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Mr. Wayne Davis
Project Manager
U.S. Army Corps of Engineers, Baltimore District
ATTN: Environmental and Munitions Design Center
2 Hopkins Plaza
Baltimore, MD 21201

Work Order No.: 03886.553.003

Re: Contract No. W912DR-18-D-0006, Delivery Order W912DR18F0692
Draft Final Letter Work Plan for the Investigation of Pathways Relating to Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS) for Protection of Locally Utilized Water Supplies, Fort Drum, NY

Dear Mr. Davis:

This letter presents the Draft Final Letter Work Plan for the Investigation of Pathways Relating to Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS) for Protection of Locally Utilized Water Supplies, Fort Drum, NY.

Background and Scope of Investigation

This Letter Work Plan has been developed by Weston Solutions, Inc. (WESTON®) to address additional investigations requested by the United States Army (Army) for PFAS in soil, groundwater, seeps, surface water, and sediment at Fort Drum, Jefferson County, New York (**Figure 1**). The proposed investigations at five sites on base are to evaluate pathways pertaining to fate and transport of PFAS for protection of locally utilized water supplies at Fort Drum.

Additional terms used to describe these and related fluorinated organic compounds include perfluorinated alkyl acids (PFAAs) and PFAS. Hereinafter, the term "PFAS" will be used throughout this document. Twenty-four PFAS compounds will be analyzed for during this additional investigation:

Analyte Name	Acronym	CAS Number
Perfluorotetradecanoic acid	PFTreA	376-06-7
Perfluorotridecanoic acid	PFTriA	72629-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluoroheptanoic acid	PFHpA	375-85-9

Analyte Name	Acronym	CAS Number
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorobutanoic acid	PFBA	375-22-4
Perfluorodecanesulfonate	PFDS	335-77-3
Perfluorononanesulfonate	PFNS	474511-07-4
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorohexanesulfonate	PFHxS	355-46-4
Perfluoropentanesulfonate	PFPeS	2706-91-4
Perfluorobutanesulfonate	PFBS	375-73-5
Perfluorooctanesulfonamide	PFOSA	754-91-6
Fluorotelomer sulfonate 8:2	FtS 8:2	39108-34-4
Fluorotelomer sulfonate 6:2	FtS 6:2	27619-97-2
Fluorotelomer sulfonate 4:2	FtS 4:2	757124-72-4
2-(N-Ethylperfluorooctanesulfonamido)acetic acid	NEtFOSAA	2991-50-6
2-(N-Methylperfluorooctanesulfonamido)acetic acid	NMeFOSAA	2355-31-9

PFAS compounds have been detected in previous investigations at the base conducted by the Army in several base water supply wells, in the soil and groundwater at a fire training area, airfield sanitary landfill, and in groundwater seeps to the Black River (Fort Drum Public Works [FDPW], 2017; U.S. Army Corps of Engineers, Baltimore District [CENAB], 2017a, 2017b, and 2018). Additional investigations are being completed to evaluate the fate and transport of PFAS between the Fire Training Area and the base's active drinking water supply wells located near the northern boundary of Wheeler Sack Airfield, referred to hereafter as the New Well-Field Wells 14 through 18, and the Black River, which is also used locally for water supply.

The Army is the current owner of Fort Drum, where the additional site investigation is to be implemented, and is the lead agency for the PFAS investigations. The New York State Department of Environmental Conservation (NYSDEC) is the lead regulatory agency. The scope for the additional site investigation described in this Letter Work Plan was specified by the Army with field activities tentatively scheduled to begin in spring 2019. The full project schedule is presented as **Attachment 1**. The investigation described in this Letter Work Plan will include sampling and analysis at the following five areas at Fort Drum (**Figure 2**):

- Old Fire Training Pit (FTP) (referred to as the Fire Training Area, or FTA hereinafter)
- Airfield Sanitary Landfill (ASL)
- Former Fire House (FFH)
- Small Arms Range 7 (SAR-7)
- Black River locations above, adjacent to, and below the FTA and seeps downgradient of the FTA

Objectives

The objectives of the pathways investigation to support evaluation of fate and transport of PFAS-related constituents to drinking water resources are as follows:

- To further define the extent of PFAS concentrations in the vicinity of the FTA and ASL that exceed the U.S. Environmental Protection Agency (EPA) health advisory levels (HALs), and to refine the Conceptual Site Model (CSM).
- To determine the fate and transport of PFAS and to ascertain the magnitude, transport mechanisms, and timeframe for potential impacts of PFAS on drinking water supplies, which includes the Black River (determine vulnerability of the existing water supplies and what is the timeframe for potential future exposure/exceedances of HALs or maximum contaminant levels).
- To determine the presence or absence of PFAS constituents in groundwater and soil at the FFH and SAR-7, and provide additional data to the fate and transport study.
- To determine the nature and extent of PFAS in seeps at the bank of the Black River downgradient of the FTA, as well as in sediment and surface water of the Black River, and provide additional data to the fate and transport study.

Sites of Interest

The PFAS areas of interest included in this investigation are shown on **Figure 2**.

Fire Training Area (FTA)

The FTA (**Figure 3**) consisted of an 80-foot-diameter concrete basin with a drainage system that led to an underground storage tank and oil water separator. Fuel was poured into the pit and ignited, and firefighters would practice extinguishing the fires. One such practice for extinguishing the fires was to employ the use of aqueous film forming foam (AFFF), which contained PFAS constituents as a principal ingredient. PFAS that may have been present in the AFFF were not identified (and not known) as potential constituents of concern during previous investigations. Investigations were conducted by the Army in June and August 2016 and January 2018 at the FTA to determine the nature and extent of PFAS impacts at the site and to develop a preliminary understanding of the extent of PFAS contamination in soil and groundwater. A generalized hydrogeologic cross section of the FTA is provided as **Figure 4**.

Former Fire House (FFH)

Another area identified during the interview process of the baseline screening level investigation was the FFH (**Figure 5**). Formerly Building 2061, once located on the grounds at Wheeler-Sack Army Airfield (WSAAF) just inside the main airfield gate off of now Munns Corner Road, the FFH was where the Fort Drum Fire Department was stationed by WSAAF prior to moving to its current location at FOB Road by the Airfield Base Operations building. The FFH was part of the emergency response system at the airfield. The fire department may have used and stored AFFF for firefighting purposes at this location. It is possible that AFFF may have also been discharged around the area due to historical cleaning and disposal practices. No PFAS sampling has been conducted at the FFH to date.

Small Arms Range 7 (SAR-7)

There was a one-time use of AFFF at the SAR-7 north of the FTA (**Figure 6**) to extinguish a fire in 2001. It was reported that the rubber backing where the ammunition was fired into was what initially caught on fire. It is not known how much AFFF was used; however, the crash vehicle used to fight the fire has an onboard, 390-gallon booster tank, and the foam system is set for 3 percent (%) foam. The fire-damaged structure was subsequently razed, and a new structure was constructed. There currently is a newer, shed-like, earthen bottom structure on the site, but it is not located in the same footprint as the original structure. No PFAS sampling has been conducted at the SAR-7 to date.

Airfield Sanitary Landfill (ASL)

The ASL (**Figure 7**) is located adjacent to the WSAAF northeast boundary and approximately 1,000 feet northwest of the Black River. The 37-acre landfill is closed and capped with a surficial impermeable liner, surface cover, and vegetation. The ASL began operating in 1973 after closure of the Old Sanitary Landfill. Solid wastes generated from various locations on base were placed into trenches in the sandy soil until the landfill was closed in 1987. The types of wastes placed in the ASL included municipal solid waste, paint wastes, solvent containers, triple-rinsed pesticide containers, and petroleum, oil, and lubricants (POL)-saturated wastes. The trenches were approximately 20 feet deep and were unlined. They were covered with native sandy soil, and some areas were grassed. The northeast 14 acres of the site (referred to as “Phase I”) were covered with an impermeable 20-millimeter polyvinyl chloride (PVC) liner and 6 inches of soil cover, and were re-vegetated. Solid waste was also disposed of on the 23 acres southwest of, and adjacent to, the Phase I area until October 1987 (referred to as “Phase II”). In 1990, Phase II was closed by installing a 40-millimeter PVC cover, 18 PVC gas vents, 12 inches of soil cover, and vegetation (PIKA-MP JV LLC [PIKA-MP], 2017).

Sampling Design, Rationale, and Procedures

Soil Sampling – Former Fire House, Fire Training Area, and Small Arms Range 7

The following information describes the logic for the locations, numbers, and depths of soil samples to be collected for laboratory analysis of PFAS constituents (see Laboratory Methods and Quality Control section). Subsurface soil samples will be collected from the three surficial aquifer well locations proposed for each of the FTA, FFH, and SAR-7 areas shown on **Figures 8, 9,** and **10**, respectively. Soil samples will be collected to characterize the concentrations of PFAS in soils in each of the proposed well locations. In general, the soil samples will be collected from the vadose zone soils with the initial samples collected within the 0- to 5-foot interval; the second set of samples will be collected from a mid-boring location and/or based upon instrument screening and visual or olfactory evidence of staining or impacts; the third set of samples will be collected from an interval just above the zone of saturation/water table. All samples will be collected from the soil cores retrieved during the Rota-Sonic drilling operations. Soil sampling locations will be documented in the field with a handheld Global Positioning System (GPS) unit.

Continuous soil sampling will be conducted at each boring location for field screening and lithologic description purposes. Soil samples within the three depth intervals will be selected for analysis based on field screening as cited above. PFAS samples from each sample interval will be homogenized and placed in appropriate sample containers. The sample containers will be labeled, placed in an ice-filled cooler, and shipped to Eurofins Lancaster Laboratories Environmental, LLC (ELLE) for analyses under chain-of-custody (COC) protocol. Lithology, field observations, instrument readings, and sample collection depths will be recorded in the field notebook and on the lithologic boring logs associated with each well. Following sampling at each site, the Rota-Sonic borings will be converted to overburden monitoring wells.

Soil samples will be collected from three areas of Fort Drum during the investigation activities, which include the following:

- **FFH:** During the installation of the three proposed shallow aquifer wells at the FFH, soil samples will be collected to determine the presence/absence of PFAS compounds that may have been released or stored at the FFH when it was operational. Soil samples will be collected from the Rota-Sonic soil cores, which will be retrieved during the drilling of the three surficial aquifer wells at the site.

- **FTA:** During the installation of the three proposed shallow aquifer wells at the FTA, soil samples will be collected to determine the presence/absence of PFAS compounds that may have been released during the fire training exercises that were conducted historically at the FTA. Soil samples will be collected from the Rota-Sonic soil cores, which will be retrieved during the drilling of the three surficial aquifer wells proposed for the FTA.

- **SAR-7:** During the installation of the three proposed shallow aquifer wells at the SAR-7, soil samples will be collected to determine the presence/absence of PFAS compounds that may have been released during the one-time firefighting response (cited above) that reportedly included the use of AFFF (CENAB, 2018). Soil samples will be collected from the Rota-Sonic soil cores, which will be retrieved during the drilling of the three surficial aquifer wells proposed for the SAR-7.

Proposed soil boring locations in the three areas are illustrated on **Figures 8, 9,** and **10**. These soil borings/shallow well locations are approximated and will be field-verified with Fort Drum environmental personnel and utility clearance personnel prior to conducting the drilling activities.

All soil samples will be analyzed for PFAS by ELLE (see Laboratory Methods and Quality Control section). PFAS is an emerging constituent of interest; as such, it is understood that the Army's goal is to establish the presence or absence of these constituents in the soil samples collected from the site.

In each of the soil borings, three soil samples will be collected from the vadose zone above shallow groundwater for PFAS constituents, each from a distinctly different vertical depth, as determined in the field. In general, the first sample will be collected from the surface soil (0 to 5 feet); the second sample will be collected from the approximate mid-boring depth; and the third sample will be collected from the capillary zone just above the water table. The depth intervals for analysis were selected to vertically assess PFAS concentrations in soils, which may be contributing PFAS to groundwater. Nine subsurface soil samples (excluding quality control [QC] samples) will be analyzed from each of the three sites proposed for soil sampling/shallow well installations. At each sample point, field parameters, such as photoionization detector (PID) readings, sample collection intervals, depth to water, and GPS coordinates, will be recorded, along with the normal lithologic descriptions of the cores in accordance with the Unified Soil Classification System (USCS).

Soil samples will be analyzed by ELLE for the 24 PFAS compounds listed above under Method 537 Revision 1.1 Modified within the 28-day preparation holding time and 28-day analytical holding time. ELLE will provide data packages within a standard turnaround time (TAT) of 21 days. Data will be provided to project stakeholders after validation is completed.

Monitoring Well Installations

Twenty-three new permanent groundwater monitoring wells will be installed at the site as summarized on the schedule (**Attachment 1**) and shown on **Figure 11**. Groundwater monitoring wells will be drilled and constructed with precautions required when investigating for PFAS constituents. An on-site field manager will supervise the drilling and monitoring well construction and will be a licensed professional geologist, hydrogeologist, or geotechnical engineer.

The lithology in all boreholes will be logged in accordance with the USCS, or equivalent. A boring log form will be used for recording the lithologic logging information. Information on the boring log sheet will include the borehole location; drilling information; and sampling information such as sample intervals, recovery, and detailed sample description information. The rationale for the number and locations of the newly proposed surficial aquifer and bedrock aquifer monitoring wells is detailed below:

- **FTA:** As shown on **Figure 11**, 13 wells are proposed for installation in the areas both north of the FTA and south of the New Wellfield Wells 14 through 18, and in the immediate area of the FTA and the Black River. Of the 13 wells proposed for installation in the FTA project area, 3 will be surficial aquifer wells and 10 will be deep bedrock aquifer wells. As shown on **Figure 8**, bedrock wells FTA-1D through FTA-3D are proposed for installation in the immediate area of the former FTA, with the objective of further assessing deep bedrock aquifer PFAS concentrations in this area below the elevation of 580 feet above mean sea level (ft msl). As requested by the U.S. Army Corps of Engineers (USACE), these wells will be double-cased bedrock wells to ensure that the elevated surficial aquifer PFAS levels detected in the immediate vicinity of the FTA pit are prevented from being introduced into the deep bedrock groundwater. In addition, a provision for double-casing up to six of the additionally proposed wells (FTA-5D through FTA-10D) north of the FTA will be included, based upon the sampling results in wells FTA-2S and FTA-2I. Well FTA-4D is proposed with the objective of characterizing bedrock aquifer PFAS concentrations west of the FTA and east of the former base supply well 1. Well FTA-1S is proposed for installation in the surficial aquifer upgradient of existing shallow monitoring well (MW-9), which has been reported as dry during periods of seasonally low groundwater conditions.

  Wells FTA-5D through FTA-10D are proposed for installation in the open area north of the FTA and the former base supply wells 7, 11, and 12. These bedrock aquifer wells are proposed with the objective of characterizing bedrock aquifer PFAS concentrations between the FTA and the northern base supply wells 14 through 18. Preliminary groundwater modeling conducted by USACE suggests that operation of the northern base supply wells could artificially draw PFAS constituents from the FTA area if elevated PFAS levels are present in the open area adjacent to WSAAF north of the FTA. Wells FTA-2S and FTA-2I are proposed for installation in the open area north of the FTA to assess whether PFAS constituents are present in the surficial aquifer in this area. These wells will be completed as a shallow and intermediate well pair to evaluate the magnitude of the vertical hydraulic gradient in this area.

- **ASL:** There are four new bedrock monitoring wells (ASL-1D through ASL-4D) proposed for installation in the vicinity of the ASL. As shown on **Figure 12**, wells ASL-1D and ASL-2D are proposed for installation north of the ASL and south of the northern base supply wells. These bedrock wells are proposed with the objective of assessing whether PFAS constituents are present in the bedrock aquifer between the base well field and the ASL and FTA. Although these wells will serve in the capacity mentioned to determine any potential contribution from the ASL, the main purpose is relating to potential migration between the FTA and New Wellfield Wells 14 through 18. Wells ASL-3D and ASL-4D are proposed for installation south of the ASL and north of the Black River to assess whether PFAS constituents from the ASL have impacted the bedrock aquifer in this area and whether potential impacts to the Black River exist.

- **FFH:** There are three surficial aquifer monitoring wells (FFH-1S through FFH-3S) proposed for installation at the FFH. As shown on **Figure 9**, these wells are proposed with the objective of determining whether PFAS constituents are present in the shallow groundwater at the site. The wells are generally positioned with two wells (FFH-2S and FFH-3S) in a downgradient direction, with one well (FFH-1S) positioned in an upgradient direction.

- **SAR-7:** There are three surficial aquifer monitoring wells (SAR-1S, SAR-2S, and SAR-2I) proposed for installation at the SAR-7. As shown on **Figure 10**, these wells are proposed with the objective of determining whether PFAS constituents are present in the shallow groundwater at the site. The wells are generally positioned with two wells (SAR-2S and SAR-2I) in a downgradient direction, with one well (SAR-1S) positioned in an upgradient direction. Wells SAR-2S and SAR-2I will be completed as a shallow and intermediate well pair to evaluate the magnitude of the vertical hydraulic gradient in this area.

Monitoring Well Construction Methods

The nine proposed shallow and intermediate monitoring wells will be drilled using Rota-Sonic drilling methods. Rota-Sonic drilling methods were selected due to the highly variable nature of the shallow aquifer soils that can range from silty, sandy gravels to dense, low permeability silty tills and/or lacustrine clays. Direct-push technology (DPT) Geoprobe® rigs have reportedly experienced difficulty penetrating sufficient depths at the site to achieve proper well construction requirements. In addition, Rota-Sonic drilling typically achieves excellent soil core recoveries because of the advancement of an outer casing prior to the retrieval of each 10-foot soil core. In this manner, 4- to 6-inch diameter soil cores will be retrieved throughout the drilling process until the desired well completion depth is reached. At that time, a 2-inch-diameter PVC well will be installed using a 10-foot length of 10- or 20-slot screen, depending on the lithologic characteristics encountered at the target well completion depth. In order to address the fine-grained nature of the overburden sands, well construction will include a 0.0090-inch PVC screen. A 12- to 14-foot, fine to medium-grained sandpack will be emplaced across the well screen, and a 2-foot bentonite pellet seal will be emplaced above the sandpack. The remaining annular space will be tremie-grouted to surface using a 4% bentonite/cement slurry. Depending on each well location, the surface completion at each well will consist of either a flush-mounted, traffic-rated well cover and pad or a stick-up well completion with a 6-inch diameter steel protective casing. The type of surface completion for each well will be determined and approved by the Fort Drum environmental staff.

The 14 proposed bedrock monitoring wells will be advanced into bedrock using mud rotary drilling methods with a nominal 10-inch-diameter bit. The 10-inch borehole will be advanced approximately 5 to 10 feet into competent bedrock, which is estimated to occur between 70 to 80 feet below ground surface (ft bgs).

At that time, a 6-inch-diameter, low carbon steel casing will be installed. The casing will then be tremie- or pressure-grouted to the surface using a 4% bentonite/cement slurry. Following a minimum of 12 hours for allowing the cement to set, the bottom hole portion of each well will be advanced using a nominal 6-inch-diameter air rotary bit to the desired total depth, which is estimated to be between 140 and 150 ft bgs. Throughout the drilling process, continuous collection of bedrock cuttings will be performed and logged for evidence of water-bearing fracture zones. Once the targeted depth at each well is achieved (estimated to be 50 to 60 feet beyond the initial bedrock casing), the well will be initially completed as an open-hole, bedrock well. The wells will initially be developed using the rig air for a minimum of 1 hour once reaching the well total depth (TD). Drill cuttings and fluids will be transported by the drilling contractor to a central area for holding/disposal.

If multiple, discrete water-bearing zones (WBZs) are encountered and verified by the results of the borehole geophysical logging, an option for installation of a bridge-plug packer system may be exercised. Bridge-plug packer systems use shale traps to emplace a bentonite/cement seal across a smooth, un-fractured interval within the borehole, as confirmed by the caliper logs. The shale traps are initially affixed to lengths of 2-inch diameter PVC screen and risers that permit accessing the borehole interval below the bridge-plug packer with groundwater sampling devices or pumps. In addition, the zone above the bridge-plug packer seal can be accessed with sampling tools by lowering the devices down the annular space above the bridge-plug packer seal. In this manner, the open borehole segment in each well can be hydraulically segregated to allow for an assessment of the vertical extent of contaminants of concern (in this case, PFAS constituents).

As requested by USACE, the three proposed bedrock monitoring wells located in the immediate vicinity of the FTA will be double-cased bedrock wells as an additional precaution for sealing the boreholes from the impacted shallow aquifer groundwater documented in this area. This will include the drilling of a 12- to 14-inch-diameter tophole into the low-permeability clays and/or silty till units that overlie bedrock in this area. An 8- to 10-inch-diameter, low carbon steel casing will be tremie- or pressure-grouted into the low-permeability units with a 4 to 6% bentonite/cement slurry. A second steel casing (nominal 4- to 6-inch diameter) will then be installed 10 to 15 feet into competent bedrock, and again grouted to surface with a bentonite/cement slurry. These double-cased wells will be completed as either 4- to 6-inch-diameter open hole wells, again with the option of installing bridge-plug packers following borehole geophysical logging.

Well Development

The newly completed monitoring wells will not be developed for at least 24 hours after well casings have been grouted to allow the cement to properly cure. The new monitoring wells will be developed using decontaminated submersible pumps and surge blocks. The screened wells will be developed using a combination of over-pumping and surging to mobilize fines and to grade formational soils into the gravel pack. Gravimetric analyses of development water (sediment/sand accumulation per gallon via Imhoff cone method) and periodic well efficiency checks (gallons per minute [gpm] per feet of drawdown) will be performed. Well development will be performed until diminishing returns on sediment/sand accumulation and improved well efficiency are observed. In addition, well development will be conducted until indicator parameters (pH, specific conductance, oxidation/reduction potential [ORP], dissolved oxygen [DO], and turbidity) stabilize as follows:

▪ pH:	±0.1 unit
▪ Specific Conductance:	±5%
▪ ORP:	±10 millivolts (mV)
▪ DO:	±10% milligrams per liter (mg/L)

▪ Temperature	±1 degrees Celsius (°C)
▪ Turbidity:	±10 Nephelometric turbidity unit (NTU)

Although turbidity will be measured during well development, the 10 NTU goal will not be used as an absolute criteria to determine if a well is developed. If stabilization is achieved for the other indicator parameters listed above and the gravimetric analyses and well efficiency data have reached diminishing returns, well development will be considered complete. All gravimetric analyses, well efficiency data, and final NTU values obtained during development will be documented in the field logbook.

Borehole Geophysical Logging

Following well development activities, a complete suite of borehole geophysical logs will be run on 10 of the 14 newly installed bedrock wells. The 10 wells selected for geophysical logging will be determined in the field based upon the fracture frequencies and yield encountered in the open hole portions of the wells. Low yielding wells (<0.5 gpm) with limited WBZs or diffuse flow would not require segregation or logging. The logging suite will include the following tools:

- Caliper
- Natural Gamma
- Single Point Resistance
- Spontaneous Potential (SP)
- Fluid Temperature
- Fluid Conductivity/Resistivity
- Oriented Acoustic Televiewer (ATV)
- Heat Pulse Flowmeter (HPFM) under ambient and stressed conditions (optional)

In addition to the full logging suite planned for 10 of the newly installed wells, an additional 5 wells will be logged with the natural gamma tool. The additional gamma logs may be run on either newly installed or existing wells with the objective of identifying the presence or absence of the primary lacustrine clays and/or silty till confining units. The five wells selected will be based upon a review of the existing monitoring well network at the base and during the planning discussions between WESTON and the USACE/Fort Drum personnel. Identification of areas where the confining unit above bedrock is discontinuous or absent will be useful in further refining the CSM.

The following section provides a narrative description of the borehole geophysical logs proposed for the newly installed wells at Fort Drum. Borehole geophysical logs will be run once all well development activities have been completed. In general, wells must have a minimum of 24 hours to stabilize following development prior to running borehole geophysical logs. This is to allow the normal flow patterns to equilibrate within the well/aquifer.

- **Caliper** – The caliper log measures changes in borehole size normally through the use of a three-arm, spring-activated tool, which runs from the base of the borehole ascending to surface. This is normally the first tool run in a logging suite. The caliper log is effective at measuring variations within the borehole, such as washouts, voids, or fractured zones. Important to be run with other logs (single-point resistance, ATV) that are affected by changes in borehole sizes in order to apply appropriate correction factors.

- **Natural Gamma** – The gamma log is a passive scintillation counter that measures the amount of naturally-occurring radioactivity emitted from various geologic units within a borehole. Naturally-occurring radioactive elements, such as potassium, thorium, and uranium, that are commonly present in fine-grained shales and clays, typically exhibit high natural gamma log response. Conversely, rocks such as sandstone and limestone that typically contain little or no radioactive elements exhibit low gamma log response. Gamma logs are, therefore, very useful lithologic indicators in most geologic settings, especially when run in combination with other geophysical logs, such as fluid and formation resistance logs.
- **Single Point Resistance** – Single point resistance measurements are made of the borehole wall and are reflective of the electrical resistance of the aquifer matrix. Shales generally exhibit low electrical resistance, whereas sandstones and limestones exhibit intermediate to high resistance values. Useful when combined with natural gamma logs for correlating changes in sedimentary rock stratigraphy.
- **SP** – The SP log measures natural voltages that are created within a borehole due to the presence of differing borehole fluids, formation fluids, and formation matrix. Normally requires a contrast in salinity between borehole and formation fluids; limited effectiveness in fresh water environments (normally a feature of a gamma/single point resistance/SP logging tool).
- **Fluid Temperature** – Fluid temperature logs are run from the top of the water column measuring the changes in fluid temperature as a function of depth. Water producing strata or fractures are indicated by sharp reflections or changes in the geothermal gradient within a borehole. Fluids entering a stable borehole from water producing zones are often cooler or warmer than the fluid within the borehole, often indicated by temperature anomalies on the log.
- **Fluid Resistivity/Conductivity** – Fluid resistivity/conductivity logs measure the electrical resistance or conductance of the borehole fluid and are often related to dissolved solids content in the water column. Contrast or spikes on resistivity logs are often indicative of water-producing zones or fractures, and are useful when combined with other logs. Low resistivity spikes across highly resistivity rocks or strata can indicate the influx of conductive fluids.
- **ATV** – The oriented ATV provides a 360° acoustic image of the borehole wall that is used to identify and determine the orientation of planar features, such as bedding plane partings and fractures/joints. The ATV tool emits ultra-sonic pulses from a rotating transducer that are transmitted and reflected off the borehole wall. The transmitted pulses return to a receiver on the sonic tool, which measures the speed and amplitude of the sonic signal. Greater travel times and lower amplitude signals indicate openings in the borehole wall or less competent rock. Short travel times and higher amplitude signals indicated smooth, competent borehole walls. The strike and dip orientation of bedding planes and other fracture features within a well can be determined from ATV logs. ATV logs require a fluid-filled borehole to transmit the sonic signals.
- **HPFM** – Measures the vertical flow rates within a borehole. The log operates by generating heat pulses from a wire grid that is positioned between two temperature thermistors at the top and bottom of the logging tool. As pulses of heat are transmitted by the tool when stationary within the borehole, the heated body of water will move towards either the upper or lower temperature thermistor, depending on the direction of vertical borehole flow within the borehole. Positive and negative values on the log represent upward or downward flow, respectively. The magnitude and direction of borehole flow can be measured within a well under either ambient or stressed pumping conditions.

The HPFM will be run following the completion of the other logging runs to allow for a review of the logs to determine the likely fracture zones that are the targets for the HPFM measurements. Running the HPFM under ambient and pumping conditions will allow for the estimation of transmissivity values for each WBZ. The borehole logging subcontractor will provide field copies of the logs on a daily basis, and real-time logging data will be available for viewing from the logging vehicles on-board computer. Structural interpretation of the ATV logs (including the mean orientation of each bedding plane or fracture set and aperture of fracture features), aquifer characteristics (such as depth to water, water temperature, water conductivity/resistivity, in-well groundwater flow direction, and interpreted depths of water producing or receiving zones), data on existing well construction details, and borehole diameters will be provided in the final report (see Reporting section).

Groundwater Sampling

The following information describes the logic for the locations and numbers of groundwater samples to be collected and chemical analyses to be performed.

As shown in **Figure 11**, 16 existing monitoring wells and 23 newly installed monitoring wells at the site will be sampled to provide data on the presence of PFAS concentrations in both the shallow surficial aquifer and the underlying bedrock aquifer. Sampling will be performed to evaluate whether PFAS are present above the EPA lifetime drinking water HAL of 70 nanograms per liter (ng/L) for both PFOA and PFOS.

Groundwater samples will be collected using Hydra-Sleeve™ grab sampling devices. Hydra-Sleeve™ samplers are zero purge sampling devices that are lowered to the primary water-bearing fracture or mid-screen interval in each well and are opened to obtain a discrete grab sample from the well. They will be deployed in each of the wells a minimum of 2 weeks prior to sampling to reduce any chance of disturbance within the well. Hydra-Sleeve™ sampling devices have proven comparable to low-flow sampling methods for obtaining representative concentrations for a variety of analytical constituents. Instrument readings and sample collection depths will be recorded in the field notebook and on a sampling form associated with each well.

The rationale for each of the 16 existing sampling locations is discussed in **Table 1**. These existing wells, along with the 23 newly installed monitoring wells, will be used for the groundwater monitoring program and will be sampled once during high groundwater conditions (likely spring) and again during low groundwater conditions (likely autumn), to account for the seasonal variability in groundwater quality that can occur in the limestone aquifers.

Table 1
Existing Well Construction and Sampling Summary, FTA and ASL – Ft. Drum, NY

Well No.	Sample Method	Well Construction Summary and Water-Bearing Unit	Sampler Depth	*Rationale for Sampling Well (PFOA/PFOS)	Sample Parameters
FTA Wells Proposed for Sampling					
MW-5	Hydra-Sleeve™ Grab Samplers	**TD – 25 feet;** 2-inch diameter PVC with screen from 15-25 ft bgs; surficial aquifer.	Mid Screen 20 ft bgs	Shallow well upgradient from former FTA **(51.9 ppt)**	PFAS
MW-6	Hydra-Sleeve™ Grab Samplers	**TD – 54 feet;** 2-inch diameter PVC with screen from 44-54 ft bgs; surficial aquifer.	Mid Screen 49 ft bgs	Shallow well upgradient from former FTA paired with well MW-6D **(264 ppt)**	PFAS
MW-8	Hydra-Sleeve™ Grab Samplers	**TD – 56 ft;** 2-inch diameter PVC well with screen from 46-56 ft bgs; surficial aquifer.	Mid Screen 51 ft bgs	Shallow well cross gradient from former FTA **(128 ppt)**	PFAS
MW-11	Hydra-Sleeve™ Grab Samplers	**TD – 36 ft**; 2-inch PVC well with screen from 26-36 ft bgs; surficial aquifer.	Mid Screen 31 ft bgs	Shallow well downgradient from former FTA paired with well MW-11D **(14,940 ppt)**	PFAS
MW-12	Hydra-Sleeve™ Grab Samplers	**TD – 28 feet;** 2-inch PVC well with screen from 18-28 ft bgs; surficial aquifer.	Mid Screen 23 ft bgs	Shallow well downgradient from former FTA **(9,928 ppt)**	PFAS
MW-6D	Hydra-Sleeve™ Grab Samplers	**TD – 100 feet**; 2-inch PVC well with screen from 90-100 ft bgs; limestone bedrock aquifer.	Mid Screen 95 ft bgs	Deep bedrock well upgradient from former FTA paired with well MW-6 **(215 ppt)**	PFAS
MW-11D	Hydra-Sleeve™ Grab Samplers	**TD – 86 feet**; 2-inch PVC well screened from 76-86 ft bgs; limestone bedrock aquifer.	Mid Screen 81 ft bgs	Deep well downgradient of former FTA paired with well MW-11 **(280 ppt)**	PFAS
MW-13D	Hydra-Sleeve™ Grab Samplers	**TD – 110 feet**; 2-inch PVC well screened from 100-110 ft bgs; limestone bedrock aquifer.	Mid Screen 105 ft bgs	Deep well upgradient of former FTA paired with well MW-13 **(64 ppt)**	PFAS

Table 1
Existing Well Construction and Sampling Summary, FTA and ASL – Ft. Drum, NY (Continued)

Well No.	Sample Method	Well Construction Summary and Water-Bearing Unit	Sampler Depth	*Rationale for Sampling Well (PFOA/PFOS)	Sample Parameters
MW-10	Hydra-Sleeve™ Grab Samplers	**TD – 42 feet;** 2-inch PVC well screened from 37-42 ft bgs; limestone bedrock aquifer.	Mid Screen 39-40 ft bgs	Bedrock well downgradient from former FTA **(21 ppt)**	PFAS
ASL Wells Proposed for Sampling					
ASL-MW-12A	Hydra-Sleeve™ Grab Samplers	**TD – 76 feet;** 2-inch PVC well screened from 66-76 ft bgs; surficial aquifer sands.	Mid Screen 71 ft bgs	Shallow aquifer well at the ASL	PFAS
ASL-MW-13	Hydra-Sleeve™ Grab Samplers	**TD – 66 feet**; 2-inch PVC well screened from 56-66 ft bgs; surficial aquifer sands.	Mid Screen 61 ft bgs	Shallow aquifer well at the ASL	PFAS
ASL-MW-14A	Hydra-Sleeve™ Grab Samplers	**TD – 74 feet**; 2-inch PVC well screened from 64-74 ft bgs; surficial aquifer sands.	Mid Screen 69 ft bgs	Shallow aquifer well at the ASL	PFAS
ASL-MW-94-1	Hydra-Sleeve™ Grab Samplers	**TD – 80 feet;** 2-inch PVC well screened from 65-80 ft bgs; surficial aquifer sands.	Mid Screen 72-73 ft bgs	Shallow aquifer well at the ASL	PFAS
ASL-MW-94-2	Hydra-Sleeve™ Grab Samplers	**TD – 60 feet;** 2-inch PVC well screened from 45-60 ft bgs; surficial aquifer sands.	Mid Screen 52-53 ft bgs	Shallow aquifer well at the ASL	PFAS
ASL-MW-94-3	Hydra-Sleeve™ Grab Samplers	**TD – 70 feet;** 2-inch PVC well screened from 64-74 ft bgs; surficial aquifer sands.	Mid Screen 69 ft bgs	Shallow aquifer well at the ASL	PFAS
ASL-MW-18 Bedrock	Hydra-Sleeve™ Grab Samplers	Well construction details not available – assumed limestone bedrock aquifer well.	NA	Bedrock aquifer well at the ASL	PFAS

Notes:

*Results are total PFOA/PFOS concentrations from May 2017 sampling event at the FTA. PFAS sampling has not yet been performed at the ASL.

FTA – Fire Training Area
NA – not applicable
ppt – parts per trillion
TD – Total Depth

Groundwater samples will be analyzed by ELLE for the 24 PFAS compounds listed above under Method 537 Revision 1.1 Modified within the 14-day preparation holding time and 28-day analytical holding time. ELLE will provide data packages within a standard TAT of 21 days. Data will be provided to project stakeholders after validation is completed.

FTA Seep Sampling

To support the fate and transport model and assess PFAS contamination migrating to the Black River, six select seep locations will be sampled and selected based upon lateral distribution, in the area adjacent to the FTA. The locations of the six seeps proposed for sampling at the FTA are shown on **Figure 13**. The seeps will be sampled over two rounds in conjunction with the monitoring well sampling. The seeps will be sampled using a peristaltic pump with silicone (Masterflex®) tubing and polyethylene tubing in accordance with applicable standard operating procedures (SOPs) over two rounds in conjunction with the monitoring well sampling. The second round of seep sampling will take place approximately 6 months after the initial sampling round. Because the second round of sampling will likely be during winter weather, it is possible that the surface water seeps could be frozen and not flowing, thus making sample collection of all six seep locations not feasible until the following spring.

Seep samples will be analyzed by ELLE for the 24 PFAS compounds listed above under Method 537 Revision 1.1 Modified within the 14-day preparation holding time and 28-day analytical holding time. ELLE will provide data packages within a standard TAT of 21 days. Data will be provided to project stakeholders after validation is completed.

Black River Surface Water and Sediment Sampling

Surface water sampling in Black River will be performed during low to normal flow conditions. Black River flows will be monitored by accessing data from the U.S. Geological Survey (USGS) gaging station in Watertown, approximately 14 miles downstream of the FTA site.

The following is the planned surface water and sediment sampling approach to assess PFAS concentrations in the Black River. Both surface water and sediment samples will be collected along transects at an upstream background location (upriver of ASL), upstream of the FTA, adjacent to the FTA, and downstream of the FTA, for four unique locations, as shown as approximate locations on **Figure 14**. Selection of the upstream background location will be based on examination of other potential Department of Defense (DoD) and non-DoD PFAS source(s) to the Black River. This location will be positioned upstream of any potential DoD source areas, but downstream of any tributary confluences that might drain from industrial facilities, wastewater treatment plant discharges, etc. The transect upstream of the FTA will be used as a comparison to the adjacent to the FTA transect to identify any possible PFAS loads associated with groundwater flow or seeps from the SAR-7 and ASL areas.

At each surface water location, samples will be collected in accordance with applicable SOPs from three water column depths representing surface flow, mid-column flow, and bottom flow. At each sediment location, samples will be collected at the near, middle, and far shore of each transect location in accordance with applicable SOPs.

Surface water samples will be analyzed by ELLE for the 24 PFAS compounds listed above under Method 537 Revision 1.1 Modified within the 14-day preparation holding time and 28-day analytical holding time. Sediment samples will be analyzed by ELLE for the 24 PFAS compounds listed above under Method 537 Revision 1.1 Modified within the 28-day preparation holding time and 28-day analytical holding time.

ELLE will provide data packages within a standard TAT of 21 days. Data will be provided to project stakeholders after validation is completed.

Sample Handling

Samples will be collected and placed in appropriate sample containers. The sample containers will be labeled, placed in an ice-filled cooler, and shipped overnight via FedEx to ELLE for analysis under COC protocol. A COC record will be completed for each sample shipment by the field team to maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory. Samples will be shipped in compliance with all applicable regulations. The U.S. Department of Transportation and the International Air Transport Association have established specific regulations governing the packaging of hazardous and environmental samples for shipment. These regulations include specifications for packing materials, shipping containers, and shipping labels. The samples will be shipped in accordance with these regulations based on the best available knowledge of the samples being collected.

Laboratory Methods and Quality Control

Analytical methods and associated QC for the sampling program will be in accordance with the *U.S. Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality System Manual (QSM)* Version 5.1.1 (DoD and DOE, 2018), and the sample will be analyzed by Eurofins Lancaster Laboratory Environmental, which is an accredited laboratory with the DoD Environmental Laboratory Accreditation Program (ELAP) and New York State Department of Health (NYSDOH) National Environmental Laboratory Accreditation Program (NELAP). PFAS data will be validated by Laboratory Data Consultants, Inc. QC samples will include field duplicates, field regent blanks, equipment rinse blanks (only when dedicated/disposable equipment is not used), and matrix spike/matrix spike duplicates.

Reporting

The Army will prepare a report for the PFAS fate and transport study following receipt and validation of site sampling data and evaluation of fate and transport. The report will include a summary of previous studies, summary of field activities and results, and tables and figures presenting new site data. Results of the third-party data validation will be included, which will be comprised of major findings related to calibration procedures and minor findings related to quality assurance/QC samples, method blanks, matrix duplicates, and matrix spike recovery.

Copies of this Letter Work Plan will be forwarded to Heather Bishop at NYSDEC, Wendy Kuehner at NYSDOH, James Miller at the Fort Drum Department of Public Works, and Eric Faust at the U.S. Army Environmental Command (USAEC). If you have any questions, please give me a call at (610) 701-3793.

Very truly yours,

Weston Solutions, Inc.

John P. Gerhard, PMP®
Senior Project Manager

Enclosures
Figures
cc: File
H. Bishop (NYSDEC)
W. Kuehner (NYSDOH)
J. Miller (Fort Drum)
E. Faust (USAEC)
B. Wagner (WESTON)

References

CENAB (U.S. Army Corps of Engineers, Baltimore District). 2018. *PFC Site Characterization Investigation Summary Report. – Old FTA, Fort Drum, New York.* January 2018.

CENAB. 2017a. *Basewide PFC Screening Level Investigation, Fort Drum, New York.* Draft Final Project Report. May 2017.

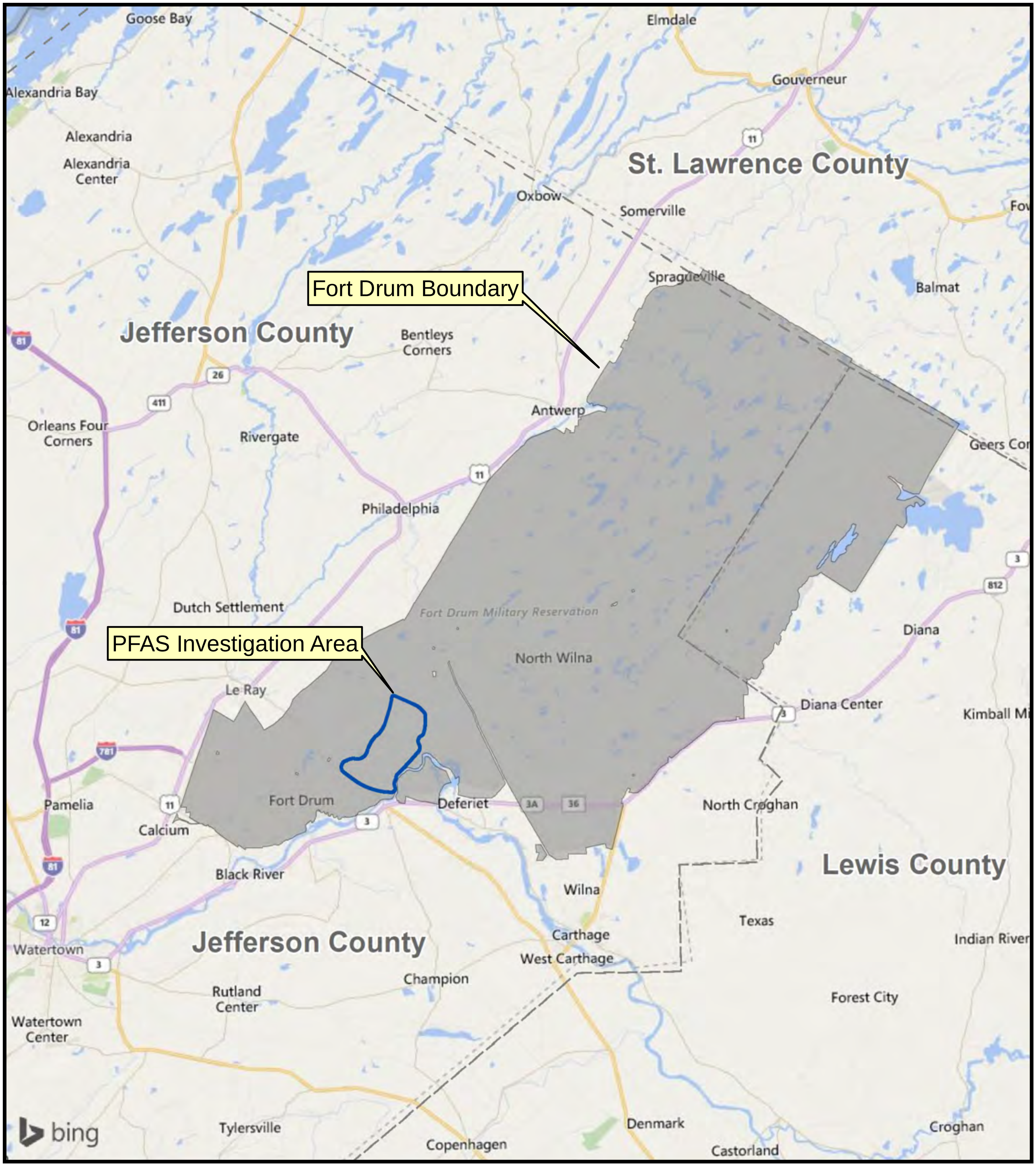
CENAB. 2017b. *Draft Field and Data Summary Report, PFC Screening Level Investigation – Old FTA, Fort Drum, New York.* May 2017.

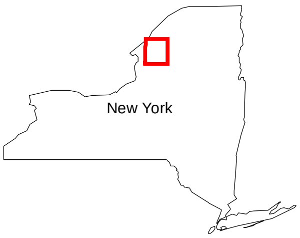
DoD (Department of Defense) and DOE (Department of Energy). 2018. *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories,* Version 5.1.1. February 2018.

FDPW (Fort Drum Public Works). 2017. *2016 Annual Drinking Water Quality Report.* Public Water Supply ID #2212214. April 2017.

PIKA-MP (PIKA-MP JV LLC). 2017. *2016 Annual Basewide Monitoring Report Fort Drum Installation Restoration Program Fort Drum, New York* (Rep. No. W912DR-12-D-0007-0003). 2017.

FIGURES





Background - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 3 6
Miles

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 1
Site Location Map

WESTON SOLUTIONS

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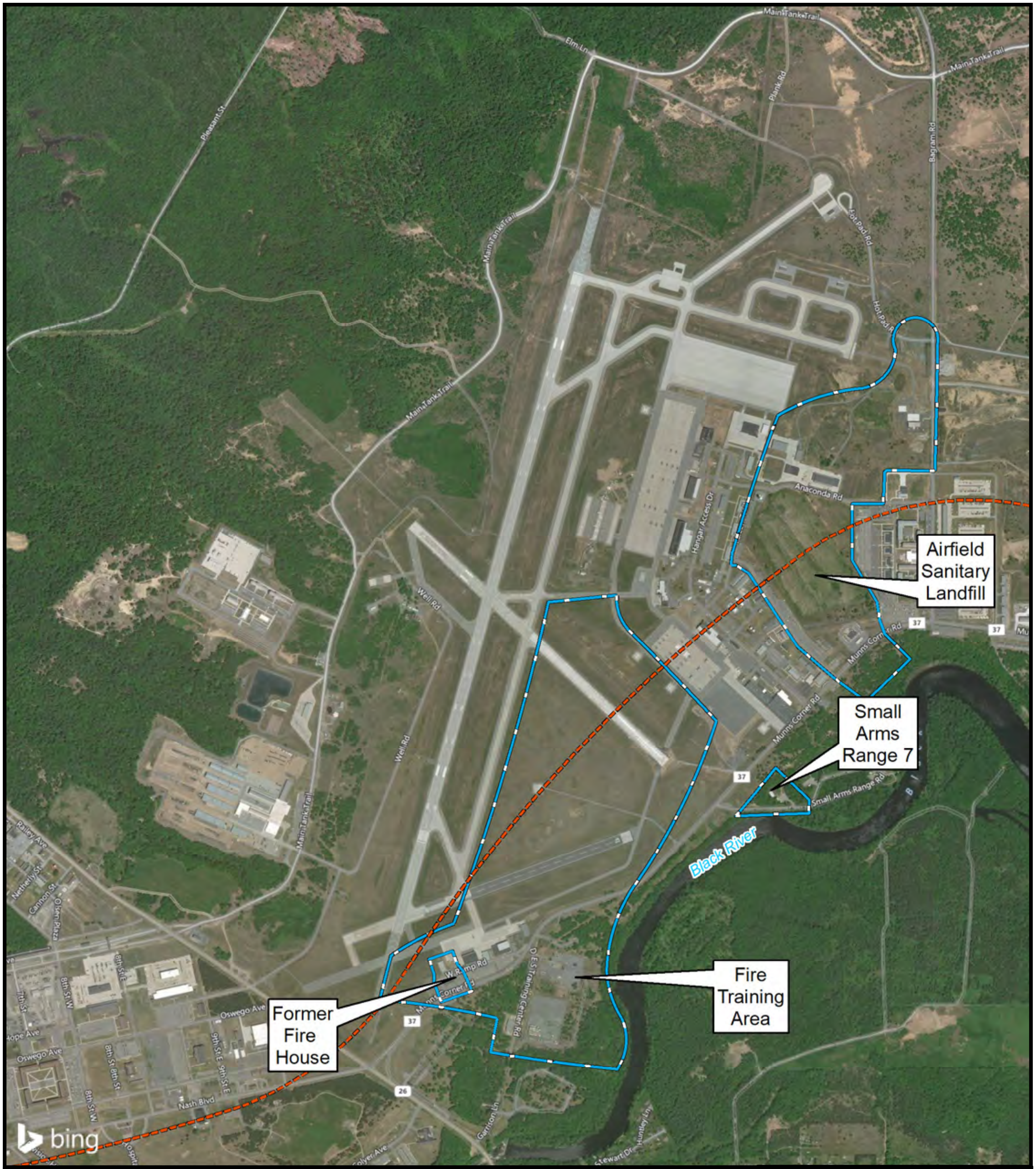

Legend

- - - - Approximate Shallow Groundwater Divide

▭ Project Areas

Aerial Imagery - ESRI, Bing Mapping Service

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Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 1,000 2,000
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 2
Site Locations of Former Fire House, Fire Training Area, Small Arms Range, and Airfield Sanitary Landfill, and Approximate Shallow Groundwater Divide

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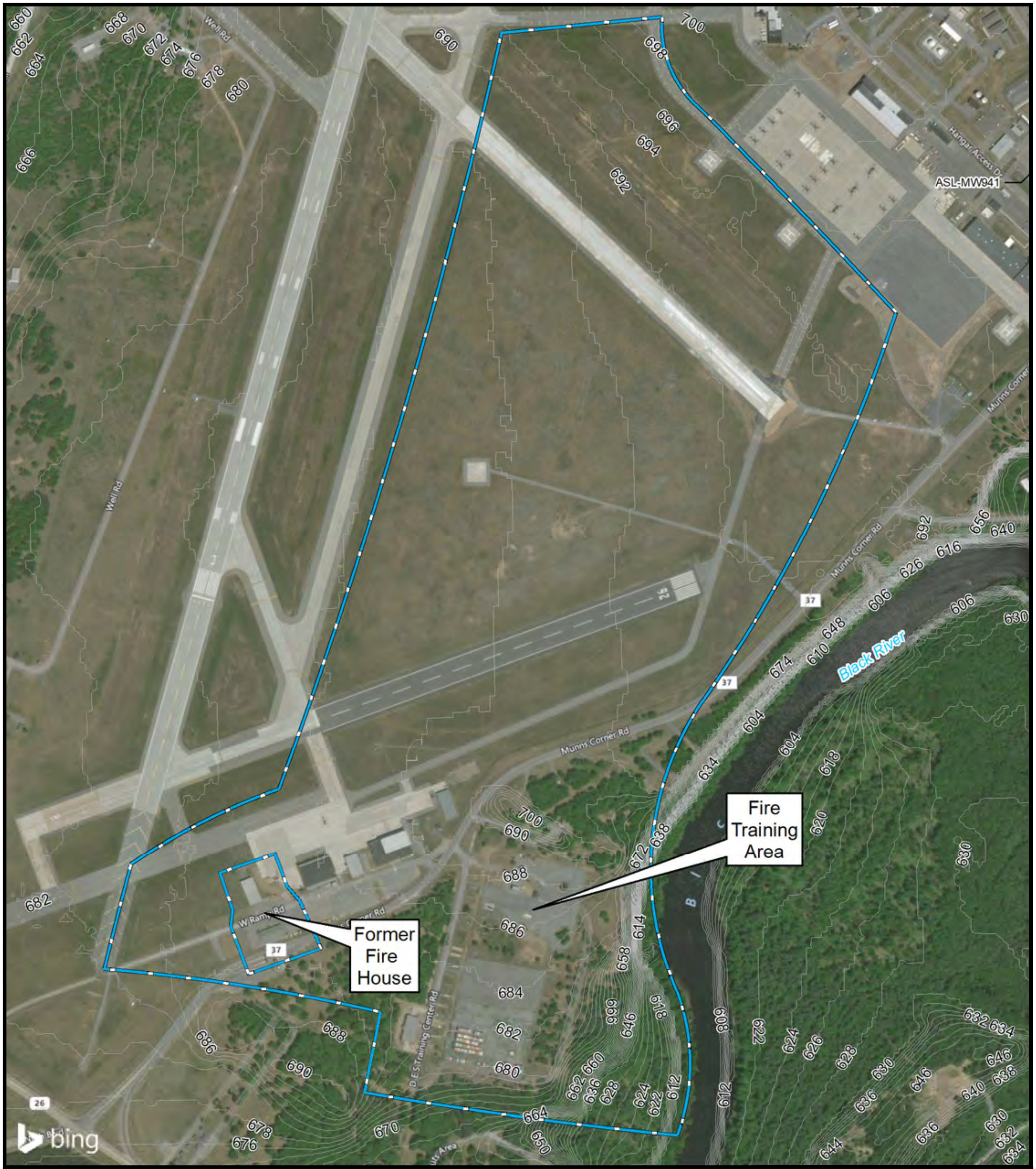

Legend

Contours 2 foot interval

▭ Project Areas

Aerial Imagery - ESRI, Bing Mapping Service

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Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 425 850
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 3
Site Layout and Topography
Fire Training Area

WESTON SOLUTIONS

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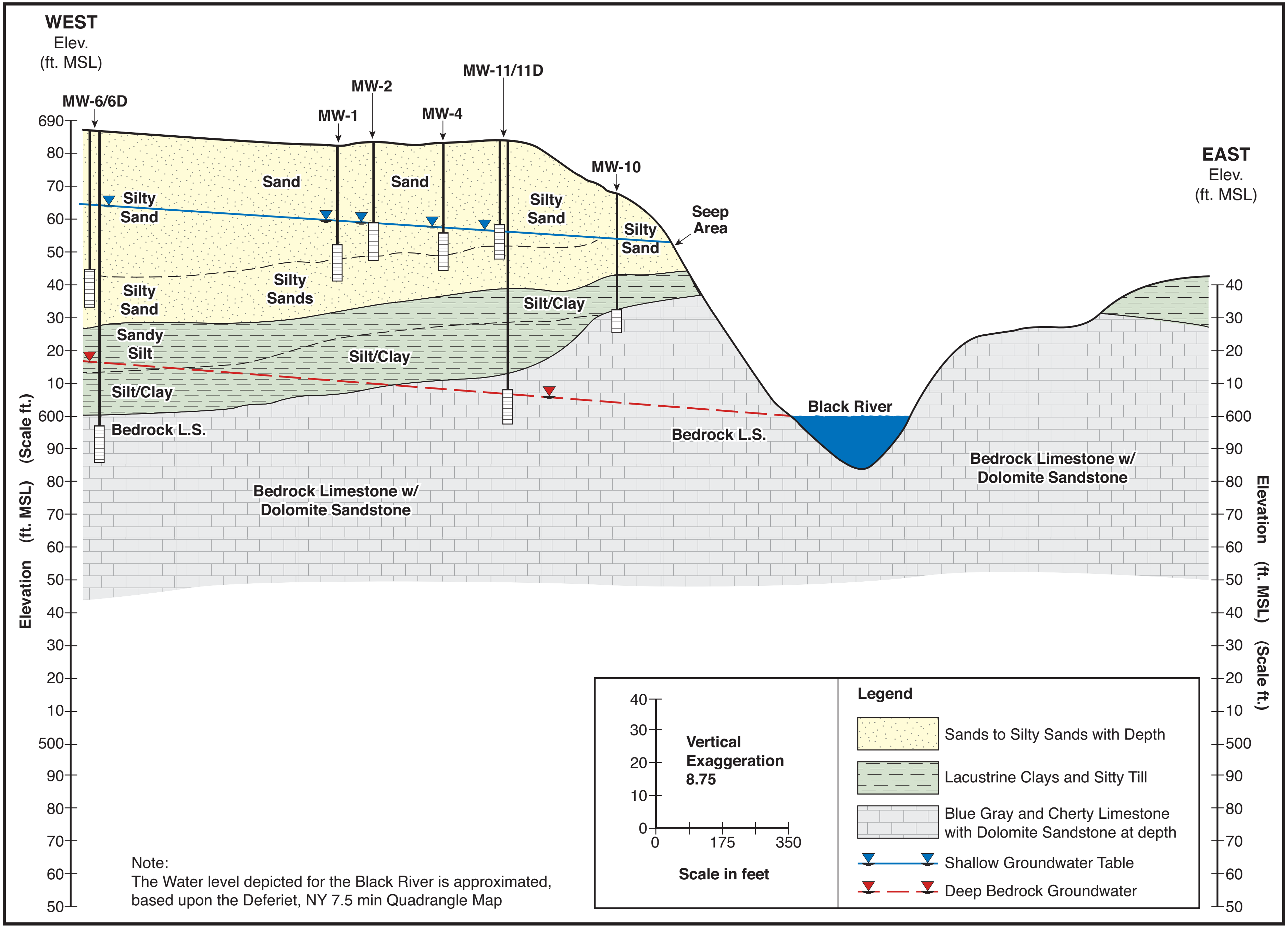
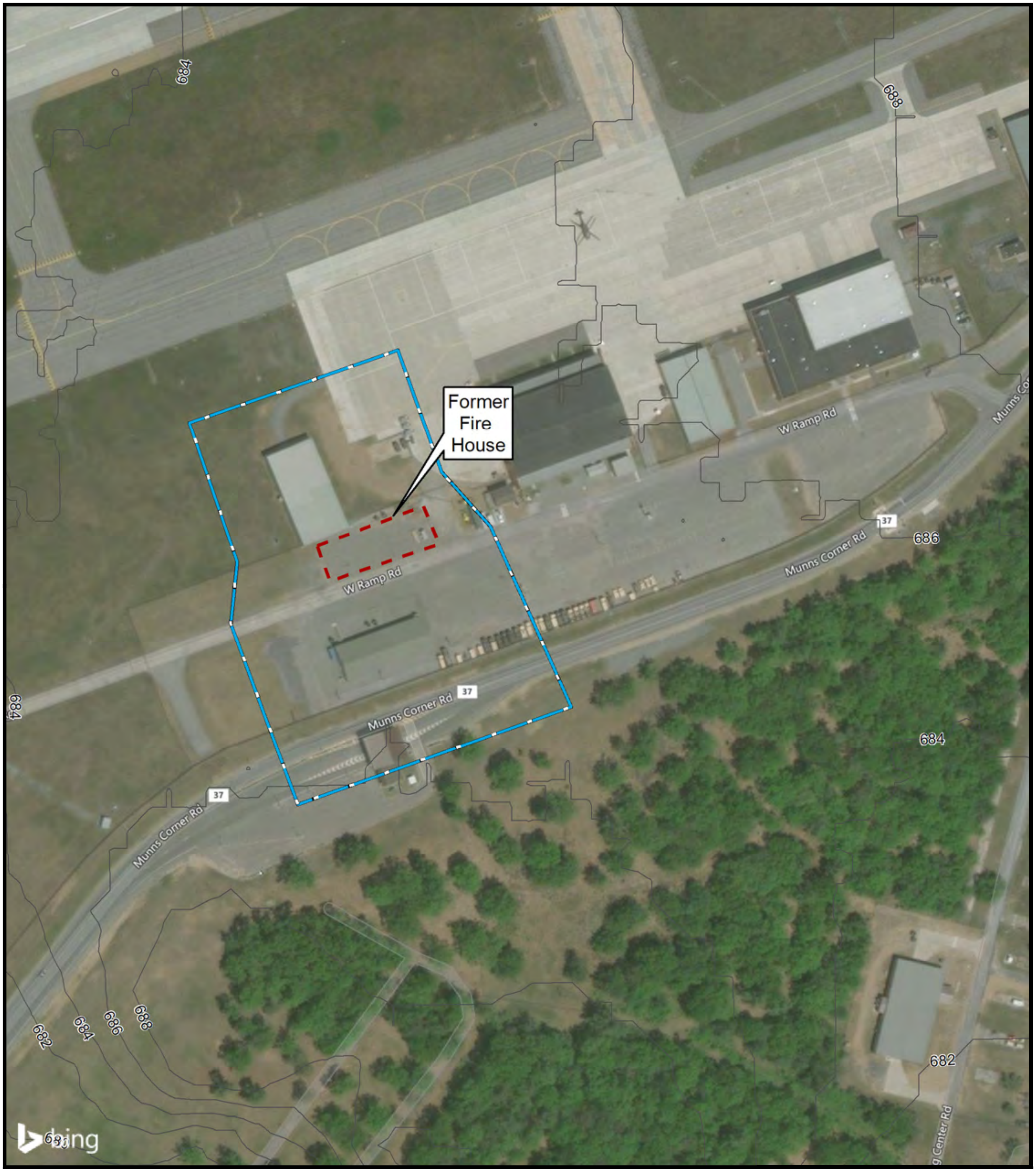


Note:
The Water level depicted for the Black River is approximated, based upon the Deferiet, NY 7.5 min Quadrangle Map

17P-0251-1

FIGURE 4
GENERALIZED HYDROLOGIC CROSS SECTION
FIRE TRAINING AREA
FORT DRUM, NEW YORK



Legend

—— Contours 2 foot interval

▭ Project Area

▭ Approximate Razed Building Footprint

Aerial Imagery - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 112.5 225
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 5
Site Layout and Topography
Former Fire House

WESTON SOLUTIONS

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Legend

Contours 2 foot interval

▭ Project Area

Aerial Imagery - ESRI, Bing Mapping Service

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Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 112.5 225 Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 6
Site Layout and Topography
Small Arms Range 7

WESTON SOLUTIONS

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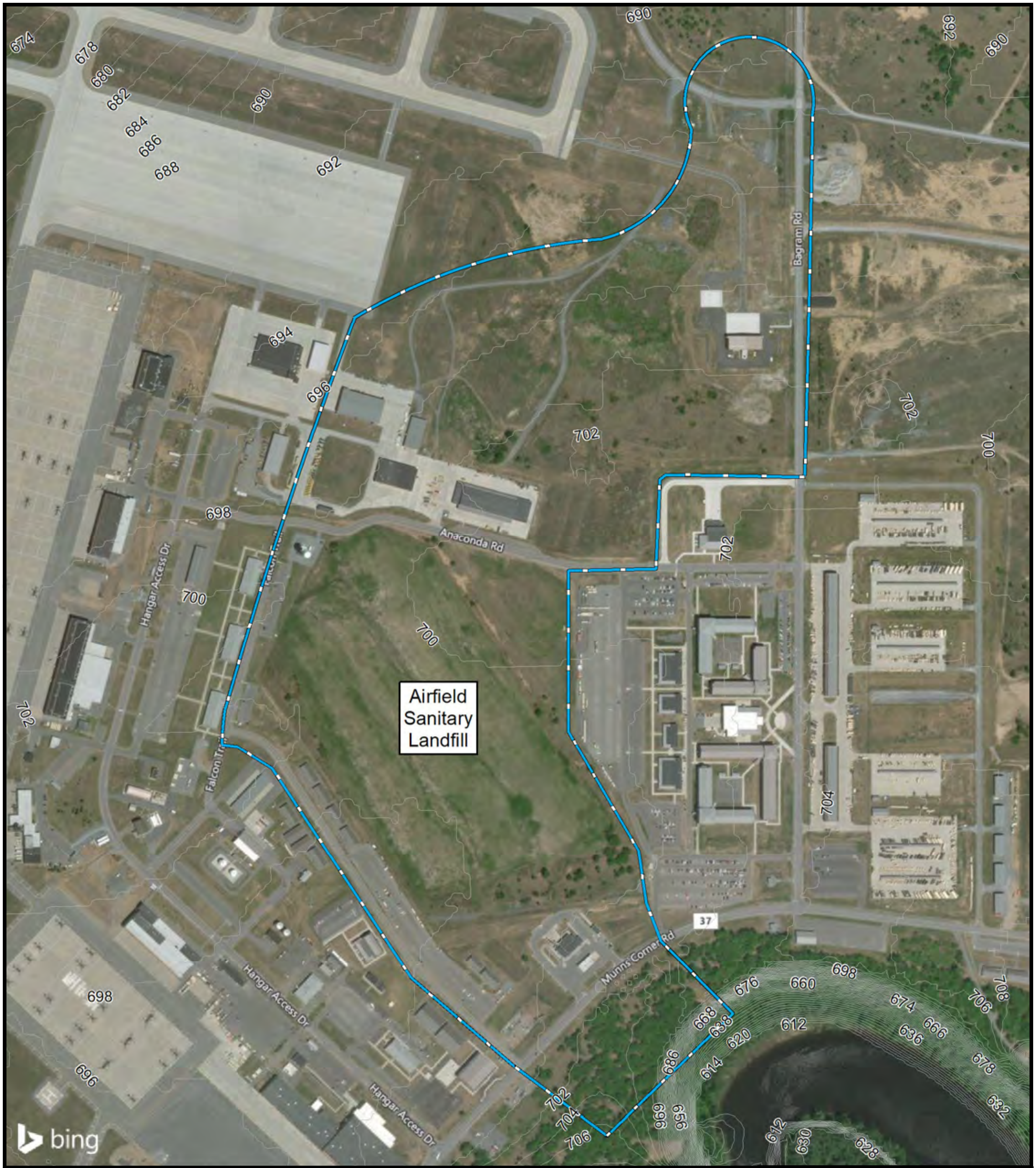

Legend

— Contours 2 foot interval

▭ Project Area

Aerial Imagery - ESRI, Bing Mapping Service

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

N

0 350 700
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 7
Site Layout and Topography
Airfield Sanitary Landfill

WESTON SOLUTIONS

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Legend

- ⊕ Existing Monitoring Well Locations
- ⊕ Existing Supply Well Locations
- ⊕ Proposed Deep Bedrock Well Locations
- ⊕ Proposed Shallow Overburden Well Locations
- ▭ Project Areas

Aerial Imagery - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 350 700
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 8
Proposed Well Locations
Fire Training Area

WESTON SOLUTIONS

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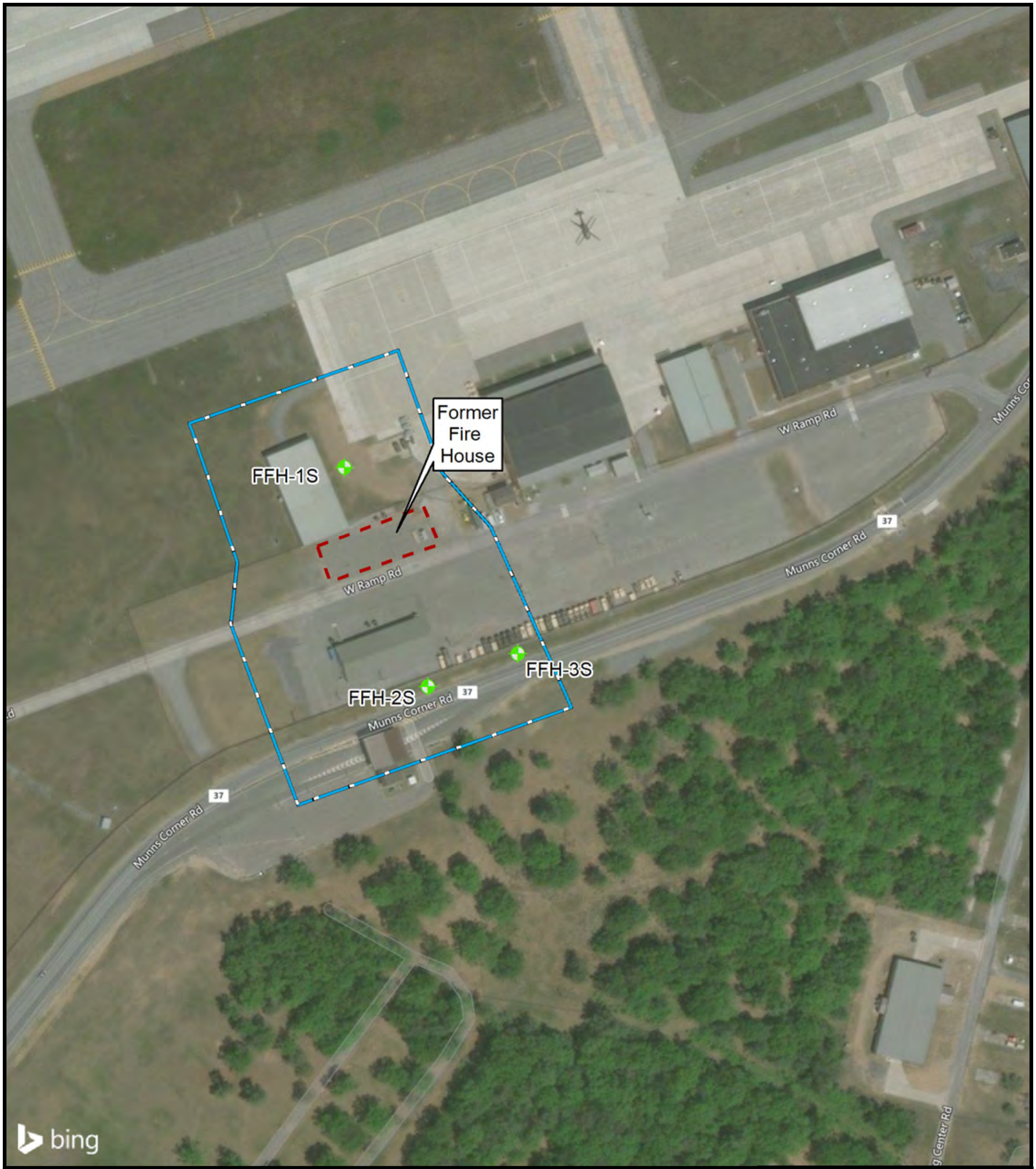

Legend

- Proposed Shallow Overburden Well Locations
- Project Area
- Approximate Razed Building Footprint

Aerial Imagery - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 112.5 225
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 9
Proposed Well Locations
Former Fire House

WESTON SOLUTIONS

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Legend

⊕ Proposed Shallow Overburden Well Locations

▭ Project Area

Aerial Imagery - ESRI, Bing Mapping Service

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Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 112.5 225
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 10
Proposed Well Locations
Small Arms Range 7

WESTON SOLUTIONS

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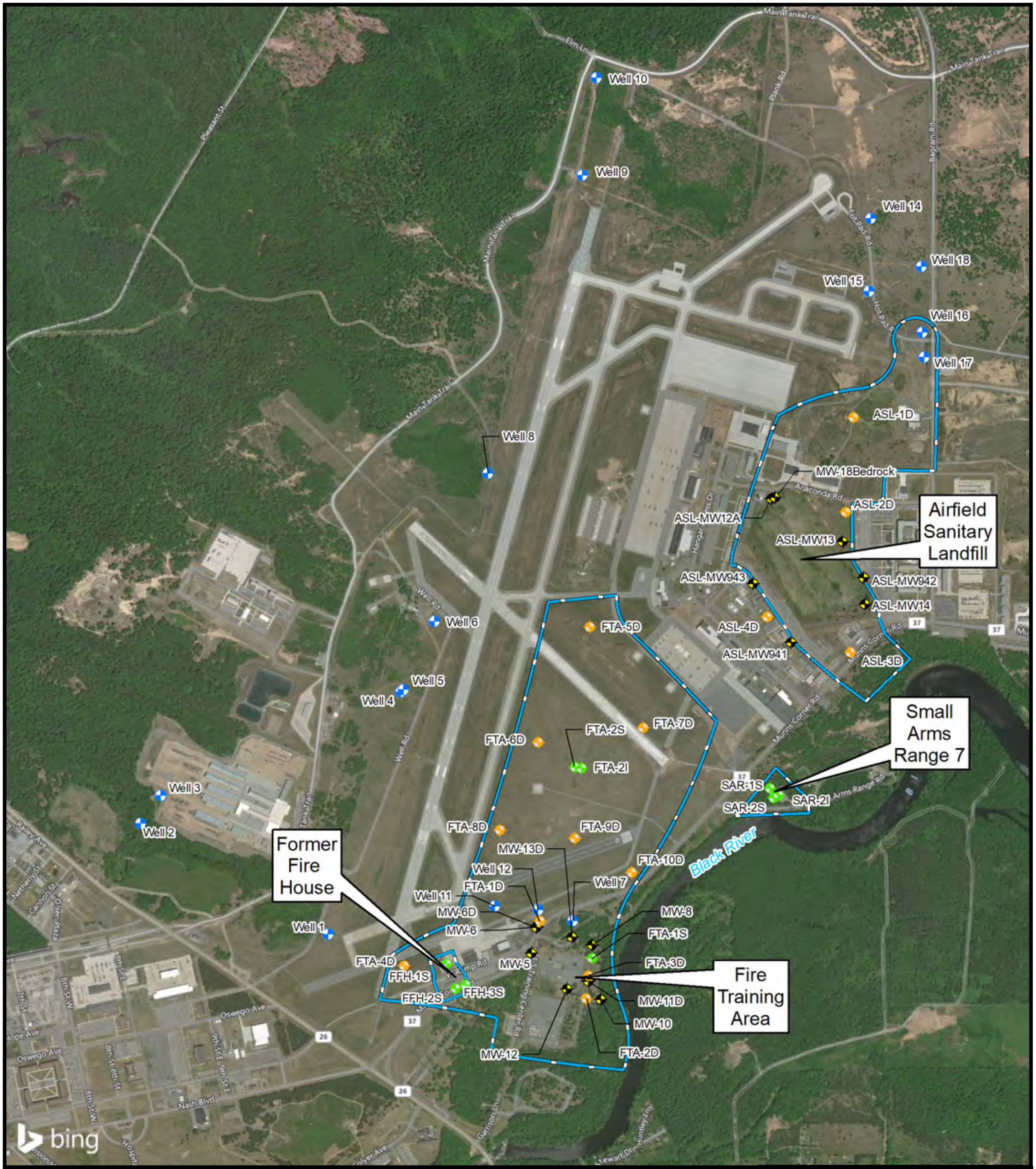

Legend

⊕ Existing Monitoring Well Locations

⊕ Existing Supply Well Locations

⊕ Proposed Deep Bedrock Well Locations

⊕ Proposed Shallow Overburden Well Locations

▭ Project Areas

Aerial Imagery - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 1,000 2,000 Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 11
Proposed Well Locations

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Legend

- ⊕ Existing Monitoring Well Locations
- ⊕ Existing Supply Well Locations
- ⊕ Proposed Deep Bedrock Well Locations
- ⊕ Proposed Shallow Overburden Well Locations
- ▭ Project Area

Aerial Imagery - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 225 450
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 12
Proposed Well Locations
Airfield Sanitary Landfill

WESTON SOLUTIONS

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Legend

- ⊕ Existing Well Locations
- ⬠ Seep Locations (Approximate)
- ⊕ Proposed Deep Bedrock Well Locations
- ⊕ Proposed Shallow Overburden Well Locations
- ▭ Project Area

Aerial Imagery - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 112.5 225
Feet

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 13
Proposed Monitoring Wells and Seep Locations
Main Portion of Fire Training Area

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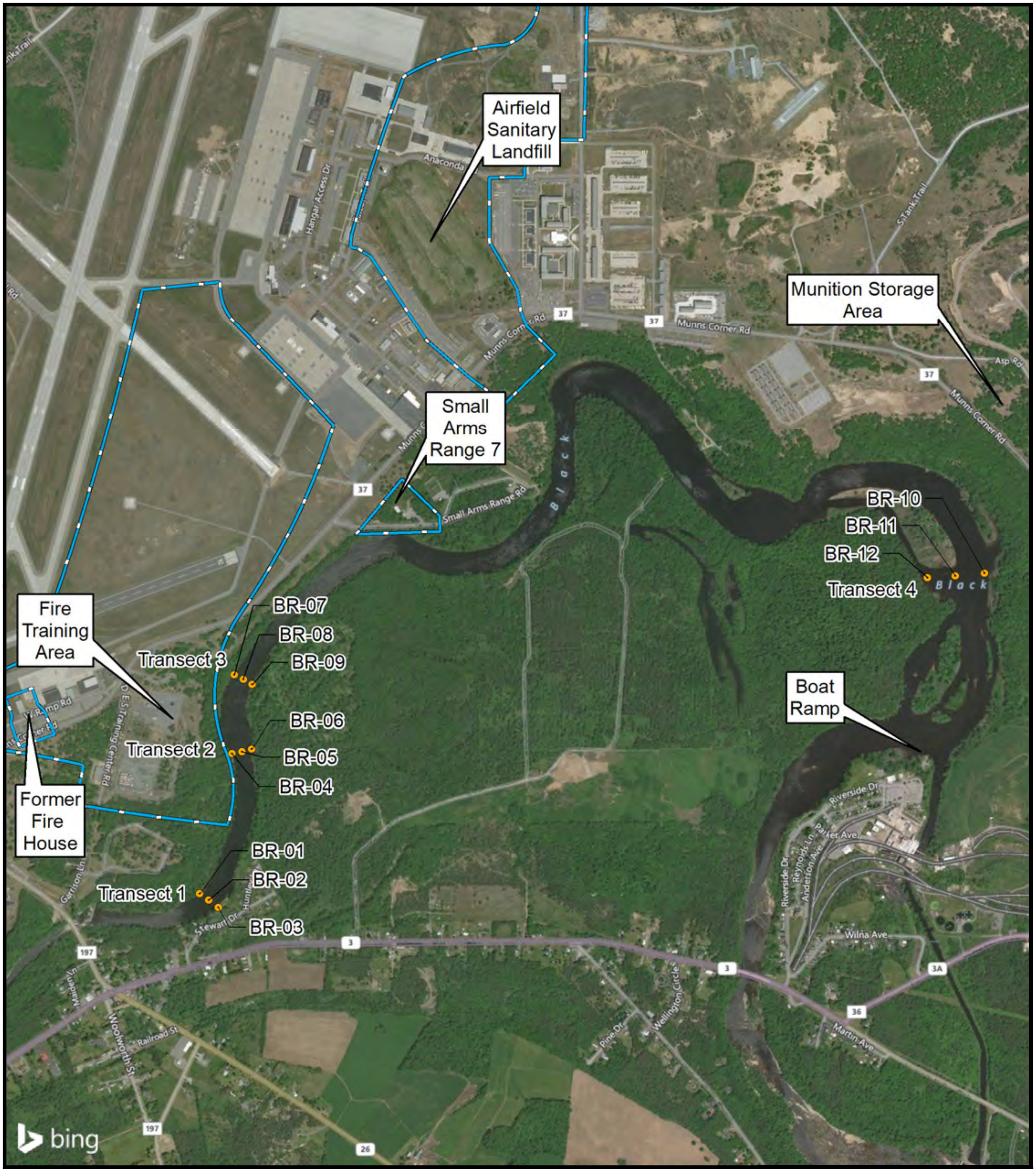

Legend

● Proposed Sediment and Surface Water Sampling Locations

▭ Project Areas

Aerial Imagery - ESRI, Bing Mapping Service

N

Coordinate System:
NAD 1983 State Plane
New York Central, Feet

0 0.1 0.2 0.4 Miles

Fort Drum PFAS Investigation
Fort Drum, New York

Figure 14
Black River Sediment and Surface Water Sampling Locations

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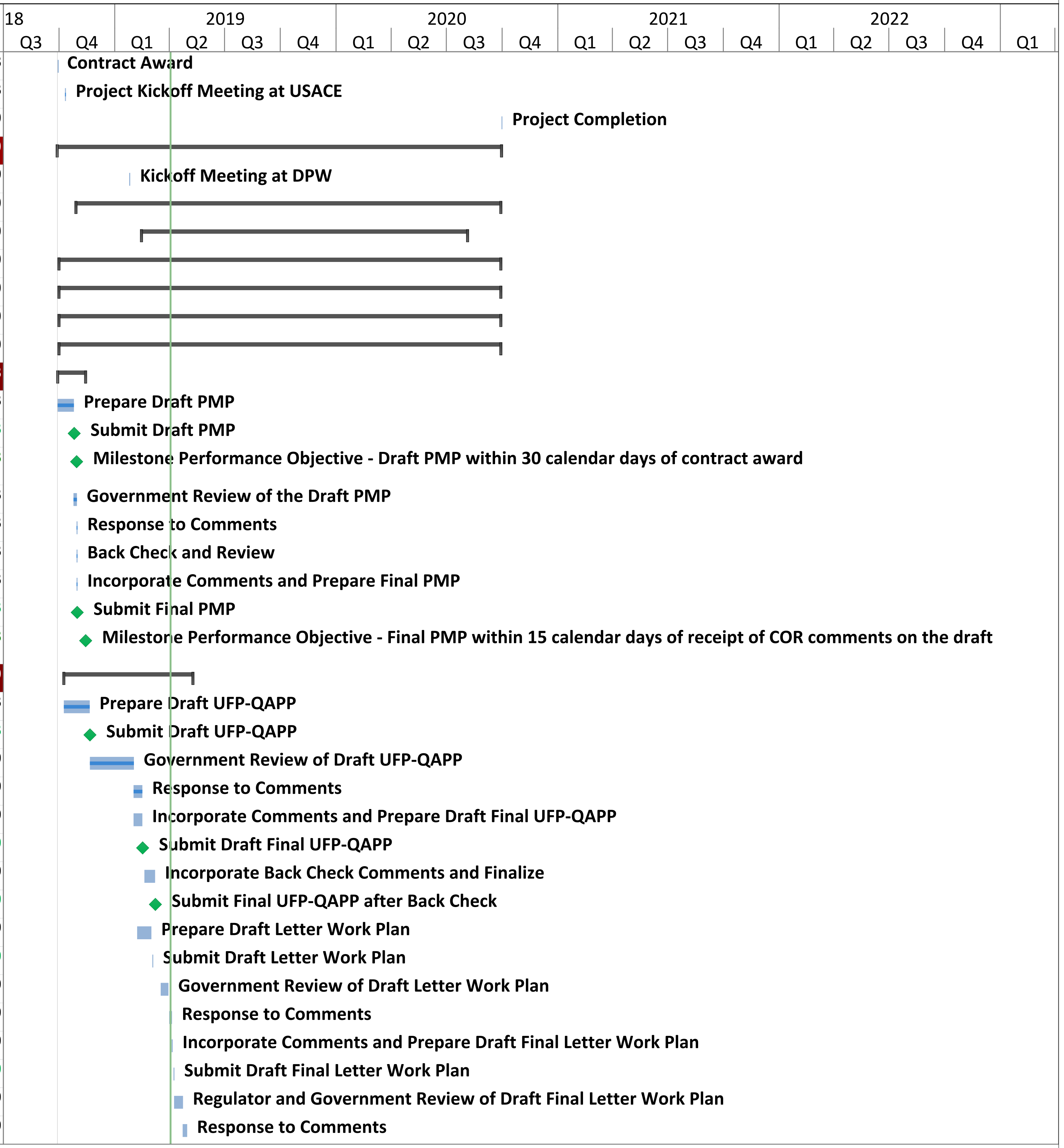
ATTACHMENT 1

SCHEDULE

Investigation of Pathways Relating to Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS) for Protection of Locally Utilized Water Supplies
Fort Drum, NY

ID	CLIN	Activity ID	Task Name	Cal Day Duration	Work Day Duration	Start	Finish
1			**Contract Award**	**1 day**	**1 day**	**Sat 9/29/18**	**Sat 9/29/18**
2			Project Kickoff Meeting at USACE	1 day	1 day	Thu 10/11/18	Thu 10/11/18
3			Project Completion	1 day	1 day	Wed 9/30/20	Wed 9/30/20
4			**Meetings & Support**	**733 days**	**500 days**	**Fri 9/28/18**	**Tue 9/29/20**
5			Kickoff Meeting at DPW	1 day	1 day	Fri 1/25/19	Fri 1/25/19
6			**Monthly Status Meetings**	**701 days**	**478 days**	**Mon 10/29/18**	**Mon 9/28/20**
9			**Semi-Annual Meetings**	**538 days**	**369 days**	**Thu 2/14/19**	**Tue 8/4/20**
14			**Programmatic Reporting**	**729 days**	**497 days**	**Mon 10/1/18**	**Mon 9/28/20**
15			**Monthly Progress Reports**	**729 days**	**497 days**	**Mon 10/1/18**	**Mon 9/28/20**
18			**Contractor Manpower Reporting**	**729 days**	**497 days**	**Mon 10/1/18**	**Mon 9/28/20**
21			**Information Repository Updates**	**729 days**	**497 days**	**Mon 10/1/18**	**Mon 9/28/20**
24	0001		**Prepare Project Management Plan (PMP)**	**46 days**	**31 days**	**Sat 9/29/18**	**Tue 11/13/18**
25			Prepare Draft PMP	26 days	18 days	Sat 9/29/18	Wed 10/24/18
26		PM	Submit Draft PMP	0 days	0 days	Thu 10/25/18	Thu 10/25/18
27			**Milestone Performance Objective - Draft PMP within 30 calendar days of contract award**	**0 days**	**0 days**	**Mon 10/29/18**	**Mon 10/29/18**
28		QA	Government Review of the Draft PMP	5 days	3 days	Thu 10/25/18	Mon 10/29/18
29			Response to Comments	1 day	1 day	Tue 10/30/18	Tue 10/30/18
30			Back Check and Review	1 day	1 day	Tue 10/30/18	Tue 10/30/18
31			Incorporate Comments and Prepare Final PMP	1 day	1 day	Tue 10/30/18	Tue 10/30/18
32		PM	Submit Final PMP	0 days	0 days	Tue 10/30/18	Tue 10/30/18
33			**Milestone Performance Objective - Final PMP within 15 calendar days of receipt of COR comments on the draft**	**0 days**	**0 days**	**Tue 11/13/18**	**Tue 11/13/18**
34	0002		**UFP-QAPP, APP/SSHP, Letter Report Work Plan**	**213 days**	**145 days**	**Tue 10/9/18**	**Thu 5/9/19**
35			Prepare Draft UFP-QAPP	42 days	29 days	Tue 10/9/18	Mon 11/19/18
36			Submit Draft UFP-QAPP	1 day	1 day	Tue 11/20/18	Tue 11/20/18
37		QA	Government Review of Draft UFP-QAPP	72 days	46 days	Wed 11/21/18	Thu 1/31/19
38			Response to Comments	14 days	10 days	Fri 2/1/19	Thu 2/14/19
39			Incorporate Comments and Prepare Draft Final UFP-QAPP	14 days	10 days	Fri 2/1/19	Thu 2/14/19
40		PM	Submit Draft Final UFP-QAPP	1 day	1 day	Fri 2/15/19	Fri 2/15/19
41			Incorporate Back Check Comments and Finalize	17 days	13 days	Tue 2/19/19	Thu 3/7/19
42		PM	Submit Final UFP-QAPP after Back Check	1 day	1 day	Fri 3/8/19	Fri 3/8/19
43			Prepare Draft Letter Work Plan	23 days	16 days	Thu 2/7/19	Fri 3/1/19
44			Submit Draft Letter Work Plan	1 day	1 day	Mon 3/4/19	Mon 3/4/19
45		QA	Government Review of Draft Letter Work Plan	12 days	10 days	Mon 3/18/19	Fri 3/29/19
46			Response to Comments	4 days	4 days	Mon 4/1/19	Thu 4/4/19
47			Incorporate Comments and Prepare Draft Final Letter Work Plan	1 day	1 day	Fri 4/5/19	Fri 4/5/19
48		PM	Submit Draft Final Letter Work Plan	1 day	1 day	Mon 4/8/19	Mon 4/8/19
49			Regulator and Government Review of Draft Final Letter Work Plan	14 days	10 days	Tue 4/9/19	Mon 4/22/19
50			Response to Comments	7 days	5 days	Tue 4/23/19	Mon 4/29/19



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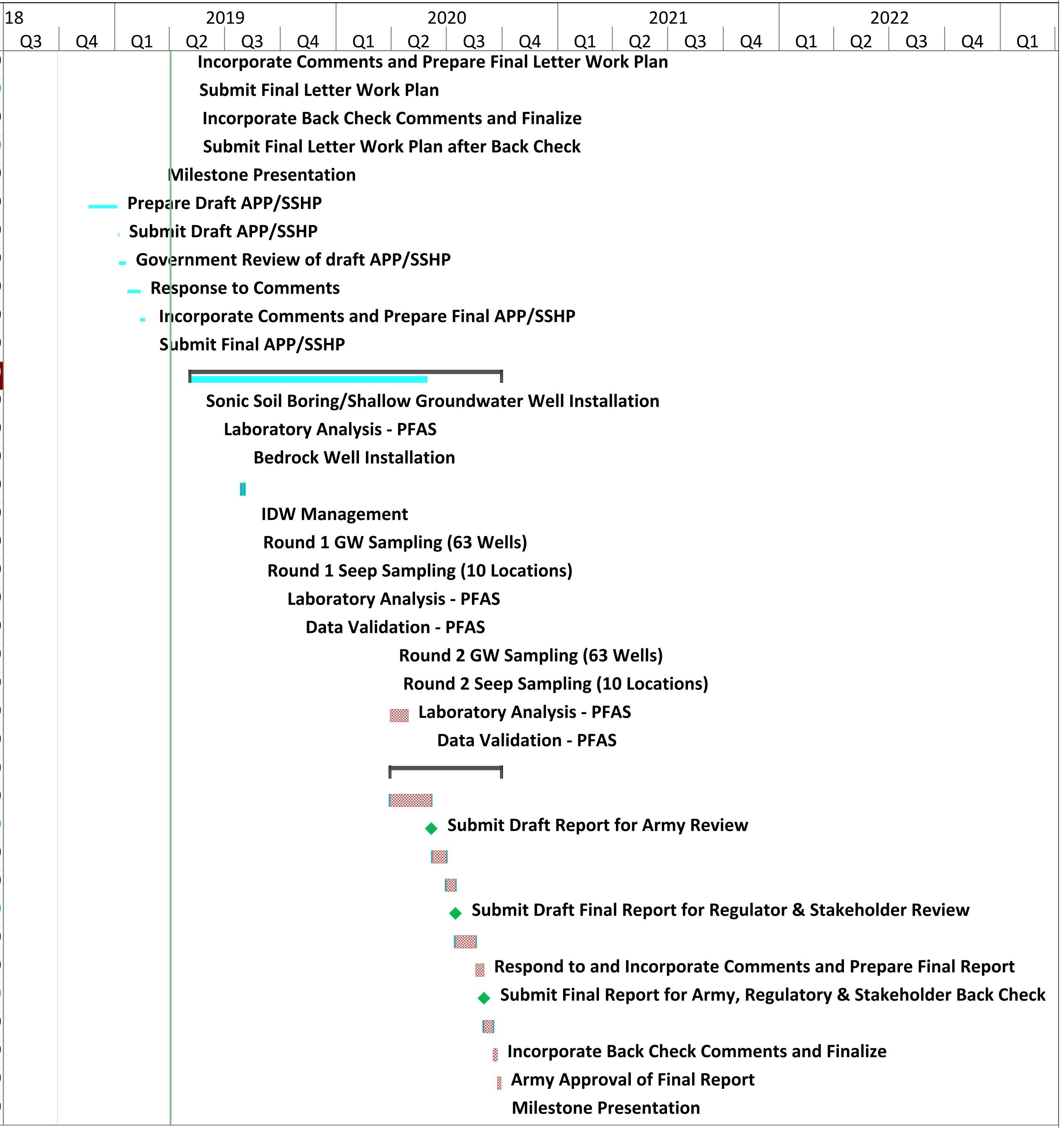
Task	▬	Milestone	◆	Project Summary	⊓	Progress	▬
Split	┈	Summary	⊓	Critical	▨	Manual Progress	▬

Investigation of Pathways Relating to Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS)
for Protection of Locally Utilized Water Supplies
Fort Drum, NY

ID	CLIN	Activity ID	Task Name	Cal Day Duration	Work Day Duration	Start	Finish
51			Incorporate Comments and Prepare Final Letter Work Plan	3 days	3 days	Tue 4/30/19	Thu 5/2/19
52			Submit Final Letter Work Plan	1 day	1 day	Fri 5/3/19	Fri 5/3/19
53			Incorporate Back Check Comments and Finalize	3 days	3 days	Mon 5/6/19	Wed 5/8/19
54		PM	Submit Final Letter Work Plan after Back Check	1 day	1 day	Thu 5/9/19	Thu 5/9/19
55			Milestone Presentation	1 day	1 day	Mon 3/11/19	Mon 3/11/19
56			Prepare Draft APP/SSHP	47 days	30 days	Mon 11/19/18	Fri 1/4/19
57			Submit Draft APP/SSHP	1 day	1 day	Mon 1/7/19	Mon 1/7/19
58		QA	Government Review of draft APP/SSHP	11 days	9 days	Tue 1/8/19	Fri 1/18/19
59			Response to Comments	21 days	15 days	Tue 1/22/19	Mon 2/11/19
60			Incorporate Comments and Prepare Final APP/SSHP	14 days	9 days	Tue 2/12/19	Mon 2/25/19
61		PM	Submit Final APP/SSHP	1 day	1 day	Tue 2/26/19	Tue 2/26/19
62	0003		**Subsurface Investigations**	**514 days**	**353 days**	**Sun 5/5/19**	**Tue 9/29/20**
63			Sonic Soil Boring/Shallow Groundwater Well Installation	9 days	7 days	Mon 5/6/19	Tue 5/14/19
64			Laboratory Analysis - PFAS	15 days	11 days	Wed 5/29/19	Wed 6/12/19
65			Bedrock Well Installation	45 days	32 days	Mon 6/17/19	Wed 7/31/19
66			Borehole Geophysics	5 days	5 days	Mon 7/29/19	Fri 8/2/19
67			IDW Management	2 days	2 days	Mon 8/12/19	Tue 8/13/19
68			Round 1 GW Sampling (63 Wells)	5 days	5 days	Mon 8/12/19	Fri 8/16/19
69			Round 1 Seep Sampling (10 Locations)	5 days	5 days	Mon 8/19/19	Fri 8/23/19
70			Laboratory Analysis - PFAS	31 days	22 days	Mon 8/26/19	Wed 9/25/19
71			Data Validation - PFAS	30 days	21 days	Thu 9/26/19	Fri 10/25/19
72			Round 2 GW Sampling (63 Wells)	5 days	5 days	Mon 3/23/20	Fri 3/27/20
73			Round 2 Seep Sampling (10 Locations)	5 days	5 days	Mon 3/30/20	Fri 4/3/20
74			Laboratory Analysis - PFAS	30 days	22 days	Mon 3/30/20	Tue 4/28/20
75			Data Validation - PFAS	31 days	22 days	Wed 4/29/20	Fri 5/29/20
76			**Subsurface Investigation Report**	**184 days**	**129 days**	**Mon 3/30/20**	**Tue 9/29/20**
77			Prepare Draft Report	68 days	49 days	Mon 3/30/20	Fri 6/5/20
78			Submit Draft Report for Army Review	0 days	0 days	Fri 6/5/20	Fri 6/5/20
79		QA	Army Review of Draft Report	23 days	17 days	Mon 6/8/20	Tue 6/30/20
80			Respond to and Incorporate Comments and Prepare Draft Final Report	15 days	10 days	Wed 7/1/20	Wed 7/15/20
81		PM	Submit Draft Final Report for Regulator & Stakeholder Review	0 days	0 days	Wed 7/15/20	Wed 7/15/20
82		QA	Regulatory & Stakeholder Review of Draft Final Report	33 days	23 days	Thu 7/16/20	Mon 8/17/20
83			Respond to and Incorporate Comments and Prepare Final Report	14 days	10 days	Tue 8/18/20	Mon 8/31/20
84		PM	Submit Final Report for Army, Regulatory & Stakeholder Back Check	0 days	0 days	Mon 8/31/20	Mon 8/31/20
85		QA	Army, Regulatory & Stakeholder Back Check of Final Report	15 days	10 days	Tue 9/1/20	Tue 9/15/20
86			Incorporate Back Check Comments and Finalize	7 days	5 days	Wed 9/16/20	Tue 9/22/20
87			Army Approval of Final Report	6 days	4 days	Wed 9/23/20	Mon 9/28/20
88			Milestone Presentation	1 day	1 day	Tue 9/29/20	Tue 9/29/20

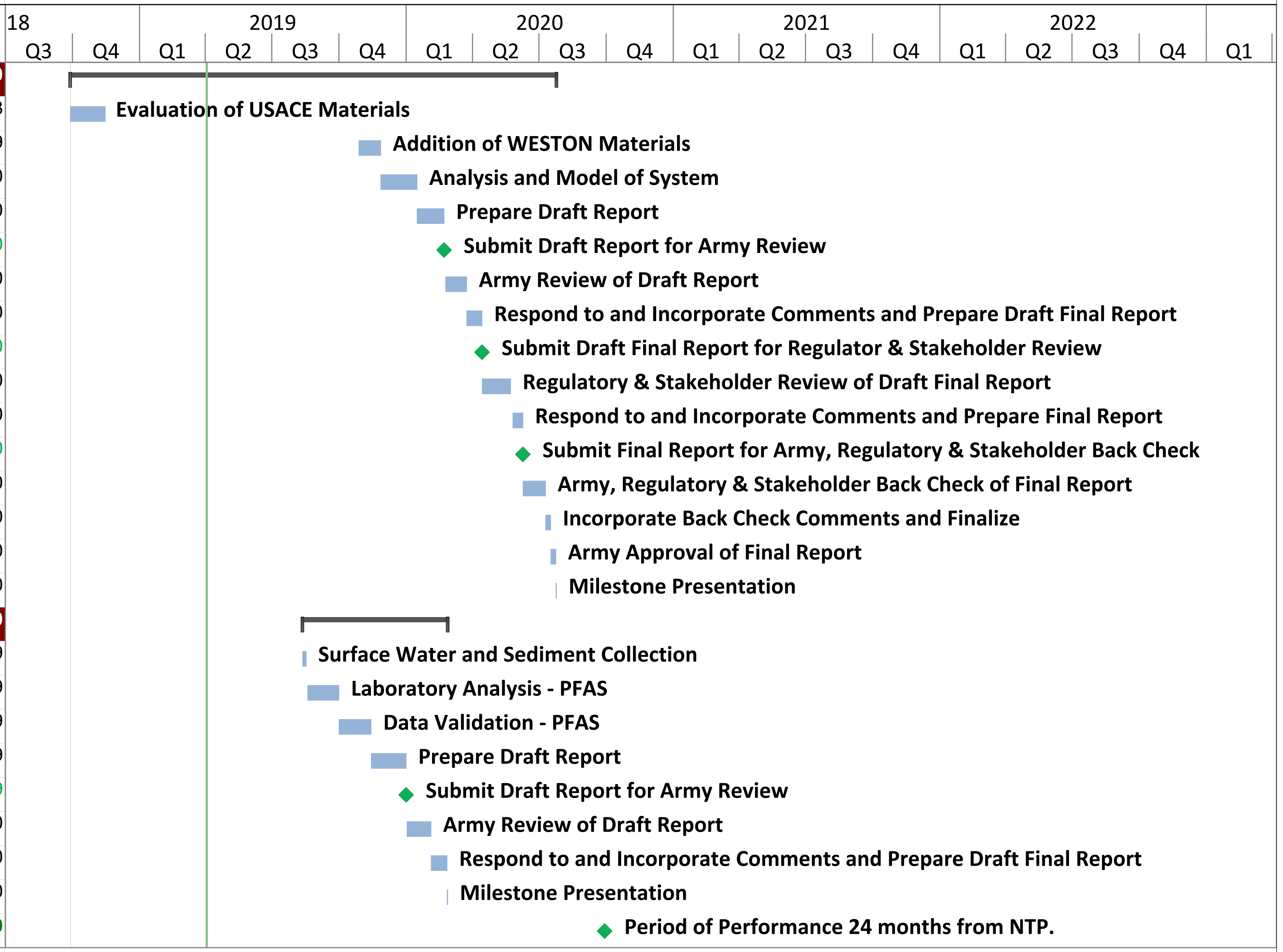


WESTON SOLUTIONS

Task		Milestone	◆	Project Summary		Progress	
Split		Summary		Critical	▨	Manual Progress	

Investigation of Pathways Relating to Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS)
for Protection of Locally Utilized Water Supplies
Fort Drum, NY

ID	CLIN	Activity ID	Task Name	Cal Day Duration	Work Day Duration	Start	Finish
89	0004		**OPTION - Data Evaluation Report**	**666 days**	**454 days**	**Fri 9/28/18**	**Fri 7/24/20**
90			Evaluation of USACE Materials	48 days	33 days	Fri 9/28/18	Wed 11/14/18
91			Addition of WESTON Materials	30 days	21 days	Mon 10/28/19	Tue 11/26/19
92			Analysis and Model of System	50 days	31 days	Wed 11/27/19	Wed 1/15/20
93			Prepare Draft Report	37 days	25 days	Thu 1/16/20	Fri 2/21/20
94			Submit Draft Report for Army Review	0 days	0 days	Fri 2/21/20	Fri 2/21/20
95		QA	Army Review of Draft Report	29 days	21 days	Mon 2/24/20	Mon 3/23/20
96			Respond to and Incorporate Comments and Prepare Draft Final Report	21 days	15 days	Tue 3/24/20	Mon 4/13/20
97		PM	Submit Draft Final Report for Regulator & Stakeholder Review	0 days	0 days	Mon 4/13/20	Mon 4/13/20
98		QA	Regulatory & Stakeholder Review of Draft Final Report	39 days	29 days	Tue 4/14/20	Fri 5/22/20
99			Respond to and Incorporate Comments and Prepare Final Report	14 days	10 days	Tue 5/26/20	Mon 6/8/20
100		PM	Submit Final Report for Army, Regulatory & Stakeholder Back Check	0 days	0 days	Mon 6/8/20	Mon 6/8/20
101		QA	Army, Regulatory & Stakeholder Back Check of Final Report	31 days	22 days	Tue 6/9/20	Thu 7/9/20
102			Incorporate Back Check Comments and Finalize	7 days	5 days	Fri 7/10/20	Thu 7/16/20
103			Army Approval of Final Report	7 days	5 days	Fri 7/17/20	Thu 7/23/20
104			Milestone Presentation	1 day	1 day	Fri 7/24/20	Fri 7/24/20
105	0005		**OPTION - Surface Water and Sediment Investigation**	**199 days**	**133 days**	**Mon 8/12/19**	**Wed 2/26/20**
106			Surface Water and Sediment Collection	5 days	5 days	Mon 8/12/19	Fri 8/16/19
107			Laboratory Analysis - PFAS	43 days	30 days	Mon 8/19/19	Mon 9/30/19
108			Data Validation - PFAS	44 days	30 days	Tue 10/1/19	Wed 11/13/19
109			Prepare Draft Report	48 days	30 days	Thu 11/14/19	Tue 12/31/19
110			Submit Draft Report for Army Review	0 days	0 days	Tue 12/31/19	Tue 12/31/19
111		QA	Army Review of Draft Report	33 days	22 days	Thu 1/2/20	Mon 2/3/20
112			Respond to and Incorporate Comments and Prepare Draft Final Report	22 days	15 days	Tue 2/4/20	Tue 2/25/20
113			Milestone Presentation	1 day	1 day	Wed 2/26/20	Wed 2/26/20
432			**Period of Performance 24 months from NTP.**	**0 days**	**0 days**	**Mon 9/28/20**	**Mon 9/28/20**



Task	▬	Milestone	◆	Project Summary	▭	Progress	▬
Split	┈	Summary	▭	Critical	▨	Manual Progress	▬