a potential point source area within the landfill is present, advancement of soil borings may be considered.

4.4 Surface Water and Sediment Investigation

Collection of surface water and sediment samples from Area 2 surface water bodies was not conducted during the SI or SI addendum (BERS-Weston, 2018b and 2018a) or LTM sampling (KGS, 2018b). To date, no surface water or sediment samples have been collected at Area 2 for PFAS analysis. Therefore, a network of collocated surface water and sediment samples has been developed for Area 2 aquatic systems to determine if PFAS are present in these media. The locations and number of samples within each aquatic system were selected for two purposes: 1) to determine if PFAS are present in areas most likely to be impacted by PFAS originating (either through groundwater discharge or overland flow of contaminated surface soils and/or AFFF) from the Area 2 AOCs, and 2) determine if PFAS are present in surface water and sediment at locations upgradient and downgradient of AOCs (for rivers and streams) or along shoreline of ponds that are more distal from the AOCs.

If PFAS are detected in surface water and/or sediment at concentrations that represent a potential risk to human health and the environment (i.e., concentrations greater than the USEPA site-specific screening levels (SSLs) [USEPA, 2018] or ecological screening levels presented in the Draft HERA Work Plan [KGS, 2018d]), then additional sampling of surface water and sediment may be conducted near areas of potential risk that were identified.

4.5 Initial Data Review

The results from groundwater vertical profiling, soil sampling, sampling of existing monitoring wells, and surface water and sediment sampling at Area 2 will be evaluated in coordination with USEPA and MassDEP to determine if the vertical and lateral extent of PFAS in environmental media have been adequately delineated. If significant data gaps in the extent of PFAS are identified, then additional activities will be completed to address data gaps. If additional potential point sources or secondary sources, such as sewer lines and storm water drainage systems are identified through review of the results, then additional groundwater vertical profiling and/or soil sampling may be completed to further delineate the nature and extent of PFAS related to these potential sources.

4.6 Monitoring Well Installation

The Army plans to install overburden monitoring wells in Area 2 following a review of the PFAS data obtained from groundwater vertical profiling, soil sampling, and existing monitoring wells, which will aid in determining the location and screen settings of the permanent monitoring wells. Tentative well locations are shown on figures, but actual well locations will be determined based on review of data and discussion with the regulatory agencies. The PFAS groundwater monitoring network will be designed to monitor PFAS concentrations within and bounding potential plumes identified through the groundwater vertical profiling and existing monitoring well sampling effort associated with this RI. The wells will be installed through drive and wash drilling.

During advancement of borings for permanent monitoring well installations, continuous soil cores collected from the water table to the bottom of the boring will be logged for field lithologic classification at select locations and select soil samples will be collected from the saturated zone. This logging/sampling will provide for further evaluation of hydrogeology and PFAS fate and transport. In addition to field descriptions of soil characteristics, a select subset of soil samples will be collected for grain size, total organic carbon (TOC), and total oxidizable precursor (TOP) assay analysis. These borings and well installations will be conducted using DPT and/or sonic drilling technology. These technologies provide for continuous soil logging and sampling, as needed during borehole advancement.

4.7 Baseline Sampling of New Monitoring Wells

After new monitoring wells are installed and developed, a synoptic water level measurement event will be conducted for Area 2 to evaluate groundwater flow within and between each AOC. The synoptic water level event will consist of monitoring water levels at a combination of new and existing monitoring wells. The specific wells for the synoptic water level event will be determined after the locations and screen settings of the new monitoring wells are determined. In addition, one round of groundwater samples will be collected from the new monitoring wells and analyzed for PFAS. A subset of samples from select wells in areas of high PFAS concentrations will also be sampled for dissolved organic carbon (DOC) and total oxidizable precursor (TOP) assay analysis to evaluate the fate and transport of PFAS and assess potential for total PFOS and PFOA mass in each sample through evaluation of the presence of compounds that biotransform into fully fluorinated PFAS compounds including PFOS and PFOA. These data will be used to assess the potential for continuing sources.

4.8 Sampling of Water Supply Wells

Sampling of public or private water supply wells may be completed in support of the RI, if, during completion of the above RI activities, a potential migration pathway to public or private water supply wells located beyond Devens is identified.

5.0 FIELD ACTIVITIES BY AREAS OF CONCERN/AREAS OF INTEREST

5.1 AOC 05

5.1.1 Introduction/ Conceptual Site Model Discussion

AOC 05 was not identified during the base-wide PFAS PA (KGS, 2017) as an area of known use, storage, or disposal of AFFF. However, it was included in the SI due to its historical use as a municipal landfill that may have received materials containing PFAS. Shepley's Hill Landfill (SHL) is located in the northeast corner of the former Main Post of Fort Devens and occupies 84 contiguous acres (Figure 1). The landfill is bordered to the east by Plow Shop Pond and land formerly containing a railroad roundhouse, to the west by Shepley's Hill, to the south by recent commercial development and AOC 32, and to the north by wooded and residential areas. Nonacoicus Brook, which drains Plow Shop Pond to the Nashua River, is located north of the landfill, and is identified as the northern boundary of what is called the North Impact Area (NIA) (i.e., the area downgradient of the landfill with groundwater that is believed to have been impacted by the presence of SHL).

An extensive overburden and bedrock monitoring well network occupies much of AOC 05. Groundwater flow direction in the overburden and bedrock at Shepley's Hill has been extensively studied (Geosyntec, 2018). Groundwater flow direction in the southern portion of the landfill is generally to the east/northeast toward Plow Shop Pond. Groundwater flow in the middle portion of the landfill is also generally to the northeast, toward Plow Shop Pond. An impermeable barrier wall was installed in 2012 west of Plow Shop Pond to mitigate the arsenic flux to Red Cove/Plow Shop Pond by groundwater flow from the SHL. Groundwater flow in the northern most portion of the landfill is to the north toward Nonacoicus Brook. Groundwater flow beyond the northern limits of the landfill is generally to the north toward Nonacoicus Brook. The generalized groundwater flow direction at AOC 5 is shown on Figure 2.

5.1.2 Previous PFAS Sampling

As part of the SI (BERS-Weston, 2018b) and LTM sampling (KGS, 2018b), samples were collected from a total of 25 groundwater monitoring wells and two extraction wells within SHL and the NIA to assess potential PFAS impacts to groundwater. PFAS were detected in the influent to each extraction well, but at concentrations that were less than the LHA.

PFAS concentrations greater the LHA were detected at two of 25 monitoring wells sampled during the SI and LTM sampling. The LHA exceedances in groundwater were reported in monitoring wells located to the northeast and north of the landfill. The data from previous sampling events are shown on Figure 2.

5.1.3 Remedial Investigation Approach/Sampling Plan

Due to the extensive groundwater monitoring well network that exists at AOC 5, the PFAS remedial investigation at AOC 5 will rely on the existing monitoring well network to better define the vertical and lateral extent of PFAS in groundwater at AOC 5 and characterize groundwater in this area that originates from SHL and Plow Shop Pond. No new monitoring well installations are proposed for this AOC. The groundwater data set will be augmented with surface water and sediment samples to be collected from Plow Shop Pond and Nonacoicus Brook. Details on the sampling plan for AOC 5 are provided below.

5.1.3.1 Groundwater Sample Collection

A network of existing monitoring wells will be sampled for PFAS analysis to further define the vertical and lateral distribution of PFAS in groundwater in areas where PFAS concentrations are exceeding the LHA or are approaching the LHA. The locations of monitoring wells to be sampled for PFAS analysis are shown on Figure 2. A listing of existing wells at AOC 5 to be sampled during the RI, including well construction information, is provided in Table 1. The sampling nomenclature and analytical scope is provided in Table 2.

Groundwater samples will be collected from existing monitoring wells for PFAS analysis using technical procedures specified in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A).

5.1.3.2 Surface Water and Sediment Collection

Collocated surface water and shallow sediment samples, involving cores (0 to 6 inches), will be collected from six locations in Plow Shop Pond and at seven locations along a run of the Nonacoicus Brook between Plow Shop Pond to the Nashua River to determine if PFAS are present in surface water and sediment at these surface water features (Figures 1, 2, 10, and 11). If a potential for human health and/or ecological risks are identified (i.e., PFAS are present at concentrations greater than USEPA SSLs [USEPA, 2018] or ecological screening values presented in the HERA Work Plan [KGS, 2018d]), additional surface water and sediment sampling may be needed to identify which areas of Plow Shop Pond or Nonacoicus Brook are contributing the greatest risk.

Surface water and sediment samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15), TOC, and grain size. Field quality control (QC) samples will be collected at a frequency specified by Worksheet #20 of the UFP-QAPP (Appendix A). Sample collection procedures are provided in Worksheet #21. The sampling nomenclature for each surface water and sediment location and the quality control samples are provided in Table 3. In addition, Table 3 provides direction on whether surface water and sediments should be collected from the shoreline or main channel of a surface water system. The Nonacoicus Brook is surrounded by relatively wide wetland systems and in general, surface water and sediment will be collected from the bank of the main stream channel to evaluate whether PFAS are present in surface water and sediment at locations that potentially receive PFAS contaminated surface water from upstream locations (i.e., Plow Shop Pond). However, at a couple of locations along the Nonacoicus Brook, samples will be collected from the southern shoreline of the wetland system to assess surface water and sediment where groundwater impacted by SHL may be discharging directly to the wetland.

5.1.3.3 Soil Sample Collection

As discussed in Section 4.3, soil sampling within the landfill is not planned at this time. SHL was not identified as an area of known use, storage, or disposal of AFFF (KGS, 2017). No exceedances of the LHA were reported at monitoring wells located within landfilled material at SHL. Based on the lack of known use of AFFF at SHL and a review of the groundwater results obtained during the SI (BERS-Weston, 2018b) and LTM sampling (KGS, 2018b) the presence of low concentration PFAS in groundwater within SHL is not attributed to a specific point sources involving past activities associated with the use of AFFF (i.e., fire training, hose cleaning, etc.). However, if groundwater data indicate that a potential point source area within the landfill is present, advancement of soil borings may be considered.

5.2 AOC 32/43A

5.2.1 Introduction/Conceptual Site Model Discussion

AOC 32 (Former Defense Reutilization and Marketing Office [DRMO] Yard) was used by the Army as an active materials storage facility from approximately 1964 to 1995, where various materials were processed and stored, including a former waste oil underground storage tank (UST). In 1994, an RI was conducted and concluded that soil and groundwater at AOC 32 were impacted by petroleum contamination that was a result of past storage activities in the area (KGS, 2018a). The selected remedy at AOC 32 included excavation and off-site disposal of petroleum contaminated soils with monitored natural attenuation (MNA) and establishment of institutional controls to address residual petroleum contamination in groundwater. The DRMO yard historically consisted of three fenced areas (West Yard, East Yard and Tire Recycling Area), and a former waste oil UST (Figure 3).

AOC 43A (Petroleum, Oil, and Lubricants [POL] Storage Area) served as the central distribution point for all gasoline stations at Fort Devens during the 1940’s and 1950’s and was subsequently used until the early 1990's to store fuels for various purposes. In 1994, an RI was conducted to determine the nature and extent of petroleum contamination in soil and groundwater at AOC 43A. The 1998 Record of Decision (ROD) documented the final remedy of MNA with institutional controls to address residual petroleum contamination in groundwater (KGS 2018a).

AOCs 32 and 43A were not identified during the base-wide PFAS PA (KGS, 2017) as an area of known use, storage, or disposal of AFFF. However, at the request of USEPA it was included in the SI (BERS-Weston, 2018b) due to historical storage of materials for recycling.

The Devens Fire Department reportedly applied AFFF to a 2015 warehouse fire at the Devens Recycling Center, which is located to the east and downgradient of AOC 32. Based on a review of site topography, it is possible that AFFF or AFFF-impacted water may have discharged via overland flow to a nearby detention pond during response actions.

Interpretive groundwater flow direction in overburden and bedrock wells at AOCs 32 and 43A are shown in Figures 3 and 4. Groundwater flow paths at AOCs 32 and 43A are complicated by thin glacial overburden over bedrock beneath the area and the steep terrain with exposed bedrock within Shepley's Hill to the west. Previous remedial investigation work completed at AOC 32 indicates that based on bedrock well installation, the bedrock in the area is comprised of Ayer Granite (a granodioritic gneiss) which exhibits few fractures and little weathering (Ecology and Environment, 1994). The Ayer granite was determined to be fairly-competent rock expected to have relatively high rock quality designations (RQD). The report concludes, "the major influence of the bedrock on the hydrology of the area is the control that the top of bedrock has on groundwater flow, because of the contrast in hydraulic conductivity between bedrock and the glacial outwash overburden."

Fairly significant variation in overburden horizontal groundwater gradients, mimicking the geometry of the bedrock surface, are identified. Hydraulic testing indicated an approximate two orders-of-magnitude contrast in average hydraulic conductivity between bedrock and glacial outwash involving 2.5×10^{-4} centimeters per second (cm/sec) and 1×10^{-2} cm/sec, respectively. Silty sand/till hydraulic conductivity averaged 2.3×10^{-3} cm/sec. Permeability of the crystalline rock is related to secondary porosity (presence and interconnectedness of fractures) rather than primary porosity. In some locations the water table is below the top of rock due to generally shallow bedrock depths, lack of primary porosity in the crystalline bedrock, and good interconnection with the much more transmissive glacial overburden above. Consequently, groundwater movement into fractures is expected to reemerge or "daylight" into the increasingly transmissive glacial overburden which thickens over short distances down gradient and away from AOCs 32 and 43A.

In this area, the Shepley's Hill groundwater advective flow model treats shallow bedrock and the glacial outwash as interconnected (Geosyntec, 2018). A study of shallow bedrock within the Ayer granodiorite of Shepley's Hill nearby found a geometric mean hydraulic conductivity of 2.0 ft per day (7.1×10^{-4} cm/sec) with rising and falling head hydraulic (slug) testing of 15 open boreholes (Gannett Fleming and USEPA Region 1, 2012). Local, shallow bedrock fracture movement of PFAS impacted groundwater from overburden releases which may move into surficial bedrock fractures is expected to result in reemergence of groundwater over short flow paths down gradient into considerably more conductive overburden. This is due to bedrock surface relief, gradients, the hydraulic conductivity contrast, and increasing transmissivity of glacial overburden along flow paths to the north, east, and south. Therefore, bedrock fractures are not considered a significant mode of dissolved contaminant transport from the source areas.

Based on a review of depth to water measurements obtained at LTM monitoring wells, overburden and bedrock groundwater flow direction is variable. Overburden and bedrock groundwater originating near the UST at AOC 32 migrates to the south/southeast toward the Devens Recycling Center and then flows primarily to the east, downgradient of the Devens Recycling Center (Figures 3 and 4). Overburden and bedrock groundwater near the East and West yards flows to the south toward AOC 43A, where the direction of groundwater flow then becomes primarily to the west. Lastly, overburden and bedrock groundwater north of the Tire Recycling Yard at AOC 32 is predicted to flow to the east and northeast, under the SHL.

5.2.2 Previous PFAS Sampling

Select overburden and bedrock monitoring wells at AOCs 32 and 43A were sampled for PFAS in as part of the SI (BERS-Weston, 2018b) and LTM sampling (KGS, 2018b). Six overburden and two bedrock wells were sampled at AOC 32 and one overburden/bedrock well couplet was sampled at AOC 43A (Figure 5). At AOC 32, PFAS was detected at concentrations that exceed the LHA at one overburden well (32Z-01-07XOB).

At AOC 43A, there were no exceedances of the LHA. The PFAS results from both overburden and shallow bedrock wells at AOCs 32 and 43A can be considered together due to the characteristics of glacial overburden and bedrock in the area described above associated with hydraulics, fracture dominated flow in shallow bedrock, and likely reemergence of shallow bedrock groundwater into glacial overburden (Ecology and the Environment, 1994). The data from previous sampling events are shown on Figure 5.

No soil samples, surface water, or sediment samples were collected at either AOC.

5.2.3 Remedial Investigation Approach/Sampling Plan

The remedial investigation for PFAS at AOCs 32/43A will entail expanding the groundwater PFAS data set at these AOCs by sampling a network of existing overburden and shallow bedrock monitoring wells and/or advancing groundwater vertical profile borings at locations that are crossgradient and downgradient of the PFAS detections. In addition, surface water and sediment sampling, soil sampling (if needed), and installation of a monitoring well network will be completed during this RI. Details on the sampling plan for AOCs 32/43A are provided below.

5.2.3.1 Groundwater Sample Collection

Due to the variability in the direction of groundwater flow in the area of AOCs 32 and 43A, a synoptic set of groundwater data will be collected from existing groundwater wells to be sampled prior to initiating sampling to provide concurrent data to support evaluation of static water table and the associated flow field within the glacial overburden/shallow bedrock system at the time of sampling. The synoptic data will also be used to evaluate and potentially modify the groundwater vertical profile locations.

A network of wells has been selected at locations that are located upgradient, cross gradient, and downgradient of PFAS groundwater contamination. The locations of monitoring wells to be sampled are shown on Figures 2 and 5. A listing of monitoring wells to be sampled at AOCs 32 and 43A along with the sampling nomenclature and analytical scope are summarized in Table 2 and well construction information is provided in Table 4.

Groundwater samples will be collected from existing monitoring wells for PFAS analysis using technical procedures specified in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP.

Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A). Groundwater samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15). The sampling nomenclature and analytical scope for existing monitoring wells is provided in Table 2.

5.2.3.2 Groundwater Vertical Profiling

Monitoring well data collection will be followed by groundwater vertical profiling at new locations. Six vertical profiles are planned at AOC 32 and three vertical profiles are planned at AOC 43A. Due to the relatively thin nature of the saturated overburden at AOCs 32 and 43A (10 ft to 20 ft) (ABB, 1994) extensive groundwater vertical profiling is not anticipated in areas with existing overburden and bedrock monitoring wells. Instead, groundwater vertical profiling locations at each AOC were selected to define the nature and extent of PFAS in areas downgradient of PFAS groundwater contamination that do not have good monitoring well coverage.

Figures 2 and 5 show proposed vertical profile locations for AOC 32/43A. The rationale for each groundwater vertical profile boring is provided in Table 5. Groundwater vertical profile samples will be collected in 10-ft intervals from water table to rig refusal or the bedrock surface. The depth to water will be measured in accordance with Field Procedure SOP-F0002 (Worksheet # 21 of the UFP-QAPP, Appendix A) at nearby monitoring wells and depth to bedrock will be estimated based on the results of previous remedial investigations completed at AOCs 32/43A (ABB, 1994). If rig refusal is encountered significantly shallower than the anticipated depth to bedrock, one 10-ft step out boring will be conducted. The sampling nomenclature, anticipated depths, and analytical scope are summarized in Table 6.

Groundwater samples will be collected during advancement of the vertical profiling borings using field procedure SOP-F014 (Direct Push Technology) and SOP-F003 (Groundwater Sampling) and SOP-F009 (PFAS Sampling) as listed in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A).

5.2.3.3 Soil Sampling

No potential soil source areas have been identified at AOCs 32 and 43A. In addition, detections of PFAS at concentrations slightly greater the LHA have been reported in only one monitoring well sampled in this area. Due to the lack of reported AFFF use at AOCs 32 and 43A (the Devens Recycling Center is located downgradient of AOC 32), coupled with the limited PFAS data set in groundwater, insufficient data are available to determine where soil sampling may be warranted. If groundwater data collected during this RI indicate that a PFAS soil source area is present, up to five soil borings will be advanced at the potential source area(s) to determine if PFAS contamination is present in soils. The location of the soil borings will be reviewed with USEPA and MassDEP and will be determined based on a review of the PFAS groundwater data. Soil samples will be collected for PFAS analysis from 0-0.5, 0.5-3, 3-7, 7-15 ft below ground surface (bgs), and 2 ft above the water table. If the water table is encountered at a depth less than 17 ft bgs then the final soil sampling interval at the boring will be shortened by the appropriate amount to collect a separate 2-foot sample just above the water table to assess leaching threat to groundwater. Soil borings will be conducted using DPT and the samples would be analyzed for PFAS by isotopic dilution analyte list in QAPP worksheet #15 (Appendix A). The sampling nomenclature, anticipated depths, and analytical scope are summarized in Table 7.

If PFAS contamination is confirmed in soils, additional soil sampling may be needed to determine the nature and extent of PFAS contamination in soil, to support a human health and ecological risk assessment, and to collect data for the assessment of the source as a continuing source of PFAS to groundwater.

5.2.3.4 Surface Water and Sediment Sampling

A surface water and shallow sediment sample (0 to 6 inches), will be collected from the southern edge of the detention pond located north of the Devens recycling center facility (Figure 5). This location was selected to determine if PFAS are present in surface water and/or sediment associated with this detention pond. The selected location represents the area most likely to be impacted by historic releases of AFFF to this detention pond, which is located downgradient of AOC 32 and potentially received AFFF or AFFF-impacted water via overland flow during the Devens Fire Department response to the 2015 recycling facility fire. If a potential for human health and/or ecological risks are identified (i.e., PFAS are present at concentrations greater than USEPA SSLs [USEPA, 2018] or ecological screening values presented in the HERA Work Plan [KGS, 2018d]), additional surface water and sediment sampling may be needed to characterize the extent of PFAS in surface water and/or sediment at the detention pond. The sampling nomenclature for each surface water and sediment location and the quality control samples are provided in Table 3.

Surface water and sediment samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15), TOC, and grain size. Sample collection procedures are provided in Worksheet #21. Field QC samples will be collected at a frequency specified by Worksheet #20 of the UFP-QAPP (Appendix A).

5.2.3.5 Monitoring Well Installation

An overburden and bedrock monitoring well network for PFAS will be developed for AOCs 32/43A. The PFAS groundwater monitoring network at AOCs 32/43A will entail the use of existing monitoring wells that will be augmented with installation of new monitoring wells. For planning purposes up to two new overburden and one new bedrock monitoring wells will be installed at AOC 32 and up to two new overburden wells will be installed at AOC 43. The rationale for installing new monitoring wells at AOC 32/43A is provided in Table 8. Tentative locations for the new monitoring wells are shown on Figure 5. However, monitoring well installation will be completed following a review of the PFAS data obtained from groundwater vertical profiling, soil sampling, and existing monitoring wells; the final location and screen settings of the permanent monitoring wells will be reviewed with the USEPA and MassDEP and will be based on that data. The monitoring well network will be designed to monitor PFAS contamination in groundwater at AOCs 32/43A as well as provide bounding locations to demonstrate the limits of PFAS contamination in groundwater.

During advancement of the monitoring well borings, soil cores may be collected from the water table to the bottom of the boring for field lithologic classification at select locations and a subset of select samples will be collected for grain size, TOC, and total oxidizable precursor (TOP) assay analysis (Table 9). Confirmation of the depth to the top of bedrock may also be conducted, where it is an identified data gap after review of the vertical profiling data and previous bedrock elevation data from other investigations.

During installation of the bedrock monitoring well, bedrock will be continuously cored 20 ft into rock to evaluate the competency of the rock and weathering/fractures present. The well will be installed through drive and wash drilling. Rock cores will be described to evaluate fracturing and establish rock quality designations. Core will be archived at Devens. If little or no evidence of fracturing is observed, it may be determined unnecessary to install a bedrock monitoring well. Whether the bedrock hole is left open or a well screen is installed will be determined before the well is drilled. If installed, the well will be cased into rock and hydraulic testing of the well may be conducted to document hydraulic characteristics. After the new wells are installed, an Area 2 synoptic water level survey will be conducted.

5.2.3.6 Baseline Sampling of New Monitoring Wells

New monitoring wells will be sampled after installation. The samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15). Samples from selected wells (approximately two per AOC) located within areas of high PFAS concentrations will be analyzed for PFAS via the TOP assay and for DOC. The new monitoring wells to be sampled along with the sampling nomenclature and analytical scope are provided in Table 10.

As discussed in Section 4.7, after new monitoring wells are installed, a synoptic water level measurement event will be conducted for Area 2 to evaluate groundwater flow within and between each AOC. The synoptic water level event will consist of monitoring water levels at a combination of new and existing monitoring wells. The specific wells for the synoptic water level event will be determined after the locations and screen settings of the new monitoring wells are determined.

5.3 AOC 43G

5.3.1 Introduction/Conceptual Site Model Discussion

AOC 43G consists of the former Army Air Force Exchange Service (AAFES) gas station (Areas 2 and 3) and historical Gas Station G (Area 1) and has been the subject of previous site investigations and remedial investigations due to petroleum contamination in soil and groundwater resulting from the past operations. Historical Gas Station G was used by the Army primarily during World War II through the 1950’s, prior to the development of AFFF. Therefore, Area 1 at AOC 43G is not considered to be a potential source for PFAS. The AAFES gas station was reportedly in use through 1993 with the associated underground tanks removed in 1996. The Army and USEPA signed a ROD in 1996 documenting the selection of intrinsic remediation with LTM as the selected remedy for AAFES. The major components of the selected remedy included intrinsic bioremediation, intrinsic bioremediation assessment data collection and groundwater modeling, installing additional monitoring wells, long-term groundwater monitoring, annual data reports to USEPA and MassDEP, and five-year reviews. Intrinsic bioremediation is the principal component proposed to prevent petroleum-related contaminants of concern that exceed groundwater cleanup levels from potentially migrating off Army property (ABB, 1996a, Sovereign/HGL, 2015).

This AOC was not identified as a potential site for use and/or storage of AFFF during the base-wide PFAS PA (KGS, 2017). However, groundwater samples were collected from two monitoring wells at AOC 43G as part of the LTM sampling (KGS, 2018b) to provide more information about the overall extent of PFAS in groundwater at Devens. The monitoring wells selected for PFAS sampling are shown on Figure 6 and are located downgradient of both the AOC 43G source area and Devens Department of Public Works buildings.

Depth to bedrock at AOC 43G was determined during the previous remedial investigation (ABB, 1996a) and is characterized a sloping downward to the southeast from an elevation of approximately 280 ft mean sea level near Queenstown Street to approximately 255 ft mean sea level near monitoring well XGM-94-06X (Figure 6). Overburden at AOC 43G is comprised of unconsolidated sand and gravel with basal till deposits (ABB, 1996a). The overburden at AOCS 43 is approximately 30 feet thick with the surface topography generally mimicking the bedrock topography in the area (ABB, 1996a).

The interpretive water-table elevations for the 2017 LTM gauging event completed at AOC 43G are shown on Figure 6. Groundwater flow at AOC 43G is generally to the east/southeast direction, which is consistent with the site's surficial topography and historic flow directions (KGS, 2018c).

5.3.2 Previous PFAS Sampling

Two overburden monitoring wells located downgradient of the AOC 43G source area were sampled for PFAS as part of the LTM sampling (KGS, 2018b). The locations of wells sampled, and associated results are presented on Figure 6. PFAS exceeded the USEPA LHA at both wells. No soil, surface water, or sediment samples were collected at AOC 43G for PFAS analysis. The data from previous sampling events are shown on Figure 6.

5.3.3 Remedial Investigation Approach/Sampling Plan

The remedial investigation for PFAS at AOC 43G will entail sampling existing monitoring wells located upgradient of the PFAS contamination to assess the nature and extent of PFAS. The existing monitoring network will be augmented with groundwater vertical profiling at borings to delineate the vertical and lateral extent of PFAS in groundwater upgradient, downgradient, and crossgradient of PFAS detections. Surface water and sediment samples will be collected from the unnamed tributary to Robbins Pond, which is located approximately 450 feet downgradient of PFAS groundwater contamination reported at monitoring well AAFES-7. New monitoring wells will be installed at AOC 43G to supplement the existing monitoring well network. Details on the sampling plan for AOC 43G are provided below.

5.3.3.1 Groundwater Sample Collection

A network of existing monitoring wells has been selected at locations that are located upgradient of PFAS groundwater contamination to define the extent of PFAS in groundwater. The locations of monitoring wells to be sampled are shown on Figure 6. A listing of monitoring wells to be sampled at AOC 43G along with the sampling nomenclature and analytical scope are summarized in Table 2 and well construction information is provided in Table 4.

Groundwater samples will be collected from existing monitoring wells for PFAS analysis using technical procedures specified in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A). Groundwater samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15).

5.3.3.2 Groundwater Vertical Profiling

Monitoring well data collection will be followed by groundwater vertical profiling at new locations. Eight vertical profiles are planned at AOC 43G. Groundwater vertical profiling locations were selected to enhance the evaluation of PFAS nature and extent in areas upgradient, crossgradient and downgradient of PFAS groundwater contamination.

Figure 6 shows proposed vertical profile locations for AOC 43G. The rationale for each groundwater vertical profile boring is provided in Table 5. Groundwater vertical profile samples will be collected in 10-ft intervals from water table to rig refusal or the bedrock surface. The depth to water at AOC 43G will be measured at nearby monitoring wells (in accordance with Field Procedure SOP-F0002 [Worksheet # 21 of the UFP-QAPP], Appendix A) and depth to bedrock will be estimated based on the results of previous remedial investigations completed at AOC 43G (ABB, 1996a). If rig refusal is encountered significantly shallower than the anticipated depth to bedrock, one 10-ft step out boring will be conducted. The sampling nomenclature, anticipated depths, and analytical scope are summarized in Table 6.

Groundwater samples will be collected during advancement of the vertical profiling borings using field procedure SOP-F014 (Direct Push Technology) and SOP-F003 (Groundwater Sampling) and SOP-F009 (PFAS Sampling) as listed in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A).

5.3.3.3 Soil Sampling

No potential soil source areas have been identified at AOC 43G. The existing PFAS data set for AOC 43G is limited to a one-time sampling of groundwater from two monitoring wells located downgradient of the AOC 43G source area. Therefore, an insufficient data set is currently available to determine where soil sampling may be warranted. If groundwater data collected from monitoring wells and groundwater vertical profile borings during this RI indicate that a PFAS source area is present, up to five soil borings will be advanced at the potential source area(s) to determine if PFAS contamination is present in soils. The location of the soil borings will be reviewed with USEPA and MassDEP and will be based on a review of the PFAS groundwater data. Soil samples will be collected from 0-0.5, 0.5-3, 3-7, 7-15 ft bgs, and 2 ft above the water table. If the water table is encountered at a depth less than 17 ft bgs then the final soil sampling interval at the boring will be shortened by the appropriate amount to collect a separate 2-foot sample just above the water table to assess leaching threat to groundwater. Soil borings will be conducted using DPT and the samples would be analyzed for PFAS by isotopic dilution analyte list in QAPP worksheet #15 (Appendix A). The sampling nomenclature, anticipated depths, and analytical scope are summarized in Table 7.

If PFAS contamination is confirmed in soils at, additional soil sampling may be needed to determine nature and extent of PFAS contamination in soil, to support a human health and ecological risk assessment, and to collect data for the assessment of the source as a continuing source of PFAS to groundwater.

5.3.3.4 Surface Water and Sediment Sampling

Collocated surface water and shallow sediment samples, involving cores (0 to 6 inches), will be collected from three locations in the unnamed tributary to Robbins Pond (Figure 6) and three locations within Robbins Pond to determine if PFAS are present in surface water and sediment at these surface water features (Figure 11). If a potential for human health and/or ecological risks are identified (i.e., PFAS are present at concentrations greater than USEPA SSLs (USEPA, 2018) or ecological screening values presented in the HERA Work Plan [KGS, 2018d]), additional surface water and sediment sampling may be needed to identify which areas of the unnamed tributary or Robbins Pond are contributing the greatest risk.

Surface water and sediment samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15), TOC, and grain size. Field QC samples will be collected at a frequency specified by Worksheet #20 of the UFP-QAPP (Appendix A). Sample collection procedures are provided in Worksheet #21. The sampling nomenclature for each surface water and sediment location and the quality control samples are provided in Table 3. In addition, Table 3 provides direction on whether surface water and sediments should be collected from the shoreline or main channel of a surface water system.

5.3.3.5 Monitoring Well Installation

A monitoring well network for PFAS will be developed based on a review of the monitoring well sampling, groundwater vertical profiling and, if completed, soil sampling PFAS results. One or more overburden monitoring wells will be installed at AOC 43G. The rationale for installing new monitoring wells at AOC 43G is provided in Table 8. Tentative locations for the new monitoring wells are shown on Figure 6. However, monitoring well installation will be completed following a review of the PFAS data obtained from groundwater vertical profiling, soil sampling, and existing monitoring wells; the final location and screen settings of the permanent monitoring wells will be reviewed with the USEPA and MassDEP and will be based on that data. During advancement of the monitoring well borings, soil cores may be collected from the water table to the bottom of the boring for field lithologic classification from select locations and select samples will be collected for grain size, TOC, and TOP assay analysis (Table 9). Confirmation of the depth to the top of bedrock may also be conducted, where it is an identified data gap after review of the vertical profiling data and previous bedrock elevation data from other investigations. After the new wells are installed, an Area 2 synoptic water level survey will be conducted.

5.3.3.6 Baseline Sampling of New Monitoring Wells

New monitoring wells will be sampled after installation. The samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15). Samples from selected wells (approximately two per AOC) located within areas of high PFAS concentrations will be analyzed for PFAS via the TOP assay and for DOC. The new monitoring wells to be sampled along with the sampling nomenclature and analytical scope are provided in Table 10.

As discussed in Section 4.7, after new monitoring wells are installed, a synoptic water level measurement event will be conducted for Area 2 to evaluate groundwater flow within and between each AOC. The synoptic water level event will consist of monitoring water levels at a combination of new and existing monitoring wells. The specific wells for the synoptic water level event will be determined after the locations and screen settings of the new monitoring wells are determined.

5.4 AOC 43J

5.4.1 Introduction/Conceptual Site Model Discussion

The Army historically used AOC 43J as a former gas station/motor pool, and subsequently as a vehicle storage yard and maintenance facility for Fort Devens up to the time of base closure in 1996. Several USTs for gasoline, waste oil and diesel were formerly located at AOC 43J as shown on Figure 7. In addition, a 1,000-gallon UST for storage of maintenance wastes was reportedly located to the south of former building T2446 (Haley and Aldrich, 2017).

The Army and USEPA signed a ROD in 1996 documenting the selection of intrinsic remediation with LTM as the selected remedy for AAFES (ABB, 1996b). The major components of the selected remedy included intrinsic bioremediation (i.e., MNA), intrinsic bioremediation assessment data collection and groundwater modeling, installing additional monitoring wells, long-term groundwater monitoring, annual data reports to USEPA and MassDEP, and five-year reviews. It was noted during a five-year review that MNA would not reach the ROD goals within the required 30-year performance period. Therefore, pilot testing in 2010 and 2011 (Haley and Aldrich, 2015) and subsequent injections performed in 2012 of sodium persulfate/calcium peroxide were conducted to provide short-term oxidation and long-term reduction processes to augment MNA to reduce petroleum-related contaminant concentrations remaining at the site (Haley and Aldrich, 2015 and 2017).

The depth to bedrock at AOC 43J ranges from near surface at the northwestern edge of AOC 43J (near monitoring well XJM-93-01X) to approximately 20 ft bgs in the vicinity of the AOC 43J source area, to approximately 60 ft bgs to the southeast, near XJM-94-07X (ABB, 1996b).

Generalized groundwater flow direction in the overburden near AOC 43J are shown on Figure 7 and are based on historic depth to water measurements collected during LTM activities at this AOC (Haley & Aldrich, 2017). Groundwater flow at AOC 43J is generally to the east/southeast direction, which is consistent with the site's surficial and bedrock topography and historic flow directions (ABB 1996b).

AOC 43J was not identified as a potential site for use and/or storage of AFFF during the base-wide PFAS PA (KGS, 2017). However, groundwater samples were collected from four monitoring wells at AOC 43J as part of the LTM sampling (KGS, 2018b). The monitoring wells selected for PFAS sampling are shown on Figure 7 and are located downgradient of the AOC 43J source area.

5.4.2 Previous PFAS Sampling

PFOS and PFOA were not detected at three of the four monitoring wells sampled. A combined PFOS and PFOA concentration of 11.1 ng/L was reported at the most downgradient well sampled (XJM-94-07X). Based on this detection, AOC 43J was added to the Devens PFAS RI for further investigation. The data from previous sampling events are shown on Figure 7.

5.4.3 Remedial Investigation Approach/Sampling Plan

The remedial investigation for PFAS at AOC 43J will entail sampling existing monitoring wells located upgradient and crossgradient of the PFAS detections in groundwater to determine the nature and extent of PFAS in groundwater. There are no surface water bodies or wetland areas located in the immediate vicinity of AOC 43J. Therefore, surface water and sediment sampling at AOC 43J is not planned at this time. No new monitoring well installations are proposed for this AOC. Details on the sampling plan for AOC 43Jare provided below.

5.4.3.1 Groundwater Sample Collection

Ten existing overburden monitoring wells will be sampled for PFAS analysis. These wells are located upgradient, within and downgradient of the AOC 43J source area and were selected to determine PFAS concentrations in groundwater. The locations of monitoring wells to be sampled are shown on Figure 7. A listing of monitoring wells to be sampled at AOC 43J along with the sampling nomenclature and analytical scope are summarized in Table 2 and well construction information is provided in Table 4.

Groundwater samples will be collected from existing monitoring wells for PFAS analysis using technical procedures specified in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A). Groundwater samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15).

5.4.3.2 Groundwater Vertical Profiling

Due to the relatively thin nature of the overburden at the AOC 43J source area (0 ft to 20 ft bgs) the existing monitoring wells are screened across much of the saturated zone of the overburden aquifer at AOC 43J (ABB, 1996b). Therefore, groundwater vertical profiling to delineate the vertical distribution of PFAS in the vicinity of the AOC 43J area wells (if present) is not anticipated. However, if the PFAS results obtained from the existing monitoring wells indicate that data gaps regarding either the lateral of vertical distribution of PFAS in groundwater at AOC 43J exist, groundwater vertical profiling may be considered. The number and placement of the vertical profiles will be reviewed with the USEPA and MassDEP and will be based on the existing monitoring well data.

If advanced, groundwater vertical profile samples will be collected in 10-ft intervals from water table to rig refusal or the bedrock surface. The depth to water will be measured in accordance with Field Procedure SOP-F0002 (Worksheet # 21 of the UFP-QAPP, Appendix A) at nearby monitoring wells and depth to bedrock will be estimated based on the results of previous remedial investigations completed at AOCs 43J (ABB, 1996b). If rig refusal is encountered significantly shallower than the anticipated depth to bedrock, one 10-ft step out boring will be conducted.

Groundwater samples will be collected during advancement of the vertical profiling borings using field procedure SOP-F014 (Direct Push Technology) and SOP-F003 (Groundwater Sampling) and SOP-F009 (PFAS Sampling) as listed in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A).

5.4.3.3 Soil Sampling

No potential soil source areas have been identified at AOC 43J. The existing PFAS data set for AOC 43J is limited to a one-time sampling of three monitoring wells located downgradient of the AOC 43J source area during the LTM sampling (KGS, 2018b). Therefore, an insufficient data set is currently available to determine where soil sampling may be warranted. If groundwater data collected from monitoring wells and groundwater vertical profile borings, if completed, during this RI indicate that a PFAS source area is present, up to five soil borings will be advanced at the potential source area(s) to determine if PFAS contamination is present in soils. The location of the soil borings will be reviewed with USEPA and MassDEP and will be based on a review of the PFAS groundwater data. Soil samples will be collected from 0-0.5, 0.5-3, 3-7, 7-15 ft bgs, and 2 ft above the water table. Soil borings will be conducted using DPT and the samples would be analyzed for PFAS by isotopic dilution analyte list in QAPP worksheet #15 (Appendix A). The sampling nomenclature, anticipated depths, and analytical scope are summarized in Table 7.

If PFAS contamination is confirmed in soils, additional soil sampling may be needed to determine nature and extent of PFAS contamination in soil, to support a human health and ecological risk assessment, and to collect data for the assessment of the source as a continuing source of PFAS to groundwater.

5.5 AOC 76

5.5.1 Introduction/Conceptual Site Model Discussion

The fire station at Jackson Road began operation in the 1940's by the Army for Fort Devens. Following the base closure in 1996, all Army fire and emergency response operations were transferred to MassDevelopment and the Devens Fire Department (KGS, 2018b). It has been reported that AFFF was applied to a dumpster fire at the fire station in the early 1990's. After 1996, this facility was transferred to MassDevelopment and fire-hose training with AFFF resulted in discharge of AFFF to pavement behind (east/southeast of) the building. AFFF likely flowed to edges of pavement to the east and south and also into the nearby storm water detention basin. AFFF was also reportedly stored in an area located immediately south of the fire department building (Figure 9).

Willow Brook is located east of AOC 76. Surficial topography slopes slightly downward to the northeast, toward Willow Brook. There are no existing monitoring wells in the vicinity of AOC 76; however, knowledge of the regional flow field indicates that groundwater flow direction at AOC 76 is likely to the northeast from the Devens Fire Station toward Willow Brook.

5.5.2 Previous PFAS Sampling

Groundwater samples were collected at the water table and soil samples were collected from 0-5 ft bgs from nine temporary well points that were advanced during the SI addendum (BERS-Weston, 2018b). Maximum PFAS concentrations were reported in groundwater to the northeast of the parking lot and beneath the drainage retention pond at temporary well point FH-17-09 (Figure 9). Concentrations of PFAS that exceed the USEPA LHA were also detected in groundwater located to the southeast of parking area, near Willow Brook (former extent of pavement) and beneath the former storage area located immediately south of the Fire Station (Figure 9). PFAS were reported in composite soil samples collected from 0-5 ft bgs. Both PFOS and PFOA were detected in soil. The data from previous sampling events are shown on Figure 9.

5.5.3 Remedial Investigation Approach/Sampling Plan

There are no existing groundwater monitoring wells at AOC 76. Therefore, the remedial investigation approach at AOC 76 entails advancement of groundwater vertical profiles to delineate the vertical and lateral extent of PFAS in groundwater, installation of piezometers to characterize groundwater flow direction, soil sampling near reported source areas, surface/sediment sampling at Willow Brook, and development of a monitoring well network through installation of monitoring wells. Details on the sampling plan for AOC 76 are provided below.

5.5.3.1 Groundwater Vertical Profiling

Groundwater vertical profiling will first be conducted to better delineate extent of PFAS in groundwater. The rationale for each vertical profile location is provided in Table 5. Groundwater vertical profile samples will be collected in 10-ft intervals from water table to rig refusal or the bedrock surface. Depth to water at AOC 76 is estimated to be approximately 12 ft bgs at the detention pond to 25 ft bgs near the Devens Fire Station (BERS-Weston, 2018b). Due to the absence of existing monitoring wells within AOC 76, during advancement of vertical profile borings for this RI, the water level will be measured at each vertical profile by advancing the stainless-steel sampling screen to the estimated water table depth, inserting a decontaminated electronic water level meter in to the inner rods and monitoring the water levels until it stabilizes. The screened interval for the first vertical profile sample will be adjusted to coincide with the water table. Groundwater samples will subsequently be collected at 10-ft intervals to refusal. The depth to bedrock is estimated to be approximately 50 ft bgs (MassGIS, 2018). If rig refusal is encountered significantly shallower than the anticipated depth to bedrock, one 10-ft step out boring will be conducted. The sampling nomenclature, anticipated depths, and analytical scope are summarized in Table 6.

Groundwater samples will be collected during advancement of the vertical profiling borings using field procedure SOP-F014 (Direct Push Technology) and SOP-F003 (Groundwater Sampling) and SOP-F009 (PFAS Sampling) as listed in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A).

At 12 of the vertical profiling locations, piezometers will be set at the water table. The piezometers will be surveyed, and a synoptic water level survey will be performed. The synoptic water level survey will be used to assist in placement of monitoring wells, and additional vertical profiling locations if they are needed. Locations tentatively identified for piezometer installation are noted on Table 5.

5.5.3.2 Soil Sampling

Soil sampling will be conducted at locations within and near suspected AFFF discharge/storage areas including the drainage detention pond, edge of pavement, former AFFF storage area behind the Devens Fire Station, and near the dumpster fire locations (Figure 9). The rationale for soil borings placement at AOC 76 is included in Table 5. The soil sampling locations were selected in consideration of historic AFFF use and storage at the site and the PFAS soil sampling results obtained during the SI addendum (BERS-Weston, 2018b). The soil sampling program at AOC 76 is designed to identify/confirm the location of soil source areas at AOC 76. PFAS contamination in groundwater at AOC 76 is attributed to releases of AFFF at the ground surface and PFAS migrated downward through the vadose zone (either as pure AFFF or in the dissolved-phase to the water table) where, due to their unique electrostatic properties, may have preferentially adsorbed to soil at the groundwater/air interface associated with the water table. Therefore, at each soil boring location composite soil samples will be collected from 0-1 ft bgs, 3-7 ft bgs, and another sample will be collected at the water table to identify the presence or absence of soil contamination in the overburden at each of the potential source areas associated with AOC 76. The sampling nomenclature, anticipated depths, and analytical scope for the soil borings at AOC 76 are summarized in Table 7. Once source areas as identified, additional soil sampling will be completed to further delineate PFAS in soil contamination and support a risk assessment.

5.5.3.3 Surface Water and Sediment Sampling

Surface water and shallow sediment samples, involving cores (0 to 6 inches), will be collected from six locations along Willow Brook between Robbins Shop Pond and the Nonacoicus Brook to determine if PFAS are present in surface water and sediment at Willow Brook. The locations are shown on Figure 11. WB-18-01 was selected to determine PFAS in surface water and sediment at the beginning of Willow Brook, prior to any potential inputs of PFAS from AOC 76. WB18-02 and 18-03 were located in areas most likely to be impacted by groundwater discharge of PFAS contaminated water originating from AOC 76. WB-18-04, WB-18-05, and WB-18-06 are located downstream of AOC 76.

If a potential for human health and/or ecological risks are identified (i.e., PFAS are present at concentrations greater than USEPA SSLs [USEPA, 2018] or ecological screening values presented in the HERA Work Plan [KGS, 2018d]), additional surface water and sediment sampling may be needed to identify which areas of Willow Brook is contributing the greatest potential risk.

Surface water and sediment samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15), TOC, and grain size. The sampling nomenclature for each surface water and sediment location and the quality control samples are provided in Table 3. Sample collection procedures are provided in Worksheet #21. Field QC samples will be collected at a frequency specified by Worksheet #20 of the UFP-QAPP (Appendix A).

5.5.3.4 Monitoring Well Installation

A monitoring well network for PFAS will be developed based on a review of the groundwater vertical profiling and soil sampling PFAS results, and the synoptic water level survey of the piezometers. New overburden monitoring wells will be installed (in addition to the 12 piezometers described in Section 5.5.3.1) at AOC 76. Tentative locations for the new monitoring wells are shown on Figure 9. However, monitoring well installation will be completed following a review of the PFAS data obtained from groundwater vertical profiling, soil sampling, and existing monitoring wells; the final location and screen settings of the permanent monitoring wells will be reviewed with the USEPA and MassDEP and will be based on that data. During advancement of the monitoring well borings, soil cores may be collected from the water table to the bottom of the boring for field lithologic classification from select locations and select samples will be collected for grain size, TOC, and TOP assay analysis (Table 9). Confirmation of the depth to the top of bedrock may also be conducted, where it is an identified data gap after review of the vertical profiling data. After the new wells are installed, an Area 2 synoptic water level survey will be conducted.

5.5.3.5 Baseline Sampling of New Monitoring Wells

New monitoring wells will be sampled after installation. The samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15). Samples from selected wells (approximately two per AOC) located within areas of high PFAS concentrations will be analyzed for PFAS via the TOP assay and for TOC. The new monitoring wells to be sampled along with the sampling nomenclature and analytical scope are provided in Table 10.

5.6 MACPHERSON WATER SUPPLY WELL

5.6.1 Introduction/Conceptual Site Model Discussion

MacPherson well is located on an undeveloped parcel of land that is bound by the Nashua River to the west and north, by the Nonacoicus Brook to the east and West Main Street to the south. The town of Ayer municipal wastewater treatment facility and sludge disposal landfill are located to the east of the MacPherson well, on the opposite side of the Nonacoicus Brook. Residential properties and a plastic manufacturing facility are located to the west of the MacPherson well, on the opposite side of the Nashua River. Various commercial properties and Fort Devens are located to the south of west Main Street.

5.6.2 Previous PFAS Sampling

MassDevelopment operates the MacPherson water supply well as part of the Devens municipal water supply. MassDevelopment first sampled the MacPherson well for PFAS in July 2016 and the sum of PFOS and PFOA was reported at 69 ng/L, just under the USEPA LHA of 70 ng/L. MassDevelopment continued to sample the well on a quarterly basis and the sum of PFOS and PFOA ranged between 62 ng/L and 107 ng/L. In February 2018, the MacPherson municipal well was taken out of service after MassDEP informed MassDevelopment that MassDEP is considering adopting a guideline, known as an Office of Research and Standards Guideline (ORSG), which provides recommended contaminant levels in drinking water and is set to be protective against adverse health effects for all people consuming the water for a lifetime. The ORSG is the level of the five PFAS compounds (PFOS, PFOA, perfluorononanoic acid [PFNA], perfluorohexane sulfonic acid [PFHxS], and perfluoroheptanoic acid [PFHpA]), individually or in combination of 70 ng/L.

5.6.3 Remedial Investigation Approach/Sampling Plan

The remedial investigation for PFAS at MacPherson water supply well will entail sampling existing groundwater wells that are located upgradient of the MacPherson water supply well and groundwater vertical profiling. In addition, the effluent from the Town of Ayer waste water treatment plant, which discharges to the Nonacoicus Brook (Figure10) will be sampled for PFAS. Details on the sampling plan for the MacPherson water supply well are provided below.

5.6.3.1 Groundwater Sampling

Existing monitoring wells at AOC 69W, which is located approximately 1,800 ft south and upgradient of the MacPherson water supply well (Figures 1 and 8) will be sampled for PFAS analysis. These wells are the closest available Devens monitoring wells located upgradient of the MacPherson water supply well and will provide data regarding the presence or absence of PFAS in groundwater upgradient (to the south) of the MacPherson water supply well. The locations of AOC 69W monitoring wells are shown on Figure 8. A listing of monitoring wells to be sampled at AOC 69W along with the sampling nomenclature and analytical scope are summarized in Table 2 and well construction information is provided in Table 4.

There are three observation wells (MPP-93-01 through MPP-93-03) near the MacPherson water supply well that are proposed to be sampled for PFAS analysis (Table 2). These wells are not maintained by the Army and are not routinely sampled. Therefore, the viability of these wells for sampling will be assessed as part of this RI. If the wells are determined to be viable and well construction information can be obtained, then these wells will be sampled for PFAS analysis.

Four monitoring wells located around the Town of Ayer sludge landfill at the waste water treatment plant east of MacPherson water supply well (Figure 10) will be sampled for PFAS analysis. The locations of the wells are shown on Figure 10. A listing of monitoring wells to be sampled along with the sampling nomenclature and analytical scope are summarized in Table 2 and well construction information is provided in Table 4.

Groundwater samples will be collected from existing monitoring wells for PFAS analysis using technical procedures specified in Section 7.0 of this FSP and Worksheet #21 of the UFP QAPP. Field quality control samples, such as field duplicate and field blanks will be collected at a frequency as specified in Worksheet #20 of the UFP-QAPP (Appendix A). Groundwater samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15).

5.6.3.2 Groundwater Vertical Profiling

Groundwater vertical profiling will be conducted along a perimeter transect that encircles the MacPherson water supply well to delineate the vertical and lateral extent of PFAS in groundwater in the immediate vicinity of the well. The locations of proposed vertical profiles are shown on Figure 10 and the rationale for each vertical profile is provided in Table 5. Groundwater vertical profile samples will be collected in 10-ft intervals from water table to rig refusal or the bedrock surface. The depth to water will be measured in accordance with Field Procedure SOP-F0002

(Worksheet #21 of the UFP-QAPP, Appendix A) at nearby monitoring wells. If rig refusal is encountered significantly shallower than the anticipated depth to bedrock, one 10-ft step out boring will be conducted.

Additional groundwater vertical profiling locations are anticipated to be advanced at Devens along subsequent transects located to the south and upgradient of the PFAS contamination identified at the MacPherson water supply well in an effort to trace PFAS groundwater contamination back to a known or unknown source at Devens (Figure 10). The depth intervals sampled at these additional vertical profile borings may target the zone of PFAS contamination observed at the initial transect and may/or may not extend to bedrock. The final location of additional groundwater vertical profile borings and the associated sampling intervals will be based on a review of the groundwater vertical profile results obtained from the initial transect of vertical profiles, but for planning purposes are anticipated to be in the vicinity of the transect shown on Figure 10.

5.6.3.3 Soil Sampling

The presence of PFAS in groundwater near the MacPherson water supply well vertical profiling locations is assumed to be distal from potential PFAS sources. Therefore, PFAS near the MacPherson water supply well likely exists in the dissolved phase in this area of the aquifer and, as such, collection of soil samples is not planned at the eight initial groundwater vertical profiles or six subsequent vertical profiles. If groundwater data collected during this RI indicate that a PFAS soil source area is present, up to five soil borings will be advanced at the potential source area(s) to determine if PFAS contamination is present in soils. The location of the soil borings will be reviewed with USEPA and MassDEP and will be determined based on a review of the PFAS groundwater data. Soil samples will be collected from 0-0.5, 0.5-3, 3-7, 7-15 ft bgs, and 2 ft above the water table. If the water table is encountered at a depth less than 17 ft bgs then the final soil sampling interval at the boring will be shortened by the appropriate amount to collect a separate 2-foot sample just above the water table to assess leaching threat to groundwater. Soil borings will be conducted using DPT and the samples would be analyzed for PFAS by isotopic dilution analyte list in QAPP Worksheet #15 (Appendix A). The sampling nomenclature, anticipated depths, and analytical scope are summarized in Table 7.

If PFAS contamination is confirmed in soils at, additional soil sampling may be needed to determine nature and extent of PFAS contamination in soil, to support a human health and ecological risk assessment, and to collect data for the assessment of the source as a continuing source of PFAS to groundwater.

5.6.3.4 Surface Water and Sediment Sampling

As described in Sections 5.1.3.2 and 5.5.3.3 surface water and sediment samples will be collected from Nonacoicus Brook (located approximately 750 feet northeast of the MacPherson water supply well) and Willow Brook (located approximately 900 feet east of the MacPherson water supply well) will be sampled.

It is unknown if PFAS at the MacPherson water supply well are related to surface water from the Nashua River. However, if PFAS are detected in groundwater at vertical profiles advanced between the MacPherson water supply well and the Nashua River, surface water and sediment sampling of the Nashua River near the MacPherson water supply well may be conducted. The number and location of surface water and sediment locations in the Nashua River will be determined on a review of the PFAS groundwater results.

5.6.3.5 Other Sampling

The effluent of the Town of Ayer Water Treatment plant will be sampled for PFAS analysis. The effluent from this plant discharges to the Nashua River downstream of the MacPherson water supply well (Figure 10).

5.6.3.6 Monitoring Well Installation

A PFAS groundwater monitoring well network will be developed based on a review of the groundwater vertical profiling and existing monitoring well PFAS results. For planning purposes, up to six monitoring wells will be advanced to support monitoring of PFAS at the MacPherson water supply well. Tentative locations for the new monitoring wells are shown on Figure 10. However, monitoring well installation will be completed following a review of the PFAS data obtained from groundwater vertical profiling and existing monitoring wells; the final location and screen settings of the permanent monitoring wells will be reviewed with the USEPA and MassDEP and will be based on that data. During advancement of the monitoring well borings, soil cores may be collected from the water table to the bottom of the boring for field lithologic classification from select locations and select samples will be collected for grain size, TOC, and TOP assay analysis. Confirmation of the depth to the top of bedrock may also be conducted, where it is an identified data gap after review of the vertical profiling data and previous bedrock elevation data from other investigations. After the new wells are installed, an Area 2 synoptic water level survey will be conducted.

5.6.3.7 Baseline Sampling of New Monitoring Wells

New monitoring wells will be sampled after installation. The samples will be analyzed for PFAS by isotope dilution (analyte list in QAPP Worksheet #15). Samples from selected wells (approximately two per AOC) located within areas of high PFAS concentrations will be analyzed for PFAS via the TOP assay and for DOC. The new monitoring wells to be sampled along with the sampling nomenclature and analytical scope are provided in Table 10.

6.0 FIELD QUALITY CONTROL SAMPLES

Collection of field QC samples, including field duplicates, equipment blanks, field reagent blanks, matrix spikes, and matrix spike duplicates, associated with groundwater, soil, surface water, and sediment sampling efforts are required. A summary of the types and frequency of field quality control samples to be collected is provided in Worksheet #20 (Field Quality Control Sample Summary) of the UFP-QAPP (Appendix A).

7.0 FIELD PROCEDURES

The field SOP associated with the project are listed in Worksheet #21 of the UFP-QAPP and the field equipment calibration, maintenance, testing and inspection requirements are listed in Worksheet #22 of the UFP-QAPP, which are both provided in Attachment A of the UFP-QAPP (Appendix A). The field SOPs are summarized below.

- Groundwater vertical profile borings will be conducted in accordance with the procedure specified in Worksheet #17 of the UFP-QAPP and SOP-F014 (Direct Push Technology).

- Soil samples will be collected in accordance with SOP-F015 (Soil Sampling – Surface and Shallow Depth) and SOP-F009 (PFAS Sampling).
- Surface water and sediment samples will be collected in accordance with SOP-F004 (Sediment-Surface Water Sampling) and SOP-F009 (PFAS Sampling).
- Groundwater samples will be collected in accordance with SOP-F003 (Groundwater Sampling) and SOP-F009 (PFAS Sampling).
- Water quality parameters: dissolved oxygen, oxidation reduction potential, specific conductance, temperature, and pH will be collected in accordance with SOP-F003 (Groundwater Sampling).
- Static depth to groundwater measurements will be measured in accordance with SOP-F002 (Evaluation of Existing Monitoring Wells and Water Level Measurements).
- New groundwater monitoring wells will be constructed and developed in accordance with SOP-F017 (Monitoring Well Construction and Development).
- Soil samples and soil cores will be described in the field in accordance with SOP-F018 (Soil Description).
- Private water supply wells will be purged and samples in accordance with SOP-F016 (Private and Water Supply Well Sampling).

8.0 SAMPLING PACKAGING AND SHIPPING REQUIREMENTS

Sample volume, containers, preservation, and holding time requirements are provided in combined Worksheet #19 and #30 (Sample Containers, Preservation and Hold Times) of the UFP-QAPP (Appendix A). Procedures for field sample handling, packing and shipment are detailed in SOP-F008 (Sample Handling), which is listed in Worksheet #21 of the UFP-QAPP (Appendix A). Sampling handling, custody and disposal requirements are provided in Worksheet #26 and 27 of the UFP-QAPP and provided in Attachment A of the UFP-QAPP (Appendix A).

9.0 INVESTIGATION-DERIVED WASTE

IDW management procedures are presented in Worksheet #17 of the UFP-QAPP and will be managed in accordance with SOP-F011 (IDW Management), which is listed in Worksheet #21 of the UFP-QAPP and provided in Attachment A of the UFP-QAPP (Appendix A).

10.0 FIELD ASSESSMENT PROCEDURES AND CORRECTIVE ACTIONS

Periodic assessments will be performed during the course of the project so that the planned project activities are implemented in accordance with the UFP-QAPP. The type, frequency, and responsible parties of planned assessment activities to be performed for the project as well as any corrective action measures, are provided in Combined Worksheet #31, 32, and 33 (Assessment and Corrective Actions) of the UFP-QAPP (Appendix A).

11.0 REFERENCES

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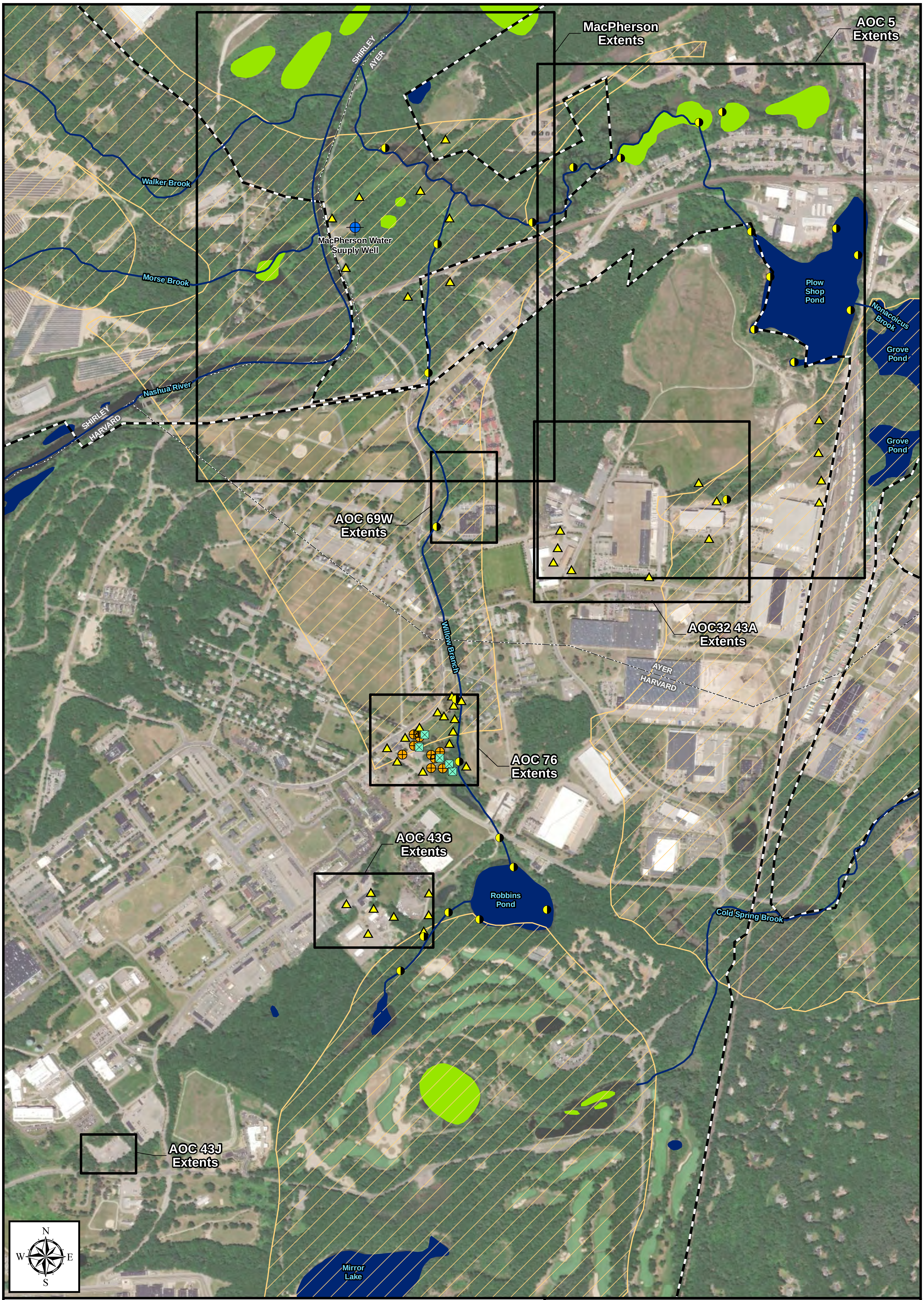
FIGURES



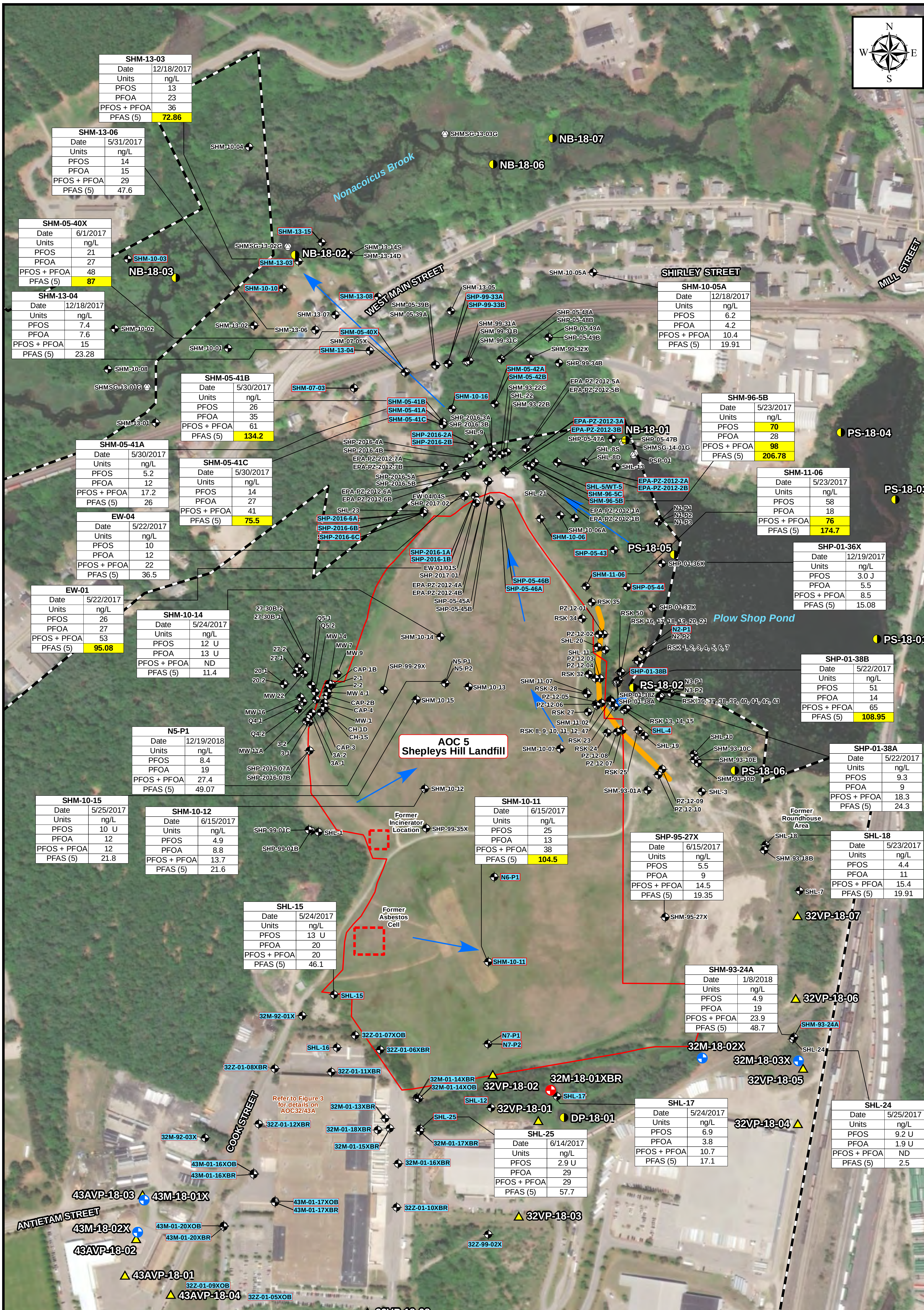
Legend

- Proposed Surface Water and Sediment Sampling Location
- Proposed Soil Boring and Vertical Profiling Location
- Proposed Vertical Profiling Location
- Proposed Soil Boring Location
- MacPherson Water Supply Well
- Stream/River
- Lake/Pond
- Swamp/Marsh
- MassDEP Zone II Wellhead Protection Area
- City/Town Boundary
- Former Fort Devens Boundary

Area 2 Figure Extents Devens PFAS RI WP - Area 2 FSP Addendum			
Former Fort Devens Army Installation Devens, Massachusetts			
KOMAN Government Solutions, LLC 293 Boston Post Road West, Suite 100, Marlborough, MA 01752			
0 500 1,000 Feet	Date: 11/16/2018	Figure 1	KGS

File: PFAS2018_A2FSP_F1_Extents_VPL.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- Tentative Overburden Monitoring Well
- Tentative Bedrock Well
- Proposed Vertical Profiling Location
- Proposed Surface Water and Sediment Sampling Location
- Monitoring Well
- Extraction Well
- Stream Gauge
- Barrier Wall
- Approximate Groundwater Flow Direction
- SHL-25 Proposed Wells to be Sampled
- AOC 5 Feature
- AOC 5 Boundary
- Former Fort Devens Boundary

Notes:

All concentrations in nanograms per liter (ng/L)
Bold/highlighted results exceed EPA LHA of 70 ng/L for separate or combined PFOS +PFOA and/or exceed MA ORSG of 70 ng/L for the combined concentrations of PFOS, PFOA, PFHxS, PFNA, and PFHpA.

Perfluorooctane Sulfonic Acid (PFOS)
Perfluorooctanoic Acid (PFOA)
Perfluorohexane Sulfonic Acid (PFHxS)
Perfluorononanoic Acid (PFNA)
Perfluoroheptanoic Acid (PFHpA)

ng/L = nanograms per liter
J = estimated result
U = non-detect

AOC 5 and AOC 32/43A Locations
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

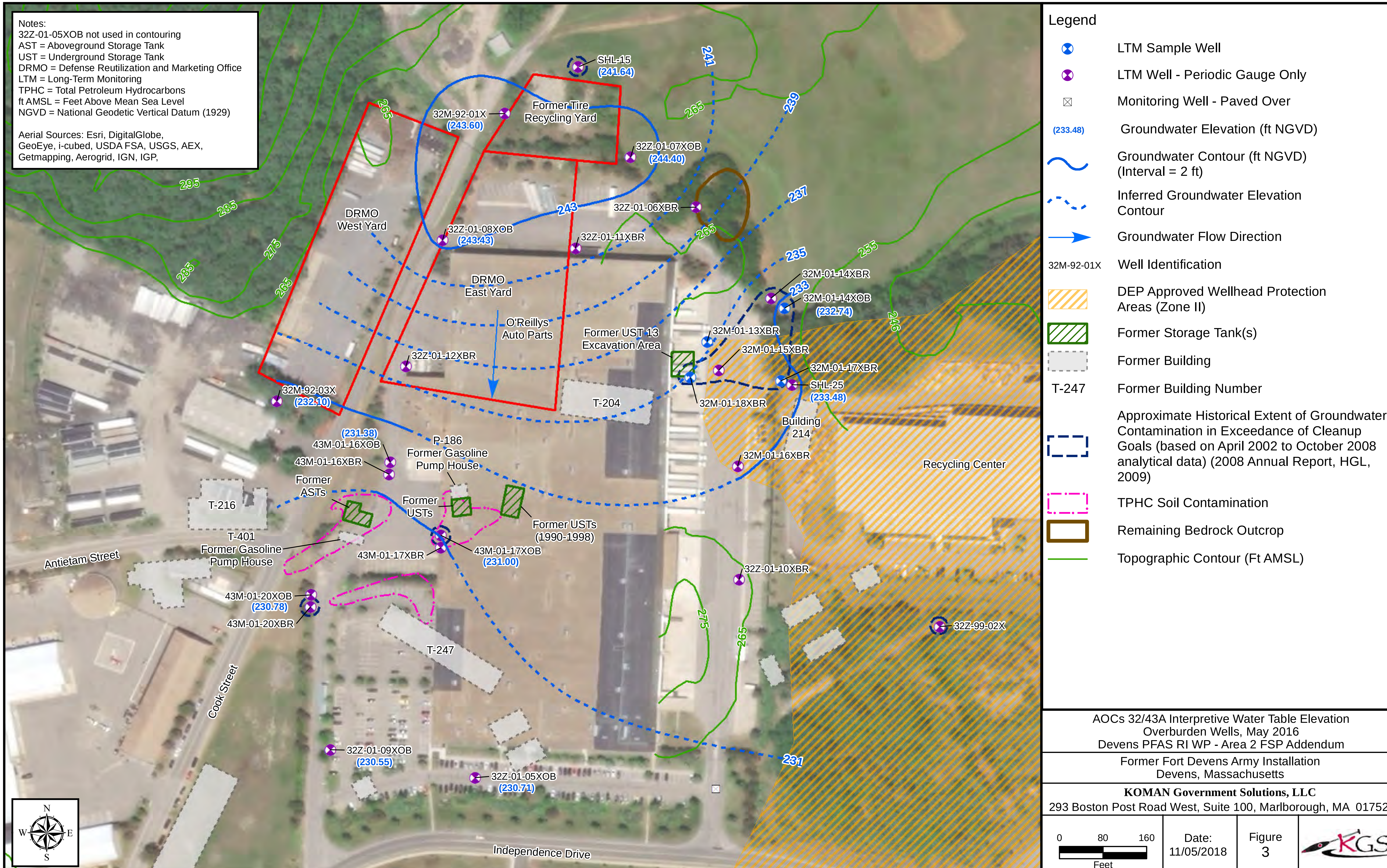
0 200 400
Feet

Date: 11/16/2018

Figure 2

File: PFAS2018_A2FSP_F2_AOC5_VPL.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



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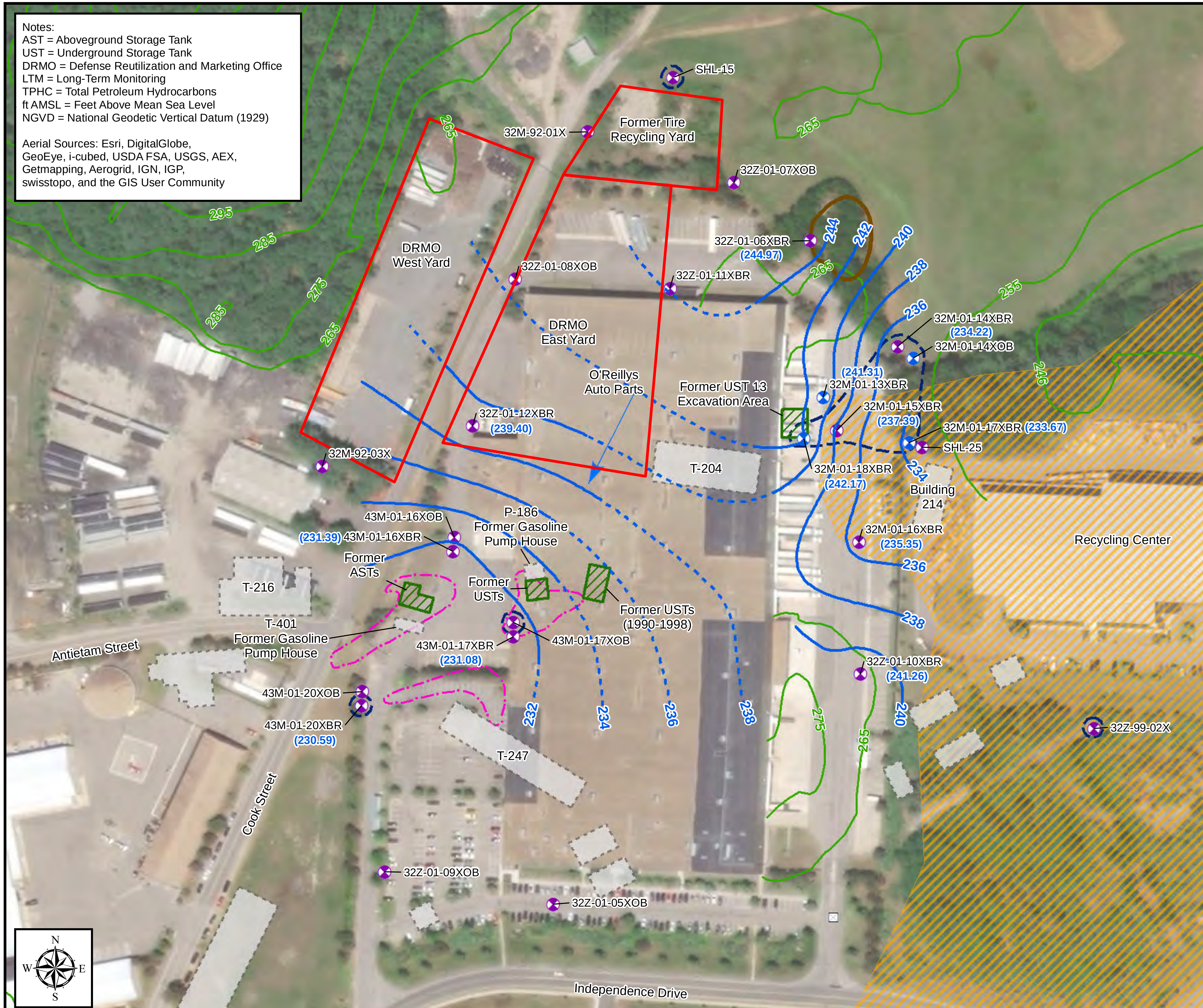

Legend

- LTM Sample Well
- LTM Well - Periodic Gauge Only
- Monitoring Well - Paved Over
- (233.04) Groundwater Elevation (ft NGVD)
- Groundwater Elevation Contour (ft NGVD) (Contour Interval = 2.0 ft)
- Inferred Groundwater Elevation Contour
- Groundwater Flow Direction
- DEP Approved Wellhead Protection Areas (Zone II)
- 32M-92-01X Well Identification
- Former Storage Tank(s)
- Former Building
- T-247 Former Building Number
- Approximate Historical Extent of Groundwater Contamination in Exceedance of Cleanup Goals (based on April 2002 to October 2008 analytical data) (2008 Annual Report, HGL, 2009)
- TPHC Soil Contamination
- Remaining Bedrock Outcrop
- Topographic Contour (Ft AMSL)

AOCs 32/43A Interpretive Water Table Elevation
Bedrock Wells, May 2016
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
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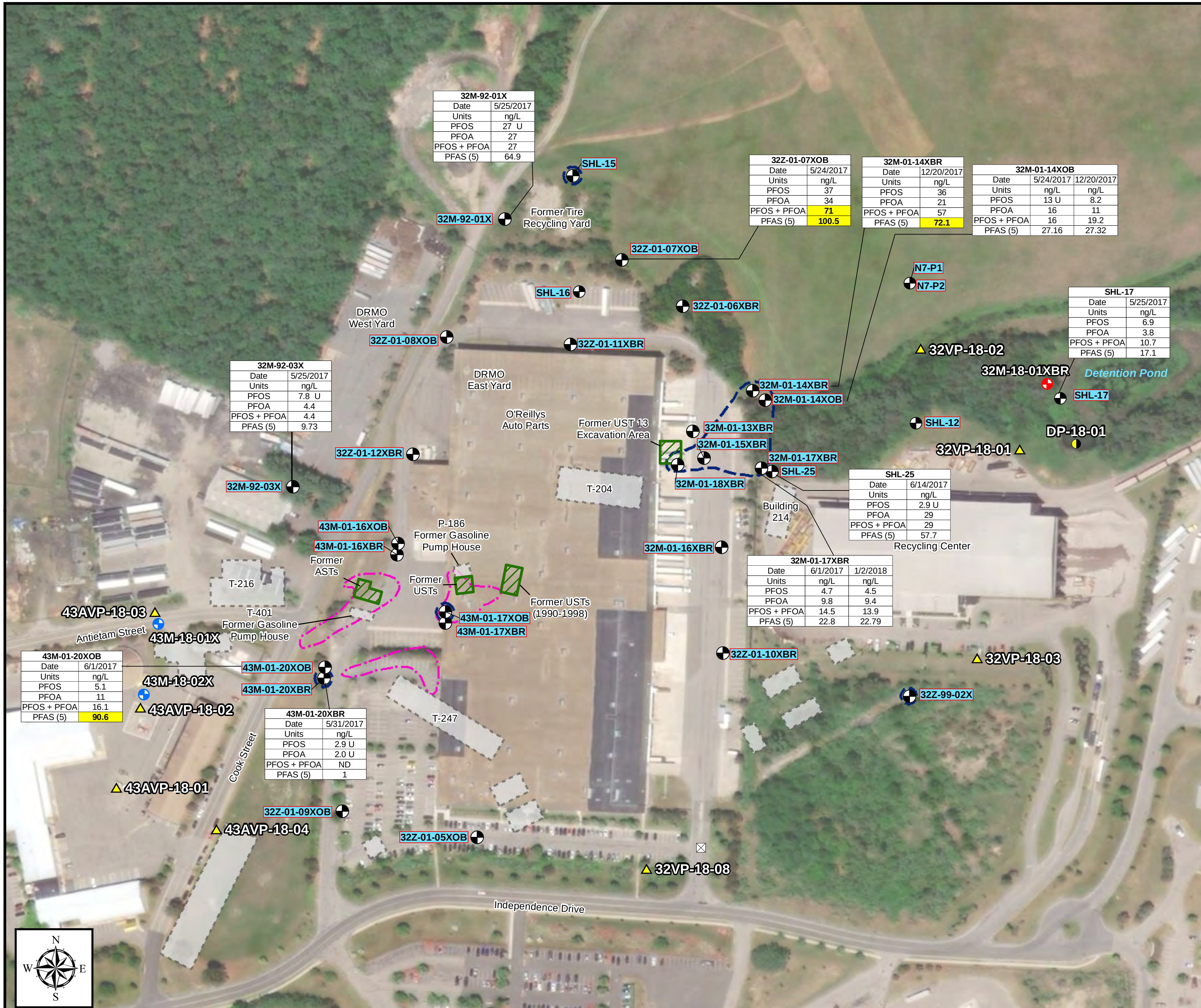
0 80 160 Feet	Date: 11/05/2018	Figure 4	KGS

File: PFAS2018_A2FSP_F4_AOC32-43A_July17GW-BR.mxd



Legend

- Proposed Surface Water and Sediment Sampling Location
- Tentative Overburden Monitoring Well
- Tentative Bedrock Well
- Proposed Vertical Profiling Location
- Monitoring Well
- Monitoring Well - Paved Over
- SHL-25 Proposed Wells to be Sampled
- Former Storage Tank(s)
- Former Building
- T-247 Former Building Number
- Approximate Historical Extent of Groundwater Contamination in Exceedance of Cleanup Goals (based on April 2002 to October 2008 analytical data) (2008 Annual Report, HGL, 2009)
- TPHC Soil Contamination

Notes:

Bold/highlighted results exceed EPA LHA of 70 ng/L for separate or combined PFOS +PFOA and/or exceed MA ORSG of 70 ng/L for the combined concentrations of PFOS, PFOA, PFHxS, PFNA, and PFHpA.

Perfluorooctane Sulfonic Acid (PFOS)
Perfluorooctanoic Acid (PFOA)
Perfluorohexane Sulfonic Acid (PFHxS)
Perfluorononanoic Acid (PFNA)
Perfluorohepatanoic Acid (PFHpA)

ng/L = nanograms per liter
J = estimated result
U = non-detect

AST = Above ground storage tank
UST = Underground storage Tank
DRMO = Defense Reutilization and Marketing Office
TPHC = Total petroleum hydrocarbons

See AOC 5 Figure for additional AOC 32 vertical profile locations along railroad tracks.

Aerial Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

AOC 32/43A Vertical Profiling Locations
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

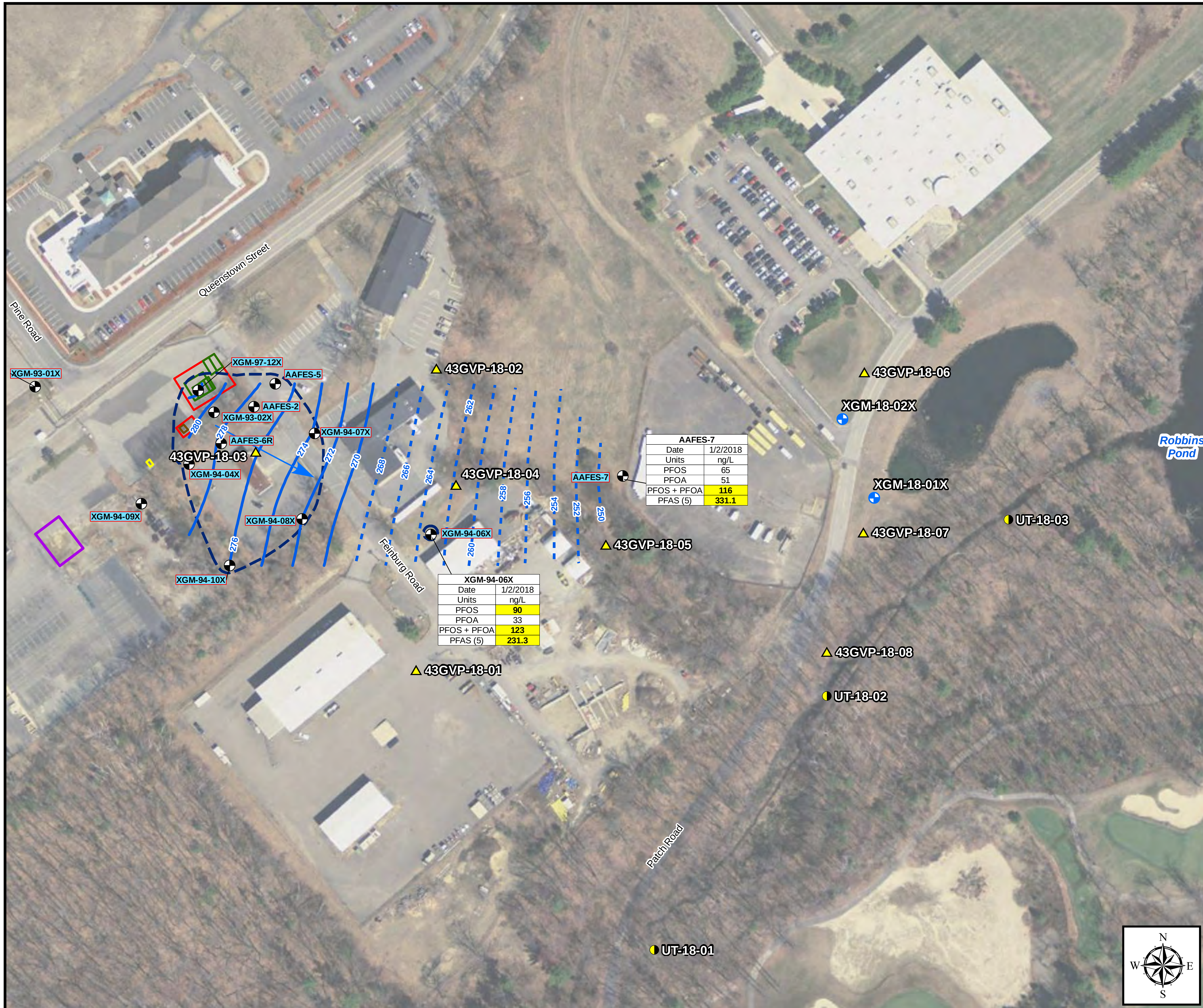
KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

0 100 200
Feet

Date: 11/16/2018

Figure 5

File: PFAS2018_A2FSP_F5_AOC32_43A_VPL_SB.mxd



AAFES-7	
Date	1/2/2018
Units	ng/L
PFOS	65
PFOA	51
PFOS + PFOA	**116**
PFAS (5)	**331.1**

XGM-94-06X	
Date	1/2/2018
Units	ng/L
PFOS	**90**
PFOA	33
PFOS + PFOA	**123**
PFAS (5)	**231.3**

Legend

- AAFES-2 Proposed Wells to be Sampled
- Proposed Vertical Profiling Location
- Proposed Surface Water and Sediment Sampling Location
- Tentative Overburden Monitoring Well
- Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour (ft NGVD) (Contour Interval = 2 ft) October 2017
- Inferred Groundwater Elevation Contour
- Approximate Historical Extent of Groundwater Contamination in Exceedance of Cleanup Goals (based on 1999 to 2008 analytical data) (2008 Annual Report, HGL, 2009)
- Area 1
- Former Gasoline UST(s)
- Former Waste Oil UST
- Former Waste Oil AST
- Former UST Area

Notes:

All concentrations in nanograms per liter (ng/L)
Bold/highlighted results exceed EPA LHA of 70 ng/L for separate or combined PFOS +PFOA and/or exceed MA ORSG of 70 ng/L for the combined concentrations of PFOS, PFOA, PFHxS, PFNA, and PFHpA.

Perfluorooctane Sulfonic Acid (PFOS)
Perfluorooctanoic Acid (PFOA)
Perfluorohexane Sulfonic Acid (PFHxS)
Perfluorononanoic Acid (PFNA)
Perfluorohepatanoic Acid (PFHpA)

ng/L = nanograms per liter
J = estimated result
U = non-detect
AST = Above ground storage tank
UST = Underground storage Tank

Aerial Sources: 2013, USGS, MassGIS

AOC 43G Vertical Profiling Locations
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

N W E S

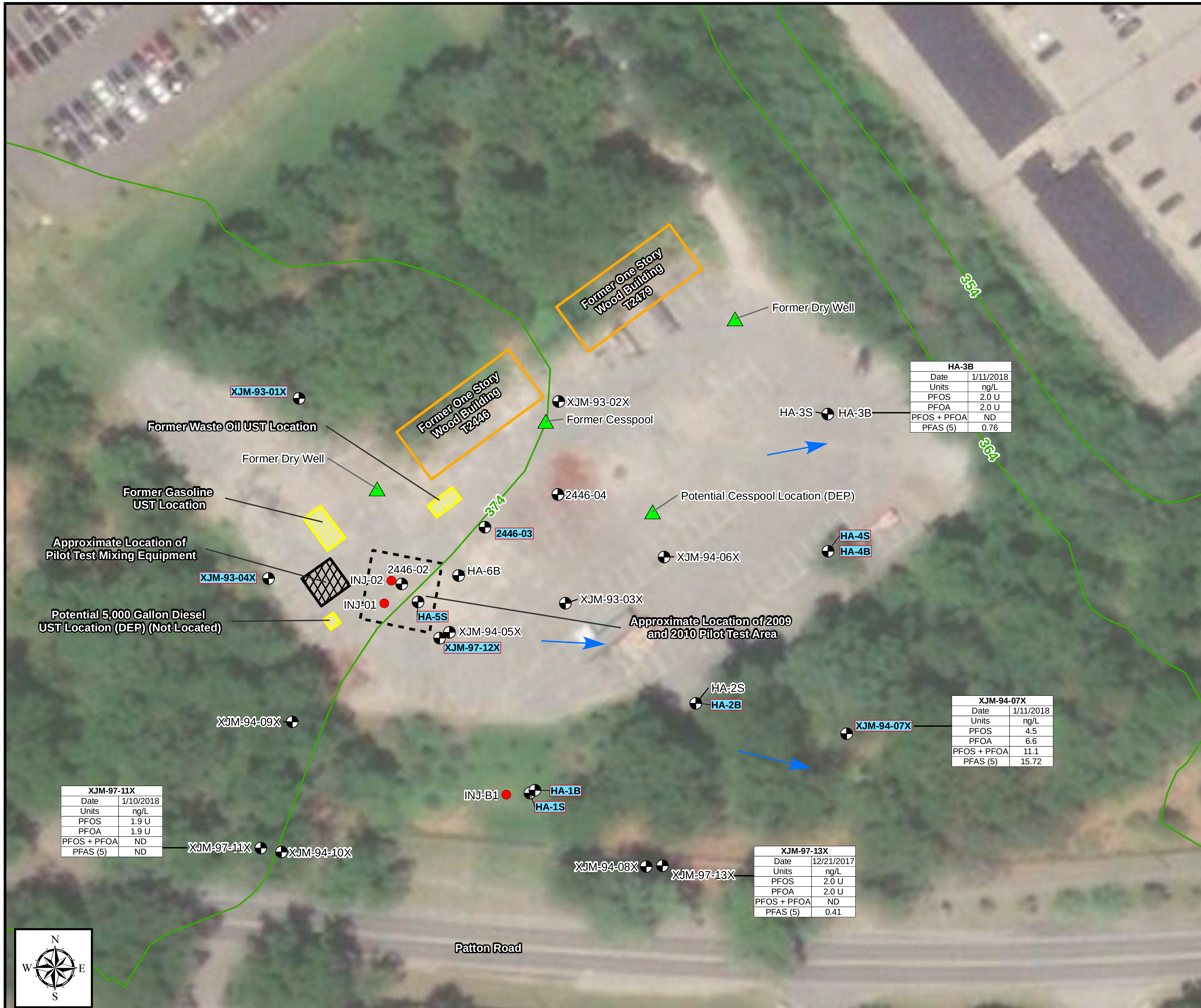
0 75 150
Feet

Date: 11/21/2018

Figure 6

KGS

File: PFAS2018_A2FSP_F6_AOC43G_VPL_SB.mxd



HA-3B	
Date	1/11/2018
Units	ng/L
PFOS	2.0 U
PFOA	2.0 U
PFOS + PFOA	ND
PFAS (5)	0.76

XJM-94-07X	
Date	1/11/2018
Units	ng/L
PFOS	4.5
PFOA	6.6
PFOS + PFOA	11.1
PFAS (5)	15.72

XJM-97-11X	
Date	1/10/2018
Units	ng/L
PFOS	1.9 U
PFOA	1.9 U
PFOS + PFOA	ND
PFAS (5)	ND

XJM-97-13X	
Date	12/21/2017
Units	ng/L
PFOS	2.0 U
PFOA	2.0 U
PFOS + PFOA	ND
PFAS (5)	0.41

Legend

Approximate Location of Potential Former Source Area Investigated

Monitoring Well

Injection Well

HA-4B Proposed Wells to be Sampled

Approximate Groundwater Flow Direction

Topographic Contour (ft

Approximate Location of Former UST

Approximate Location of 2009 and 2010 Pilot Test Area

Approximate Location of Pilot Test Mixing Equipment

Former Building

Notes:

All concentrations in nanograms per liter (ng/L)
Bold/highlighted results exceed EPA LHA of 70 ng/L for separate or combined PFOS +PFOA and/or exceed MA ORSG of 70 ng/L for the combined concentrations of PFOS, PFOA, PFHxS, PFNA, and PFHpA.

Perfluorooctane Sulfonic Acid (PFOS)
Perfluorooctanoic Acid (PFOA)
Perfluorohexane Sulfonic Acid (PFHxS)
Perfluorononanoic Acid (PFNA)
Perfluorohepatanoic Acid (PFHpA)

ng/L = nanograms per liter
J = estimated result
U = non-detect

References:
HGL. LTMMP 2010, Haley Aldrich Inc. 2015

Aerial Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

AOC 43J Monitoring Well Sampling Locations
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

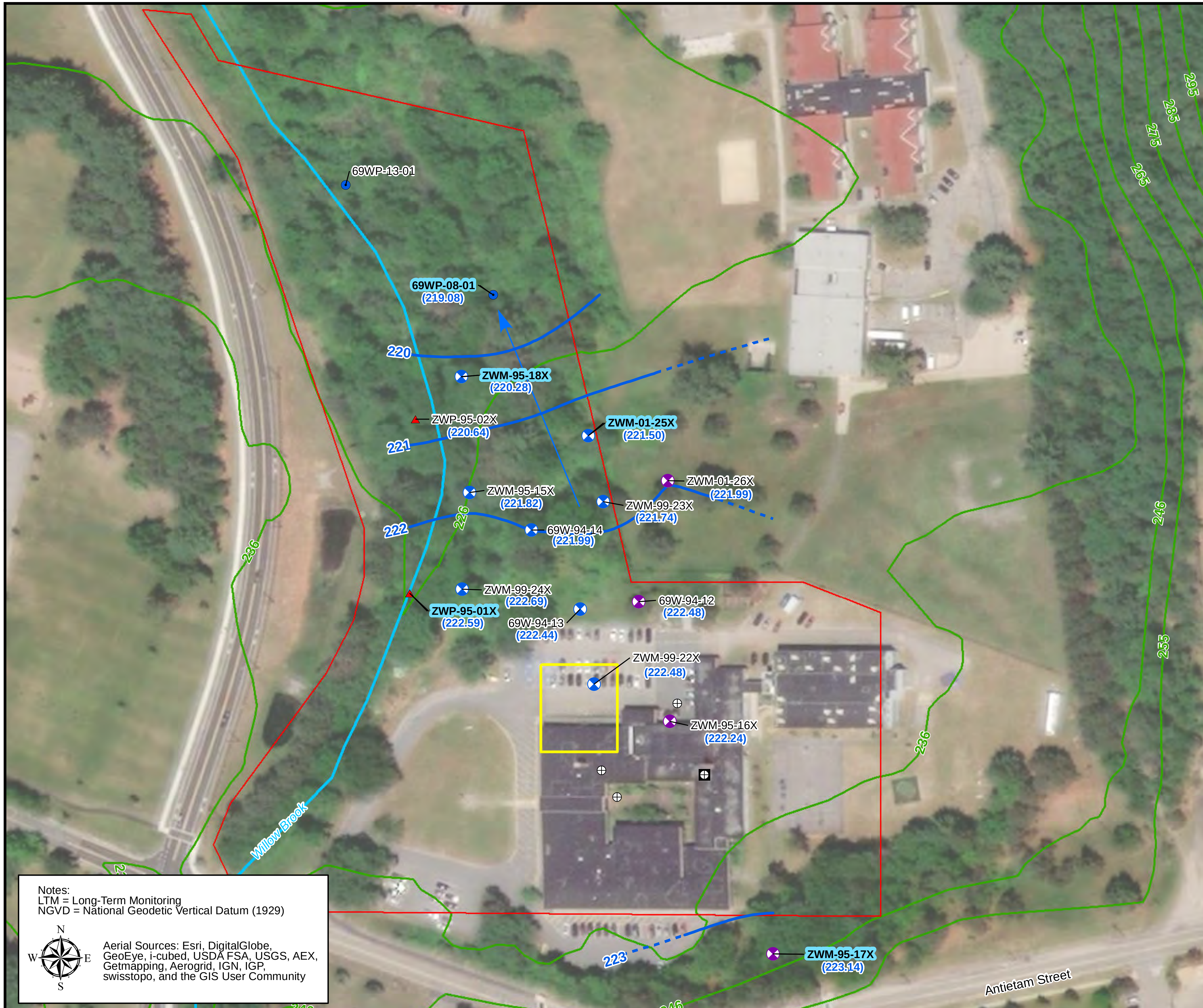
0 30 60
Feet

Date: 12/06/2018

Figure 7

KGS

File: PFAS2018_A2FSP_F7_AOC43J_VP.mxd



Notes:
LTM = Long-Term Monitoring
NGVD = National Geodetic Vertical Datum (1929)

N
W E
S

Aerial Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- LTM Sample Well
- LTM Sample Well Point
- LTM Well - Gauge Only
- LTM Piezometer
- Monitoring Well - Abandoned (2012)
- Monitoring Well - Presumed Destroyed
- Groundwater Contour (ft NGVD) (Interval = 1 ft)
- Inferred Groundwater Elevation Contour
- Groundwater Flow Direction
- ZWM-99-22X Proposed Monitoring Well to be Sampled - PFAS RI
- ZWM-01-26X Well/Piezometer/Surface Water Elevation Location
- (223.14) Groundwater Elevation (ft NGVD)
- Former Fort Devens Boundary
- Parcel Boundary
- Surface Water Course
- Topographic Contour (ft AMSL)
- Excavated Soils Management Area

AOC 69W Monitoring Well Sampling Locations
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

0 60 120
Feet

Date: 07/18/2018

Figure 8

File: PFAS2018_A2FSP_F8_AOC69W_MWSamp.mxd

FH-17-09

Date	1/23/2018
Units	µg/Kg
Type	Soil
PFOS	0.58 U
PFOA	0.23 U

FH-17-09

Date	1/23/2018
Units	ng/L
PFOS	**4000**
PFOA	**160**
PFOS + PFOA	**4160**
PFAS (5)	**5089**

FH-17-07

Date	1/23/2018
Units	µg/Kg
Type	Soil
PFOS	0.68 J
PFOA	0.22 U

FH-17-07

Date	1/23/2018
Units	ng/L
PFOS	13
PFOA	11
PFOS + PFOA	24
PFAS (5)	44.65

FH-17-08

Date	1/23/2018
Units	µg/Kg
Type	Soil
PFOS	1.5
PFOA	0.21 J

FH-17-08

Date	1/23/2018
Units	ng/L
PFOS	**1500**
PFOA	21
PFOS + PFOA	**1521**
PFAS (5)	**1656**

FH-17-06

Date	1/23/2018
Units	ng/L
PFOS	42
PFOA	30
PFOS + PFOA	**72**
PFAS (5)	**114.7**

FH-17-06

Date	1/23/2018
Units	µg/Kg
Type	Soil
PFOS	1.2
PFOA	0.24 J

FH-17-01

Date	1/22/2018
Units	ng/L
PFOS	3.7 U
PFOA	9.2
PFOS + PFOA	9.2
PFAS (5)	**121.3**

FH-17-01

Date	1/22/2018
Units	µg/Kg
Type	Soil
PFOS	30
PFOA	5.3

FH-17-02

Date	1/22/2018
Units	ng/L
PFOS	5.3
PFOA	23
PFOS + PFOA	28.3
PFAS (5)	**202.3**

FH-17-02

Date	1/22/2018
Units	µg/Kg
Type	Soil
PFOS	18
PFOA	0.92

FH-17-04

Date	1/22/2018
Units	ng/L
PFOS	14 J
PFOA	56 J
PFOS + PFOA	**70**
PFAS (5)	**306**

FH-17-04

Date	1/22/2018
Units	µg/Kg
Type	Soil
PFOS	0.71 J
PFOA	0.16 J

FH-17-05

Date	1/22/2018
Units	µg/Kg
Type	Soil
PFOS	200
PFOA	1.2

FH-17-05

Date	1/22/2018
Units	ng/L
PFOS	46
PFOA	34
PFOS + PFOA	**80**
PFAS (5)	**235.2**

FH-17-03

Date	1/22/2018
Units	µg/Kg
Type	Soil
PFOS	0.23 J
PFOA	0.24 J

FH-17-03

Date	1/22/2018
Units	ng/L
PFOS	26
PFOA	**330**
PFOS + PFOA	**356**
PFAS (5)	**1045**

Legend

- Tentative Overburden Monitoring Well
- Proposed Surface Water and Sediment Sampling Location
- Proposed Soil Boring and Vertical Profiling Location
- Proposed Vertical Profiling Location
- Proposed Soil Boring Location
- Temporary Well Location from SI
- Approximate Groundwater Flow Direction
- Detention Basin Area
- Area of Contamination (AOC)

Notes:

ng/L = nanograms per Liter
µg/Kg = micrograms per Kilogram

Bold/highlighted results exceed EPA LHA of 70 ng/L for separate or combined PFOS +PFOA and/or exceed MA ORSG of 70 ng/L for the combined concentrations of PFOS, PFOA, PFHxS, PFNA, and PFHpA.

Perfluorooctane Sulfonic Acid (PFOS)
Perfluorooctanoic Acid (PFOA)
Perfluorohexane Sulfonic Acid (PFHxS)
Perfluorononanoic Acid (PFNA)
Perfluorohepatanoic Acid (PFHpA)

J = estimated result
U = non-detect

AOC 76 Vertical Profiling and Soil Boring Locations
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

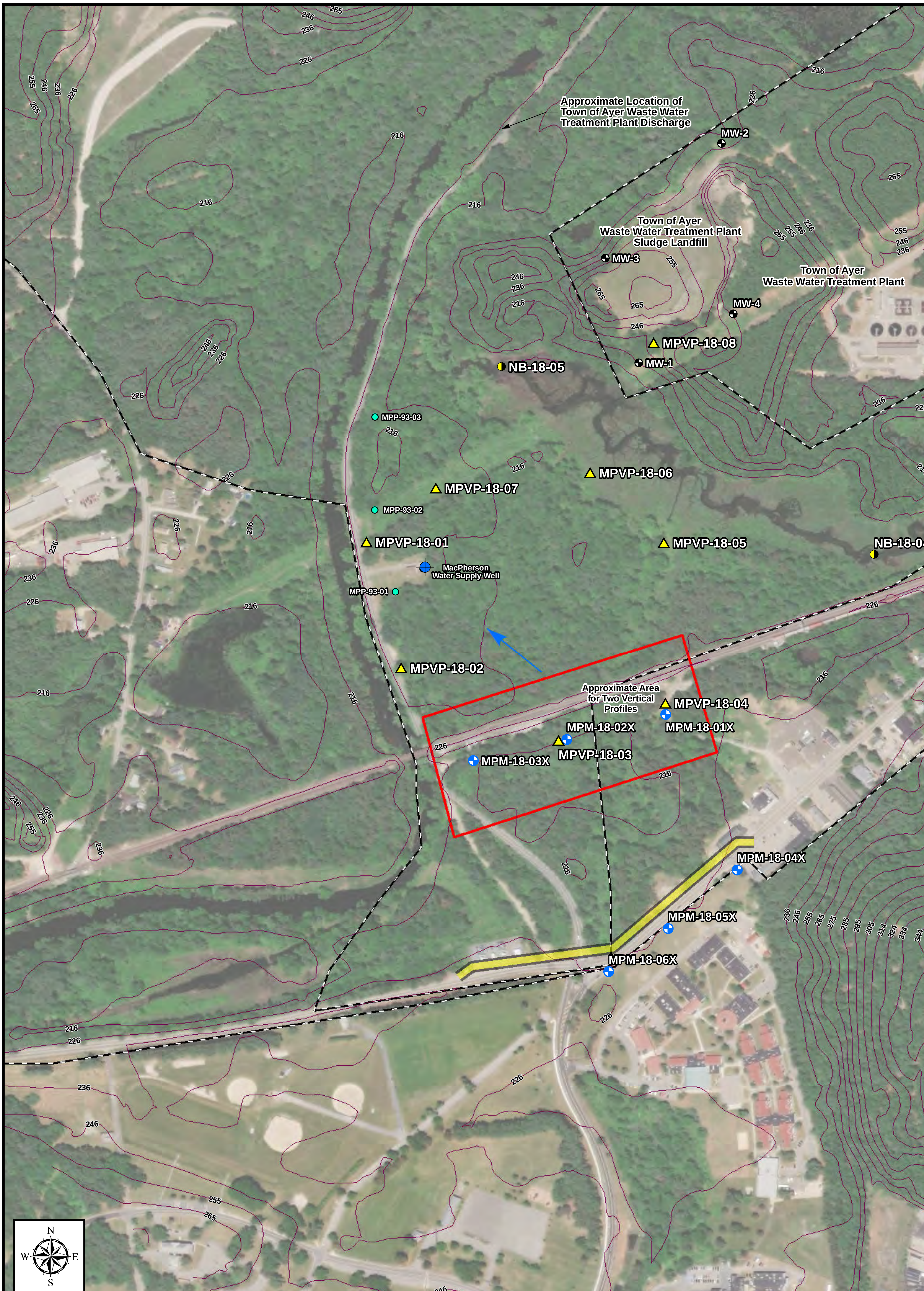
0 50 100
Feet

Date: 11/16/2018

Figure 9

File: PFAS2018_A2FSP_F9_AOC76_VPL_SB.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- Tentative Overburden Monitoring Well
- Proposed Vertical Profiling Location
- Proposed Surface Water and Sediment Sampling Location
- MacPherson Water Supply Well
- Public/Sentry Well
- Monitoring Well
- Potential Future Vertical Profiling Transect
- Approximate Groundwater Flow Direction
- Topographic Contour (feet above sea level)
- Former Fort Devens Boundary

Note:
Topographic Contour Source: MassGIS, Elevation Contours (1:5,000) - North American Vertical Datum of 1988.

MacPherson Well falls within the MassDEP Zone II Wellhead Protection Area

MacPherson Water Supply Well Vertical Profiling Locations and Town of Ayer Wells
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

0 200 400
Feet

Date: 12/04/2018

Figure 10

File: PFAS2018_A2FSP_F10_MacPherson_VPL.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Proposed Surface Water and Sediment Sampling Location
- City/Town Boundary
- Stream/River
- Lake/Pond
- Swamp/Marsh
- Former Fort Devens Boundary

Willow Brook and Vicinity Surface Water and Sediment Locations
Devens PFAS RI WP - Area 2 FSP Addendum

Former Fort Devens Army Installation
Devens, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

0 400 800
Feet

Date: 11/02/2018

Figure 11

File: PFAS2018_A2FSP_F11_WillowBrook_SW.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

TABLES

Table 1
Area 2 Existing Monitoring Well Construction Information – AOC 5
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Well Identifier	Screen Interval (ft bgs)	Screen Elevation (ft NAVD88)	Ground Surface (ft NAVD88)	TOC Elevation (ft NAVD88)	Formation Type at Screen Interval
UPGRADIENT AREA					
SHL-12	15.0 - 30.0	232.22 - 217.22	247.22	248.62	Overburden
SHL-15	14.5 - 24.5	244.52 - 234.52	259.02	259.92	Overburden
SHL-17	6.0 - 16.0	225.88 - 215.88	231.88	233.79	Overburden
SHL-24	110.0 - 120.0[1]	126.79 - 116.79	236.79	238.75	OB/Till/BR
SHL-25	23.5 - 33.5	232.78 - 222.78	256.28	258.01	Overburden
SHM-93-24A	13.2 - 23.2	222.19 - 212.19	235.39	238.42	Overburden
SHL-7	11.0 - 21.0	223.79 - 213.79	234.79	236.33	Overburden
LANDFILL AREA					
N5-P1	95.5 - 97.5	144.96 - 142.96	240.46	242.65	Bedrock
N5-P2	23.0 - 28.0[1]	217.46 - 212.46	240.46	242.69	Bedrock
N7-P1	66.0 - 68.0[1]	187.18 - 185.18	253.18	255.59	Bedrock
N7-P2	29.0 - 34.0[1]	224.18 - 219.18	253.18	256.04	Overburden
SHL-18	16.0 - 26.0	219.67 - 209.67	235.67	237.56	Overburden
SHM-93-18B	78.5 - 88.5	156.71 - 146.71	235.21	237.31	Overburden
SHM-10-07	40.0 - 50.0	204.98 - 194.98	244.98	246.82	Mid Overburden
SHM-10-12	45.0 - 55.0	207.57 - 197.57	252.57	255.17	Mid Overburden
SHM-10-13	60.0 - 70.0	181.51 - 171.51	241.51	244.77	Deep Overburden
SHM-10-14	60.0 - 80.0	174.80 - 154.80	234.80	237.62	Deep Overburden
SHM-10-15	45.0 - 55.0	196.95 - 186.95	241.95	243.68	Mid Overburden
SHP-95-27X	30.5 - 40.5	204.81 - 194.81	235.31	237.45	Overburden
SHP-99-01B	4.0 - 8.0	267.76 - 263.76	271.76	273.16	Shallow Overburden
SHP-99-01C	19.7 - 29.7	252.46 - 242.46	272.16	274.15	Bedrock
SHP-99-29X	19.0 - 29.0	222.46 - 212.46	241.46	243.34	Shallow Overburden
SHP-99-35X	30.2 - 40.2	226.50 - 216.50	256.70	258.23	Shallow Overburden
N6-P1	85.5 - 87.5[1]	170.56 - 168.53	256.06	259.60	Bedrock
SHM-10-11	50.0 - 60.0	211.16 - 201.16	261.16	263.76	Deep Overburden
SHP-2016-07A	22.0 - 32.0	240.98 - 230.98	262.98	265.30	Bedrock
SHP-2016-07B	70.0 - 80.0	192.98 - 182.98	262.98	265.33	Bedrock
SHEPLEY'S HILL AREA					
CH-1S	36.0 - 41.0	212.46 - 207.46	248.46	250.63	Bedrock
CH-1D	85.0 - 95.0	163.46 - 153.46	248.46	250.59	Bedrock
2-1	UKN	UNK	243.51	245.90	UKN
2-2	UKN	UNK	245.63	248.06	UKN
20-1	40.7 - 55.7	237.01 - 222.01	277.78	278.52	Bedrock
20-2	0.0 - 25.2	277.30 - 252.10	277.3	277.71	Bedrock
27-1	61.2 - 66.2	209.89 - 204.89	268.09	270.66	Bedrock
27-2	60.4 - 70.4	215.07 - 205.07	273.07	275.15	Bedrock
27-30B-1	36.3 - 46.3	236.56 - 226.56	271.56	272.95	Bedrock
27-30B-2	0.0 - 22.5	271.75 - 249.25	271.75	274.00	Bedrock
CAP-1B	7.0 - 54.9	236.13 - 188.23	243.13	245.98	Bedrock
CAP-2B	54.0 - 59.0	196.66 - 191.66	248.66	250.21	Bedrock
CAP-3	6.0 - 40.0	245.45 - 211.45	251.45	252.63	Bedrock
CAP-4	9.0 - 13.8	237.73 - 232.93	246.73	248.63	Bedrock
MW-1	6.58 - 8. 58[2]	242.31 - 240.31	248.89	251.84	Overburden
MW-11A	4.18 - 6.18[2]	251.42 - 249.42	255.60	258.57	Overburden
MW-14	5.14 - 7.14[2]	248.61 - 246.61	253.75	256.61	Overburden
MW-16	5.18 - 7.18[2]	262.53 - 260.53	267.71	270.23	Overburden
MW-22	4.70 - 6.70[2]	260.83 - 258.83	265.53	267.64	Overburden

Table 1
Area 2 Existing Monitoring Well Construction Information – AOC 5
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Well Identifier	Screen Interval (ft bgs)	Screen Elevation (ft NAVD88)	Ground Surface (ft NAVD88)	TOC Elevation (ft NAVD88)	Formation Type at Screen Interval
MW-4-1	3.72 - 5.72[2]	241.67 - 239.67	245.39	247.33	Overburden
MW-7	6.58 - 8.98[2]	239.51 - 237.51	246.09	249.10	Overburden
MW-9	7.65 - 9.65[2]	233.40 - 231.40	241.05	243.91	Overburden
Q4-1	30.0 - 40.0	236.20 - 226.20	266.20	268.38	Bedrock
Q4-2	8.5 - 53.0	262.55 - 218.05	271.05	273.37	Bedrock
Q5-1	49.3 - 54.3	212.32 - 207.32	259.32	260.99	Bedrock
Q5-2	UKN	UNK	259.14	259.90	UKN
3-1	UKN	UNK	264.10	265.18	UKN
Well 3-2	55.0 - 60.0	211.28 - 206.28	267.28	268.20	Bedrock
3A-1	UKN	UNK	266.05	266.90	UKN
3A-2	0 - 54.9	263.27 - 208.37	263.27	264.56	Bedrock
BARRIER WALL AREA					
N1-P1	65.0 - 70.0	162.78 - 157.78	227.78	229.92	Deep Overburden
N1-P2	40.0 - 45.0	187.78 - 182.78	227.78	229.93	Mid Overburden
N1-P3	12.0 - 17.0	215.78 - 210.78	227.78	230.08	Shallow Overburden
N2-P1	35.0 - 40.0	185.55 - 180.55	220.55	222.16	Bedrock
N2-P2	4.0 - 9.0	216.55 - 211.55	220.55	222.01	Shallow Water Table
N3-P1	33.0 - 35.0[1]	185.81 - 183.81	218.81	220.83	Bedrock
N3-P2	4.0 - 9.0[1]	214.81 - 209.81	218.81	220.84	Shallow Water Table
SHL-10	24.0 - 39.0	222.62 - 207.62	246.62	248.02	Shallow Overburden
SHM-93-10C	44.0 - 54.0	202.06 - 192.06	246.06	247.68	Bedrock
SHM-93-10D	46.0 - 56.0	199.51 - 189.51	245.51	248.01	Bedrock
SHM-93-10E	UKN	UNK	245.60	247.54	UKN
SHL-11	12.0 - 27.0	221.95 - 206.95	233.95	235.47	Shallow Overburden
SHL-19	20.0 - 30.0	218.59 - 208.59	238.59	240.50	Shallow Overburden
SHL-20	39.0 - 49.0	195.72 - 185.72	234.72	235.95	Deep Overburden
SHL-3	24.0 - 34.0	221.80 - 211.80	245.8	246.95	Mid-Overburden
SHL-4	3.0 - 13.0	223.08 - 213.08	226.08	227.48	Shallow Overburden
SHM-11-02	39.0 - 49.0	199.66 - 189.66	238.66	240.73	Bedrock
SHM-11-06	25.0 - 35.0	208.33 - 198.33	233.33	236.17	Shallow Overburden
SHM-11-07	41.0 - 46.0	197.22 - 192.22	238.22	240.83	Bedrock
SHP-01-36X	3.0 - 8.0	216.97 - 211.97	219.97	223.95	Shallow Overburden
SHP-01-37X	1.0 - 6.0	217.67 - 212.67	218.67	222.79	Shallow Overburden
SHP-01-38A	1.5 - 6.5	217.27 - 212.27	218.77	220.86	Shallow Overburden
SHP-01-38B	18.0 - 23.0	200.88 - 195.88	218.88	221.03	Deep Overburden
SHP-01-38Z	UKN	UNK	218.66	220.75	UKN
SHP-05-43	50.5 - 60.5	207.88 - 197.88	258.38	260.71	Shallow Overburden
SHP-05-44	51.0 - 61.0	204.56 - 194.56	255.56	258.14	Mid Overburden
PZ-12-01	24.0 - 34.0	209.85 - 109.85	233.85	237.55	Shallow Overburden
PZ-12-02	24.0 - 34.0	209.75 - 109.75	233.75	237.79	Shallow Overburden
PZ-12-03	22.0 - 32.0	210.85 - 200.85	232.85	236.40	Shallow Overburden
PZ-12-04	22.0 - 32.0	213.05 - 203.05	235.05	238.20	Shallow Overburden
PZ-12-05	26.0 - 36.0	210.08 - 200.08	236.08	238.73	Mid-Overburden
PZ-12-06	26.0 - 36.0	212.42 - 202.42	238.42	242.18	Mid-Overburden
PZ-12-07	18.0 - 28.0	222.80 - 212.80	240.80	244.59	Mid-Overburden
PZ-12-08	18.0 - 28.0	223.74 - 213.74	241.74	244.83	Mid-Overburden
PZ-12-09	22.0 - 32.0	216.43 - 206.43	238.43	241.93	Shallow Overburden
PZ-12-10	22.0 - 32.0	216.98 - 206.98	238.98	242.28	Shallow Overburden
RSK 1	30.02 - 35.02	191.42 - 186.42	221.44	222.58	UKN
RSK 2	25.05 - 30.05	196.52 - 191.52	221.57	222.15	UKN

Table 1
Area 2 Existing Monitoring Well Construction Information – AOC 5
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Well Identifier	Screen Interval (ft bgs)	Screen Elevation (ft NAVD88)	Ground Surface (ft NAVD88)	TOC Elevation (ft NAVD88)	Formation Type at Screen Interval
RSK 3	20.01 - 25.01	201.82 - 196.82	221.83	222.95	UKN
RSK 4	14.67 - 19.67	207.02 - 202.02	221.69	222.97	UKN
RSK 5	9.96 - 14.96	211.72 - 206.72	221.68	222.75	UKN
RSK 6	20.12 - 25.12	201.42 - 196.42	221.54	222.49	UKN
RSK 7	4.24 - 9.24	217.32 - 212.32	221.56	222.01	UKN
RSK 8	28.06 - 33.06	197.92 - 192.92	225.98	226.96	UKN
RSK 9	22.29 - 27.29	203.42 - 198.42	225.71	226.45	UKN
RSK 10	17.2 - 22.2	208.42 - 203.42	225.62	226.37	UKN
RSK 11	12.35 - 17.35	213.72 - 208.72	226.07	226.75	UKN
RSK 12	8.0 - 13.0	217.63 - 212.63	225.63	226.42	UKN
RSK 13	16.26 - 21.26	208.32 - 203.32	224.58	225.37	UKN
RSK 14	12.35 - 17.35	212.12 - 207.12	224.47	225.30	UKN
RSK 15	7.27 - 12.27	217.42 - 212.42	224.69	225.54	UKN
RSK 16	16.72 - 21.72	201.32 - 196.32	218.04	218.58	UKN
RSK 17	12.2 - 17.2	205.52 - 200.52	217.72	218.85	UKN
RSK 18	7.15 - 12.15	210.82 - 205.82	217.97	218.73	UKN
RSK 19	2.06 - 7.06	215.72 - 210.72	217.78	218.76	UKN
RSK 20	12.13 - 17.13	205.92 - 200.92	218.05	219.05	UKN
RSK 21	1.33 - 21.33	216.72 - 196.72	218.05	220.04	UKN
RSK 23	5.31 - 30.31	222.22 - 197.22	227.53	227.80	UKN
RSK 24	18.16 - 23.16	222.22 - 217.22	240.38	240.41	UKN
RSK 25	20.21 - 25.21	219.32 - 214.32	239.53	239.21	UKN
RSK 27	19.43 - 24.43	220.80 - 215.80	240.23	241.45	UKN
RSK 28	19.62 - 24.62	218.62 - 213.62	238.24	239.24	UKN
RSK 32	19.49 - 24.49	216.38 - 211.38	235.87	236.91	UKN
RSK 34	17.84 - 22.84	215.71 - 210.71	233.55	233.16	UKN
RSK 35	20.42 - 25.42	212.57 - 207.57	232.99	233.64	UKN
RSK 36	3.70 - 23.70	216.35 - 196.35	220.05	220.22	UKN
RSK 37	2.13 - 7.13	217.51 - 212.51	219.64	220.55	UKN
RSK 38	5.11 - 10.11	214.50 - 209.50	219.61	220.53	UKN
RSK 39	9.91 - 14.91	209.65 - 204.65	219.56	220.33	UKN
RSK 40	15.07 - 20.07	204.50 - 199.50	219.57	220.39	UKN
RSK 41	20.09 - 25.09	199.44 - 194..44	219.53	220.41	UKN
RSK 42	10.15 - 15.15	209.51- 204.51	219.66	220.57	UKN
RSK 43	3.91 - 23.91	215.71 - 195.71	219.62	220.43	UKN
RSK 47	11.21 - 16.21	214.66 - 209.66	225.87	226.83	UKN
RSK 50	2.31 - 2.81	215.73 - 215.23	218.04	220.23	UKN
NEARFIELD AREA					
SHL-13	5.0 - 20.0	213.97 - 198.97	218.98	220.71	Shallow Overburden
SHL-21	42.0 - 52.0	216.14 - 206.14	258.14	260.00	Overburden
SHL-22	105.0 - 115.0	113.90 - 103.90	218.90	219.58	Deep Overburden/Till
SHL-23	23.0 - 33.0	216.44 - 206.44	239.44	241.29	Overburden
SHL-5	3.0 - 13.0	213.90 - 203.90	216.90	217.60	Shallow Overburden
SHL-8D	68.0 - 70.0	150.83 - 148.83	218.83	220.78	Deep Overburden
SHL-8S	52.0 - 54.0	166.83 - 164.83	218.83	220.97	Shallow Overburden
SHL-9	15.0 - 25.0	205.72 - 195.72	220.72	221.95	Shallow Overburden
SHM-05-41A	42.0 - 44.0	180.72 - 178.72	222.72	222.48	Shallow Overburden
SHM-05-41B	62.0 - 64.0	160.50 - 158.33	222.50	222.33	Mid Overburden
SHM-05-41C	88.0 - 93.0	134.91 - 129.91	222.91	222.57	Deep Overburden/Till
SHM-05-42A	40.0 - 42.0	173.65 - 171.65	213.65	216.81	Shallow Overburden

Table 1
Area 2 Existing Monitoring Well Construction Information – AOC 5
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Well Identifier	Screen Interval (ft bgs)	Screen Elevation (ft NAVD88)	Ground Surface (ft NAVD88)	TOC Elevation (ft NAVD88)	Formation Type at Screen Interval
SHM-05-42B	70.0 - 72.0	143.65 - 141.65	213.65	216.80	Mid Overburden
SHM-10-06	69.5 - 79.5	160.53 - 150.53	230.03	232.91	Deep Overburden
SHM-10-06A	77.0 - 87.0	168.96 - 158.96	245.96	248.54	Deep Overburden
SHM-10-16	75.0 - 85.0	141.72 - 131.72	216.72	219.23	Deep Overburden
SHM-93-22B	82.3 - 92.3	136.54 - 126.54	218.84	219.39	Mid-depth Overburden
SHM-93-22C	124.3 - 134.3	94.62 - 84.62	218.92	220.69	Deep Bedrock
SHM-96-5B	80.0 - 90.0	137.38 - 127.38	217.38	218.92	Sand/Till
SHM-96-5C	50.0 - 60.0	167.39 - 157.39	217.39	218.39	Mid Overburden
SHP-05-45A	20.0 - 25.0	206.32 - 201.32	226.32	228.48	Shallow Overburden
SHP-05-45B	65.0 - 75.0	161.72 - 151.72	226.72	229.11	Mid Overburden
SHP-05-46A	20.0 - 25.0	206.30 - 201.30	226.31	228.18	Mid Overburden
SHP-05-46B	65.0 - 75.0	161.03 - 151.03	226.03	227.60	Shallow Overburden
SHP-05-47A	1.0 - 2.0	212.35 - 211.35	213.35	217.39	Shallow Water Table
SHP-05-47B	3.0 - 4.0	210.33 - 209.33	213.33	215.40	Shallow Water Table
SHP-2017-01	70.0 - 75.0	157.22 - 152.22	227.22	229.63	Overburden
SHP-2017-02	85.0 - 90.0	142.26 - 137.26	227.26	230.05	Overburden
EPA-PZ-2012-1A	20.0 - 25.0	199.90 - 194.90	219.91	223.79	Shallow Overburden
EPA-PZ-2012-1B	70.0 - 75.0	149.81 - 144.81	219.81	223.53	Deep Overburden
EPA-PZ-2012-2A	20.0 - 25.0	199.72 - 194.72	219.72	223.38	Shallow Overburden
EPA-PZ-2012-2B	75.0 - 80.0	144.75 - 139.75	219.76	223.37	Deep Overburden
EPA-PZ-2012-3A	20.0 - 25.0	199.19 - 194.19	219.20	222.65	Shallow Overburden
EPA-PZ-2012-3B	70.0 - 75.0	149.25 - 144.25	219.25	222.57	Deep Overburden
EPA-PZ-2012-4A	20.0 - 25.0	203.30 - 198.30	223.30	226.60	Shallow Overburden
EPA-PZ-2012-4B	70.0 - 75.0	153.51 - 148.51	223.51	226.39	Deep Overburden
EPA-PZ-2012-5A	20.0 - 25.0	196.33 - 191.33	216.33	220.01	Shallow Overburden
EPA-PZ-2012-5B	80.0 - 85.0	136.20 - 131.20	216.20	219.38	Deep Overburden
EPA-PZ-2012-6A	25.0 - 30.0	205.71 - 200.71	230.71	234.25	Shallow Overburden
EPA-PZ-2012-6B	75.0 - 80.0	155.85 - 150.85	230.85	234.08	Deep Overburden
EPA-PZ-2012-7A	25.0 - 30.0	209.42 - 204.42	234.42	234.16	Shallow Overburden
EPA-PZ-2012-7B	60.0 - 65.0	174.28 - 169.28	234.28	234.03	Deep Overburden
SHP-2016-1A	13.9 - 23.0	211.69- 201.69	224.69	227.27	Shallow Overburden
SHP-2016-1B	75.0 - 85.0	149.68 - 139.68	224.69	227.24	Deep Overburden
SHP-2016-2A	20.0 - 25.0	203.72 - 198.72	223.73	225.93	Shallow Overburden
SHP-2016-2B	80.0 - 85.0	143.72 - 138.72	223.73	225.95	Deep Overburden
SHP-2016-3A	20.0 - 25.0	201.12 - 196.12	221.13	223.18	Shallow Overburden
SHP-2016-3B	80.0 - 85.0	141.12 - 136.12	221.13	223.18	Deep Overburden
SHP-2016-4A	25.0 - 30.0	202.57 - 197.57	227.57	229.97	Shallow Overburden
SHP-2016-4B	85.0 - 90.0	142.57 - 137.57	227.57	229.75	Deep Overburden
SHP-2016-5A	25.0 - 30.0	199.87 - 194.87	224.88	227.01	Shallow Overburden
SHP-2016-5B	85.0 - 90.0	139.87 - 134.87	224.88	226.95	Deep Overburden
SHP-2016-06A	81.0 - 86.0	159.05 - 154.05	240.05	241.90	Bedrock
SHP-2016-06B	102.0 -112.0	138.05 - 128.05	240.05	241.89	Bedrock
SHP-2016-06C	123.0 - 133.0	117.05 - 107.05	240.05	241.92	Bedrock
NORTHERN IMPACT AREA					
SHM-10-01	60.5 - 70.5	146.19 - 136.69	206.69	209.65	Deep Overburden/Till
SHM-10-02	53.0 - 63.0	167.19 - 157.19	220.19	223.03	Mid Overburden
SHM-10-03	58.5 - 68.5	171.27 - 161.27	229.77	232.05	Mid Overburden
SHM-10-04	55.0 - 65.0	155.00 - 145.00	210.00	212.61	Mid Overburden
SHM-10-05A	50.0 - 60.0	185.41- 175.41	235.41	235.09	Mid Overburden
SHM-10-08	46.0 - 56.0	165.86 - 155.86	211.86	214.36	Deep OB / Till

Table 1
Area 2 Existing Monitoring Well Construction Information – AOC 5
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Well Identifier	Screen Interval (ft bgs)	Screen Elevation (ft NAVD88)	Ground Surface (ft NAVD88)	TOC Elevation (ft NAVD88)	Formation Type at Screen Interval
SHM-10-10	56.0 - 66.0	159.40 - 149.40	215.40	217.11	Deep OB / Till
SHM-05-39A	37.0 - 39.0	184.79 - 182.79	221.79	221.53	Mid Overburden
SHM-05-39B	66.0 - 68.0	155.77 - 153.77	221.77	221.51	Deep Overburden
SHM-13-01	39.0 - 49.0	166.77 - 156.77	205.77	208.08	Mid Overburden
SHM-13-02	60.0 - 70.0	156.92 - 146.92	216.92	218.72	Deep Overburden
SHM-13-05	75.0 - 85.0	150.39 - 140.39	225.39	225.14	Deep Overburden
SHM-13-14D	45.0 - 55.0	162.48 - 152.48	207.48	210.48	Deep Overburden
SHM-13-14S	5.0 - 15.0	202.67 - 192.67	207.67	210.55	Shallow Overburden
SHM-13-15	50.0 - 60.0	155.98 - 145.98	205.98	210.58	Deep Overburden
SHM-99-32X	72.0 - 82.0	147.12 - 137.12	219.12	221.28	Deep Overburden
SHM-99-31A	4.0 - 14.0	208.82 - 198.82	212.82	214.34	Shallow OB / WT
SHM-99-31B	50.0 - 60.0	162.52 - 152.52	212.52	214.39	Mid Overburden
SHM-99-31C	68.0 - 78.0	144.64 - 134.64	212.64	214.60	Deep Overburden
SHP-99-33A	10.5 - 15.5	210.56 - 205.56	221.06	223.03	Overburden
SHP-99-33B	74.5 - 79.5	146.66 - 141.66	221.16	222.65	Overburden
SHM-99-34B	74.5-79.5	148.19 - 143.19	222.69	224.91	Deep Overburden
SHP-05-48A	1.0 - 2.0	212.08 - 211.08	213.09	217.31	Shallow Water Table
SHP-05-48B	2.0 - 3.0	211.03 - 210.03	213.03	215.96	Shallow Water Table
SHP-05-49A	1.0 - 2.0	211.34 - 210.34	212.34	216.67	Shallow Water Table
SHP-05-49B	2.5 - 3.5	209.89 - 208.89	212.39	215.14	Shallow Water Table
SHM-05-40X	32.0 - 34.0	191.48 - 189.48	223.48	223.19	Mid Overburden/Till
SHM-07-03	25.0 - 35.0	202.96 - 192.96	227.96	227.90	Shallow Overburden
SHM-07-05X	56.0 - 66.0	167.66 - 157.66	223.66	223.40	Mid Overburden
SHM-13-03	42.0 - 52.0	167.91 - 157.91	209.91	212.05	Deep OB / Till
SHM-13-04	20.0 - 30.0	207.34 - 197.34	227.34	227.02	Shallow Overburden
SHM-13-06	36.0 - 46.0	188.23 -178.23	224.23	223.89	Deep Overburden/Till
SHM-13-07	27.0 - 37.0	199.11 - 189.11	226.11	225.64	Unknown
SHM-13-08	55.0 - 65.0	173.19 - 163.19	228.19	227.90	Mid Overburden/Till
EXTRACTION WELLS					
EW-1	60.0 - 85.0	166.97 - 141.97	226.97	226.80	Overburden
EW-4	70.0 - 95.0	157.36 - 202.36	227.36	227.03	Overburden

Notes:

[1] estimated value derived from Supplemental Groundwater Investigation (Harding ESE, 2003).

[2] screen interval approximated based boring log depth and depth to bottom (no well construction log)

ft bgs = feet below ground surface

ft = feet

PFAS = per- and polyfluoroalkyl substances

UKN = unkown

Wells designated to be sampled in RI

Table 2
Area 2 Existing Monitoring Well Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Sample Type
AOC 5 (Upgradient Area)	SHM-93-24A	SHM-93-24A-MONYY	Native Sample
	SHL-12**	NA	Native Sample
	SHL-15 **	NA	Native Sample
	SHL-17 **	NA	Native Sample
	SHL-25 **	NA	Native Sample
AOC 5 (Landfill Area)	N6-P1	N6-P1-MONYY	Native Sample
	N7-P1	N7-P1-MONYY	Native Sample
	N7-P2	N7-P2-MONYY	Native Sample
	SHM-10-11	SHM-10-11-MONYY	Native Sample
AOC 5 (Barrier Wall Area)	N2-P1	N2-P1-MONYY	Native Sample
	SHL-4	SHL-4-MONYY	Native Sample
	SHM-11-06	SHM-11-06-MONYY	Native Sample
	SHP-01-38B	SHP-01-38B-MONYY	Native Sample
	SHP-05-43	SHP-05-43-MONYY	Native Sample
	SHP-05-44	SHP-05-44-MONYY	Native Sample
AOC 5 (Nearfield Area)	SHL-5	SHL-5-MONYY	Native Sample
	SHM-05-41A	SHM-05-41A-MONYY	Native Sample
	SHM-05-41B	SHM-05-41B-MONYY	Native Sample
	SHM-05-41C	SHM-05-41C-MONYY	Native Sample
	SHM-05-42A	SHM-05-42A-MONYY	Native Sample
	SHM-05-42B	SHM-05042B-MONYY	Native Sample
	SHM-10-06	SHM-10-06-MONYY	Native Sample
	SHM-10-16	SHM-10-16-MONYY	Native Sample
	SHM-96-5B	SHM-96-5B-MONYY	Native Sample
	SHM-96-5C	SHM-96-5C-MONYY	Native Sample
	SHP-05-46A	SHP-05-46A-MONYY	Native Sample
	SHP-05-46B	SHP-05-46B-MONYY	Native Sample
	EPA-PZ-2012-2A	EPA-PZ-2012-2A-MONYY	Native Sample
	EPA-PZ-2012-2B	EPA-PZ-2012-2B-MONYY	Native Sample
	EPA-PZ-2012-3A	EPA-PZ-2012-3A-MONYY	Native Sample
	EPA-PZ-2012-3B	EPA-PZ-2012-3B-MONYY	Native Sample
	SHP-2016-1A	SHP-2016-1A-MONYY	Native Sample
	SHP-2016-1B	SHP-2016-1B-MONYY	Native Sample
	SHP-2016-2A	SHP-2016-2A-MONYY	Native Sample
	SHP-2016-2B	SHP-2016-2B-MONYY	Native Sample
	SHP-2016-06A	SHP-2016-06A	Native Sample
	SHP-2016-06B	SHP-2016-06B	Native Sample
	SHP-2016-06C	SHP-2016-06C	Native Sample
AOC 5 (Northern Impact Area)	SHM-10-03	SHM-10-03-MONYY	Native Sample
	SHM-10-10	SHM-10-10-MONYY	Native Sample
	SHM-13-15	SHM-13-15-MONYY	Native Sample
	SHP-99-33A	SHP-99-33A-MONYY	Native Sample
	SHP-99-33B	SHP-99-33B-MONYY	Native Sample
	SHM-05-40X	SHM-05-40X-MONYY	Native Sample

Table 2
Area 2 Existing Monitoring Well Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Sample Type
	SHM-07-03	SHM-07-03-MONYY	Native Sample
	SHM-13-03	SHM-13-03-MONYY	Native Sample
	SHM-13-04	SHM-13-04-MONYY	Native Sample
	SHM-13-08	SHM-13-08-MONYY	Native Sample
AOC 32/43A	32M-01-13XBR	32M-01-13XBR-MONYY	Native Sample
	32M-01-14XBR	32M-01-14XBR-MONYY	Native Sample
	32M-01-14XOB	32M-01-14XOB-MONYY	Native Sample
	32M-01-15XBR	32M-01-15XBR-MONYY	Native Sample
	32M-01-16XBR	32M-01-16XBR-MONYY	Native Sample
	32M-01-17XBR	32M-01-17XBR-MONYY	Native Sample
	32M-01-18XBR	32M-01-18XBR-MONYY	Native Sample
	32M-92-01X	32M-92-01X-MONYY	Native Sample
	32M-92-03X	32M-92-03X-MONYY	Native Sample
	32X-99-02X	32X-99-02X-MONYY	Native Sample
	32Z-01-05XOB	32Z-01-05XOB-MONYY	Native Sample
	32Z-01-06XBR	32Z-01-06XBR-MONYY	Native Sample
	32Z-01-07XOB	32Z-01-07XOB-MONYY	Native Sample
	32Z-01-08XOB	32Z-01-08XOB-MONYY	Native Sample
	32Z-01-09XOB	32Z-01-09XOB-MONYY	Native Sample
	32Z-01-10XBR	32Z-01-10XBR-MONYY	Native Sample
	32Z-01-11XBR	32Z-01-11XBR-MONYY	Native Sample
	32Z-01-12XBR	32Z-01-12XBR-MONYY	Native Sample
	43M-01-16XBR	43M-01-16XBR-MONYY	Native Sample
	43M-01-16XOB	43M-01-16XOB-MONYY	Native Sample
	43M-01-17XBR	43M-01-17XBR-MONYY	Native Sample
	43M-01-17XOB	43M-01-17XOB-MONYY	Native Sample
	43M-01-20XBR	43M-01-20XBR-MONYY	Native Sample
	43M-01-20XOB	43M-01-20XOB-MONYY	Native Sample
	SHL-12	SHL-12-MONYY	Native Sample
	SHL-15	SHL-15-MONYY	Native Sample
	SHL-16	SHL-16-MONYY	Native Sample
	SHL-17	SHL-17-MONYY	Native Sample
	SHL-25	SHL-25-MONYY	Native Sample
AOC 43G	AAFES-2	AAFES-2-MONYY	Native Sample
	AAFES-5	AAFES-5-MONYY	Native Sample
	AAFES-6R	AAFES-6R-MONYY	Native Sample
	AAFES-7	AAFES-7-MONYY	Native Sample
	XGM-93-01X	XGM-93-01X-MONYY	Native Sample
	XGM-93-02X	XGM-93-02X-MONYY	Native Sample
	XGM-94-04X	XGM-94-04X-MONYY	Native Sample
	XGM-94-06X	XGM-94-06X-MONYY	Native Sample
	XGM-94-07X	XGM-94-07X-MONYY	Native Sample
	XGM-94-08X	XGM-94-08X-MONYY	Native Sample
	XGM-94-09X	XGM-94-09X-MONYY	Native Sample

Table 2
Area 2 Existing Monitoring Well Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Sample Type
	XGM-94-10X	XGM-94-10X-MONYY	Native Sample
	XGM-97-12X	XGM-97-12X-MONYY	Native Sample
AOC 43J	2446-03	2446-03-MONYY	Native Sample
	HA-1B	HA-1B-MONYY	Native Sample
	HA-2B	HA-2B-MONYY	Native Sample
	HA-1S	HA-1S-MONYY	Native Sample
	HA-4B	HA-4B-MONYY	Native Sample
	HA-4S	HA-4S-MONYY	Native Sample
	HA-5S	HA-5S-MONYY	Native Sample
	XJM-93-01X	XJM-93-01X	Native Sample
	XJM-93-04X	XJM-93-04X	Native Sample
	XJM-94-07X	XJM-94-07X	Native Sample
	XJM-97-12X	XJM-97-12X	Native Sample
MacPherson (with AOC 69 wells)	69WP-08-01	69WP-08-01-MONYY	Native Sample
	ZWM-95-01X	ZWM-95-01X-MONYY	Native Sample
	ZWM-95-17X	ZWM-95-17X-MONYY	Native Sample
	ZWM-95-18X	ZWM-95-18X-MONYY	Native Sample
	ZWM-01-25X	ZWM-01-25X-MONYY	Native Sample
	MPP-93-01	MPP-93-01-MONYY	Native Sample
	MPP-93-02	MPP-93-01-MONYY	Native Sample
	MPP-93-03	MPP-93-01-MONYY	Native Sample
Town of Ayer Waste Water Treatment	MW-1	MW-1-MONYY	Native Sample
	MW-2	MW-2-MONYY	Native Sample
	MW-3	MW-3-MONYY	Native Sample
	MW-4	MW-4-MONYY	Native Sample
QC Samples ***	N2-P1	A2-MW-DUP-MMDDYY	Field Duplicate
	SHM-05-42A	A2-MW-DUP-MMDDYY	Field Duplicate
	SHM-93-24A	A2-MW-DUP-MMDDYY	Field Duplicate
	SHP-01-38B	A2-MW-DUP-MMDDYY	Field Duplicate
	SHM-05-41A	A2-MW-DUP-MMDDYY	Field Duplicate
	32Z-01-07XOB	A2-MW-DUP-MMDDYY	Field Duplicate
	32M-91-01X	A2-MW-DUP-MMDDYY	Field Duplicate
	43M-01-20XBR	A2-MW-DUP-MMDDYY	Field Duplicate
	XGM-93-01X	A2-MW-DUP-MMDDYY	Field Duplicate
	HA-4B	A2-MW-DUP-MMDDYY	Field Duplicate
	ZWM-95-01X	A2-MW-DUP-MMDDYY	Field Duplicate
	EPA-PZ-2012-2A	EPA-PZ-2012-2A-MONYY	MS/MSD
	SHM-10-11	SHM-10-11-MONYY	MS/MSD
	SHM-05-42A	SHM-05-42A-MONYY	MS/MSD
	43M-01-20XBR	43M-01-20XBR-MONYY	MS/MSD
	XGM-93-01X	XGM-93-01X-MONYY	MS/MSD
	69WP-08-01	69WP-08-01-MONYY	MS/MSD
	NA	A2-MW-EB-MMDDYY	Equipment Blank
	NA	A2-MW-FRB-MMDDYY	Field Blank

Table 2
Area 2 Existing Monitoring Well Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Sample Type

Notes:

All samples will be analyzed for PFAS via isotope dilution. Analyte list is specified in UFP-QAPP Worksheet #15.

* = The sample name will consist of the well identifier followed by the month and the year the sample was collected. The month will be represented by three letters and the year by two numbers.

** = The wells will be sampled as part of AOC 32 activities.

*** Field Quality Control Samples (FD, MS/MSD, EBs and Field Reagent Blanks) will be collected at a frequency specified in UFP-QAPP worksheet #20. The FD will be collected at a 10% frequency, MS/MSD will be collected at a 5% frequency, EB will be collected at least once a week per piece of equipment, the FRB will be collected is at least once during each sampling event. The frequency will be applied to all of Area 2. The QC samples IDs are approximated and can change based on field conditions. Equipment blanks only collected if non-disposal equipment is used. Only one EB and FRB sample IDs are shown, but the appropriate number will be collected.

AOC = area of contamination
EB = equipment rinsate blank
FRB = field reagant blank
FD = field duplicate
MS/MSD = matrix spike/matrix spike duplicate
QC = quality control

Table 3
Area 2 Surface Water and Sediment Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Sample Matrix	Sample Type	Sample Location**
Plow Shop Pond	PS-18-01	PS-SW-18-01-MONYY	surface water	Native Sample	Shoreline
		PS-SED-18-01-MONYY	sediment	Native Sample	
	PS-18-02	PS-SW-18-02-MONYY	surface water	Native Sample	Shoreline
		PS-SED-18-02-MONYY	sediment	Native Sample	
	PS-18-03	PS-SW-18-03-MONYY	surface water	Native Sample	Shoreline
		PS-SED-18-03-MONYY	sediment	Native Sample	
	PS-18-04	PS-SW-18-04-MONYY	surface water	Native Sample	Shoreline
		PS-SED-18-04-MONYY	sediment	Native Sample	
	PS-18-05	PS-SW-18-05-MONYY	surface water	Native Sample	Shoreline
		PS-SED-18-05-MONYY	sediment	Native Sample	
	PS-18-06	PS-SW-18-06-MONYY	surface water	Native Sample	Shoreline
		PS-SED-18-06-MONYY	sediment	Native Sample	
Nonacoicus Brook	NB-18-01	NB-SW-18-01-MONYY	surface water	Native Sample	Main Channel
		NB-SED-18-01-MONYY	sediment	Native Sample	
	NB-18-02	NB-SW-18-02-MONYY	surface water	Native Sample	Shoreline (south side of brook)
		NB-SED-18-02-MONYY	sediment	Native Sample	
	NB-18-03	NB-SW-18-03-MONYY	surface water	Native Sample	Shoreline (south side of brook)
		NB-SED-18-03-MONYY	sediment	Native Sample	
	NB-18-04	NB-SW-18-04-MONYY	surface water	Native Sample	Main Channel
		NB-SED-18-04-MONYY	sediment	Native Sample	
	NB-18-05	NB-SW-18-05-MONYY	surface water	Native Sample	Main Channel
		NB-SED-18-05-MONYY	sediment	Native Sample	
	NB-18-06	NB-SW-18-06-MONYY	surface water	Native Sample	Main Channel
		NB-SED-18-06-MONYY	sediment	Native Sample	
	NB-18-07	NB-SW-18-07-MONYY	surface water	Native Sample	Main Channel
		NB-SED-18-07-MONYY	sediment	Native Sample	
Willow Brook	WB-18-01	WB-SW-18-01-MONYY	surface water	Native Sample	Main Channel
		WB-SED-18-01-MONYY	sediment	Native Sample	
	WB-18-02	WB-SW-18-02-MONYY	surface water	Native Sample	Shoreline (west side of brook)
		WB-SED-18-02-MONYY	sediment	Native Sample	
	WB-18-03	WB-SW-18-03-MONYY	surface water	Native Sample	Shoreline (west side of brook)
		WB-SED-18-03-MONYY	sediment	Native Sample	
	WB-18-04	WB-SW-18-04-MONYY	surface water	Native Sample	Main Channel
		WB-SED-18-04-MONYY	sediment	Native Sample	
	WB-18-05	WB-SW-18-05-MONYY	surface water	Native Sample	Main Channel
		WB-SED-18-05-MONYY	sediment	Native Sample	
	WB-18-06	WB-SW-18-06-MONYY	surface water	Native Sample	Main Channel
		WB-SED-18-06-MONYY	sediment	Native Sample	

Table 3
Area 2 Surface Water and Sediment Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Sample Matrix	Sample Type	Sample Location**
Robbins Pond	RP-18-01	RP-SW-18-01-MONYY	surface water	Native Sample	Shoreline
		RP-SED-18-01-MONYY	sediment	Native Sample	
	RP-18-02	RP-SW-18-02-MONYY	surface water	Native Sample	Shoreline
		RP-SED-18-02-MONYY	sediment	Native Sample	
	RP-18-03	RP-SW-18-03-MONYY	surface water	Native Sample	Shoreline
		RP-SED-18-03-MONYY	sediment	Native Sample	
Unnamed Tributary (Robbins Pond)	UT-18-01	UT-SW-18-01-MONYY	surface water	Native Sample	Main Channel
		UT-SED-18-01-MONYY	sediment	Native Sample	
	UT-18-02	UT-SW-18-02-MONYY	surface water	Native Sample	Main Channel
		UT-SED-18-02-MONYY	sediment	Native Sample	
	UT-18-03	UT-SW-18-03-MONYY	surface water	Native Sample	Main Channel
		UT-SED-18-03-MONYY	sediment	Native Sample	
Detention Pond	DP-18-01	DP-SW-18-01-MONYY	surface water	Native Sample	Shoreline
		DP-SED-18-01-MONYY	sediment	Native Sample	
Surface Water and Sediment QC Samples***	WB-18-05	A2-SW-DUP-MMDDYY	surface water	Field Duplicate	Main Channel
		A2-SED-DUP-MMDDYY	sediment	Field Duplicate	
	RP-18-03	A2-SW-DUP-MMDDYY	surface water	Field Duplicate	Shoreline
		A2-SED-DUP-MMDDYY	sediment	Field Duplicate	
	UT-18-01	A2-SW-DUP-MMDDYY	surface water	Field Duplicate	Shoreline
		A2-SED-DUP-MMDDYY	sediment	Field Duplicate	
	UT-18-03	UT-SW-18-03-MONYY	surface water	MS/MSD	Shoreline
		UT-SED-18-03-MONYY	sediment	MS/MSD	
	NB-18-03	NB-SW-18-03-MONYY	surface water	MS/MSD	Shoreline (south side of brook)
		NB-SED-18-03-MONYY	sediment	MS/MSD	
	NA	A2-SW-EB-MMDDYY	NA	Equipment Blank	NA
	NA	A2-SED-EB-MMDDYY	NA	Equipment Blank	NA
	NA	A2-SW-FRB-MMDDYY	NA	Field Reagent Blank	NA

Notes:

Samples will be analyzed for PFAS via isotope dilution. Analyte list is specified in UFP-QAPP Worksheet #15. Select samples will also be analyzed for Total Organic Carbon and grain size.

* = The sample name will consist of the location, followed by the matrix code, followed by the month and the year the sample was collected. The month will be represented by three letters and the year by two numbers.

**Main Channel: Samples will be collected from the bank of the main stream channel. Shoreline: Samples will be collected from the edge of the wetland system by accessing the shoreline by foot and wading approximately 3 feet from shore. All samples should be collected in an area that is conducive to deposition (i.e., away from areas of turbulent flow and/or wave action).

*** Field Quality Control Samples (FD, MS/MSD, EBs and Field Reagent Blanks) will be collected at a frequency specified in UFP-QAPP Worksheet #20. The FD will be collected at a 10% frequency, MS/MSD will be collected at a 5% frequency, EB will be collected at least once a week per piece of equipment, the FRB will be collected is at least once during the sampling event. The frequency will be applied to all of Area 2. The QC samples IDs are approximated and can change based on field conditions. Equipment blanks only collected if non-disposal equipment is used.

EB = equipment blank
FRB = field reagant blank
NA = not applicable
FD = field duplicate
MS/MSD = matrix spike/matrix spike duplicate
QC = quality control

Table 4
Area 2 Existing Monitoring Well Construction Information -
AOCs 32/43A, 43G, 43J, 69W, MacPherson Wells, and Town of Ayer Wells
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Monitoring Well	Well Screen Interval (ft bgs)	Well Screen Interval (ft NGVD29)	Top of Casing Elevation (ft NGVD29)	Ground Surface Elevation (ft NGVD29)	Well Screen Interval (ft NAVD88)	Top of Casing Elevation (ft NAVD88)	Ground Surface Elevation (ft NAVD88)
AOC 32/43A							
32M-92-01X	13.70 - 23.70	244.70 - 234.70	260.93	258.40	243.76 - 228.76	260.17	258.26
32M-92-03X	23.20 - 33.20	235.60 - 225.60	260.99	258.80	243.73 - 228.73	260.02	258.23
32M-01-13XBR	13.70 - 23.70	245.40 - 235.40	UKN	259.10	244.60 - 234.60	257.88	258.30
32M-01-14XBR	34.00 - 44.00	221.10 - 211.10	UKN	255.10	220.11 - 210.11	256.06	254.11
32M-01-14XOB	17.30 - 27.30	237.90 - 227.90	UKN	255.20	237.00 - 227.00	256.56	254.30
32M-01-15XBR	34.50 - 44.50	224.21 - 214.21	258.36	258.71	223.53 - 213.53	257.70	258.03
32M-01-16XBR	21.00 - 31.00	237.50 - 227.50	UKN	258.50	236.70 - 226.70	257.50	257.70
32M-01-17XBR	41.40 - 51.40	215.70 - 205.70	UKN	257.10	215.45 - 205.45	259.11	256.85
32M-01-18XBR	14.00 - 24.00	245.40 - 235.40	UKN	259.40	244.61 - 234.61	258.32	258.61
32Z-99-02X	14.50 - 29.50	243.90 - 228.90	260.79	258.40	242.98 - 227.98	259.71	257.48
32Z-01-04XBR	25.00 - 35.00	236.50 - 226.50	UKN	261.50	UKN	UKN	UKN
32Z-01-05XOB	25.50 - 35.50	236.30 - 226.30	UKN	261.80	UKN	UKN	UKN
32Z-01-06XBR	16.70 - 26.70	244.10 - 234.10	UKN	260.80	243.12 - 233.12	261.85	259.82
32Z-01-07XOB	12.70 - 22.70	245.30 - 235.30	UKN	258.00	244.98 - 234.98	259.48	257.68
32Z-01-08XOB	12.00 - 22.00	246.80 - 236.80	UKN	258.80	246.59 - 236.59	260.49	258.59
32Z-01-09XOB	23.50 - 33.50	235.10 - 225.10	UKN	258.60	UKN	UKN	UKN
32Z-01-10XBR	12.50 - 22.50	246.10 - 236.10	UKN	258.60	245.26 - 235.26	257.41	257.76
32Z-01-11XBR	9.00 - 19.00	253.80 - 243.80	UKN	262.80	253.07 - 243.07	261.50	262.07
32Z-01-12XBR	28.20 - 38.20	230.90 - 220.90	UKN	259.10	230.04 - 220.04	257.85	258.24
43M-01-20XOB	24.00 - 34.00	232.96 - 222.96	UKN	258.70	233.78 - 223.78	257.40	257.78
43M-01-20XBR	68.30 - 78.30	190.40 - 180.40	UKN	258.70	189.48 - 179.48	257.30	257.78
43M-01-17XOB	23.50 - 33.50	235.90 - 225.90	UKN	259.40	235.01 - 225.01	258.08	258.51
43M-01-17XBR	47.50 - 57.50	211.80 - 201.80	UKN	259.30	211.03 - 201.03	258.29	258.53
43M-01-16XOB	24.00 - 34.00	233.90 - 223.90	UKN	257.90	233.11 - 223.11	256.88	257.11
43M-01-16XBR	47.50 - 57.50	210.30 - 200.30	UNK	257.80	209.54 - 199.54	256.84	257.04
SHL-12	15.0 - 30.0	233.62 - 218.62	248.62	UKN	232.22 - 217.22	248.62	247.22
SHL-15	14.5 - 24.5	UKN	UKN	UKN	244.52 - 234.52	259.92	259.02
SHL-16	UKN	UKN	UKN	UKN	UKN	UKN	UKN
SHL-17	6.0 - 16.0	226.77 - 216.77	UKN	232.77	225.88 - 215.88	233.79	231.88
SHL-25	23.5 - 33.5	233.60 - 223.60	UKN	257.10	232.78 - 222.78	258.01	256.28
AOC-43G							
AAFES-2	16.20 - 31.20	284.07 - 269.07	302.52	300.27	UKN	UKN	UKN
AAFES-5	15.50 - 30.50	285.31 - 270.31	300.60	300.81	UKN	UKN	UKN
AAFES-6R	15.00 - 25.00	UKN	UKN	UKN	UKN	UKN	UKN
AAFES-7	4.50 - 14.50	251.61 - 241.61	258.57	256.11	UKN	UKN	UKN
XGM-93-01X	23.00 - 33.00	288.55 - 278.55	313.62	311.55	UKN	UKN	UKN
XGM-93-02X	28.00 - 38.00	282.20 - 272.20	309.81	310.20	UKN	UKN	UKN
XGM-94-04X	18.15 - 28.15	280.95 - 270.95	301.49	299.10	UKN	UKN	UKN
XGM-94-06X	17.00 - 27.00	265.20 - 255.20	284.87	282.20	UKN	UKN	UKN
XGM-94-07X	17.00 - 27.00	276.00 - 266.00	295.62	293.00	UKN	UKN	UKN
XGM-94-08X	23.50 - 33.50	273.70 - 263.70	299.78	297.20	UKN	UKN	UKN
XGM-94-09X	23.00 - 33.00	285.40 - 275.40	310.73	308.40	UKN	UKN	UKN
XGM-94-10X	21.50 - 31.50	278.90 - 268.90	302.76	300.40	UKN	UKN	UKN
XGM-97-12X	24.00 - 34.00	286.06 - 282.06	309.63	310.06	UKN	UKN	UKN
AOC-43J							
2446-02	5-15	364.00 - 354.00	368.90	369.00	UNK	UNK	UNK
2446-03	8-18	361.50 - 351.50	369.20	369.50	UNK	UNK	UNK
2446-04	10 -20	359.60 - 349.60	369.40	369.60	UNK	UNK	UNK
HA-1B	UKN	UKN	371.50	366.30	UNK	UNK	UNK
HA-1S	UKN	UKN	371.40	366.40	UNK	UNK	UNK
HA-2B	UKN	UKN	366.10	366.40	UNK	UNK	UNK
HA-2S	UKN	UKN	366.00	366.20	UNK	UNK	UNK
HA-3B	UKN	UKN	363.70	364.00	UNK	UNK	UNK
HA-3S	UKN	UKN	363.60	363.80	UNK	UNK	UNK
HA-4B	UKN	UKN	366.10	366.40	UNK	UNK	UNK
HA-4S	UKN	UKN	366.30	366.60	UNK	UNK	UNK
HA-5S	UKN	UKN	368.80	UNK	UNK	UNK	UNK
HA-6B	UKN	UKN	368.90	UNK	UNK	UNK	UNK
XJM-93-01X	6.50 -16.5	362.70 - 352.70	371.40	369.20	UNK	UNK	UNK
XJM-93-02X	5.9-15.9	365.20 - 355.20	370.60	371.10	UNK	UNK	UNK
XJM-93-03X	6.6-16.6	362.00 - 352.00	368.00	368.50	UNK	UNK	UNK
XJM-93-04X	4.5-14.5	364.20 - 354.20	371.20	368.70	UNK	UNK	UNK

Table 4
Area 2 Existing Monitoring Well Construction Information -
AOCs 32/43A, 43G, 43J, 69W, MacPherson Wells, and Town of Ayer Wells
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Monitoring Well	Well Screen Interval (ft bgs)	Well Screen Interval (ft NGVD29)	Top of Casing Elevation (ft NGVD29)	Ground Surface Elevation (ft NGVD29)	Well Screen Interval (ft NAVD88)	Top of Casing Elevation (ft NAVD88)	Ground Surface Elevation (ft NAVD88)
XJM-94-05X	6.1-16.1	362.80 - 352.80	368.50	368.90	UNK	UNK	UNK
XJM-94-06X	6.7 - 16.7	361.20 - 351.20	367.40	367.90	UNK	UNK	UNK
XJM-94-07X	3.7-13.7	358.50 - 348.50	365.00	362.20	UNK	UNK	UNK
XJM-94-08X	7.6-17.6	359.10 - 349.10	369.30	366.70	UNK	UNK	UNK
XJM-94-09X	8.7-17.7	360.30 - 350.30	371.60	369.00	UNK	UNK	UNK
XJM-94-10X	7.8-17.8	361.20 - 351.20	371.40	369.00	UNK	UNK	UNK
XJM-97-11X	25.5-35.5	343.80 - 333.80	371.50	369.30	UNK	UNK	UNK
XJM-97-12X	20.0 - 30.0	348.80 - 338.80	368.40	368.80	UNK	UNK	UNK
XJM-97-13X	41.5-51.5	325.10 - 315.10	369.30	366.60	UNK	UNK	UNK
INJ-01	UNK	UNK	368.10	UNK	UNK	UNK	UNK
INJ-02	UNK	UNK	369.00	UNK	UNK	UNK	UNK
AOC 69W							
69W-94-12	3.00 - 13.00	223.45 - 213.45	228.94	226.45	UKN	UKN	UKN
69W-94-13	3.00 - 13.00	221.30 - 212.30	227.79	225.30	UKN	UKN	UKN
69W-94-14	3.00 - 13.00	222.53 - 212.53	228.02	225.53	UKN	UKN	UKN
ZWM-95-15X	3.0 - 13.00	219.94 - 209.94	225.81	222.94	UKN	UKN	UKN
ZWM-95-18X	3.0 - 13.00	217.73 - 207.73	222.95	220.73	UKN	UKN	UKN
ZWM-99-22X	4.63 - 14.63	223.06 - 213.06	227.52	227.69	UKN	UKN	UKN
ZWM-99-23X	3.0 - 13.00	221.20 - 211.20	225.88	224.20	UKN	UKN	UKN
ZWM-99-24X	2.50 - 12.50	221.13 - 211.13	226.65	223.63	UKN	UKN	UKN
ZWM-01-25X	4.00 - 14.00	219.38 - 209.38	225.51	223.38	UKN	UKN	UKN
ZWM-95-17X	12.20 - 22.20	223.87 - 213.87	238.63	236.07	UKN	UKN	UKN
ZWM-01-26X	4.00 - 14.00	221.16 - 211.16	227.61	225.16	UKN	UKN	UKN
ZWP-95-01X	10.00 - 12.00	214.43 - 212.43	226.84	224.43	UKN	UKN	UKN
ZWP-95-02X	9.50 - 11.50	211.21 - 209.21	223.63	220.71	UKN	UKN	UKN
ZWM-95-16X	6.30 - 16.30	222.71 - 212.71	228.38	229.01	UKN	UKN	UKN
ZWM-96-19X	5.80 - 15.80	225.73 - 215.73	231.11	231.53	UKN	UKN	UKN
ZWM-96-20X	2.80 - 12.80	223.69 - 213.69	225.99	226.49	UKN	UKN	UKN
ZWM-96-21X	4.80 - 14.80	226.37 - 216.37	230.93	231.17	UKN	UKN	UKN
69WP-08-01	10.00 - 13.00	211.50 - 208.50	UKN	UKN	UKN	UKN	UKN
69WP-13-01	10.02 - 13.02	211.50 - 208.50	221.50	UKN	UKN	UKN	UKN
MacPherson Supply Well	72-93		215.42	211.7			
MPP-93-01	UKN	UKN	215.28	212.7	UKN	UKN	UKN
MPP-93-02	UKN	UKN	213.6	211.8	UKN	UKN	UKN
MPP-93-03	UKN	UKN	215.09	211.9	UKN	UKN	UKN
Town of Ayer Waste Water Treatment Plant							
MW-1	UKN	UKN	UKN	UKN	UKN	UKN	UKN
MW-2	UKN	UKN	UKN	UKN	UKN	UKN	UKN
MW-3	UKN	UKN	UKN	UKN	UKN	UKN	UKN
MW-4	UKN	UKN	UKN	UKN	UKN	UKN	UKN

Notes:
AOC = Area of Concern
bgs = below ground surface
ft = feet
NGVD29 = National Geodetic Vertical Datum 29, Sources are various historical reports.
NAVD88 = Vertical Datum 88, Source is Shepley's Hill Landfill, Devens, Massachusetts Monitoring Well Survey, WSP, November 2017 and Januar
PFAS = per- and polyfluoroalkyl substances
UKN = unkown
Wells designated to be sampled in RI

Table 5
Area 2 Groundwater Vertical Profiling Locations and Rationale
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Proposed Location	Rationale
Area of Concern 32/43A	
32VP-18-01	Determine if PFAS contamination is present in groundwater to the north of the Recycling Center, upgradient of the detention pond.
32VP-18-02	Determine if PFAS contamination is present in groundwater to the north of the Recycling Center.
32VP-18-03	Determine if PFAS contamination is present in groundwater to the south of the Recycling Center.
32VP-18-04	Determine the extent of PFAS contamination in groundwater downgradient of AOC 32.
32VP-18-05	Determine the extent of PFAS contamination in groundwater downgradient of AOC 32.
32VP-18-06	Determine the extent of PFAS contamination in groundwater downgradient of AOC 32.
32VP-18-07	Determine the extent of PFAS contamination in groundwater downgradient of AOC 32.
32VP-18-08	Determine the extent of PFAS contamination in groundwater downgradient of AOC 32.
43AVP-18-01	Determine the extent of PFAS detections in groundwater downgradient of AOC 43A.
43AVP-18-02	Determine the extent of PFAS detections in groundwater downgradient of AOC 43A.
43AVP-18-03	Determine the extent of PFAS detections in groundwater downgradient of AOC 43A.
43AVP-18-04	Determine the extent of PFAS detections in groundwater downgradient of AOC 43A.
Area of Concern 43G	
43GVP-18-01	Determine the extent of PFAS contamination in groundwater crossgradient to the south of known PFAS contamination at XGM-94-06X.
43GVP-18-02	Determine the extent of PFAS contamination in groundwater crossgradient to the north of known PFAS contamination at XGM-94-06X.
43GVP-18-03	Determine if PFAS contamination is present in groundwater upgradient of known PFAS contamination.
43GVP-18-04	Determine extent of PFAS contamination in groundwater in area of known PFAS contamination.
43GVP-18-05	Determine extent of PFAS contamination in groundwater in area of known PFAS contamination.
43GVP-18-06	Determine the extent of PFAS contamination in groundwater downgradient and crossgradient to the north of known PFAS contamination at AAFES-7.
43GVP-18-07	Determine the extent of PFAS contamination in groundwater downgradient of known PFAS contamination at AAFES-7.
43GVP-18-08	Determine the extent of PFAS contamination in groundwater downgradient and crossgradient to the south of known PFAS contamination at AAFES-7.
Area of Concern 76	
76VP-18-01*	Define the extent of PFAS contamination in groundwater upgradient of AOC 76.
76VP-18-02*	Define the extent of PFAS contamination in groundwater upgradient of AOC 76.
76VP-18-03*	Define the extent of PFAS contamination in groundwater upgradient of AOC 76.
76VP-18-04	Define the extent of PFAS contamination in groundwater cross-gradient (northwest) of known PFAS contamination.
76SB-18-05/ 76VP-18-05*	Define the extent of PFAS contamination in soil and groundwater at the dumpster fire area.
76SB-18-06 / 76VP-18-06*	Define the extent of PFAS contamination in groundwater and soil at edge of former pavement.
76VP-18-07*	Define the extent of PFAS contamination in groundwater cross-gradient (northwest) of known PFAS contamination.
76SB-18-08 / 76VP-18-08	Define the extent of PFAS contamination in groundwater and soil within area of known groundwater contamination (detention pond).
76VP-18-09*	Define the downgradient extent of PFAS contamination in groundwater cross-gradient of an area of known PFAS contamination, upgradient to Willow Brook
76VP-18-10	Define the downgradient extent of PFAS contamination in groundwater downgradient of an area of known PFAS contamination, upgradient to Willow Brook.

Table 5
Area 2 Groundwater Vertical Profiling Locations and Rationale
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Proposed Location	Rationale
76VP-18-11*	Define the downgradient extent of PFAS contamination in groundwater downgradient of an area of known PFAS contamination, upgradient to Willow Brook.
76VP-18-12	Define the extent of PFAS contamination in groundwater downgradient of known PFAS contamination and investigate migration of PFAS contamination beneath Willow Brook.
76VP-18-13*	Define the downgradient extent of PFAS contamination in groundwater downgradient of an area of known PFAS contamination, upgradient to Willow Brook.
76SB-18-14/ 76VP-18-14	Define the extent of PFAS contamination in groundwater and soil downslope of the Firefighting Training Area.
76SB-18-15/ 76VP-18-15*	Define the extent of PFAS contamination in groundwater and soil downslope of the Firefighting Training Area.
76VP-18-16	Define the extent of PFAS contamination in groundwater downgradient of known PFAS contamination and investigate migration of PFAS contamination beneath Willow Brook.
76VP-18-17	Define the downgradient extent of PFAS contamination in groundwater downgradient of an area of known PFAS contamination, upgradient to Willow Brook.
76VP-18-18	Define the downgradient extent of PFAS contamination in groundwater downgradient of an area of known PFAS contamination, upgradient to Willow Brook.
76VP-18-19*	Define the downgradient extent of PFAS contamination in groundwater downgradient of an area of known PFAS contamination, upgradient to Willow Brook.
76SB-18-01	Determine if PFAS in soil within limits of detention pond.
76SB-18-02	Delineate the extent of PFAS contamination in soil at dumpster fire area.
76SB-18-03	Determine if PFAS in soil within limits of detention pond.
76SB-18-04	Determine if PFAS in soil within limits of detention pond.
76SB-18-07	Delineate the extent of PFAS contamination in soil at edge of pavement near training area.
76SB-18-09	Delineate the extent of PFAS contamination in soil at edge of pavement near training area.
76SB-18-10	Delineate the extent of PFAS contamination in soil in Former AFFF Storage Area.
76SB-18-11	Delineate the extent of PFAS contamination in soil at edge of pavement near training area.
76SB-18-12	Delineate the extent of PFAS contamination in soil at edge of pavement near training area.
76SB-18-13	Delineate the extent of PFAS contamination in soil at edge of pavement near training area.
MacPherson Municipal Well	
MPVP-18-01	Determine if PFAS is present in groundwater to the west of MacPherson Well.
MPVP-18-02	Determine if PFAS is present in groundwater to the southwest of MacPherson Well.
MPVP-18-03	Determine if PFAS is present in groundwater to the south of MacPherson Well.
MPVP-18-04	Determine if PFAS is present in groundwater to the southeast of MacPherson Well.
MPVP-18-05	Determine if PFAS is present in groundwater to the east of MacPherson Well.
MPVP-18-06	Determine if PFAS is present in groundwater to the northeast of MacPherson Well.
MPVP-18-07	Determine if PFAS is present in groundwater to the north of MacPherson Well.
MPVP-18-08	Determine if PFAS is present in groundwater to the northeast of MacPherson Well, across Nonacoicus Brook.
6 Contingency Profiles to the south of MacPherson Well	If PFAS detected in initial vertical profiles located south of MacPherson Well. Establish a transect downgradient (to the south) along West Main Street to further define the vertical and lateral extent of PFAS in groundwater that is migrating toward MacPherson well from the south (from Devens).

AOC = Area of

PFAS = per- and poly-fluoroalkyl substances

1. Evaluation of need for any groundwater vertical profiling locations will be based on a review of PFAS data from the existing monitoring well network at this AOC.

* Location where a piezometer will be installed at the water table after groundwater vertical profiling to provide depth to water measurements and determine groundwater flow direction at AOC 76.

Table 6
Area 2 Groundwater Vertical Profiling Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Area	Location Identifier	Sample Name**	Maximum Target Depth (ft bgs) *	Approximate Depth to Groundwater (ft bgs)**	Proposed Sample Depth (ft bgs)**	Sample Type***
AOC 32/43A	32VP-18-01	32VP-18-01-XX-XX	50	25	25-29	Native Sample
		32VP-18-01-XX-XX	50	25	35-39	Native Sample
		32VP-18-01-XX-XX	50	25	45-49	Native Sample
	32VP-18-02	32VP-18-02-XX-XX	50	25	25-29	Native Sample
		32VP-18-02-XX-XX	50	25	35-39	Native Sample
		32VP-18-02-XX-XX	50	25	45-49	Native Sample
	32VP-18-03	32VP-18-03-XX-XX	50	25	25-29	Native Sample
		32VP-18-03-XX-XX	50	25	35-39	Native Sample
		32VP-18-03-XX-XX	50	25	45-49	Native Sample
	32VP-18-04	32VP-18-04-XX-XX	50	25	25-29	Native Sample
		32VP-18-04-XX-XX	50	25	35-39	Native Sample
		32VP-18-04-XX-XX	50	25	45-49	Native Sample
	32VP-18-05	32VP-18-05-XX-XX	50	25	25-29	Native Sample
		32VP-18-05-XX-XX	50	25	35-39	Native Sample
		32VP-18-05-XX-XX	50	25	45-49	Native Sample
	32VP-18-06	32VP-18-06-XX-XX	50	25	25-29	Native Sample
		32VP-18-06-XX-XX	50	25	35-39	Native Sample
		32VP-18-06-XX-XX	50	25	45-49	Native Sample
	32VP-18-07	32VP-18-07-XX-XX	50	25	25-29	Native Sample
		32VP-18-07-XX-XX	50	25	35-39	Native Sample
		32VP-18-07-XX-XX	50	25	45-49	Native Sample
	32VP-18-08	32VP-18-07-XX-XX	50	20	20-24	Native Sample
		32VP-18-07-XX-XX	50	20	30-24	Native Sample
		32VP-18-07-XX-XX	50	20	40-44	Native Sample
	43AVP-18-01	43AVP-18-01-XX-XX	50	20	20-24	Native Sample
		43AVP-18-01-XX-XX	50	20	30-24	Native Sample
		43AVP-18-01-XX-XX	50	20	40-44	Native Sample
	43AVP-18-02	43AVP-18-02-XX-XX	50	20	20-24	Native Sample
		43AVP-18-02-XX-XX	50	20	30-24	Native Sample
		43AVP-18-02-XX-XX	50	20	40-44	Native Sample
	43AVP-18-03	43AVP-18-03-XX-XX	50	20	20-24	Native Sample
		43AVP-18-03-XX-XX	50	20	30-24	Native Sample
		43AVP-18-03-XX-XX	50	20	40-44	Native Sample
	43AVP-18-04	43AVP-18-04-XX-XX	50	20	20-24	Native Sample
		43AVP-18-04-XX-XX	50	20	30-24	Native Sample
		43AVP-18-04-XX-XX	50	20	40-44	Native Sample
AOC-43G	43GVP-18-01	43GVP-18-01-XX-XX	30	11	10-14	Native Sample
		43GVP-18-01-XX-XX	30	11	20-24	Native Sample
		43GVP-18-01-XX-XX	30	11	30-34	Native Sample
	43GVP-18-02	43GVP-18-01-XX-XX	30	11	10-14	Native Sample
		43GVP-18-01-XX-XX	30	11	20-24	Native Sample
		43GVP-18-01-XX-XX	30	11	30-34	Native Sample
	43GVP-18-03	43GVP-18-03-XX-XX	50	25	25-29	Native Sample
		43GVP-18-03-XX-XX	50	25	35-39	Native Sample
		43GVP-18-03-XX-XX	50	25	45-49	Native Sample
	43GVP-18-04	43GVP-18-04-XX-XX	50	11	10-14	Native Sample
		43GVP-18-04-XX-XX	50	11	20-24	Native Sample
		43GVP-18-04-XX-XX	50	11	30-34	Native Sample
		43GVP-18-04-XX-XX	50	11	40-44	Native Sample
	43GVP-18-05	43GVP-18-05-XX-XX	40	11	10-14	Native Sample
		43GVP-18-05-XX-XX	40	11	20-24	Native Sample
		43GVP-18-05-XX-XX	40	11	30-34	Native Sample
		43GVP-18-05-XX-XX	40	11	40-44	Native Sample
	43GVP-18-06	43GVP-18-06-XX-XX	50	25	25-29	Native Sample
		43GVP-18-06-XX-XX	50	25	35-39	Native Sample
		43GVP-18-06-XX-XX	50	25	45-49	Native Sample
	43GVP-18-07	43GVP-18-07-XX-XX	50	11	10-14	Native Sample
		43GVP-18-07-XX-XX	50	11	20-24	Native Sample
		43GVP-18-07-XX-XX	50	11	30-34	Native Sample
		43GVP-18-07-XX-XX	50	11	40-44	Native Sample
	43GVP-18-08	43GVP-18-08-XX-XX	50	11	10-14	Native Sample
		43GVP-18-08-XX-XX	50	11	20-24	Native Sample
		43GVP-18-08-XX-XX	50	11	30-34	Native Sample
		43GVP-18-08-XX-XX	50	11	40-44	Native Sample
AOC-76	76VP-18-01	76VP-18-01-XX-XX	50	27	27-31	Native Sample
		76VP-18-01-XX-XX	50	27	37-41	Native Sample
		76VP-18-01-XX-XX	50	27	47-51	Native Sample
	76VP-18-02	76VP-18-02-XX-XX	50	27	27-31	Native Sample
		76VP-18-02-XX-XX	50	27	37-41	Native Sample
		76VP-18-02-XX-XX	50	27	47-51	Native Sample

Table 6
Area 2 Groundwater Vertical Profiling Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Area	Location Identifier	Sample Name**	Maximum Target Depth (ft bgs) *	Approximate Depth to Groundwater (ft bgs)**	Proposed Sample Depth (ft bgs)**	Sample Type***
AOC-76	76VP-18-03	76VP-18-03-XX-XX	50	27	27-31	Native Sample
		76VP-18-03-XX-XX	50	27	37-41	Native Sample
		76VP-18-03-XX-XX	50	27	47-51	Native Sample
	76VP-18-04	76VP-18-04-XX-XX	50	20	20-24	Native Sample
		76VP-18-04-XX-XX	50	20	30-34	Native Sample
		76VP-18-04-XX-XX	50	20	40-44	Native Sample
		76VP-18-04-XX-XX	50	20	50-54	Native Sample
	76VP-18-05	76VP-18-05-XX-XX	50	20	20-24	Native Sample
		76VP-18-05-XX-XX	50	20	30-34	Native Sample
		76VP-18-05-XX-XX	50	20	40-44	Native Sample
		76VP-18-05-XX-XX	50	20	50-54	Native Sample
	76VP-18-06	76VP-18-06-XX-XX	50	15	15-19	Native Sample
		76VP-18-06-XX-XX	50	15	25-29	Native Sample
		76VP-18-06-XX-XX	50	15	35-39	Native Sample
		76VP-18-06-XX-XX	50	15	45-49	Native Sample
	76VP-18-07	76VP-18-07-XX-XX	50	20	20-24	Native Sample
		76VP-18-07-XX-XX	50	20	30-34	Native Sample
		76VP-18-07-XX-XX	50	20	40-44	Native Sample
		76VP-18-07-XX-XX	50	20	50-54	Native Sample
	76VP-18-08	76VP-18-08-XX-XX	50	13	13-17	Native Sample
		76VP-18-08-XX-XX	50	13	23-27	Native Sample
		76VP-18-08-XX-XX	50	13	33-37	Native Sample
		76VP-18-08-XX-XX	50	13	43-47	Native Sample
	76VP-18-09	76VP-18-09-XX-XX	50	20	20-24	Native Sample
		76VP-18-09-XX-XX	50	20	30-34	Native Sample
		76VP-18-09-XX-XX	50	20	40-44	Native Sample
		76VP-18-09-XX-XX	50	20	50-54	Native Sample
	76VP-18-10	76VP-18-10-XX-XX	50	20	20-24	Native Sample
		76VP-18-10-XX-XX	50	20	30-34	Native Sample
		76VP-18-10-XX-XX	50	20	40-44	Native Sample
		76VP-18-10-XX-XX	50	20	50-54	Native Sample
	76VP-18-11	76VP-18-11-XX-XX	50	20	20-24	Native Sample
		76VP-18-11-XX-XX	50	20	30-34	Native Sample
		76VP-18-11-XX-XX	50	20	40-44	Native Sample
		76VP-18-11-XX-XX	50	20	50-54	Native Sample
	76VP-18-12	76VP-18-12-XX-XX	50	20	20-24	Native Sample
		76VP-18-12-XX-XX	50	20	30-34	Native Sample
		76VP-18-12-XX-XX	50	20	40-44	Native Sample
		76VP-18-12-XX-XX	50	20	50-54	Native Sample
	76VP-18-13	76VP-18-13-XX-XX	50	20	20-24	Native Sample
		76VP-18-13-XX-XX	50	20	30-34	Native Sample
		76VP-18-13-XX-XX	50	20	40-44	Native Sample
		76VP-18-13-XX-XX	50	20	50-54	Native Sample
	76VP-18-14	76VP-18-14-XX-XX	50	20	20-24	Native Sample
		76VP-18-14-XX-XX	50	20	30-34	Native Sample
		76VP-18-14-XX-XX	50	20	40-44	Native Sample
		76VP-18-14-XX-XX	50	20	50-54	Native Sample
	76VP-18-15	76VP-18-15-XX-XX	50	20	20-24	Native Sample
		76VP-18-15-XX-XX	50	20	30-34	Native Sample
		76VP-18-15-XX-XX	50	20	40-44	Native Sample
		76VP-18-15-XX-XX	50	20	50-54	Native Sample
	76VP-18-16	76VP-18-16-XX-XX	50	20	20-24	Native Sample
		76VP-18-16-XX-XX	50	20	30-34	Native Sample
		76VP-18-16-XX-XX	50	20	40-44	Native Sample
		76VP-18-16-XX-XX	50	20	50-54	Native Sample
	76VP-18-17	76VP-18-17-XX-XX	50	20	20-24	Native Sample
		76VP-18-17-XX-XX	50	20	30-34	Native Sample
		76VP-18-17-XX-XX	50	20	40-44	Native Sample
		76VP-18-17-XX-XX	50	20	50-54	Native Sample
	76VP-18-18	76VP-18-18-XX-XX	50	15	15-19	Native Sample
		76VP-18-18-XX-XX	50	15	25-29	Native Sample
		76VP-18-18-XX-XX	50	15	35-39	Native Sample
		76VP-18-18-XX-XX	50	15	45-49	Native Sample
	76VP-18-19	76VP-18-19-XX-XX	50	15	15-19	Native Sample
		76VP-18-19-XX-XX	50	15	25-29	Native Sample
		76VP-18-19-XX-XX	50	15	35-39	Native Sample
		76VP-18-19-XX-XX	50	15	45-49	Native Sample
MacPherson Well	MPVP-18-01	MPVP-18-01-XX-XX	100	10	10-14	Native Sample
		MPVP-18-01-XX-XX	100	10	20-24	Native Sample
		MPVP-18-01-XX-XX	100	10	30-34	Native Sample

Table 6
Area 2 Groundwater Vertical Profiling Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Area	Location Identifier	Sample Name**	Maximum Target Depth (ft bgs) *	Approximate Depth to Groundwater (ft bgs)**	Proposed Sample Depth (ft bgs)**	Sample Type***
MacPherson Well		MPVP-18-01-XX-XX	100	10	40-44	Native Sample
		MPVP-18-01-XX-XX	100	10	50-54	Native Sample
		MPVP-18-01-XX-XX	100	10	60-64	Native Sample
		MPVP-18-01-XX-XX	100	10	70-74	Native Sample
		MPVP-18-01-XX-XX	100	10	80-84	Native Sample
		MPVP-18-01-XX-XX	100	10	90-94	Native Sample
	MPVP-18-02	MPVP-18-02-XX-XX	100	10	10-20	Native Sample
		MPVP-18-02-XX-XX	100	10	20-30	Native Sample
		MPVP-18-02-XX-XX	100	10	30-40	Native Sample
		MPVP-18-02-XX-XX	100	10	40-50	Native Sample
		MPVP-18-02-XX-XX	100	10	50-60	Native Sample
		MPVP-18-02-XX-XX	100	10	60-70	Native Sample
		MPVP-18-02-XX-XX	100	10	70-80	Native Sample
		MPVP-18-02-XX-XX	100	10	80-90	Native Sample
		MPVP-18-02-XX-XX	100	10	90-100	Native Sample
	MPVP-18-03	MPVP-18-03-XX-XX	100	10	10-20	Native Sample
		MPVP-18-03-XX-XX	100	10	20-30	Native Sample
		MPVP-18-03-XX-XX	100	10	30-40	Native Sample
		MPVP-18-03-XX-XX	100	10	40-50	Native Sample
		MPVP-18-03-XX-XX	100	10	50-60	Native Sample
		MPVP-18-03-XX-XX	100	10	60-70	Native Sample
		MPVP-18-03-XX-XX	100	10	70-80	Native Sample
		MPVP-18-03-XX-XX	100	10	80-90	Native Sample
		MPVP-18-03-XX-XX	100	10	90-100	Native Sample
	MPVP-18-04	MPVP-18-04-XX-XX	100	10	10-20	Native Sample
		MPVP-18-04-XX-XX	100	10	20-30	Native Sample
		MPVP-18-04-XX-XX	100	10	30-40	Native Sample
		MPVP-18-04-XX-XX	100	10	40-50	Native Sample
		MPVP-18-04-XX-XX	100	10	50-60	Native Sample
		MPVP-18-04-XX-XX	100	10	60-70	Native Sample
		MPVP-18-04-XX-XX	100	10	70-80	Native Sample
		MPVP-18-04-XX-XX	100	10	80-90	Native Sample
		MPVP-18-04-XX-XX	100	10	90-100	Native Sample
	MPVP-18-05	MPVP-18-05-XX-XX	100	10	10-20	Native Sample
		MPVP-18-05-XX-XX	100	10	20-30	Native Sample
		MPVP-18-05-XX-XX	100	10	30-40	Native Sample
		MPVP-18-05-XX-XX	100	10	40-50	Native Sample
		MPVP-18-05-XX-XX	100	10	50-60	Native Sample
		MPVP-18-05-XX-XX	100	10	60-70	Native Sample
		MPVP-18-05-XX-XX	100	10	70-80	Native Sample
		MPVP-18-05-XX-XX	100	10	80-90	Native Sample
		MPVP-18-05-XX-XX	100	10	90-100	Native Sample
	MPVP-18-06	MPVP-18-06-XX-XX	100	10	10-20	Native Sample
		MPVP-18-06-XX-XX	100	10	20-30	Native Sample
		MPVP-18-06-XX-XX	100	10	30-40	Native Sample
		MPVP-18-06-XX-XX	100	10	40-50	Native Sample
		MPVP-18-06-XX-XX	100	10	50-60	Native Sample
		MPVP-18-06-XX-XX	100	10	60-70	Native Sample
		MPVP-18-06-XX-XX	100	10	70-80	Native Sample
		MPVP-18-06-XX-XX	100	10	80-90	Native Sample
		MPVP-18-06-XX-XX	100	10	90-100	Native Sample
	MPVP-18-07	MPVP-18-07-XX-XX	100	10	10-20	Native Sample
		MPVP-18-07-XX-XX	100	10	20-30	Native Sample
		MPVP-18-07-XX-XX	100	10	30-40	Native Sample
		MPVP-18-07-XX-XX	100	10	40-50	Native Sample
		MPVP-18-07-XX-XX	100	10	50-60	Native Sample
		MPVP-18-07-XX-XX	100	10	60-70	Native Sample
		MPVP-18-07-XX-XX	100	10	70-80	Native Sample
		MPVP-18-07-XX-XX	100	10	80-90	Native Sample
		MPVP-18-07-XX-XX	100	10	90-100	Native Sample
	MPVP-18-08	MPVP-18-08-XX-XX	100	10	10-20	Native Sample
		MPVP-18-08-XX-XX	100	10	20-30	Native Sample
		MPVP-18-08-XX-XX	100	10	30-40	Native Sample
		MPVP-18-08-XX-XX	100	10	40-50	Native Sample
		MPVP-18-08-XX-XX	100	10	50-60	Native Sample
		MPVP-18-08-XX-XX	100	10	60-70	Native Sample
		MPVP-18-08-XX-XX	100	10	70-80	Native Sample

Table 6
Area 2 Groundwater Vertical Profiling Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Area	Location Identifier	Sample Name**	Maximum Target Depth (ft bgs) *	Approximate Depth to Groundwater (ft bgs)**	Proposed Sample Depth (ft bgs)**	Sample Type***
MacPherson Well		MPVP-18-08-XX-XX	100	10	80-90	Native Sample
		MPVP-18-08-XX-XX	100	10	90-100	Native Sample
QC Samples***	32VP-18-02	A2-VP-DUP-MMDDYY	NA	NA	NA	Field Duplicate
	32VP-18-03	32VP-18-03-XX-XX	NA	NA	NA	MS/MSD
	43GVP-18-01	A2-VP-DUP-MMDDYY	NA	NA	NA	Field Duplicate
	43GVP-18-04	43GVP-18-04-XX-XX	NA	NA	NA	MS/MSD
	76VP-18-10	A2-VP-DUP-MMDDYY	NA	NA	NA	Field Duplicate
	76VP-18-11	76VP-18-11-XX-XX	NA	NA	NA	MS/MSD
	MPVP-18-01	MPVP-DUP-XX	NA	NA	NA	Field Duplicate
	MPVP-18-04	MPVP-18-04-XX-XX	NA	NA	NA	MS/MSD
	NA	A2-VP-EB-MMDDYY	NA	NA	NA	Equipment Blank
	NA	A2-VP-FRB-MMDDYY	NA	NA	NA	Field Blank

Notes:

All samples will be analyzed for PFAS via isotope dilution. Analyte list is specified in UFP-QAPP Worksheet #15.

If additional groundwater vertical profiles are advanced at an AOC, the location identifiers, sample identifiers and QC sample identifiers will be sequential to the locations provided in the table above.

* Groundwater samples will be collected from the water table to bedrock. Maximum target depth is anticipated depth to bedrock based on previous Remedial Investigation at AOCs 32 (ABB, 1994), 43A (ABB, 1996a) and 43G (ABB, 1996b) or a review of the Surficial Geology overlay from MassGIS (https://maps.massgis.state.ma.us/map_ol/oliver.php). The actual depths and number of sampling intervals at a given location may be more or less than anticipated, depending on field conditions observed during profiling. Depth to bedrock may be confirmed at select locations during installation of long-term monitoring wells.

** Approximate depth to groundwater and proposed sample depths are for planning purposes and are estimated from depth to water measurements made at nearby temporary wells or long-term monitoring wells sampled during the SI or SI Addendum (BERS-Weston, 2018a, 2018b) or LTM monitoring (KGS, 2018b). Actual depth to water will be measured during advancement of the groundwater vertical profile borings and sample depths and sample nomenclature will be adjusted to reflect actual

*** Field Quality Control Samples (FD, MS/MSD, EBs and Field Reagent Blanks) will be collected at a frequency specified in UFP-QAPP worksheet #20. The FD will be collected at a 10% frequency, MS/MSD will be collected at a 5% frequency, EB will be collected at least once a week per piece of equipment, the FRB will be collected is at least once during the event. The frequency will be applied to all of Area 2. The QC samples IDs are approximated and can change based on field conditions. Equipment blanks only collected if non-disposal equipment is used.

XX = Final sample name to be determined in the field. For the native samples XX-XX will represent the depth relative to ground surface of the sample interval. For the QC samples XX respresents the sample number and will be incremented as each sample is collected. MS/MSD samples will be identified in the notes of the chain of custody (i.e., a unique field sample identifier will not be used to denote a MS/MSD sample).

AOC = area of contamination
EB = equipment rinsate blank
FRB = field reagent blank
FD = field duplicate
ft bgs = feet below ground surface
LTM = long-term monitoring program
MS/MSD = matrix spike/matrix spike duplicate
NA = not applicable
QC = quality control
SI = site inspection

Table 7
Area 2 Soil Boring Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Area	Location Identifier	Sample Name*	Proposed Sample Depth (ft bgs)*	Approximate Depth to Groundwater (ft bgs)**	Sample Type
AOC 32/43A Contingency Borings	Up to Five Planned 32(or 43A) SB-18-01 through -18-05	to be determined	0-0.5	25	Native Sample
			0.5-3	25	Native Sample
			3-7	25	Native Sample
			7-15	25	Native Sample
			23-25	25	Native Sample
AOC 43G Contingency Borings	Up to Five Planned 43GSB-18-01 through -18-05	to be determined	0-0.5	25	Native Sample
			0.5-3	25	Native Sample
			3-7	25	Native Sample
			7-15	25	Native Sample
			23-25	25	Native Sample
AOC 43J Contingency Borings	Up to Five Planned 43JSB-18-01 through -18-05	to be determined	0-0.5	25	Native Sample
			0.5-3	25	Native Sample
			3-7	25	Native Sample
			7-15	25	Native Sample
			23-25	25	Native Sample
MacPherson Water Supply Well Contingency Borings	Up to Five Planned MPSB-18-01 through -18-05	to be determined	0-0.5	25	Native Sample
			0.5-3	25	Native Sample
			3-7	25	Native Sample
			7-15	25	Native Sample
			23-25	25	Native Sample
AOC 76	76SB-18-01	76SB-18-01-0-1	0-1	13	Native Sample
		76SB-18-01-3-7	3-7	13	Native Sample
		76SB-18-01-11-13	11-13	13	Native Sample
	76SB-18-02	76SB-18-02-0-1	0-1	20	Native Sample
		76SB-18-02-3-7	3-7	20	Native Sample
		76SB-18-02-18-20	18-20	20	Native Sample
	76SB-18-03	76SB-18-03-0-1	0-1	13	Native Sample
		76SB-18-03-3-7	3-7	13	Native Sample
		76SB-18-03-11-13	11-13	13	Native Sample
	76SB-18-04	76SB-18-04-0-1	0-1	13	Native Sample
		76SB-18-04-3-7	3-7	13	Native Sample
		76SB-18-04-11-13	11-13	13	Native Sample
	76SB-18-05	76SB-18-05-0-1	0-1	20	Native Sample
		76SB-18-05-3-7	3-7	20	Native Sample
		76SB-18-05-18-20	18-20	20	Native Sample
	76SB-18-06	76SB-18-06-0-1	0-1	15	Native Sample
		76SB-18-06-3-7	3-7	15	Native Sample
		76SB-18-06-13-15	13-15	15	Native Sample
	76SB-18-07	76SB-18-07-0-1	0-1	15	Native Sample
		76SB-18-07-3-7	3-7	15	Native Sample
		76SB-18-07-13-15	13-15	15	Native Sample
	76SB-18-08	76SB-18-08-0-1	0-1	13	Native Sample
		76SB-18-08-3-7	3-7	13	Native Sample
		76SB-18-08-11-13	11-13	13	Native Sample
	76SB-18-09	76SB-18-09-0-1	0-1	20	Native Sample
		76SB-18-09-3-7	3-7	20	Native Sample

Table 7
Area 2 Soil Boring Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Area	Location Identifier	Sample Name*	Proposed Sample Depth (ft bgs)*	Approximate Depth to Groundwater (ft bgs)**	Sample Type
AOC 76		76SB-18-09-18-20	18-20	20	Native Sample
	76SB-18-10	76SB-18-10-0-1	0-1	27	Native Sample
		76SB-18-10-3-7	3-7	27	Native Sample
		76SB-18-10-25-27	25-27	27	Native Sample
	76SB-18-11	76SB-18-11-0-1	0-1	27	Native Sample
		76SB-18-11-3-7	3-7	27	Native Sample
		76SB-18-11-25-27	25-27	27	Native Sample
	76SB-18-12	76SB-18-12-0-1	0-1	20	Native Sample
		76SB-18-12-3-7	3-7	20	Native Sample
		76SB-18-12-18-20	18-20	20	Native Sample
	76SB-18-13	76SB-18-13-0-1	0-1	15	Native Sample
		76SB-18-13-3-7	3-7	15	Native Sample
		76SB-18-13-13-15	13-15	15	Native Sample
	76SB-18-14	76SB-18-14-0-1	0-1	15	Native Sample
		76SB-18-14-3-7	3-7	15	Native Sample
		76SB-18-14-13-15	13-15	15	Native Sample
QC Samples***	76SB-18-01	A2-SB-DUP-MMDDYY	NA	NA	Field Duplicate
	76SB-18-03	A2-SB-DUP-MMDDYY	NA	NA	Field Duplicate
	76SB-18-04	A2-SB-DUP-MMDDYY	NA	NA	Field Duplicate
	76SB-18-10	A2-SB-DUP-MMDDYY	NA	NA	Field Duplicate
	76SB-18-05	76SB-18-05-XX-XX	NA	NA	MS/MSD
	76SB-18-12	76SB-18-12-XX-XX	NA	NA	MS/MSD
	NA	A2-SB-EB-MMDDYY	NA	NA	Equipment Blank
	NA	A2-SB-FRB-MMDDYY	NA	NA	Field Blank

Notes:
All samples analyzed for PFAS via isotope dilution. Select samples may be analyzed for total oxidizable precussor assay and total organic carbon.

If additional soil sampling locations are established at an AOC, the location identifiers, sample identifiers and QC sample identifiers will be sequential to the locations provided in the table above.

* AOC 76 samples are to be collected from 0-1 ft bgs, 3-7 ft bgs, and 2 feet above the water table. Sample name may be modified in the field depending on sample depth.

** Approximate depth to groundwater is for planning purposes and is estimated from the water table elevations observed at nearby temporary wells or long-term monitoring wells sampled during the SI and LTM activities. Actual depth to water will be measured during advancement of the soil borings and the final depth of soil sampling intervals will end at the water table at locations where the water table is less than 15 feet. If the water table is encountered at a depth less than 17 ft bgs then the final soil sampling interval at the boring will be shortened by the appropriate amount to collect a separate 2-foot sample just above the water table to assess leaching threat to groundwater.

**** Field Quality Control Samples (FD, MS/MSD, EBs and Field Reagent Blanks) will be collected at a frequency specified in UFP-QAPP worksheet #20. The FD will be collected at a 10% frequency, MS/MSD will be collected at a 5% frequency, EB will be collected at least once a week, the FRB will be collected is at least once during each sampling event. The frequency will be applied to all of Area 2. The QC samples IDs are approximated and can change based on field conditions. Equipment blanks only collected if non-disposal equipment is used. Field quality control samples will not be collected for total oxidizable precussor analysis.

XX = Final sample name to be determined in the field. For the QC samples XX respresents the sample number and will be incremented as each sample is collected. MS/MSD samples will be identified in the notes of the chain of custody (i.e., a unique field sample identifier will not be used to denote a MS/MSD sample).

AOC = area of contamination
ft bgs = feet below ground surface
LTM = long-term monitoring
MS/MSD = matrix spike/matrix spike duplicate
NA = not applicable
QC = quality control
SI = site inspection

Table 8
Area 2 New Monitoring Well Rationale
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Number of New Monitoring Wells	Rationale	Field Lithologic Classification	Screen settings	TOC in Soil	Grain-size analysis
Area of Concern 32					
3	Installation of up to two new overburden and one bedrock monitoring wells is planned to augment the existing monitoring well network. Locations will be based on a review of existing monitoring well and vertical profile data. The groundwater monitoring well network will be designed to monitor groundwater within the PFAS plume as well as provide bounding wells upgradient, cross gradient and downgradient of the plume.	Yes - at selection locations from the water table to the bottom of the boring.	TBD	Soil samples collected at select locations will be submitted for TOC analysis.	Soil samples collected from select intervals at select locations will be submitted for grain-size analysis.
Area of Concern 43A					
2	Installation of up to two new monitoring wells is planned. Locations will be based on a review of existing monitoring well and vertical profile data. The groundwater monitoring well network will be designed to monitor groundwater within the PFAS plume as well as provide bounding wells upgradient, cross gradient and downgradient of the plume.	Yes - at selection locations from the water table to the bottom of the boring.	TBD	Soil samples collected at select locations will be submitted for TOC analysis.	Soil samples collected from select intervals at select locations will be submitted for grain-size analysis.
Area of Concern 43G					
2	Installation of up to two new monitoring wells is planned. Locations will be based on a review of existing monitoring well and vertical profile data. The groundwater monitoring well network will be designed to monitor groundwater within the PFAS plume as well as provide bounding wells upgradient, cross gradient and downgradient of the plume.	Yes - at selection locations from the water table to the bottom of the boring.	TBD	Soil samples collected at select locations will be submitted for TOC analysis.	Soil samples collected from select intervals at select locations will be submitted for grain-size analysis.
Area of Concern 76					
12	Installation of up to 12 new piezometers screened at the water table is planned. These piezometers will be installed at twelve groundwater vertical profiling locations and will used to measure depth to water and calculate groundwater flow direction at AOC76. The locations of piezometers will be selected to support calculation of groundwater flow direction and may or may not be used as a potential groundwater monitoring location for PFAS.	No	TBD	No	No
10	Installation of up to 10 new monitoring wells is planned. Locations will be based on a review of vertical profile data. The PFAS groundwater monitoring well network will be designed to monitor groundwater within the PFAS plume as well as provide bounding wells upgradient, cross gradient and downgradient of the plume.	Yes - at selection locations from the water table to the bottom of the boring.	TBD	Soil samples collected at select locations will be submitted for TOC analysis.	Soil samples collected from select intervals at select locations will be submitted for grain-size analysis.

Table 8
Area 2 New Monitoring Well Rationale
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Number of New Monitoring Wells	Rationale	Field Lithologic Classification	Screen settings	TOC in Soil	Grain-size analysis
MacPherson Municipal Water Supply Well					
6	Installation of up to 6 new monitoring wells is planned. Locations will be based on a review of vertical profile data. The groundwater monitoring well network will be designed to monitor groundwater within the PFAS plume as well as provide bounding wells upgradient, cross gradient and downgradient of the plume.	Yes - at selection locations from the water table to the bottom of the boring.	TBD	Soil samples collected at select locations will be submitted for TOC analysis.	Soil samples collected from select intervals at select locations will be submitted for grain-size analysis.

Notes:
AOC = area of contamination
TBD = to be determined. Screen settings will be determined in consultation with the stakeholders after a review of the groundwater data.
TOC = total organic carbon

Table 9
Area 2 Soil Sampling During New Monitoring Well Installation Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Proposed Sample Depth (ft bgs)**	Sample Type
AOC 32/43A	32M-18-02X	32M-18-02X-SO-XX-XX	TBD	Native Sample
	32M-18-03X	32M-18-03X-SO-XX-XX	TBD	Native Sample
	32M-18-01XBR	32M-18-01XBR-SO-XX-XX	TBD	Native Sample
	43M-18-01X	43M-18-01X-SO-XX-XX	TBD	Native Sample
	43M-18-02X	43M-18-02X-SO-XX-XX	TBD	Native Sample
AOC 43G	XGM-18-01X	XGM-18-01X-SO-XX-XX	TBD	Native Sample
	XGM-18-02X	XGM-18-02X-SO-XX-XX	TBD	Native Sample
AOC 76	76M-18-01X	76M-18-01X-SO-XX-XX	TBD	Native Sample
	76M-18-02X	76M-18-02X-SO-XX-XX	TBD	Native Sample
	76M-18-03X	76M-18-03X-SO-XX-XX	TBD	Native Sample
	76M-18-04X	76M-18-04X-SO-XX-XX	TBD	Native Sample
	76M-18-05X	76M-18-05X-SO-XX-XX	TBD	Native Sample
	76M-18-06X	76M-18-06X-SO-XX-XX	TBD	Native Sample
	76M-18-07X	76M-18-07X-SO-XX-XX	TBD	Native Sample
	76M-18-08X	76M-18-08X-SO-XX-XX	TBD	Native Sample
	76M-18-09X	76M-18-09X-SO-XX-XX	TBD	Native Sample
	76M-18-10X	76M-18-10X-SO-XX-XX	TBD	Native Sample
MacPherson	MPM-18-01X	MPM-18-01X-SO-XX-XX	TBD	Native Sample
	MPM-18-02X	MPM-18-02X-SO-XX-XX	TBD	Native Sample
	MPM-18-03X	MPM-18-03X-SO-XX-XX	TBD	Native Sample
	MPM-18-04X	MPM-18-04X-SO-XX-XX	TBD	Native Sample
	MPM-18-05X	MPM-18-05X-SO-XX-XX	TBD	Native Sample
	MPM-18-06X	MPM-18-06X-SO-XX-XX	TBD	Native Sample
QC Samples**	32M-18-02X	A2-MW-SO-DUP-MMDDYY		Field Duplicate
	76M-18-03X	A2-MW-SO-DUP-MMDDYY		Field Duplicate
	MPM-18-03X	A2-MW-SO-DUP-MMDDYY		Field Duplicate
	32M-18-03X	32M-18-03X-SO-XX-XX		MS/MSD
	76M-18-06X	76M-18-06X-SO-XX-XX		MS/MSD
	NA	A2-MW-SO-EB-MMDDYY		Equipment Blank
	NA	A2-MW-SO-FRB-MMDDYY		Field Reagent Blank

Notes:
Selected samples will be analzyed for total organic carbon, and grain size.

* It is estimated locations at each area of investigation will be drilled during monitoring well installation and soil samples may be collected at that time. The exact locations are not known. The locations where samples will be collected will be determined before the locations are drilled.

** Sample name will be determined in the field depending on sample depth. The sample depth will be determined before the locations are drilled.

*** Field Quality Control Samples (FD, MS/MSD, EBs and Field Reagent Blanks) will be collected at a frequency specified in UFP-QAPP worksheet #20. The FD will be collected at a 10% frequency, MS/MSD will be collected at a 5% frequency, EB will be collected at least once a week per piece of equipment, the FRB will be collected is at least once during each sampling event. The frequency will be applied to all of Area 2. Equipment blanks only collected if non-disposal equipment is used. Field quality control samples will not be collected for total oxidizable precussor analysis.

AOC = area of contamination
EB = equipment blank
FD = field duplicate
FRB = field reagant blank
MS/MSD = matrix spike/matrix spike duplicate
TBD = to be determined
QC = quality control

XX = Final sample name to be determined in the field. MS/MSD samples will be identified in the notes of the chain of custody (i.e., a unique field sample identifier will not be used to denote a MS/MSD sample).

Table 10
Area 2 New Monitoring Well Sampling Summary
Area 2 Field Sampling Plan
Devens PFAS Remedial Investigation Workplan

Location	Location Identifier	Sample Name*	Sample Type
AOC 32/43A	32M-18-02X	32M-18-02X-MONYY	Native Sample
	32M-18-03X	32M-18-03X-MONYY	Native Sample
	32M-18-01XBR	32M-18-01XBR-MONYY	Native Sample
	43M-18-01X	43M-18-01X-MONYY	Native Sample
	43M-18-02X	43M-18-02X-MONYY	Native Sample
AOC 43G	XGM-18-01X	XGM-18-01X-MONYY	Native Sample
	XGM-18-02X	XGM-18-02X-MONYY	Native Sample
AOC 76	76M-18-01X	76M-18-01X-MONYY	Native Sample
	76M-18-02X	76M-18-02X-MONYY	Native Sample
	76M-18-03X	76M-18-03X-MONYY	Native Sample
	76M-18-04X	76M-18-04X-MONYY	Native Sample
	76M-18-05X	76M-18-05X-MONYY	Native Sample
	76M-18-06X	76M-18-06X-MONYY	Native Sample
	76M-18-07X	76M-18-07X-MONYY	Native Sample
	76M-18-08X	76M-18-08X-MONYY	Native Sample
	76M-18-09X	76M-18-09X-MONYY	Native Sample
	76M-18-10X	76M-18-10X-MONYY	Native Sample
MacPherson	MPM-18-01X	MPM-18-01X-MONYY	Native Sample
	MPM-18-02X	MPM-18-02X-MONYY	Native Sample
	MPM-18-03X	MPM-18-03X-MONYY	Native Sample
	MPM-18-04X	MPM-18-04X-MONYY	Native Sample
	MPM-18-05X	MPM-18-05X-MONYY	Native Sample
	MPM-18-06X	MPM-18-06X-MONYY	Native Sample
QC Samples**	32M-18-02X	A2-MW-DUP-MMDDYY	Field Duplicate
	76M-18-03X	A2-MW-DUP-MMDDYY	Field Duplicate
	MPM-18-03X	A2-MW-DUP-MMDDYY	Field Duplicate
	32M-18-03X	32M-18-03-MONYY	MS/MSD
	76M-18-06X	76M-18-06X-MONYY	MS/MSD
	NA	A2-MW-EB-MMDDYY	Equipment Blank
	NA	A2-MW-FRB-MMDDYY	Field Reagent Blank

Notes:

All samples will be analyzed for PFAS via isotope dilution. Select samples will be analyzed for total oxidizable precursor assay and dissolved organic carbon.

* = The sample name will consist of the well identifier followed by the month and the year the sample was collected. The month will be represented by three letters and the year by two numbers.

** Field Quality Control Samples (FD, MS/MSD, EBs and Field Reagent Blanks) will be collected at a frequency specified in UFP-QAPP worksheet #20. The FD will be collected at a 10% frequency, MS/MSD will be collected at a 5% frequency, EB will be collected at least once a week per piece of equipment, the FRB will be collected is at least once during each sampling event per AOC. The frequency will be applied to all of Area 2. The QC samples IDs are approximated and can change based on field conditions. Equipment blanks only collected if non-disposal equipment is used. Field quality control samples will not be collected for total oxidizable precursor analysis.

AOC = area of contamination
EB = equipment blank
FD = field duplicate
FRB = field reagent blank
MS/MSD = matrix spike/matrix spike duplicate
QC = quality control

APPENDIX A
Referenced PFAS RI QAPP Worksheets

QAPP WORKSHEET #3: DISTRIBUTION LIST FOR DEVENS

QAPP Recipients	Title	Organization	E-mail Address
Mark Applebee	Program Manager	KGS	mapplebee@komangs.com
James Ropp	Project Manager (PM)	KGS	jropp@komangs.com
John Rawlings	Corporate Director of Safety and Quality Control	KOMAN	jrawlings@komaninc.com
Katherine Thomas	Technical Lead	KGS	kthomas@komangs.com
Kevin Anderson	KGS Field Team Lead	KGS	kanderson@komangs.com
Laurie Ekes	Project Chemist	KGS	lekes@komangs.com
Denise Tripp	Hydrogeologist	Geosyntec	Dtripp@geosyntec.com
Spence Smith	PM	Jacobs	Spence.Smith@jacobs.com
Jerry Lanier	PM	Test America Savannah	Jerry.lanier@testamericainc.com
Penelope Reddy	PM	USACE	Penelope.Reddy@usace.army.mil
Yixian Zhang	Project Chemist	USACE	Yixian.Zhang@usace.army.mil
Robert Simeone	BRAC Environmental Coordinator	US Army	robert.j.simeone.civ@mail.mil
Carol Keating	Remedial PM	USEPA Region I	Keating.Carol@epa.gov
David Chaffin	Federal Sites Program	MassDEP	David.Chaffin@state.ma.us

QAPP WORKSHEET #4, 7 & 8: PERSONNEL TRAINING, RESPONSIBILITIES AND SIGN-OFF SHEET

ORGANIZATION: KGS

Name	Project Title	Specialized Training/Certifications	Responsibilities	Signature/Date
Mark Applebee	Program Manager	Project Management Professional (PMP), Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour Training; 8-Hour Refresher; CPR and first aid/AED	Oversight responsibility for contractual and technical performance.	
James Ropp	Project Manager	Licensed Professional Engineer (PE), HAZWOPER 40-hour Training; 8-Hour Refresher; CPR and first aid/AED	Manages project technical and contractual requirements; coordinates between senior management, USACE, stakeholders, and project staff.	
Katherine Thomas	Technical Lead	PMP, HAZWOPER 40-hour Training; 8-Hour Refresher; CPR and first aid/AED	Manages remedial investigation technical task requirements; supports coordination at all levels.	
Kevin Anderson	Field Team Leader	HAZWOPER 40-hour Training; 8-Hour Refresher; CPR and first aid/AED	Supervises field sampling and coordinates all field activities; serves as the site KGS coordinator.	
Laurie Ekes	Project Chemist	HAZWOPER 40-hour Training; 8-Hour Refresher; CPR and first aid/AED	Verifies that the UFP-QAPP analytical requirements are met by the laboratory and field staff. Also provides direction regarding requirements for corrective actions for field and analytical issues; evaluates and releases validated analytical results to the KGS project team.	

QAPP WORKSHEET #4, 7 AND 8 - Continued

ORGANIZATION: Army/USACE

Name	Project Title	Specialized Training/Certifications	Responsibilities	Signature/Date
Robert Simeone	BRAC Environmental Coordinator		BRAC Environmental Coordinator for Devens Environmental Remediation.	
Penelope Reddy	Technical Lead		USACE PM for Devens Environmental Remediation	
Yixian Zhang	Project Chemist	HAZWOPER 40-hour Training; 8-Hour Refresher	Coordinates with KGS project chemist. Reviews field activities and laboratory data.	

ORGANIZATION: Test America, Savannah

Name	Project Title	Specialized Training/Certifications	Responsibilities	Signature/Date
Jerry Lanier	Project Manager	Not applicable	Primary point of contact for Test America Laboratory. Receives direction from KGS Project Chemist. Responsible for ensuring the UFP-QAPP requirements are met by the laboratory.	

ORGANIZATION: Test America, Sacramento

Name	Project Title	Specialized Training/Certifications	Responsibilities	Signature/Date
Debby Wilson	Client Services Manager (PFAS)	Not applicable	Manages client services for TestAmerica Laboratories, Sacramento.	

QAPP WORKSHEET #4, 7 AND 8 - Continued

ORGANIZATION: Alpha Analytical

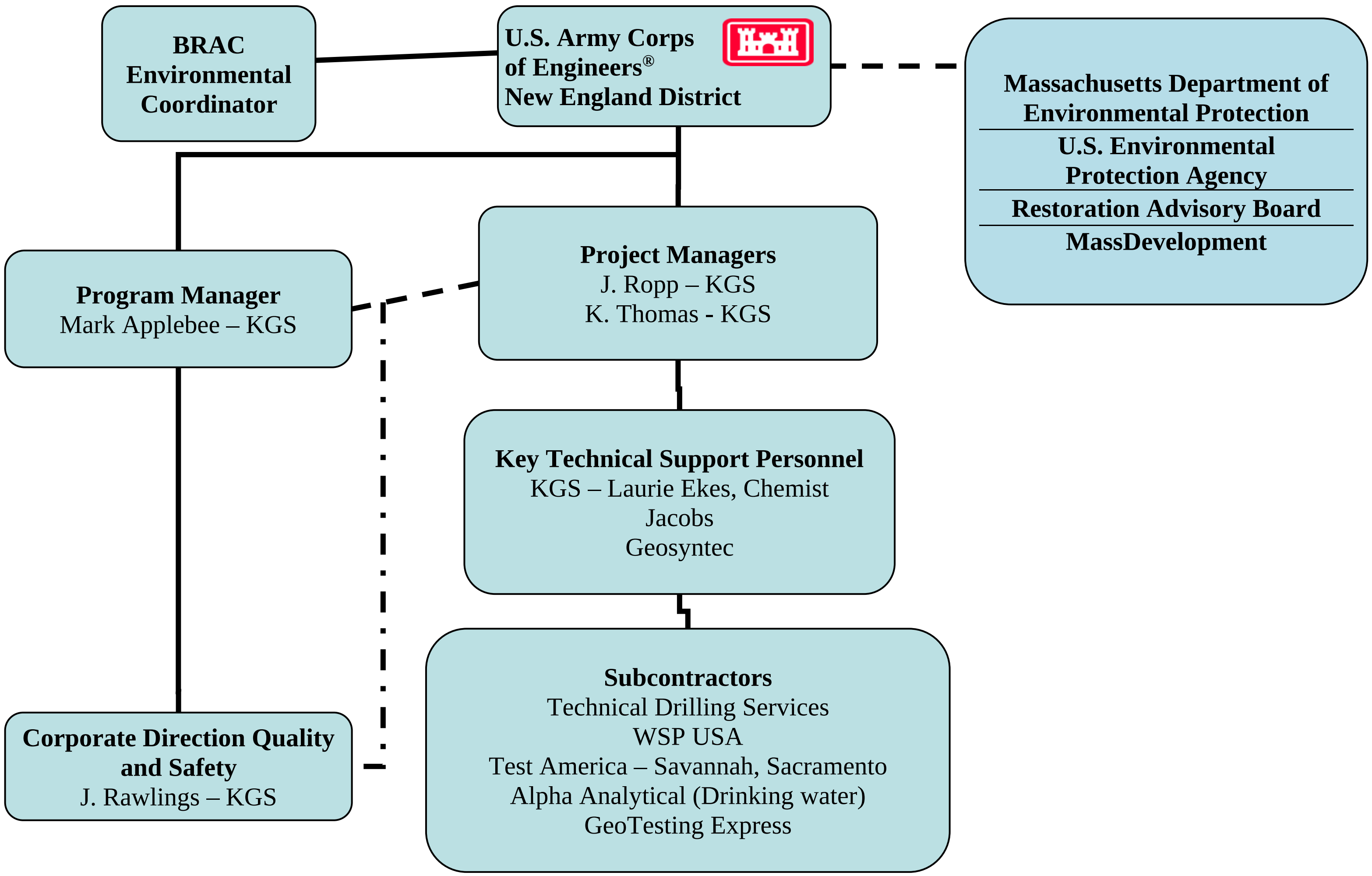
Name	Project Title	Specialized Training/Certifications	Responsibilities	Signature/Date
Jim Occhialini		Not applicable	Manages client services for Alpha Analytical.	

ORGANIZATION: GeoTesting Express

Name	Project Title	Specialized Training/Certifications	Responsibilities	Signature/Date
Mark Dobday	Laboratory Manager	Not applicable	Primary point of contact for GeoTesting Express. Receives direction from KGS Project Chemist. Responsible for ensuring the UFP-QAPP requirements are met by the laboratory for grain size analysis.	

Signatures indicate personnel have read and agree to implement this QAPP as written

QAPP WORKSHEET #5: PROJECT ORGANIZATIONAL CHART



QAPP WORKSHEET #6: COMMUNICATION PATHWAYS

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Communication with USACE (lead agency)	USACE Program Manager	Penelope Reddy	(978) 318-8160	Primary point of contact with USACE. Coordinates contracting actions. Provides direction to KGS.
Communication with BRAC	BRAC EC	Robert Simeone	(978) 796-2205	Primary point of contact for Fort Devens.
Communication with EPA	EPA RPM	Carol Keating	(617) 918-1393	Primary point of contact for EPA. Provides technical and regulatory input and recommendations to USACE.
Communication with MassDEP	MassDEP RPM	David Chaffin	(617) 348-4005	Primary point of contact for MassDEP. Provides technical and regulatory input and recommendations.
Communication with KGS	KGS PM	James Ropp	(603) 395-7986	Primary point of contact for KGS. Provides project management input and recommendation to USACE PM. Receives direction from USACE.
Secondary point of contact for KGS	KGS Technical Lead	Katherine Thomas	(774) 273-1467	Primary point of contact for technical tasks; provides technical input and recommendations to UACE. Receives technical direction from USACE; provides input to KGS PM and project team on project status.
Progress of field program	KGS	Kevin Anderson	(508) 366-7442	Conveys progress of field activities. Communication with KGS technical lead. Oversees onsite safety activities.
Communication with KGS Project Chemist	Test America (TA) Savannah Laboratory Project Manager	Jerry Lanier	(912) 354-7858	Coordinates laboratory staff to assure timely deliverables. Communicates QA/QC issues with project chemist. Approves release of analytical data from laboratory.
	TA Sacramento Laboratory Project Manager	Debby Wilson	(949) 260-3228	
	Alpha Analytical	Jim Occhialini	(508) 898-9220	PFAS drinking water sample laboratory coordination.
	GeoTesting Express Laboratory manager	Mark Dobday	(978) 635-0424	Coordinates lab staff and approves release of grain size analysis

QAPP Worksheet #6 - Continued

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Review and release of analytical data	KGS Project Chemist	Laurie Ekes	(508) 366-7442	Verifies the UFP_QAPP analytical requirements are met by the laboratory and field staff. Coordinates sampling activities with analytical laboratory. Evaluates and releases analytical results to the KGS PM.

QAPP WORKSHEET #11: DATA QUALITY OBJECTIVES

Step 1: State the Problem

PFAS have been detected in groundwater, surface water, soil, and sediment at multiple Fort Devens AOCs at concentrations that may impact human health and the environment.

Step 2: Identify the Study Goals, Questions and Decision Statements

Study Goals

Site characterization data are needed to define the nature and extent of PFAS at Fort Devens and downgradient of Fort Devens in groundwater and determine migration flow paths to evaluate current and potential impacts to public and private drinking water supply wells and surface water discharge areas.

Site characterization data are needed to identify sources of PFAS in soil at Fort Devens, either currently known sources or newly identified potential sources determined through the investigation, contributing to PFAS in groundwater and characterize the nature and extent of those sources including evaluation of sources in soil as potential continuing sources.

Additional data are also needed to support a quantitative human health risk assessment and an ecological risk evaluation, which will be completed to estimate potential human health and ecological risk from exposure to PFAS in groundwater, soil, surface water, and sediment.

Principle Study Questions and Associated Decision Statements:

- Are the PFAS detected at AOCs 32/43, 57, 74, and 75 impacting the Grove Pond water supply wells?
    - Decision Statement: Determine nature and extent of PFAS in groundwater impacting the Grove Pond water supply wells, nature and extent of PFAS in groundwater attributable to each AOC, hydraulic characteristics of the aquifer, groundwater flow directions, fate and transport of PFAS in the aquifer, and evaluate PFAS distribution using lines of evidence including ratios of select PFAS compounds.
- Are the PFAS detected in groundwater at AOCs 5, 20, 21, 32/43, and 76, impacting the MacPherson supply well?
    - Decision Statement: Determine nature and extent of PFAS in groundwater impacting the MacPherson supply well, nature and extent of PFAS in groundwater attributable to each AOC, hydraulic characteristics of the aquifer, groundwater flow directions, fate and transport of PFAS in the aquifer, evaluate PFAS distribution using lines of evidence including ratios of select PFAS compounds.
- What is the predicted impact of AOCs to water supply wells over time?
    - Decision Statement: Determine nature and extent of PFAS in groundwater attributable to each AOC, hydraulic characteristics of the aquifer, groundwater flow directions, fate and transport of PFAS in the aquifer to estimate velocity of contaminant transport and travel times), nature and extent of PFAS in soil, fate and

transport of PFAS from soil to groundwater, nature and extent of precursors in soil and groundwater, and evaluate potential for precursors to transform.

- Do other sources of PFAS exist that impact the Grove Pond and MacPherson supply wells?
  - Decision Statement: Determine nature and extent of PFAS in groundwater impacting the Grove Pond and MacPherson water supply wells, groundwater flow directions, evaluate PFAS distribution using lines of evidence including ratios of select PFAS compounds.
- Are there any other water supply wells that are potentially impacted by PFAS originating from Fort Devens?
  - Decision Statement: Determine nature and extent of PFAS associated with the AOCs, hydraulic characteristics of the aquifer, groundwater flow directions, fate and transport of PFAS in the aquifer, identify other water supply wells and associated construction information through research of appropriate public records and interviews, and sampling of other water supply wells, if appropriate.
- Are the PFAS detected in groundwater attributable to identified AOC source areas?
  - Decision Statement: Determine if PFAS in groundwater exists up gradient or cross gradient of the AOC source, hydraulic characteristics of the aquifer, groundwater flow directions, fate and transport of PFAS in the aquifer, and evaluate PFAS distribution using lines of evidence including ratios of select PFAS compounds.
- Are the PFAS detected in groundwater discharging to surface water bodies at concentrations that may pose a risk to human health and the environment?
  - Decision Statement: Determine PFAS concentrations in surface water and sediment where groundwater contaminated with PFAS is anticipated to discharge, human health and ecological risk from PFAS in surface water and sediment, hydraulic flow paths from the groundwater to the surface water, hydraulic characteristics of the aquifer, fate and transport of PFAS in the aquifer, and PFAS concentrations in groundwater discharging to surface water bodies.
- Are the PFAS detected in soil at concentration that may pose a risk to human health?
  - Decision Statement: Determine nature and extent of PFAS in soil and determine the human health risk from exposure to soil.
- Do PFAS concentrations in groundwater pose an unacceptable risk to human health?
  - Decision Statement: Determine nature and extent of PFAS in groundwater and human health risk from exposure to groundwater.
- Do PFAS concentrations in soil represent a significant continuing source impacting groundwater at concentrations that pose an unacceptable human health risk?
  - Decision Statement: Determine nature and extent of PFAS in soil, fate and transport of PFAS in soil to groundwater, nature and extent of PFAS concentrations in groundwater, hydraulic characteristics of the aquifer, groundwater flow direction,

fate and transport of PFAS in the aquifer, point of human exposure to groundwater, and human health risk via a complete exposure pathway.

Step 3: Identify Information Inputs

Information inputs include historical data gathered on the sites and analytical data collected during the investigation. PFAS concentrations in water samples collected from existing and new monitoring wells, vertical profile borings, and private and public water supply wells used for drinking water. PFAS concentrations in soil samples collected from the ground surface and soil borings. PFAS concentrations in surface water and sediment samples collected from potentially impacted water bodies. Organic carbon in soil and water collected from soil borings and existing and new monitoring wells. Inputs include the site-specific screening levels and detection level objectives as defined in Worksheet #15.

Grain size analysis of soil and sediment samples. Lithologic characterization of aquifer materials. Hydraulic conductivity test after installation of monitoring wells at select locations. Groundwater level measurements after installation of monitoring wells and/or piezometers. An inventory of water supply wells.

Step 4: Define the Boundaries of the Study

Each Area-specific Field Sampling Plan (FSP) addenda specifies drilling and sampling locations. Additional drilling and/or sampling locations may be added to the investigation based on initial investigation results and area-specific objectives.

Step 5: Develop the Analytic Approach

If data from this investigation are sufficient to adequately characterize the nature and extent of PFAS in groundwater, to determine all PFAS migration pathways, to assess the fate and transport of PFAS, to assess water supply impacts, and to adequately assess human health risk then additional data will not be collected. EPA Lifetime Health Advisories (LHA), site-specific screening levels (SSSL), EPA Regional Screening Levels (RSL), and/or appropriate MassDEP guidance will be used for comparison purposes to assess the adequacy of the data. If significant data gaps are identified, then further data will be collected.

If data from this investigation are sufficient to adequately characterize the nature and extent of PFAS in soils, surface water, and sediment and to adequately assess human health risk and conduct an ecological risk evaluation, then additional data will not be collected. If significant data gaps are identified, then further data will be collected.

Soil and groundwater containing PFAS at concentrations greater than EPA LHA, SSSLs, and/or EPA RSLs, will be evaluated for potential risk to human health. If no unacceptable risk is identified, then no further action will be recommended for soil and/or groundwater. If a CERCLA human health risk assessment indicates unacceptable risk to human health, then a feasibility study will be conducted.

Surface water and sediment containing PFAS, will be evaluated for potential risk to human health. If no unacceptable risk is identified, then no further action will be recommended for surface water and/or sediment. If a CERCLA human health risk assessment indicates unacceptable risk to human health, then a feasibility study will be conducted.

If a complete exposure pathway for ecological receptors to PFAS, is identified, then a qualitative ecological risk evaluation will be completed. PFAS data will be compared to latest ecotoxicology values presented in scientific literature and in accordance with Army Guidance (Department of the Army, 2018). If an unacceptable risk to ecological risk is identified, further evaluation will be conducted.

Step 6: Specify Performance or Acceptance Criteria

Analytical data performance criteria/data quality indicators are specified in QAPP Worksheet #12. These data quality indicators include indicators (performance criteria) for precision, accuracy/bias, sensitivity, and completeness. To determine whether the detection limits (DL), limits of detection (LOD), and limits of quantitation (LOQ) will meet the analytical DQOs, the DLs, LODs, and LOQs have been compared to the project-specific screening criteria in Worksheet #15. With respect to data verification, validation, and usability: QAPP Worksheet #34 provides Data Verification and Validation Inputs; QAPP Worksheet #35 provides Data Verification Procedures; QAPP Worksheet #36 provides Data Validation Procedures; and QAPP Worksheet #37 provides Data Usability Assessment.

Step 7: Develop the Detailed Plan for Obtaining Data

The sampling design and rationale was developed for each area of investigation and is presented in each Area-specific FSP Addendum.

QAPP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLE

One of the primary goals of the project-specific UFP-QAPP is to select appropriate analytical methods to achieve detection limits (DL), limits of detection (LOD), and/or limits of quantitation (LOQ) that will satisfy the overall project DQOs (as defined in Worksheets # 10 [Conceptual Site Model] and #11 [Data Quality Objectives]).

Groundwater and soil samples will be collected and submitted for PFAS analysis by "modified" method 537 (LC/MS/MS isotope dilution) compliant with QSM 5.1, Table B-15. Groundwater and soil samples from select locations will be processed by the laboratory through a total oxidizable precursor (TOP) assay. The TOP assay converts polyfluorinated precursors into fully fluorinated compounds (PFOS and PFOA) using a hydroxyl radical-based chemical oxidation method. The TOP assay replicates what micro-organisms in the environment would achieve after many years. Aqueous and soil samples that are oxidized via the TOP assay will have two sets of sample data reported, which will be designated pre-TOP and Post-TOP. The difference between PFAS concentrations before (Pre-TOP) and after (Post-TOP) oxidation can be used to estimate the concentration of the non-discrete oxidizable precursors in the sample. Select samples will also be submitted for organic carbon analysis, total organic carbon (TOC) for soil samples and dissolved organic carbon (DOC) for aqueous samples.

Worksheets #15-1a and #15-1b list the analytical method DLs, LODs, and LOQs for the target PFAS in aqueous samples and worksheets #15-2a and #15-2b list the analytical method DLs, LODs, and LOQs for the target PFAS in solid samples. Worksheets #15-1b and #15-2b list the respective DLs, LODs, and LOQs for post-TOP aqueous and soil samples. Slightly higher DLs, LODs and LOQs are reported for post-TOP samples due to the limited sample volume processed through the TOP assay.

Worksheets #15-1 and #15-2 show the LHA levels and SSSLs for PFAS with respect to the current analytical DL, LOD, and LOQ for each listed target compound. In all cases the expected detection levels are below the applicable LHAs, SSSLs and soil standards. If the LOD or the DL is below the screening criterion, the LOD and/or the LOQ are sufficient for quantitative use in a risk assessment.

Note that sample dilution because of target and or non-target compound concentrations or matrix interference may prevent DLs, LODs, or LOQs from being achieved. The samples must be initially analyzed undiluted when reasonable. If a dilution is necessary, both the original and diluted result must be delivered. Samples that are not analyzed undiluted must be supported by matrix interference documentation such as sample viscosity, color, odor, or results from other analyses of the same sample to show that an undiluted sample is not possible.

Worksheet #15-3 lists the analytical method DLs, LODs, and LOQs for target PFAS in drinking water samples, which will be analyzed by the drinking water method 537 Revision1.1.

Worksheet #15-4 lists the DLs, LODs, or LOQs for DOC in aqueous samples and TOC in soil.

QAPP WORKSHEET #15-1A: ANALYTICAL METHOD REPORTING LIMITS AND CONTROL LIMITS

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit (ng/L)	Project Action Limit Reference[2]	LOQ (ng/L)	LOD (ng/L)	DL (ng/L)	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
Groundwater/Surface Water	2058-94-8	Perfluoroundecanoic acid (PFUnA)	NA	--	2.00	1.50	0.72	76	105	30
Direct Analysis/Pre-TOP Assay	375-73-5	Perfluorobutanesulfonic acid (PFBS)	40,100	EPA	2.00	1.00	0.46	87	120	30
PFAS Analysis by LC/MS/MS	335-76-2	Perfluorodecanoic acid (PFDA)	NA	--	2.00	1.00	0.48	85	113	30
Isotope Dilution Method	307-55-1	Perfluorododecanoic acid (PFDoA)	NA	--	2.00	1.50	0.52	87	116	30
	375-85-9	Perfluoroheptanoic acid (PFHpA)	NA	--	2.00	1.50	0.61	80	113	30
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	NA	--	2.00	1.00	0.38	81	106	30
	307-24-4	Perfluorohexanoic acid (PFHxA)	NA	--	2.00	1.00	0.47	83	109	30
	375-95-1	Perfluorononanoic acid (PFNA)	NA	--	2.00	1.50	0.52	83	113	30
	1763-23-1	Perfluorooctanesulfonic acid (PFOS)	70/40.1	LHA/EPA	4.00	3.00	1.10	82	112	30
	335-67-1	Perfluorooctanoic acid (PFOA)	70/40.1	LHA/EPA	2.00	1.50	0.54	80	107	30
	72629-94-8	Perfluorotridecanoic Acid (PFTriA)	NA	--	4.00	3.00	0.76	75	129	30
	376-06-7	Perfluorotetradecanoic acid (PFTeA)	NA	--	4.00	3.00	0.83	82	115	30
	2991-50-6	N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	NA	--	20.0	10.0	2.80	80	109	30
	2355-31-9	N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NA	--	20.0	10.0	3.00	82	111	30
	27619-97-2	1H, 1H, 2H, 2H-perfluorooctane sulfonate (6:2 FTS)	NA	--	40.0	20.0	7.00	75	118	30
	39108-34-4	1H, 1H, 2H, 2H-perfluoroecane sulfonate (8:2 FTS)	NA	--	20.0	10.0	3.00	83	111	30

Source: Test America Sacramento - March 25, 2018

[1] See Worksheet #23 for Analytical SOP References

[2] LHA - Federal Register; Vol.81 #101, May 2016

EPA - Region 1 Memorandum: Site-Specific Screening Levels for PFOA, PFOS, and PFBS for the Fort Devens NPL Site, 2/28/18.

QAPP Worksheet #15-1A - Continued

Notes:

NA = not available
PFAS = per- and polyfluoroalkyl substances
CAS = Chemical Abstract Service
LOQ = limit of quantitation
LOD = limit of detection
LCS = laboratory control sample
DL = detection limit
MS = Matrix Spike
MSD = matrix spike
ng/L = nanogram per liter
RPD = relative percent difference

QAPP WORKSHEET #15-1B: ANALYTICAL METHOD REPORTING LIMITS AND CONTROL LIMITS

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit (ng/L)	Project Action Limit Reference[2]	LOQ (ng/L)	LOD (ng/L)	DL (ng/L)	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
Groundwater/Surface Water	2058-94-8	Perfluoroundecanoic acid (PFUnA)	NA	--	5.00	3.75	2.80	57	117	30
Post-TOP Assay	375-73-5	Perfluorobutanesulfonic acid (PFBS)	40,100	EPA	5.00	2.50	0.50	75	135	30
PFAS Analysis by LC/MS/MS	335-76-2	Perfluorodecanoic acid (PFDA)	NA	--	5.00	2.50	0.78	65	125	30
Isotope Dilution Method	307-55-1	Perfluorododecanoic acid (PFDoA)	NA	--	5.00	3.75	1.40	66	126	30
	375-85-9	Perfluoroheptanoic acid (PFHpA)	NA	--	5.00	3.75	0.63	104	171	30
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	NA	--	5.00	2.50	0.43	64	124	30
	307-24-4	Perfluorohexanoic acid (PFHxA)	NA	--	5.00	2.50	1.40	81	141	30
	375-95-1	Perfluorononanoic acid (PFNA)	NA	--	5.00	3.75	0.68	66	126	30
	1763-23-1	Perfluorooctanesulfonic acid (PFOS)	70/40.1	LHA/EPA	5.00	3.00	0.80	68	128	30
	335-67-1	Perfluorooctanoic acid (PFOA)	70/40.1	LHA/EPA	5.00	3.75	2.10	158	454	30
	72629-94-8	Perfluorotridecanoic Acid (PFTriA)	NA	--	5.00	3.50	3.20	65	136	30
	376-06-7	Perfluorotetradecanoic acid (PFTeA)	NA	--	5.00	3.00	0.73	63	123	30
	2991-50-6	N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	NA	--	50.0	12.5	7.80	0	10	30
	2355-31-9	N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NA	--	50.0	12.5	4.80	0	10	30
	27619-97-2	1H, 1H, 2H, 2H-perfluorooctane sulfonate (6:2 FTS)	NA	--	50.0	12.5	5.00	0	10	30
	39108-34-4	1H, 1H, 2H, 2H-perfluoroecane sulfonate (8:2 FTS)	NA	--	50.0	12.5	5.00	0	10	30

Source: Test America Sacramento - March 25, 2018

[1] See Worksheet #23 for Analytical SOP References

[2] LHA - Federal Register; Vol.81 #101, May 2016

EPA - Region 1 Memorandum: Site-Specific Screening Levels for PFOA, PFOS, and PFBS for the Fort Devens NPL Site, 2/28/18.

Notes:

NA = not available
PFAS = per- and polyfluoroalkyl substances
CAS = Chemical Abstract Service
LOQ = limit of quantitation
LOD = limit of detection
LCS = laboratory control sample
DL = detection limit
MS = Matrix Spike
MSD = matrix spike
ng/L = nanogram per liter
RPD = relative percent difference

QAPP WORKSHEET #15-2A: ANALYTICAL METHOD REPORTING LIMITS AND CONTROL LIMITS

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit (µg/Kg)	Project Action Limit Reference[2]	LOQ (µg/Kg)	LOD (µg/Kg)	DL (µg/Kg)	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
Soil/Sediment	2058-94-8	Perfluoroundecanoic acid (PFUnA)	NA	--	0.300	0.200	0.100	74	114	30
Direct Analysis/Pre-TOP Assay	375-73-5	Perfluorobutanesulfonic acid (PFBS)	126,000/ 609,000	EPA Soil/Sediment	0.400	0.180	0.059	73	142	30
PFAS Analysis by LC/MS/MS	335-76-2	Perfluorodecanoic acid (PFDA)	NA	--	0.300	0.200	0.089	74	124	30
Isotope Dilution Method	307-55-1	Perfluorododecanoic acid (PFDoA)	NA	--	0.300	0.200	0.100	75	123	30
	375-85-9	Perfluoroheptanoic acid (PFHpA)	NA	--	0.300	0.200	0.078	76	124	30
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	NA	--	0.300	0.200	0.062	75	121	30
	307-24-4	Perfluorohexanoic acid (PFHxA)	NA	--	0.300	0.200	0.071	75	125	30
	375-95-1	Perfluorononanoic acid (PFNA)	NA	--	0.300	0.200	0.081	74	126	30
	1763-23-1	Perfluorooctanesulfonic acid (PFOS)	126/609	EPA Soil/Sediment	1.00	0.500	0.240	69	131	30
	335-67-1	Perfluorooctanoic acid (PFOA)	126/609	EPA Soil/Sediment	0.300	0.200	0.100	76	121	30
	72629-94-8	Perfluorotridecanoic Acid (PFTriA)	NA	--	0.300	0.200	0.100	43	116	30
	376-06-7	Perfluorotetradecanoic acid (PFTeA)	NA	--	0.400	0.300	0.110	22	129	30

QAPP Worksheet #15-2A - Continued

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit (µg/Kg)	Project Action Limit Reference[2]	LOQ (µg/Kg)	LOD (µg/Kg)	DL (µg/Kg)	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
	2991-50-6	N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	NA	--	2.00	1.00	0.300	65	135	30
	2355-31-9	N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NA	--	2.00	1.00	0.300	65	135	30
	27619-97-2	1H, 1H, 2H, 2H-perfluorooctane sulfonate (6:2 FTS)	NA	--	4.00	2.00	0.660	65	135	30
	39108-34-4	1H, 1H, 2H, 2H-perfluoroecane sulfonate (8:2 FTS)	NA	--	2.00	1.00	0.300	65	135	30

Source: Test America Sacramento - March 25, 2018

[1] See Worksheet #23 for Analytical SOP References

EPA - Region 1 Memorandum: Site-Specific Screening Levels for PFOA, PFOS, and PFBS for the Fort Devens NPL Site, 2/28/18.

Notes:

NA = not available
PFAS = per- and polyfluoroalkyl substances
CAS = Chemical Abstract Service
LOQ = limit of quantitation
LOD = limit of detection
LCS = laboratory control sample
MS = matrix spike
MSD = matrix spike duplicate
µg/Kg = microgram per kilogram
RPD = relative percent difference
DL = detection limit

QAPP WORKSHEET #15-2B: ANALYTICAL METHOD REPORTING LIMITS AND CONTROL LIMITS

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit (µg/Kg)	Project Action Limit Reference[2]	LOQ (µg/Kg)	LOD (µg/Kg)	DL (µg/Kg)	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
Soil	2058-94-8	Perfluoroundecanoic acid (PFUnA)	NA	--	0.500	0.250	0.090	70	130	30
Post-TOP Assay	375-73-5	Perfluorobutanesulfonic acid (PFBS)	126,000	EPA	0.500	0.250	0.063	70	130	30
PFAS Analysis by LC/MS/MS	335-76-2	Perfluorodecanoic acid (PFDA)	NA	--	0.500	0.250	0.055	70	130	30
Isotope Dilution Method	307-55-1	Perfluorododecanoic acid (PFDoA)	NA	--	0.500	0.250	0.170	70	130	30
	375-85-9	Perfluoroheptanoic acid (PFHpA)	NA	--	0.500	0.250	0.073	70	130	30
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	NA	--	0.500	0.250	0.078	70	130	30
	307-24-4	Perfluorohexanoic acid (PFHxA)	NA	--	0.500	0.250	0.110	70	130	30
	375-95-1	Perfluorononanoic acid (PFNA)	NA	--	0.500	0.250	0.090	70	130	30
	1763-23-1	Perfluorooctanesulfonic acid (PFOS)	126	EPA	1.25	0.625	0.500	70	130	30
	335-67-1	Perfluorooctanoic acid (PFOA)	126	EPA	0.500	0.250	0.220	70	130	30
	72629-94-8	Perfluorotridecanoic Acid (PFTriA)	NA	--	0.500	0.250	0.130	70	130	30
	376-06-7	Perfluorotetradecanoic acid (PFTeA)	NA	--	0.500	0.250	0.140	70	130	30

QAPP Worksheet #15-2B - Continued

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit (µg/Kg)	Project Action Limit Reference[2]	LOQ (µg/Kg)	LOD (µg/Kg)	DL (µg/Kg)	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
	2991-50-6	N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	NA	--	5.00	2.50	0.930	70	130	30
	2355-31-9	N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NA	--	5.00	2.50	0.980	70	130	30
	27619-97-2	1H, 1H, 2H, 2H-perfluorooctane sulfonate (6:2 FTS)	NA	--	5.00	2.50	0.380	70	130	30
	39108-34-4	1H, 1H, 2H, 2H-perfluoroecane sulfonate (8:2 FTS)	NA	--	5.00	2.50	0.630	70	130	30

Source: Test America Sacramento - March 25, 2018

[1] See Worksheet #23 for Analytical SOP References

EPA - Region 1 Memorandum: Site-Specific Screening Levels for PFOA, PFOS, and PFBS for the Fort Devens NPL Site, 2/28/18.

Notes:

NA = not available
PFAS = per- and polyfluoroalkyl substances
CAS = Chemical Abstract Service
LOQ = limit of quantitation
LOD = limit of detection
LCS = laboratory control sample
MS = matrix spike
MSD = matrix spike
µg/Kg = microgram per kilogram
RPD = relative percent difference
DL = detection limit

QAPP WORKSHEET #15-3: ANALYTICAL METHOD REPORTING LIMITS AND CONTROL LIMITS DRINKING WATER SAMPLES

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit (ng/L)	Project Action Limit Reference[2]	LOQ (ng/L)	LOD (ng/L)	DL (ng/L)	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
Drinking Water	2058-94-8	Perfluoroundecanoic acid (PFUnA)	NA	--	2.00	0.80	0.218	70	130	30
PFAS Analysis by LC/MS/MS	375-73-5	Perfluorobutanesulfonic acid (PFBS)	40,100	EPA	2.00	1.6	0.650	70	130	30
Drinking Water Method 537 Revision1.1	335-76-2	Perfluorodecanoic acid (PFDA)	NA	--	2.00	0.80	0288	70	130	30
	307-55-1	Perfluorododecanoic acid (PFDoA)	NA	--	2.00	0.80	0.284	70	130	30
	375-85-9	Perfluoroheptanoic acid (PFHpA)	NA	--	2.00	0.80	0.238	70	130	30
	355-46-4	Perfluorohexanesulfonic acid (PFHxS)	NA	--	2.00	0.80	0.328	70	130	30
	307-24-4	Perfluorohexanoic acid (PFHxA)	NA	--	2.00	1.6	0.404	70	130	30
	375-95-1	Perfluorononanoic acid (PFNA)	NA	--	2.00	0.80	0.257	70	130	30
	1763-23-1	Perfluorooctanesulfonic acid (PFOS)	70/40.1	LHA/EPA	2.00	0.80	0.225	70	130	30
	335-67-1	Perfluorooctanoic acid (PFOA)	70/40.1	LHA/EPA	2.00	0.80	0.261	70	130	30
	72629-94-8	Perfluorotridecanoic Acid (PFTriA)	NA	--	2.00	1.6	0.576	70	130	30
	376-06-7	Perfluorotetradecanoic acid (PFTeA)	NA	--	2.00	1.6	0.515	70	130	30
	2991-50-6	N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	NA	--	2.00	1.6	0.595	70	130	30
	2355-31-9	N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	NA	--	2.00	1.6	0.636	70	130	30

Source: Alpha Analytical, June 2018

[1] See Worksheet #23 for Analytical SOP References

[2] LHA - Federal Register; Vol.81 #101, May 2016

EPA - Region 1 Memorandum: Site-Specific Screening Levels for PFOA, PFOS, and PFBS for the Fort Devens NPL Site, 2/28/18.

Notes:

NA = not available
PFAS = per- and polyfluoroalkyl substances
CAS = Chemical Abstract Service
LOQ = limit of quantitation
LCS = laboratory control sample
MS = matrix spike
MSD = matrix spike duplicate
ng/L = nanogram per liter
DL = detection limit

LOD = limit of detection RPD = relative percent difference

QAPP WORKSHEET #15-4: ANALYTICAL METHOD REPORTING LIMITS AND CONTROL LIMITS

Analytical Method[1]	CAS Number	PFAS Compound	Project Action Limit	LOQ	LOD	DL	Units	Control Limits (LCS, MS, MSD)		Precision (RPD, %)
Groundwater/Surface Water										
DOC analysis in aqueous samples	7440-44-0	Dissolved Organic Carbon (DOC)	NA	1.0	0.50	0.19	mg/L	88	112	20
Soil/Sediment										
TOC analysis in soil samples	7440-44-0	Total Organic Carbon (TOC)	NA	2,000	100	44.4	mg/Kg	50	140	35

Source: Test America Sacramento - March 25, 2018

[1] See Worksheet #23 for Analytical SOP References

[2] LHA - Federal Register; Vol.81 #101, May 2016

EPA - Region 1 Memorandum: Site-Specific Screening Levels for PFOA, PFOS, and PFBS for the Fort Devens NPL Site, 2/28/18.

Notes:

NA = not available
PFAS = per- and polyfluoroalkyl substances
CAS = Chemical Abstract Service
LOQ = limit of quantitation
LOD = limit of detection
LCS = laboratory control sample
MS = matrix spike
MSD = matrix spike duplicate
mg/Kg = milligram per kilogram
mg/L = milligram per Liter
DL = detection limit
RPD = relative percent difference

QAPP WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

Sampling Design and Rationale

The sampling and analysis will be completed to gather the data to achieve the DQOs (Worksheet #11). The design of the sampling program and rationale for the areas of investigation is presented in each Area-specific FSP Addendum. If further investigation is warranted after receiving and reviewing results, the field program may be expanded to include the sampling of additional existing monitoring wells, the collection of samples from new groundwater vertical profile borings and/or soil boring, and/or installation of new monitoring wells.

Field Activities

Groundwater from monitoring wells will be purged and sampled in accordance with the Region 1, Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells (USEPA Region 1, 2017) and KGS-SOP-F003 (Groundwater Sampling). Water quality parameters will be recorded for dissolved oxygen, specific conductance, oxidation-reduction potential, temperature, pH, and turbidity in accordance with KGS-SOP-F003. Prior to sampling, each well condition will be evaluated and depth to water measurement recorded in accordance with KGS-SOP-F002 (Evaluation of Existing Monitoring Wells and Water Level Measurement. Samples will be collected from each residential, water supply well or extraction well port in accordance with KGS-SOP-F016 (Private and Water Supply Well Sampling). The stringent sampling procedures required for PFAS sampling are detailed in the KGS-SOP-F009 (PFAS Sampling). Surface water and sediment samples will be collected in accordance with KGS-SOP-F004 (Sediment-Surface Water Sampling). Shallow and surface soil samples will be collected in accordance with KGS-SOP-F015 (Soil Sampling – Surface and Shallow Depth). Samples collected will be handled in accordance with KGS-SOP-F008 (Sample Handling). Equipment will be decontaminated in accordance with KGS-SOP-F005 (Decontamination of Field Equipment). Field activities using direct push technology, vertical profiling and some soil sampling, will be conducted in accordance with KGS-SOP-F012 (Direct Push Technology). Monitoring wells will be construction and developed in accordance with KGS-SOP-F017 (Monitoring Well Construction and Development). Soils will be described in accordance with KGS-SOP-F018 (Soil Description). Samples will be analyzed for the analyses listed in the Area-specific FSP addendum for each media.

Vertical Profiling

Groundwater samples will be collected via vertical profiling using direct push technology. Temporary screens will be advanced using a Geoprobe® drill rig and SP22® groundwater sampler. Direct Push technology will be used to advance the SP22® sampler to the appropriate depth. Attachment A includes SOPs for the Geoprobe® SP22® sampling device. Temporary well groundwater samples shall be collected using the following procedure:

- Advance a 2.25-inch outer casing equipped with an expendable drive point into the appropriate depth using direct-push tooling and drill rig;
- Lower a 48-inch stainless steel screen to total depth inside the outer casing;

- Retract the outer casing to expel the expendable drive point and expose two feet of the screen;
- Measure the water level inserting a decontaminated electronic water level meter inside the inner rods and monitor the water level until it appears to stabilize;
- If necessary, the screen will be raised to coincide with the water table;
- Insert new high-density polyethylene tubing (HDPE) tubing into the screened interval to collect a groundwater sample via either a check valve sampling method or peristaltic pump;
- Measure field parameters and collect groundwater sample by filling sample containers directly from tubing;
- Remove tubing and direct-push tooling with screened-tip from the borehole and decontaminate equipment with Alconox or Liquinox and de-ionized water. Dispose of tubing.
- The process will be repeated for subsequent depths.

Where boreholes for soil sampling and groundwater sampling are collocated and as feasible, the borehole for the groundwater sample will be a continuation of the borehole used to collect the collocated shallow soil samples; otherwise, the groundwater sample borehole will be installed within 3 feet of the soil sample borehole.

As noted in Attachment A, most of the components of the Geoprobe® SP22® sampling device are comprised of stainless steel; however, several O-rings of unknown construction are depicted. Prior to sampling, the drilling subcontractor will be consulted regarding the O-ring material and its potential to cause false-positive PFAS detection in groundwater samples. If the potential for false positives is uncertain, then a field blank sample will be collected of PFAS free, de-ionized water run through the sampling device.

Boreholes will be abandoned after sample collection by filling the entire length of the borehole with cement-bentonite grout.

Groundwater sample collection will include using disposable non-Teflon tubing and pumps.

Sample Analysis

Various analysis will be used including analysis for PFAS, TOC, DOC, grain size. Groundwater and soil samples from select locations will be processed by the laboratory through a total oxidizable precursor (TOP) assay. The total oxidizable precursor assay (TOP) converts polyfluorinated precursors into fully fluorinated compounds (PFOS and PFOA) using a hydroxyl radical-based chemical oxidation method. The TOP assay replicates what micro-organisms in the environment would achieve after many years. Two sets of sample results will be reported for these samples. The difference between PFAS concentrations before (Pre-TOP) and after (Post-TOP) oxidation can be used to estimate the concentration of the non-discrete oxidizable precursors in the sample. The results will allow evaluation of the total PFOS and PFOA mass in each sample through evaluation of the presence of PFOS and PFOA along with other PFAS compounds that degrade into PFAS compounds including PFOS and PFOA. The results will be used in evaluation of potential continuing sources.

Sample Nomenclature

The nomenclature for identifying locations, samples collected in the field, and quality assurance/quality control (QA/QC) samples is presented below.

Location Identifier

All new locations will be assigned a unique location identifier (ID), which will identify the specific point where measurements or samples are collected. Location IDs for new locations will be assigned prior to the sampling event. The location ID will include codes to identify the AOC or area of investigation, the location type, year established, and the location number.

The AOC or areas of investigation may be two- or three-characters and will be numbers or letters. Examples include “74” for AOC 74, “CSB” for Cold Spring Book, and “GP” for Grove Pond.

The location types are listed below.

SB – Soil Boring

VP – Vertical Profile

M – Monitoring Well

The year established will be indicated by two numerals, such as “18” to indicate 2018. The location number will be a unique sequential number for respective locations established within each AOC or area of investigation. The location ID for the second vertical profile conducted at AOC 75 in 2018 would be “75VP-18-02”.

Surface water and sediment locations will be assigned location IDs designating the area of investigation only. For example, the location ID for a surface water/sediment location established at Cold Spring Brook would be “CSB-18-01”.

Field Sample ID

A unique field sample ID will incorporate the location ID, described above, and will be used to identify individual field samples collected for a specific sampling event. The field sample ID will be used on sample labels, chain of custody forms, field logbooks, field sheets and other applicable documentation. The field sample IDs will include the location ID appended with a sample matrix code (for soil samples collected from monitoring well borings and surface water and sediment samples), and sample depth or sample date code (depending on the location type).

The sample matrix codes include:

SO – soil

SED – sediment

SW – surface water

A sample depth code will be used for soil samples and groundwater samples collected via vertical profiling. The depth will represent the depth interval of the sample with respect to feet below ground surface (ft bgs).

A sample date code (MONYY) will be used for groundwater samples collected from monitoring wells and for surface water and sediment samples to identify the sampling events and to aid in comparison of results from the same location. The sample date code will be represented by three letters representing the month and two digits representing the year the sample was collected.

The following are examples of field sampling IDs:

GPVP-18-02-25-27 represents a groundwater sample collected from the second 2018 vertical profile location at Grove Pond collected from 25 to 27 ft bgs.

75SB-18-01-0-0.5 represents a soil sample collected from the first 2018 soil boring location at AOC 75 collected from 0 to 0.5 ft bgs.

74M-19-02X-SO-55-56 represents a soil sample collected from 55 to 56 ft bgs during drilling for the second monitoring well installed at AOC 74 in 2019.

5701M-19-03-FEB19 represents a groundwater sample collected in February 2019 from the third 2019 monitoring well installed at AOC 57 Area 1.

CSB-18-04-SED-DEC18 represents a sediment sample collected in December 2018 from the fourth Cold Spring Brook location.

<u>Field Quality Assurance/Quality Control Samples</u>

Quality assurance/quality control (QA/QC) samples will be designated to indicate the type of QA/QC sample. The QA/QC sample IDs will include the AOC or area of investigation, location types or sample matrix, QA/QC sample type, and sequential numbering (01, 02, 03).

The QA/QC sample types will include the following and be identified as:

DUP – Field Duplicate

FRB – Field Reagent Blank

EB – Equipment Rinseate Blank

Field duplicate samples will include the AOC or area of investigation and the location type or sample matrix appended with DUP01, DUP02 etc. For example, the field sample ID for a field duplicate sample collected from soil boring location 74SB-18-01 would be "74SB-DUP01". A field reagent blank sample associated with vertical profile samples from AOC 74 would be "74VP-FRB01". Matrix spike and matrix spike duplicate samples (MS/MSD) will be identified in the notes of the chain of custody; the laboratory will append MS or MSD to the sample ID for reporting.

The specific location IDs and field sample IDs are presented in each Area-specific field sampling plan addendum.

Investigation-Derived Waste Management

Investigation Derived Waste (IDW) will be handled in a manner consistent with USACE and EPA guidance for managing IDW and applicable Federal and state regulations. Waste soil generated from drilling activities will be containerized, characterized, and disposed. USACE may delegate authority to KGS via email for signature of manifest of non-hazardous waste. Signed manifest will be sent to the USACE upon signature and pick up of IDW. Any groundwater generated will be containerized and upon completion of sampling, discharged back to the ground at the site of generation. IDW will be managed in accordance with KGS-SOP-F011 (IDW Management).

QAPP WORKSHEET #19 AND 30: SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

Worksheets #19 and #30 summarize the analytical methods/matrix, required sample volume, containers, preservation, and holding time requirements. Laboratory analytical SOPs are provided in Worksheet #23 (Analytical SOP). The primary point of contact is through the Test America-Savannah laboratory. PFAS groundwater, surface water, soil, and sediment samples will be analyzed at Test America-Sacramento and DOC/TOC samples will be analyzed at Test America-Seattle. PFAS drinking water samples will be analyzed at Alpha Analytical. Grain size samples will be submitted directly to GeoTesting Expresss in Acton, MA.

Primary Analytical Laboratory
Test America
Point of Contact: Jerry Lanier, Phone: (912) 354-7858

Matrix	Analytical Group	Analytical / Preparation Method SOP Reference[1]	Containers (number, size, and type)	Preservation Requirements (chemical, temperature)	Maximum Holding Time[2] (preparation/analysis)
ORGANIC ANALYSES					
Groundwater, Surface Water	PFAS	WS-LC-0025 Rev 3.0 (4/13/2018) (TAL-Sacramento)	2 x 250-ml HDPE Bottles (NO Teflon lids)	Cool to 4 ± 2°C	Extraction: 14 Days from Collection Analysis: 40 days from Extraction
Sediment, Soil	PFAS	WS-LC-0025 Rev 3.0 (4/13/2018) (TAL-Sacramento)	1-4-ounce HDPE Jar	Cool to 4 ± 2°C	Extraction: 14 Days from Collection Analysis: 40 days from Extraction
Drinking Water	PFAS	SOP 23511, Revision 4 (6/29/2017) (Alpha Analytical)	2 C -250ml polypropylene Bottles (NO Teflon Lids)	Trizma® Cool to 4 ± 2°C	Extraction: 14 Days from Collection Analysis: 40 days from Extraction
MISCELLANEOUS ANALYSES					
Groundwater, Surface Water	DOC	EPA 415.1, SW9060 SOP TA-WC-156 (TAL - Seattle)	1-500-ml Amber Glass	H_3PO_4 to pH 2 Cool to 4 ± 2°C	28 days from collection.
Sediment, Soil	TOC	EPA 9060A SOP TA-WC-192 (TAL - Seattle)	1-4-ounce glass jar	Cool to 4 ± 2°C	28 days from collection.

QAPP Worksheets #19 and 30 - Continued

Primary Analytical Laboratory
Test America
Point of Contact: Jerry Lanier, Phone: (912) 354-7858

Matrix	**Analytical Group**	**Analytical / Preparation Method SOP Reference**[1]	**Containers** (number, size, and type)	**Preservation Requirements** (chemical, temperature)	**Maximum Holding Time**[2] (preparation/analysis)
MISCELLANEOUS ANALYSES					
Sediment, Soil	Grain size	ASTM D-422 SOP ASTM D-422-07 (GeoTesting Express)	1-1-gallon ziplock bag	Cool to 4 ± 2°C	Not specified

[1] See Worksheet #23. Laboratory SOPs are provided in Attachment B.
[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

QAPP WORKSHEET #20: FIELD QC SAMPLE SUMMARY

The table below provides a summary of the types of samples to be collected and analyzed. Its purpose is to show the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix. Area-specific sample locations are summarized in tables included in each Area-specific field sampling plan addendum.

Matrix	Analysis[1]	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Equipment Rinseate Blanks[2]	Field Reagent Blanks[3]
Groundwater Drinking Water	PFAS	See Area-specific FSP addendum	10%	5%	5%	One per piece of sampling equipment	PFAS-free source water
Surface Water	PFAS	See Area-specific FSP addendum	10%	5%	5%	One per piece of sampling equipment	PFAS-free source water
Soil	PFAS	See Area-specific FSP addendum	10%	5%	5%	One per piece of sampling equipment	PFAS-free source water
Sediment	PFAS	See Area-specific FSP addendum	10%	5%	5%	One per piece of sampling equipment	PFAS-free source water
Aqueous	DOC	See Area-specific FSP addendum	10%	5%	5%	One per piece of sampling equipment	NA
Soil/Sediment	TOC	See Area-specific FSP addendum	10%	5%	5%	One per piece of sampling equipment	NA
Soil/Sediment	Grain Size	See Area-specific FSP addendum	10%	NA	NA	NA	NA

The frequency will be applied to the entire Area where samples are being collected during an event.

[1] Field QC samples for TOP assay will not be collected.

[2] Equipment rinseate blanks (EBs) are collected by pouring PFAS-free water (supplied by the laboratory) over decontaminated sampling equipment. The frequency of EB collection should be at least once a week per piece of equipment.

[3] Field Reagent Blanks (FRBs) are PFAS-free water poured into a sample bottle in the field at the time of sampling. The frequency of FRB collection is at least once during each sampling event.

QAPP WORKSHEET #21: FIELD SOPS

The field SOPs associated with the sampling acquisition tasks (including, but not limited to, sample collection, sample handling and custody) are listed in the following table. Copies of the field SOPs are provided in Attachment A.

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)
SOP-F001	Monitoring Equipment Calibration	KGS	N/A	N
SOP-F002	Evaluation of Existing Monitoring Wells and Water Level Measurement	KGS	Water Level Meter	N
SOP-F003	Groundwater Sampling	KGS	Various Sampling Equipment	N
SOP-F004	Sediment-Surface Water Sampling	KGS	Various Sampling Equipment	N
SOP-F005	Decontamination of Field Equipment	KGS	N/A	N
SOP-F007	Field Documentation	KGS	N/A	N
SOP-F008	Sample Handling	KGS	N/A	N
SOP-F009	PFAS Sampling	KGS	Various Sampling Equipment	N
SOP-F010	Global Positioning System (GPS) Measurements	KGS	Trimble, GeoXH	N
SOP-F011	Investigation Derived Waste (IDW) Management	KGS	Sampling Equipment, 55-gallon drums, bung wrench, drum funnel	N

QAPP Worksheet #21 - Continued

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)
SOP-F012	Pore Water Sampling	KGS	N/A	N
SOP-F013	Site-Specific Health and Safety Training	KGS	N/A	N
SOP-F014	Direct Push Technology	KGS	Various	N
SOP-F015	Soil Sampling - Surface and Shallow Depth	KGS	Stainless steel equipment, hand auger, core sampler	N
SOP-F016	Private and Water Supply Well Sampling	KGS	N/A	N
SOP-F017	Monitoring Well Construction and Development	KGS	Various	N
SOP-F018	Soil Description	KGS	N/A	N
	Geoprobe® Screen Point 22 Groundwater Sampler	Kefr, Inc.	GeoProbe	N

QAPP WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

Field sampling equipment will be leased from a reputable equipment leasing supplier. All equipment shall be received in good working order from the supplier. The field equipment and instruments expected to be used during the sampling events discussed in this QAPP may include:

- Water level meter
- Water quality instrument(s)
- Submersible pump and controller, bladder pump and controller, and peristaltic pump for sample acquisition
- Bladder pump and controller for sample acquisition
- Data logger and transducers
- Power generator
- Trimble GeoExplorer
- Camera

Additional equipment may be needed depending on field conditions. Manufacturer's calibration instructions shall be followed when using rental field equipment. The calibration, maintenance, testing, and/or inspection requirements are discussed in the field specific SOPs included in Attachment A.

QAPP WORKSHEETS #26 & 27: SAMPLE HANDLING, CUSTODY, AND DISPOSAL

Sampling Organization: KOMAN Government Solutions (KGS) Team
Laboratories: Test America – Sacramento (PFAS), Test America – Seattle (DOC/TOC), Alpha Analytical (PFAS), and GeoTesting Express (Grain Size)
Method of sample delivery (shipper/carrier): Test America - sample courier, sample drop off and/or Fedex overnight, Alpha Analytical – sample courier, GeoTesting Express – sample courier
Number of days from reporting until sample disposal: 30 days from invoice

Activity	Description	Organization responsible for the activity
Sample labeling	Sample labels will be affixed to each sample collected to identify the field sample with the following information: unique sample identification number, analytical method, sampler's initials, date and time collected, and preservation method used.	KGS field team
Chain-of-custody form completion	KGS will maintain the chain-of-custody records for all normal field and QC samples. A sample is defined as being under a person's custody if any of the following conditions exist: • It is in their possession/view; • It was placed in a locked location; • It is in a designated secure area The following sample information will be documented on the chain-of-custody form: • Unique sample identification • Date and time of sample collection • Source of sample (including location/sample ID, and sample type) • Analyses required • Preservative used • Designation of matrix spike/matrix spike duplicate (MS/MSD) Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory.	KGS field team

QAPP Worksheets #26 & 27 – Continued

Activity	Description	Organization responsible for the activity
Packaging and Shipping	Samples for PFAS, TOC, DOC analysis - Sample containers will be placed inside sealed plastic bags as a precaution against cross-contamination caused by leakage or breakage. Bagged sample containers will be placed in insulated coolers with bubble wrap or other wrapping to eliminate the chance of breakage during delivery or shipment. Ice in plastic bags will be placed in the coolers to keep the samples between 2 and 6 ºC throughout storage and shipment. Sample delivery or shipment will be performed in strict accordance with all applicable U.S. Department of Transportation regulations. The samples will be transported from the site to the laboratory by laboratory personnel or shipped to the laboratory by an overnight courier service. Soil samples collected for grain size analysis will be placed in coolers and delivered to Geo Testing Express in Acton, MA or picked up by a courier.	KGS team, Test America courier, Alpha Analytical courier and/or Geo Testing Express courier
Sample receipt, inspection, & log-in	A designated laboratory representative will accept the shipped samples and verify that the received samples match those on the chain-of-custody record. The condition, temperature, and preservation of the samples should be checked and documented on the chain-of-custody form. Any anomalies in the received samples and their resolution should be documented in the laboratory records. All sample information will then be entered into a tracking system, and unique laboratory sample identifiers will be assigned. The laboratory must supply sample receipt confirmation within 24 hours of sample receipt that includes the following: • A fully executed copy of the chain-of-custody received with the samples; • Sample acknowledgement and log-in report; • Cooler and sample receipt form noting any problems, breakages, holding time issues, temperature exceedances, or inconsistencies between the chain of custody.	Test America, Alpha Analytical, Geo Testing Express

QAPP Worksheets #26 & 27 – Continued

Activity	Description	Organization responsible for the activity
Sample custody and storage	Sample holding-time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for analytical methods required for this project are specified in Worksheet #19 and #30 (Sample Containers, Preservation and Hold Times). Analytical batches will be created, and laboratory QC samples will be introduced into each batch. Samples will be stored in limited-access, temperature-controlled areas.	Test America Alpha Analytical, Geo testing Express,
Sample disposal	Samples will be stored for 30 days after analysis and reporting, at which time the samples will be disposed of. Organic sample extracts will be stored for 30 days, if sufficient volume remains. The samples will be disposed of by the laboratory in accordance with applicable local, state, and federal regulations. Disposal records will be maintained by the laboratory. SOPs describing sample control and custody will be maintained by the laboratory.	Test America Alpha Analytical, Geo testing Express,

QAPP WORKSHEETS #31, #32 & #33: ASSESSMENTS AND CORRECTIVE ACTIONS

Periodic assessments may be performed during the course of the project so that the planned project activities are implemented in accordance with this UFP-QAPP. The routine data quality verification steps described in Worksheet #34 will be used to assess the effectiveness of the project data reporting system. No additional project assessment activities are planned in the project scope. If additional assessments become necessary; this worksheet will be amended as needed.

Assessment Type	Responsible Party and Organization	Frequency	Assessment Deliverable	Timeframe of Response	Person(s) Responsible for Response and Implementing Corrective Actions	Person(s) Responsible for Monitoring Corrective Action Implementation
Field Procedure Assessment	Kevin Anderson or designee/KGS	Weekly	Internal e-mail	1 business day	Kevin Anderson or designee/KGS	Katherine Thomas/KGS
Field Documentation Reviews	Lynne Klosterman/KGS	Weekly	Internal e-mail	3 business days	Kevin Anderson or designee/KGS	Lynne Klosterman/KGS
Sample Condition Report/ Log in receipt	Laurie Ekes/KGS	After sample receipt at laboratory.	External e-mail, if laboratory issue. Internal e-mail, if KGS issue.	24 hours after notification	Laboratory log in personnel, if sample ID error, or Kevin Anderson or designee/KGS, if sample collection issue.	Lynne Klosterman/KGS
Analytical Discrepancy	Laurie Ekes/KGS	After data receipt from laboratory and during data validation.	External e-mail	7 business days	Jerry Lanier/Test America Jim Occhalini/Alpha Analytical Mark Dobday/GeoTesting	Laurie Ekes/KGS
Data Validation Reports	Laurie Ekes/KGS	Prepared for each Sample Delivery Group (SDG).	Data Validation reports and validated data spreadsheet per SDG.	3 weeks after receipt of completed data package.	Laurie Ekes/KGS	Katherine Thomas/KGS

APPENDIX B
Responses to Comments

U.S. ARMY RESPONSES TO U.S. EPA COMMENTS ON THE DRAFT AREA 2 FIELD SAMPLING PLAN ADDENDUM TO REMEDIAL INVESTIGATION WORK PLAN FOR PFAS
Former Fort Devens Army Installation, Devens, MA
05 November 2018

The following Army responses pertain to the U.S. Environmental Protection Agency (EPA) comments, dated 26 October 2018, on the draft *Area 2 Field Sampling Plan, Addendum to Remedial Investigation Work Plan for Per- and Polyfluoroalkyl Substances (PFAS), Former Fort Devens Army Installation, Devens, MA,* dated September 2018.

General Comments

Comment #1: EPA previously commented that the inclusion of field sampling activities that may or may not be conducted as part of the Area 1 RI is misleading and distorts the scope of the proposed sampling program for each of the PFAS AOCs. Although Army responded that the program includes an "adaptive/dynamic site characterization approach" that "can address data gaps in real time while field work is ongoing, whereas a "phased" approach may imply re-mobilizations for supplemental work in the future", the Area 2 FSP, similar to the Area 1 FSP, contains ambiguous language regarding follow-on work. For example, for AOC 43G, the FSP states "For planning purposes up to two new overburden monitoring wells <u>may</u> be installed at AOC 43G". Further, there is no mention of the installation of permanent monitoring wells for AOC 43G within that AOC's Remedial Investigation Approach/Sampling Plan section, which gives an overview of the program. In cases such as at AOC 43G where both previously sampled existing monitoring wells contained PFAS concentrations exceeding the LHA, new monitoring wells <u>will</u> need to be installed, as data gathered from one-time vertical profiling groundwater samples are insufficient for the purposes of a CERCLA RI.

> **Response:** The following text has been added as the penultimate sentence of the first paragraph of Section 5.3.3:
>
> > *"Installation of new overburden monitoring wells are planned at AOC 43G to supplement the existing monitoring well network."*
>
> The second sentence of Section 5.3.3.5 will be revised as follows:
>
> > *"Installation of up to two new overburden monitoring wells are planned at AOC 43G."*
>
> The second sentence of Section 5.5.3.4 will be revised as follows:
>
> > *"Installation of up to ten new overburden monitoring wells are planned (in addition to the 12 piezometers described in Section 5.5.3.1) at AOC 76."*

Comment #2: While useful for determining permanent monitoring well locations and screen settings, drive point data collected during the SI should not be used to make decisions regarding groundwater flow gradients and direction. Data collected during the profiling work should be used to determine permanent monitoring well locations and screen settings for purposes of defining the boundaries of PFAS contamination in these media and confirm groundwater elevation and flow gradients and direction. In addition, water level measurements from a limited number of temporary drive points should not be relied upon to accurately predict or support decisions regarding groundwater flow gradients and directions.

Response: The SI results were not used to make decisions regarding groundwater flow gradients and direction.

Groundwater samples collected via vertical profiling, groundwater samples collected from existing wells, and, where applicable, hydraulic data from permanent piezometers, will be used to determine permanent monitoring well locations and screen settings for purposes of defining the boundaries of PFAS contamination and confirm groundwater elevation and flow gradients and direction.

The Area 2 FSP does not include utilizing water level measurements from temporary drive points.

Comment #3: EPA recommends that vertical profiling groundwater samples be collected at 5-foot intervals (from the top of the water table to bedrock) instead of the 10-foot intervals proposed at AOC 32/43A, due to the thin nature of the overburden at these AOCs (10-20 feet). The collection of samples from more discrete sampling intervals will more accurately delineate PFAS contamination in this area.

Response: The thickness of the unconsolidated overburden at AOCs 32 and 43A is thin (approximately 40 feet of saturated overburden at 43M-01-20XBR/OB and 8 feet of saturated overburden at 32M-01-14XBR/OB). Due to the relatively thin nature of the saturated zone of the overburden aquifer at AOCs 32/43A, the presence of a clean water lens above a potential PFAS plume or zone of clean water below a PFAS plume is not likely to exist. Therefore, employing a shorter sampling interval to determine the top and bottom of a PFAS plume is not likely result in a more accurate delineation of PFAS contamination in groundwater and would not change a risk calculation or groundwater remediation strategy. A 10-foot sampling interval is expected to result in a reasonable number of samples needed to characterize the extent of PFAS vertically and laterally in the groundwater column at AOCs 32 and 43A.

Comment #4: Preferential pathways for possible PFAS migration should be explored during or concurrent with implementation of the initial phase of RI work. Former and current underground utility corridors, sewer lines, floor and trench drains (and associated piping), catch basins, oil/water separators, storm water drainage systems (exterior trench drains) should be identified and evaluated as potential sources and/or conduits of PFAS contamination, most notably for AOCs 32/43A (DRMO/Former gas station), AOC 43G (AAFES and Historical Gas Station G), and AOC76 (Devens Fire Station).

Response: As indicated in the last paragraph of Section 4.5, utility maps will be reviewed and evaluated as potential preferential pathways, if review of analytical results suggests additional potential point sources or secondary sources. It is anticipated that most historic subsurface structures and utilities are located at relatively shallow depths within the vadose zone and have bedding composed of natural glacial outwash or similar materials and would have similar hydraulic properties to surrounding undisturbed natural deposits and would not be likely preferential pathways for infiltrating surface water. However, mapping and characteristics will be considered.

Page-Specific Comments

Comment #1: Page 4, Section 5.0, Field Activities by Areas of Concern/Areas of Interest – References to Section 6 throughout this section should be checked, as it appears the correct reference should be Section 7. Please address.

Response: Within Section 5, references to SOPs have been revised to Section 7.

Comment #2: Page 5, Section 5.1.3, Remedial Investigation Approach/Sampling Plan (AOC 05) – Army's statement that "... the PFAS remedial investigation at AOC 5 will use the existing monitoring well network to the maximum extent possible" could be misconstrued to suggests that all existing wells will be sampled for PFAS, which does not appear to be Army's intent. Please revise the statement and clarify the intent.

Response: The phrase "to the maximum extent possible" has been deleted from the text.

Comment #3: Page 11, Section 5.3.1, Introduction/Conceptual Site Model Discussion (AOC 43G) – This section does not include a description of subsurface geology and expected bedrock depths at AOC 43G. To be consistent with the CSMs of other AOCs being studied and inform the investigations, please include this information.

Response: The following text has been added as the third paragraph to Section 5.3.1 of the Field Sampling Plan to provide a description of the subsurface geology at AOC 43G.

"Depth to bedrock at AOC 43G was determined during the previous remedial investigation (ABB, 1996a) and is characterized as sloping downward to the southeast from an elevation of approximately 280 ft msl near Queenstown Street to approximately 255 ft msl near monitoring well XGM-94-06X (Figure 6). Overburden at AOC 43G is comprised of unconsolidated sand and gravel with basal till deposits (ABB, 1996a). The overburden at AOCS 43 is approximately 30 feet thick with the surface topography generally mimicking the bedrock topography in the area (ABB, 1996a)."

Comment #4: Page 13, Section 5.3.3.3, Soil Sampling (AOC 43G) – Based on the detection of PFAS exceeding the LHA in two existing monitoring wells, EPA anticipates that soil sampling will be required, based on the results of the sampling of existing monitoring wells and vertical profiling efforts.

Response: Comment noted. As indicated in the text, the location of the soil borings will be reviewed with USEPA and MassDEP and will be based on a review of the PFAS groundwater data.

Comment # 5: Figure 1, Area 2, Figure Extents – Please include a symbol and label the MacPherson well on Figure 1.

Response: A symbol for the MacPherson water supply well will be added to Figure 1.

Comment # 6: Figure 2 and Table 1, AOC 05 – During the SI, a combined PFOA/PFOS concentration of 76 ppt (above the LHA) was detected in monitoring well SHM-11-05. In the Area 2 FSP, Army proposes to sample two nearby wells, presumably to better delineate PFAS in this area. Since these nearby wells (SHP-05-43 and SHP-05-44) are screened at approximately 50-60 feet below ground surface, it is unclear if the sampling these wells will provide sufficient data to evaluate PFAS impacts in the vicinity of SHM-11-05, screened 25-35 feet bgs. Please address.

Response: It was not well SHM-11-05, rather it was well SHM-11-06, where PFOA/PFOS concentration of 76 ng/L was detected. Well SHM-11-05 is screened from 208.33 to 198.33 ft NAVD88. Wells SHP-05-43 and SHP-05-44 are both set at similar elevations to SHM-11-06, specifically SHP-05-43 is set from 207.88 to 197.88 ft NAVD88 and SHP-04-44 is set from 204.56 to 194.56 ft NAVD88. Both of these wells will provide information on PFAS impacts crossgradient of SHM-11-06.

Comment # 7: Figure 2, AOC32/43A and AOC 05 – The two wells previously sampled near the eastern Former Fort Devens Boundary do not provide adequate documentation of no PFAS migrating east, as both wells (SHL-18 and SHM-93-24A) are screened at approximately 15-20 feet bgs. EPA recommends that an additional vertical profile point be driven/sampled to the north of the vertical profiling locations already proposed (for AOC32/43A) to more completely evaluate the eastern migration of PFAS in this area.

Response: An additional groundwater vertical profile, 32VP-18-07, has been added approximately 350 feet north of 32VP-18-06.

Comment # 8: Figure 3, AOC32/43A - Please edit the figure to outline the extents of the storage areas (east, west, and tires).

Response: The extents of the storage areas will be added to Figure 3.

Comment # 9: Figure 3, AOC32/43A - Based on the water level data presented, the 234 contour looks questionable and could potentially extend to the northeast. The justification for the contour as presented is unclear. Also, 32Z-01-05XOB water level data appears to be a significant anomaly; is there other data supporting that water level?

Response: The 2017 water table elevations in overburden wells at AOC 43A are anomalous from previous depictions of water table elevations in overburden wells at AOC 43A. Historically, the shape of groundwater contours developed from overburden wells are similar to the groundwater contours developed from bedrock wells. Figures 3 and 4 will be revised to show the 2016 interpreted water table elevations as the 2016 elevations are more indicative of historic conditions.

Comment # 10: Figure 5, AOC32/43A – During groundwater sampling conducted during the SI, monitoring well 32Z-01-07XOB had a PFAS concentration in excess of the LHA. However, based on the groundwater flow directions shown in Figure 3, there is no monitoring proposed that is suitable for detecting PFAS downgradient of this well. EPA recommends that another vertical profile location east of 32Z-01-07XOB be installed/sampled. Note also that the groundwater flow path east of 32Z-01-07XOB is not well defined.

Response: A review of the groundwater contours presented on Figure 3 of the Area 2 FSP indicates that monitoring wells, 32Z-01-06XBR, 32M-01-14XBR, 32M-01-14XOB, N7-P1, N7-P2 and SHL-12, are located hydraulically downgradient of monitoring well 32Z-01-07OXB. Due to the uncertainty in groundwater flow direction to the east of 32Z-01-07XOB, monitoring wells along several potential flow paths from this well were selected for sampling. The data obtained from these monitoring wells, coupled with the vertical profiling data obtained at 32VP-18-02 is expected to provide data sufficient to delineate the vertical and lateral extent of PFAS in the aquifer located downgradient of monitoring well 32Z-01-07XOB.

Comment # 11: Figure 5, AOC32/43A - EPA notes that there are no wells proposed on the flow path from the DRMO East Yard southeast/south past the former building T-204. This appears to be a data gap that needs to be addressed to rule out the East Yard as a PFAS source. A vertical profile location should be added along this flow path.

> **Response:** There is no saturated overburden east of former building T-204. At well 32M-01-18XBR, the depth to bedrock is 18 feet and the depth to water in 2017 was 16 feet. At well 32M-01-16XBR, the depth to bedrock is 17 feet and the depth to water in 2017 was 21 feet. Groundwater is present only in the highly fractured top of rock in this area. Therefore, a vertical profiling of the overburden is not expected to yield groundwater. The two existing bedrock wells, 32M-01-16XBR and 32Z-01-10XBR, which have been identified for PFAS sampling in the Area 2 FSP, are located downgradient of the DRMO East Yard east/southeast of former building T-204 and should assist in delineating the presence of PFAS downgradient of the East Yard.

Comment # 12: Figure 6, AOC 43G – Another vertical profiling point is needed north of AAFES-7, where PFAS exceeded the LHA, and along Patch Road south of GVP-18-8 in order to define the PFAS plume width at these downgradient locations. Please include an additional vertical profiling point at each of these locations. Also note in Figure 6, “GVP-18-8” should be “43GVP-18-8” for consistency.

> **Response:** The northern edge of a potential PFAS groundwater contamination is anticipated to be delineated by the data obtained at vertical profile borings 43GVP-18-02 and 43GVP-18-06. An additional groundwater vertical profile north of AAFES-7 will provide PFAS data that is redundant to data collected at 43GVP-18-02 and 43GVP-18-06 and is not needed at this time to define the northern extent of contamination in this area. Similarly, PFAS contamination is anticipated to be bounded to the south by 43GVP-18-01 and GVP-18-08. If PFAS above the LHA is detected in 43GVP-18-02 or –06 (or -01/-08), then an additional location north (or south) of AAFES-7 may be considered. Presently, based on our understanding the proposed profiles are sufficient to delineate the vertical and lateral extent of contamination.
>
> GVP-18-08 will be relabeled as 43GVP-18-08.

Comment # 13: Figure 7, AOC-43J – To better assess deeper groundwater, EPA requests that HA-2B be sampled if the well screen is deeper than XJM-94-07X (Table 4 lists the well screen for HA-2B as unknown, and the well screen for XJM-94-07X as 3.7-13.7 ft bgs).

> **Response:** Sampling of existing monitoring well HA-2B will be added to the Area 2 FSP. Please note as indicated above that the well screen depth is unknown.

Comment # 14: Figure 9, AOC-76 – A vertical profiling location midway between 76-VP-18-11 and 76- VP-18-13 must be added to more fully characterize the PFAS plume. Please address.

> **Response:** An additional groundwater vertical profiling boring will be advanced adjacent to Willow Brook midway between 76VP-18-11 and 76-VP-18-13.

Comment # 15: Figure 9, AOC-76 – The text suggests that the fire training occurred on the pavement; however, the figure appears to show the FTA east of the pavement. In addition, 76-VP-18-03 should be replaced with a soil boring/vertical profile point (green square) and moved closer to pavement. Please address.

Response: Fire training activities did not occur at AOC 76, rather as discussed in the FSP, fire hose training was conducted on the end of the paved area located to the southeast of the fire station building, with the sprayed foam draining off the pavement to the east/northeast. The paved area historically extended an additional approximately 130 feet southeast of the current pavement edge. Figure 9 will be revised to indicate that the southeastern paved area was the site of former fire hose training.

The objective of groundwater vertical profile location 76VP-18-03 is to determine if PFAS are present in groundwater upgradient of the paved area associated with historic fire hose training activities. A combined soil/ groundwater vertical profile boring (76SB-18-06/76VP-18-06) is planned immediately downgradient of the edge of pavement. In addition, soil borings 76SB-18-11, 76SB-18-09, and 76SB-18-06 will be advanced to characterize PFAS in soils at the former edge of pavement to the southeast of the fire department building. Adjusting the location of groundwater vertical profile 76VP-18-03 to the northeast toward the edge of pavement, will duplicate data proposed for collection from the planned soil borings and vertical profiles discussed above.

Comment # 16: Figure 9, AOC-76 – EPA requests that a soil boring/vertical profile sample be added to the east of the Firefighting Training Area (within the square grassy area at the end of the pavement on the east).

Response: An additional combined soil boring/vertical profile location, 76SB-18-14/76VP-18-14, will be added to the east of the former training area.

Comment # 17: Figure 9, AOC-76 – EPA requests an additional vertical profiling sample west of Willow Brook at the bend located southeast of FH-17-04.

Response: Groundwater vertical profiling will be completed at the new boring to be added to the east of the former training area (see response to EPA comment #16). This new vertical profile boring will be located approximately 50 feet west of Willow Brook and will provide PFAS data in soil and groundwater between the former edge of pavement and Willow Brook. An additional vertical profiling location to the west of the bend in Willow Brook will provide PFAS data that is redundant to data that will be collected at the new boring that was added to the east of the former training area (per EPA comment #15). Figure 9 will be revised to show the additional vertical profile location.

Comment # 18: Table 4 - There is a typo for XJM-97-11X well screen elevation (i.e., 233.80 presumably should be 333.80). Please correct.

Response: The well screen elevation for XJM-97-11X will be revised accordingly.

Comment # 19: Table 5 – The rationale stated for vertical profiling locations 43AVP-18-01 through 43AVP-18-03 is to "Determine the extent of PFAS detections in groundwater downgradient of AOC 43A", yet Figure 3 shows AOC 43A overburden groundwater flowing away from these proposed locations. Please clarify the rationale of these three vertical profiling points.

Response: The 2017 water table elevations in overburden wells at AOC 43A are anomalous from previous depictions of water table elevations in overburden wells at AOC 43A. Historically, the shape of groundwater contours developed from overburden wells are similar to the groundwater contours developed from bedrock wells. Figures 3 and 4 will be revised to show the 2016 interpreted water table elevations as the 2016 elevations are more indicative of historic conditions. The locations of vertical profiles 43AVP-18-01 through 43AVP-18-03 are anticipated to characterize overburden groundwater downgradient of AOC 43A.

Comment # 20: Table 6 - Clarify the notes to state that the intent is to drill and collect samples to bedrock or refusal. Drilling and sampling to 50 feet, for example, is not sufficient unless bedrock or refusal is encountered.

Response: The notes in Table 6 will be revised to indicate groundwater samples will be collected from the water table to refusal and that the cited target depths are estimated based on past investigations or MassGIS geology overlays.

Comment # 21: Table 7 - Correct the typos in the location identifier column.

Response: Table 7 will be revised.

U.S. ARMY RESPONSES TO MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION COMMENTS ON THE DRAFT AREA 2 FIELD SAMPLING PLAN ADDENDUM TO REMEDIAL INVESTIGATION WORK PLAN FOR PFAS
Former Fort Devens Army Installation, Devens, Massachusetts
05 November 2018

The following Army responses pertain to the Massachusetts Department of Environmental Protection (MassDEP) comments, dated 12 October 2018, on the draft *Area 2 Field Sampling Plan, Addendum to Remedial Investigation Work Plan for Per- and Polyfluoroalkyl Substances (PFAS), Former Fort Devens Army Installation, Devens, MA*, dated September 2018.

Comment #1: Section 4.4: The cited HERA Work Plan could not be reviewed because it has not been submitted.

> **Response:** Comment noted. The HERA Work Plan will be submitted for review in November 2018.

Comment #2: Section 5.1.3.2 and Table 3: Please clarify the description of "main channel" and "main river" samples that will be collected from Nonacoicus Brook. These samples need not be collected far from shorelines. Apologies if prior MassDEP references to "main channel" were interpreted to mean samples should be collected far from shorelines. The term was intended to indicate that the surface water samples collected at these locations should be representative of the main stream branch conveying the bulk of the water flowing in the vicinity of the sample location, rather than a relatively small side-channel where the stream is braided. The sediment samples collected from these locations should be collected where potentially impacted sediment has accumulated.

> **Response:** Samples identified as "main channel" in Table 3 and in Section 5.1.3.2 of the text will be collected from the bank of the main stream channel of the Nonacoicus Brook, not necessarily from the middle of the channel. The locations designated as "main channel" are intended to determine if PFAS are present in surface water and sediment in the sections of the Nonacoicus Brook that most likely to receive contaminated surface water originating from upstream location, such as Plow Shop Pond. The locations within the Nonacoicus Brook that are designated as "shoreline" are locations near the edge of the wetland system where it is likely that PFAS-impacted groundwater that originates from the area of SHL may be discharging to the surface water system. For clarity, Section 5.1.3.2, paragraph 2, sentences 6 and 7 has been revised to read as follows:
>
> > *"The Nonacoicus Brook is surrounded by relatively wide wetland systems and in general, surface water and sediment will be collected from the bank of the main stream channel to evaluate whether PFAS are present in surface water and sediment at locations that potentially receive PFAS contaminated surface water from upstream locations (i.e., Plow Shop Pond). However, at a couple of locations along the Nonacoicus Brook, samples will be collected from the southern shoreline of the wetland system to assess surface water and sediment where groundwater impacted by SHL may be discharging directly to the wetland."*
>
> And the note on Table 3 has been revised to read: *"Main Channel: Samples will be collected from the bank of the main stream channel."*

Comment #3: Section 5.6.1: Please include a map showing the location of the Ayer "infiltration beds" noted here.

Response: The phrase infiltration beds was incorrectly included in the text and should have been a reference to the sludge disposal landfill. The text has been revised to read as follows:

"The town of Ayer municipal wastewater treatment facility and sludge disposal landfill are located to the east of the MacPherson well, on the opposite side of the Nonacoicus Brook."

U.S. ARMY RESPONSES TO U.S. EPA FOLLOW-ON COMMENTS ON THE DRAFT AREA 2 FIELD SAMPLING PLAN ADDENDUM TO REMEDIAL INVESTIGATION WORK PLAN FOR PFAS
Former Fort Devens Army Installation, Devens, MA
26 November 2018

The following U.S. Army responses pertain to the U.S. Environmental Protection Agency (EPA) follow-on comments (dated 7 November 2018) that were discussed during the teleconference held on 7 November 2018, pertaining to the draft *Area 2 Field Sampling Plan, Addendum to Remedial Investigation Work Plan for Per- and Polyfluoroalkyl Substances (PFAS), Former Fort Devens Army Installation, Devens, MA*, dated September 2018. The applicable, original EPA comments (26 October 2018) and Army responses (5 November 2018) are reprinted herein for reference.

General Comments

Comment #1: EPA previously commented that the inclusion of field sampling activities that may or may not be conducted as part of the Area 1 RI is misleading and distorts the scope of the proposed sampling program for each of the PFAS AOCs. Although Army responded that the program includes an "adaptive/dynamic site characterization approach" that "can address data gaps in real time while field work is ongoing, whereas a "phased" approach may imply re-mobilizations for supplemental work in the future", the Area 2 FSP, similar to the Area 1 FSP, contains ambiguous language regarding follow-on work. For example, for AOC 43G, the FSP states "For planning purposes up to two new overburden monitoring wells may be installed at AOC 43G". Further, there is no mention of the installation of permanent monitoring wells for AOC 43G within that AOC's Remedial Investigation Approach/Sampling Plan section, which gives an overview of the program. In cases such as at AOC 43G where both previously sampled existing monitoring wells contained PFAS concentrations exceeding the LHA, new monitoring wells will need to be installed, as data gathered from one-time vertical profiling groundwater samples are insufficient for the purposes of a CERCLA RI.

> **Response:** The following text has been added as the penultimate sentence of the first paragraph of Section 5.3.3:
>
> > *"Installation of new overburden monitoring wells are planned at AOC 43G to supplement the existing monitoring well network."*
>
> The second sentence of Section 5.3.3.5 will be revised as follows:
>
> > *"Installation of up to two new overburden monitoring wells are planned at AOC 43G."*
>
> The second sentence of Section 5.5.3.4 will be revised as follows:
>
> > *"Installation of up to ten new overburden monitoring wells are planned (in addition to the 12 piezometers described in Section 5.5.3.1) at AOC 76."*
>
> **EPA Follow-On Comment:** The response is unacceptable because "may be" and "are planned" are analogous. EPA's comment was intended to address a significant ambiguity in the scope of proposed field sampling. Specifically, while the draft FSP includes activities that will and/or may be performed during subsequent phases of the field investigation, EPA believes that additional monitoring wells will be required at sites with confirmed PFAS detections in existing monitoring wells, regardless of groundwater profiling results. While

it may be premature at this stage of the investigation to determine the exact number and specific locations of these new monitoring wells, Army should acknowledge that data gaps will exist without the installation of additional, permanent monitoring location to accurately delineate the extent of PFAS concentrations in groundwater exceeding EPA LHA levels.

Follow-On Response: The text revisions from the previous response will be substituted with the following revisions. The following text has been added as the penultimate sentence of the first paragraph of Section 5.3.3:

> *"New monitoring wells will be installed at AOC 43G to supplement the existing monitoring well network."*

The second sentence of Section 5.3.3.5 will be revised as follows:

> *"One or more overburden monitoring wells will be installed at AOC 43G."*

The second sentence of Section 5.5.3.4 will be revised as follows:

> *"New overburden monitoring wells will be installed (in addition to the 12 piezometers described in Section 5.5.3.1) at AOC 76."*

Comment #2: While useful for determining permanent monitoring well locations and screen settings, drive point data collected during the SI should not be used to make decisions regarding groundwater flow gradients and direction. Data collected during the profiling work should be used to determine permanent monitoring well locations and screen settings for purposes of defining the boundaries of PFAS contamination in these media and confirm groundwater elevation and flow gradients and direction. In addition, water level measurements from a limited number of temporary drive points should not be relied upon to accurately predict or support decisions regarding groundwater flow gradients and directions.

Response: The SI results were not used to make decisions regarding groundwater flow gradients and direction.

Groundwater samples collected via vertical profiling, groundwater samples collected from existing wells, and, where applicable, hydraulic data from permanent piezometers, will be used to determine permanent monitoring well locations and screen settings for purposes of defining the boundaries of PFAS contamination. Profile (i.e. drive point) and confirm groundwater elevation and flow gradients and direction derived from permanent monitoring locations.

The Area 2 FSP does not include utilizing water level measurements from temporary drive points.

EPA Follow-On Comment: Response acceptable providing that Army does not intend to use drive point (i.e. vertical profiling) data to determine groundwater flow gradients and direction for any of the PFAS RI AOCs. Water level measurements collected during vertical (i.e. direct push) profiling, while appropriate for locating additional profiling locations, identifying permanent monitoring well locations (and screen settings), and defining the boundaries of PFAS contamination, should not be used to confirm groundwater flow gradients and direction in a CERCLA RI.

Follow-On Response: Comment noted.

Comment #3: EPA recommends that vertical profiling groundwater samples be collected at 5-foot intervals (from the top of the water table to bedrock) instead of the 10-foot intervals proposed at AOC 32/43A, due to the thin nature of the overburden at these AOCs (10-20 feet). The collection of samples from more discrete sampling intervals will more accurately delineate PFAS contamination in this area.

> **Response:** The thickness of the unconsolidated overburden at AOCs 32 and 43A is thin (approximately 40 feet of saturated overburden at 43M-01-20XBR/OB and 8 feet of saturated overburden at 32M-01-14XBR/OB). Due to the relatively thin nature of the saturated zone of the overburden aquifer at AOCs 32/43A, the presence of a clean water lens above a potential PFAS plume or zone of clean water below a PFAS plume is not likely to exist. Therefore, employing a shorter sampling interval to determine the top and bottom of a PFAS plume is not likely result in a more accurate delineation of PFAS contamination in groundwater and would not change a risk calculation or groundwater remediation strategy. A 10-foot sampling interval is expected to result in a reasonable number of samples needed to characterize the extent of PFAS vertically and laterally in the groundwater column at AOCs 32 and 43A.
>
> **EPA Follow-On Comment:** Response acceptable (at this point in time). EPA will await results of Phase 1 sampling activities to determine if more discrete sampling is warranted.
>
> **Follow-On Response:** Comment noted.

Comment #4: Preferential pathways for possible PFAS migration should be explored during or concurrent with implementation of the initial phase of RI work. Former and current underground utility corridors, sewer lines, floor and trench drains (and associated piping), catch basins, oil/water separators, storm water drainage systems (exterior trench drains) should be identified and evaluated as potential sources and/or conduits of PFAS contamination, most notably for AOCs 32/43A (DRMO/Former gas station), AOC 43G (AAFES and Historical Gas Station G), and AOC76 (Devens Fire Station).

> **Response:** As indicated in the last paragraph of Section 4.5, utility maps will be reviewed and evaluated as potential preferential pathways, if review of analytical results suggests additional potential point sources or secondary sources. It is anticipated that most historic subsurface structures and utilities are located at relatively shallow depths within the vadose zone and have bedding composed of natural glacial outwash or similar materials and would have similar hydraulic properties to surrounding undisturbed natural deposits and would not be likely preferential pathways for infiltrating surface water. However, mapping and characteristics will be considered.
>
> **EPA Follow-On Comment:** As discussed during this morning's weekly status call, EPA does not agree that these features should only be evaluated "if review of analytical results suggests additional point sources or secondary sources." Regardless of the results of the Phase 1 FSP, the above-mentioned features/structures should, at a minimum, be identified and mapped for concurrent evaluation as potential, on-going PFAS sources and/or conduits of PFAS contamination from other suspected and/or confirmed PFAS AOCs. This will remain a data gap in the PFAS RI until adequately addressed/resolved.
>
> **Follow-On Response:** Potential preferential pathways will be investigated on an AOC-specific basis in determining nature and extent and fate and transport of PFAS in contaminated media.

Page-Specific Comments

Comment #4: Page 13, Section 5.3.3.3, Soil Sampling (AOC 43G) – Based on the detection of PFAS exceeding the LHA in two existing monitoring wells, EPA anticipates that soil sampling will be required, based on the results of the sampling of existing monitoring wells and vertical profiling efforts.

> **Response:** Comment noted. As indicated in the text, the location of the soil borings will be reviewed with USEPA and MassDEP and will be based on a review of the PFAS groundwater data.
>
> **EPA Follow-On Comment:** Based on current PFAS detections, EPA will likely request that the soil borings be converted to multi-sample (soil boring/vertical profiling) locations and that additional permanent monitoring wells be installed based on the results of these sample data.
>
> **Follow-On Response:** Comment noted. The number and location of soil borings, vertical profiling locations, and permanent monitoring wells will be discussed with EPA and MassDEP after additional PFAS results from groundwater samples from existing monitoring well and vertical profiling sampling are received.

Comment # 10: Figure 5, AOC32/43A – During groundwater sampling conducted during the SI, monitoring well 32Z-01-07XOB had a PFAS concentration in excess of the LHA. However, based on the groundwater flow directions shown in Figure 3, there is no monitoring proposed that is suitable for detecting PFAS downgradient of this well. EPA recommends that another vertical profile location east of 32Z-01-07XOB be installed/sampled. Note also that the groundwater flow path east of 32Z-01-07XOB is not well defined.

> **Response:** A review of the groundwater contours presented on Figure 3 of the Area 2 FSP indicates that monitoring wells, 32Z-01-06XBR, 32M-01-14XBR, 32M-01-14XOB, N7-P1, N7-P2 and SHL-12, are located hydraulically downgradient of monitoring well 32Z-01-07OXB. Due to the uncertainty in groundwater flow direction to the east of 32Z-01-07XOB, monitoring wells along several potential flow paths from this well were selected for sampling. The data obtained from these monitoring wells, coupled with the vertical profiling data obtained at 32VP-18-02 is expected to provide data sufficient to delineate the vertical and lateral extent of PFAS in the aquifer located downgradient of monitoring well 32Z-01-07XOB.
>
> **EPA Follow-On Comment:** Response unacceptable. Because the groundwater flow direction is not well defined there is a data gap to the east that needs to be addressed. EPA recommends that an additional VP be added east of -07XOB.
>
> **Follow-On Response:** As discussed during the 7 November 2018 comment resolution meeting drilling, a location east of 32Z-01-07XOB near N7-P1 and -P2 would mean drilling through the Shepley's Hill Landfill cap, which is undesirable and not warranted at this point in the investigation. A more extensive synoptic water level survey will be conducted at the onset of the Area 2 field work to provide more information on groundwater flow direction in this area. Also, as discussed during the meeting, it was agreed that there will be sufficient coverage east of 32Z-01-07X0B through the planned vertical profiling locations 32VP-18-04, -05, -06, and -07. Based on the results of this additional groundwater flow direction evaluation, monitoring well sampling results, and vertical profile sampling results, the need

for additional vertical profiles can be considered if a significant data gap remains for defining the nature and extent of PFAS in groundwater in this area.

Comment # 11: Figure 5, AOC32/43A - EPA notes that there are no wells proposed on the flow path from the DRMO East Yard southeast/south past the former building T-204. This appears to be a data gap that needs to be addressed to rule out the East Yard as a PFAS source. A vertical profile location should be added along this flow path.

Response: There is no saturated overburden east of former building T-204. At well 32M-01-18XBR, the depth to bedrock is 18 feet and the depth to water in 2017 was 16 feet. At well 32M-01-16XBR, the depth to bedrock is 17 feet and the depth to water in 2017 was 21 feet. Groundwater is present only in the highly fractured top of rock in this area. Therefore, a vertical profiling of the overburden is not expected to yield groundwater. The two existing bedrock wells, 32M-01-16XBR and 32Z-01-10XBR, which have been identified for PFAS sampling in the Area 2 FSP, are located downgradient of the DRMO East Yard east/southeast of former building T-204 and should assist in delineating the presence of PFAS downgradient of the East Yard.

EPA Follow-On Comment: Response unacceptable. There is a data gap in the area south of Building T-204 and north of Independence Drive. EPA recommends that an additional VP be added along the flow path between -10XBR and -5XOB.

Follow-On Response: A vertical profile location, 32VP-18-08, will be added between 32Z-01-10XBR and 32Z-01-05XOB. Figures 2 and 5 and Tables 5 and 6 will be revised accordingly.

Comment # 12: Figure 6, AOC 43G – Another vertical profiling point is needed north of AAFES-7, where PFAS exceeded the LHA, and along Patch Road south of GVP-18-8 in order to define the PFAS plume width at these downgradient locations. Please include an additional vertical profiling point at each of these locations. Also note in Figure 6, "GVP-18-8" should be "43GVP-18-8" for consistency.

Response: The northern edge of a potential PFAS groundwater contamination is anticipated to be delineated by the data obtained at vertical profile borings 43GVP-18-02 and 43GVP-18-06. An additional groundwater vertical profile north of AAFES-7 will provide PFAS data that is redundant to data collected at 43GVP-18-02 and 43GVP-18-06 and is not needed at this time to define the northern extent of contamination in this area. Similarly, PFAS contamination is anticipated to be bounded to the south by 43GVP-18-01 and GVP-18-08. If PFAS above the LHA is detected in 43GVP-18-02 or –06 (or -01/-08), then an additional location north (or south) of AAFES-7 may be considered. Presently, based on our understanding the proposed profiles are sufficient to delineate the vertical and lateral extent of contamination.

GVP-18-08 will be relabeled as 43GVP-18-08.

EPA Follow-On Comment: Response unacceptable. Based on available groundwater flow information and known areas of PFAS contamination, EPA remains concerned about the proposed VP sampling program's inability to adequately define the northern and southern boundaries of PFAS contamination. Although Army has indicated a willingness to expand the scope of the investigation to the south if field data reveals PFAS concentrations > the

LHA at 43GVP-18-08, EPA believes that data gaps will still exist along the southern portion of the site regardless of results at this location.

Follow-On Response: As discussed during the 7 November 2018 comment resolution meeting, if vertical profile samples or existing monitoring well sample results indicate additional data is necessary crossgradient of the existing monitoring wells and proposed vertical profiles, then additional vertical profiles will be considered at that time.

Comment # 17: Figure 9, AOC-76 – EPA requests an additional vertical profiling sample west of Willow Brook at the bend located southeast of FH-17-04.

Response: Groundwater vertical profiling will be completed at the new boring to be added to the east of the former training area (see response to EPA comment #16). This new vertical profile boring will be located approximately 50 feet west of Willow Brook and will provide PFAS data in soil and groundwater between the former edge of pavement and Willow Brook. An additional vertical profiling location to the west of the bend in Willow Brook will provide PFAS data that is redundant to data that will be collected at the new boring that was added to the east of the former training area (per EPA comment #15). Figure 9 will be revised to show the additional vertical profile location.

EPA Follow-On Comment: While EPA appreciates the addition of soil boring/vertical profile location 76SB-18-14/76VP-18-14 to the sampling program, there is still an existing data gap west of Willow Brook at the bend located southeast of FH-17-04. Please add a combined vertical profile location at the requested location to address/resolve this concern.

Follow-On Response: A combined soil boring and vertical profiling location (76SB-18-15/76VP-18-15) will be added southeast of FH-17-04. Figure 9 and Tables 5 and 6 will be revised accordingly.

Comment # 19: Table 5 – The rationale stated for vertical profiling locations 43AVP-18-01 through 43AVP-18-03 is to "Determine the extent of PFAS detections in groundwater downgradient of AOC 43A", yet Figure 3 shows AOC 43A overburden groundwater flowing away from these proposed locations. Please clarify the rationale of these three vertical profiling points.

Response: The 2017 water table elevations in overburden wells at AOC 43A are anomalous from previous depictions of water table elevations in overburden wells at AOC 43A. Historically, the shape of groundwater contours developed from overburden wells are similar to the groundwater contours developed from bedrock wells. Figures 3 and 4 will be revised to show the 2016 interpreted water table elevations as the 2016 elevations are more indicative of historic conditions. The locations of vertical profiles 43AVP-18-01 through 43AVP-18-03 are anticipated to characterize overburden groundwater downgradient of AOC 43A.

Follow-On Response: During the 7 November 2018 comment resolution meeting, EPA requested an additional vertical profiling location for AOC 43A, approximately 150 ft west of 32Z-01-09XOB. Subsequent review of aerial photography indicates that the location discussed during the meeting is in the middle of a large storm water basin and therefore may not be accessible for DPT. A vertical profiling location, 43AVP-18-04, instead will be added further west of 32Z-01-09XOB along Cook Street. Figures 2 and 5 and Tables 5 and 6 will be revised accordingly.