Final
Site Inspection Report of Aqueous Film Forming Foam Areas at Peterson Air Force Base El Paso County, Colorado

July 2017

Submitted to:

Air Force Civil Engineer Center
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San Antonio, Texas 78226-2018

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under
Contract No. W9128F-15-D-0051
Delivery Order No. 0003

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Acronyms and Abbreviations

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFFF	aqueous film forming foam
ASL	Aerostar SES LLC
bgs	below ground surface
btoc	below top of casing
CAS	Chemical Abstract Service
CDPHE	Colorado Department of Health and Environment
COS	Colorado Springs Airport
CSM	conceptual site model
DOT	Department of Transportation
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
ft	foot/feet
FTA	fire training area
HA	health advisory
HDPE	high-density polyethylene
ID	identification
IDW	investigation-derived waste
J	reported concentration is an estimated value
NL	not listed
OWS	oil/water separator
PA	preliminary assessment
PAFB	Peterson Air Force Base
PFAS	per- and polyfluorinated alkyl substance
PFBS	perfluorobutane sulfonate
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
pH	potential of hydrogen
PID	photoionization detector
QAPP	quality assurance project plan
RSL	regional screening level
SI	site inspection
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
U	analyte was not detected above the reported value
UJ	analyte was not detected at the reported value; the reported value is estimated
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force

1.0 INTRODUCTION

Aerostar SES LLC (ASL) under contract to the U.S. Army Corps of Engineers (USACE) Omaha District (Contract No.W9128F-15-D-0051, Delivery Order No. 0003) has conducted screening-level site inspections (SIs) at five known or suspected aqueous film forming foam (AFFF) release areas at Peterson Air Force Base (PAFB), El Paso County, Colorado (Figure 1 in Appendix A). The purpose of the inspections was to determine the presence or absence of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in the environment at these areas. SIs were conducted in accordance with contract requirements (USACE, July 2015), the quality assurance project plan (QAPP) (ASL, March 2016), and the PAFB site-specific addendum to the QAPP (ASL, October 2016). The QAPP and QAPP addendum were prepared in accordance with U.S. Environmental Protection Agency (EPA) guidance (EPA, March 2012) and Air Force Civil Engineer Center requirements.

Background

PFOA and PFOS are included in a class of synthetic fluorinated chemicals used in industrial and consumer products, including defense-related applications. This class of compounds is also referred to as per- and polyfluorinated alkyl substances (PFAS). In 1970, the U.S. Air Force (USAF) began using AFFF, firefighting agents containing PFOS and PFOA to extinguish petroleum fires. Releases of AFFF to the environment routinely occur during fire training, equipment maintenance, storage, and use. Although manufacturers have reformulated AFFF to eliminate PFOS, the U.S. Environmental Protection Agency (EPA) continues to permit the use of PFOS-based AFFF, and the USAF maintains a significant inventory of PFOS-based AFFF. As of this report, the USAF is actively removing PFOS-based AFFF from their inventory and replacing it with formulations based on shorter carbon chains, which may be less persistent and bioaccumulative in the environment.

Objectives

The objectives of the SIs were to

- determine if a confirmed release of PFOS and PFOA has occurred at the areas selected for inspection,
- determine if PFOS and PFOA are present in groundwater or surface water at the inspection areas at concentrations exceeding the EPA lifetime health advisory (HA) for drinking water,
- determine if PFOA and PFOS are present in soil or sediment at the inspection areas at concentrations exceeding calculated screening levels, and
- identify potential receptor pathways with immediate impacts to human health.

Screening Values

Screening levels for PFOS and PFOA in soil and sediment were calculated using EPA's Regional Screening Level (RSL) Calculator (Appendix H). Screening levels for PFOS and PFOA in groundwater and surface water are based on EPA lifetime drinking water HAs for PFOS (EPA, May 2016a) and PFOA (EPA, May 2016b). A PFAS release was considered confirmed when exceedances of the following concentrations were identified:

PFOS:

- 0.07 micrograms per liter (µg/L) in groundwater/surface water (combined with PFOA value).
- 1,260 micrograms per kilogram (µg/kg) in soil (in the absence of EPA RSL values).
- 1,260 µg/kg in sediment (in the absence of RSL values).

PFOA:

- 0.07 µg/L in groundwater/surface water (combined with PFOS value).
- 1,260 µg/kg in soil (in the absence of RSL values).
- 1,260 µg/kg in sediment (in the absence of RSL values).

While PFOS and PFOA are the focus of the HA and provide specific targets for the USAF to address in this SI, EPA has also derived RSLs for perfluorobutane sulfonate (PFBS), for which there is a Tier 2 toxicity value (Provisional Peer Reviewed Toxicity Value). The USAF also considers a release to be confirmed when exceedances of the following concentrations were identified:

PFBS:

- 400 µg/L in groundwater/surface water.
- 1,300,000 µg/kg in soil/sediment.

To better facilitate reporting and discussion of the investigation, sampling, and analysis of PFOA/PFOS/PFBS in this report, these compounds are hereafter referred to collectively as PFAS.

Table 1 presents the screening values used for comparing the analytical results for each of the PFAS compounds.

Table 1 Regulatory Screening Values

Parameter	Chemical Abstract Number	EPA Regional Screening Level Table (June 2017) [a]		Calculated Screening Levels for Soil and Sediment[b] (µg/kg)	EPA Health Advisory for Drinking Water (Surface Water or Groundwater) (µg/L) [c]
		Residential Soil (µg/kg)	Tap Water (µg/L)		
Perfluorobutane sulfonate (PFBS)[e]	375-73-5	1,300,000	400	NL	NL
Perfluorooctanoic acid (PFOA)	335-67-1	NL	NL	1,260	0.07[d]
Perfluorooctane sulfonate (PFOS)	1763-23-1	NL	NL	1,260	

[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017]
[b] Screening levels are calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
[c] EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)" and EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."
[d] When both PFOA and PFOS are both present, the combined concentrations of PFOA and PFOS were compared with the 0.07 µg/L health advisory level.
[e] The requirement to screen for PFBS was added to the project by AFCEC after the QAPP addendum (ASL, August 2016) was finalized.
µg/kg = micrograms per kilogram µg/L = micrograms per liter
AFCEC = Air Force Civil Engineer Center EPA = Environmental Protection Agency NL = not listed

A preliminary assessment (PA) conducted in March 2016 identified seven sites at PAFB where potential releases of AFFF had occurred and further investigation was needed, as summarized on Table 2 (ASL, November 2016). Due to their proximity, the golf course/leach field, Detention Pond #3, and Site 5 were combined into one area resulting in five AFFF areas. AFFF Areas 1 through 5 are discussed below and are shown on Figure 2 in Appendix A.

Table 2 AFFF Areas and Selection Rationale for Site Inspections at PAFB

AFFF Area	Location	Associated Existing ERP Site ID	Rationale
1	Site 8	FT003	• Site 8 was an active FTA from 1977 to 1991 • AFFF was potentially used during fire training events. The total volume of AFFF released is unknown.
2	Building 218, Fire Station #1	Not Applicable (New Site)	• Spray tests were primarily conducted on the paved surface leading to the aircraft apron. Runoff from these tests drain to Pond #3. • During freezing temperatures, spray testing was conducted in the sand volleyball court area adjacent to the station. • An unknown volume of AFFF has been released into the sand volleyball court area. • Building 117 was the original fire station at PAFB and was slightly southwest of Building 218. • Spray testing conducted during the time that Fire Station #1 was at Building 117 was usually performed on the apron immediately southeast of Building 104 and occasionally on the apron adjacent to Building 117.
3	Building 2032, Fire Station #2	Not Applicable (New Site)	• Spray tests were conducted along the road leading to the airfield. • An unknown volume of AFFF may have been released during spray testing.
4	Golf Course/ Leach Field	WP006	• Prior to construction of the golf course, the leach field was in this area. The leach field served as a final point to which all industrial runoff was routed. • Spray testing was conducted on the northern edge of the airfield ramp between the ramp and the golf course. • The golf course uses water from Pond #3 for irrigation. • An unknown volume of AFFF may have been released from this location.
4	Pond #3	WP006	• Pond #3 is a lined detention pond that receives all runoff from the industrial areas of PAFB. • Adjacent to Detention Pond #3 is an unlined overflow pond. If Pond #3 gets too full, it will dispense water through Outfall #4 into the overflow pond. • Water from Pond #3 is not treated for AFFF. • An unknown volume of AFFF may have been released from this location.
4	Site 5	FT002	• Site 5 was an active FTA from 1956 to 1977. Though no record confirming use could be found, it is likely that AFFF was used at this location. • Soil was excavated from Site 5 during construction of the golf course and placed in Landfill 3, approximately 1 mile south-southwest of the site. • Soil placed in Landfill 3 was subsequently excavated and relocated to a landfill immediately south of Runway 17R/35L.

AFFF Area	Location	Associated Existing ERP Site ID	Rationale
5	Current FTA	Not Applicable (New Site)	• The current FTA has been fully operational since 1991/1992 and currently uses propane as a fuel source. • From 1991/1992 until 1999, hydrocarbon fuels were used as a fuel source and an unknown volume of AFFF was used during this period. Although there were no known releases of AFFF to the environment reported in the PA, CDPHE requested that a site inspection be conducted at the current FTA.

Table Modified from ASL, November 2016
AFFF = aqueous film forming foam
CDPHE = Colorado Department of Public Health and Environment
ERP = Environmental Restoration Program
FTA = fire training area
ID = identification
PA = preliminary assessment
PAFB = Peterson Air Force Base

2.0 SITE DESCRIPTIONS

2.1 PETERSON AFB

Initially opened as Colorado Springs Municipal Airport in 1926, PAFB officially opened as Colorado Springs Army Air Base in 1942. The facility was named Peterson Army Air Base in December 1942 and has been the home of various training and operational units through several base closures, reactivations, and name changes. Renamed Peterson Air Force Base in 1976 and home to the 21st Space Wing, the base provides missile warning and space control to the North American Aerospace Defense Command and United States Strategic Command through a network of ground- and space-based sensors. PAFB and the Colorado Springs area have a semi-arid climate and receive 16 inches of rain (including 41 inches of snow) annually. The average number of days with any measurable precipitation is 89, and the average number of sunny days per year is 243. The average July high is 85 degrees Fahrenheit and the average January low is 16 degrees Fahrenheit (ASL, November 2016).

2.2 SITE 8 (FT003) – AFFF AREA 1

Site 8 (Figure 3 in Appendix A) is a former fire training area (FTA) (Environmental Restoration Program [ERP] ID FT003) that was active from 1977 until late 1991/early 1992. Now on Colorado Springs Airport (COS) property south of PAFB, Site 8 is well vegetated and maintained by COS. All structures associated with the FTA have been removed but included a collection pit, an oil/water separator (OWS), and associated piping. Water/liquids collected in the pit drained to the OWS, and water was ultimately allowed to discharge to the ground surface to a drainage area east of the site. The original size of the pit is unknown and is now filled with soil and covered with grass. Although there is no information available concerning AFFF use at Site 8, it may have been used during fire training events given the time period the FTA was in use.

2.3 FIRE STATION #1 (BUILDING 218) – AFFF AREA 2

Building 218
Fire Station #1 (Building 218) is on Suffolk Street near the intersection of East Duluth Avenue, as shown on Figure 4. Until recently, time and distance tests were conducted periodically at the fire station to certify the performance of the pump and spray system on the trucks. AFFF spray testing at Fire Station #1 was primarily conducted on the concrete on the aircraft apron side of the building. Surface runoff was

directed into the PAFB storm water system, which ultimately discharged to Pond #3. During freezing weather, however, spray testing was conducted over the adjacent volleyball court to avoid icing the concrete ramp. The volleyball court has a sand surface and a soil subsurface and AFFF released during spray testing would percolate into the ground in this area. The volume of AFFF released during previous spray testing at the volleyball court is unknown. Spray testing of AFFF has now been discontinued at PAFB.

Former Building 117
Former Building 117 was the original fire station at PAFB and was slightly southwest of Building 218, as shown on Figure 4. Spray testing conducted when Fire Station #1 was at Building 117 was usually performed on the apron west of the former leach field, as shown on Figure 2 and discussed further in Section 2.5. However, spray testing was also occasionally conducted on the apron adjacent to Building 117.

2.4 FIRE STATION #2 (BUILDING 2032) – AFFF AREA 3

Fire Station #2 is on El Dorado Street off Stewart Avenue in the eastern section of the facility, as shown on Figure 5. The fire station began operations in 1996 and until recently, time and distance tests were conducted periodically on the west side of the building along the airport access road. The total volume of AFFF released during previous spray testing at this location is unknown. As stated previously, spray testing of AFFF has now been discontinued at PAFB.

2.5 GOLF COURSE/LEACH FIELD (WP006), DETENTION POND #3, AND SITE 5 (FT002) – AFFF AREA 4

Three sites in the southern portion of PAFB and identified as known or suspected AFFF release sites include the golf course/leach field (WP006), Detention Pond #3, and Site 5 (FT002). Due to their proximity, these sites have been grouped as AFFF Area 4, as shown on Figure 6 in Appendix A.

Golf Course/Leach Field (WP006)
The PAFB golf course in the south central portion of PAFB was built in 1977. Prior to construction of the golf course, a leach field occupied a portion of this area and was active from 1956 to 1978. Irrigation water used at the golf course and industrial discharges to the leach field may have contained AFFF-impacted water.

The leach field was part of an industrial waste drainage system and consisted of a settling tank, an OWS, and a gravel envelope leach field. Effluent from the leach field infiltrated the subsurface overburden, primarily migrating downward until encountering bedrock and/or the uppermost water-bearing zone. At that point, the effluent would mix with groundwater, which flows to the southwest. In 1978, industrial discharges from PAFB were connected to the sanitary sewer line and the leach field was decommissioned. AFFF released from hangars at PAFB from 1970 until 1978 would have ultimately discharged to the leach field. Subsequently, the PAFB golf course was constructed over the leach field.

From 1979 to present day, the PAFB golf course has used water from Pond #3 and two other ponds on the course for irrigation. Pond #3 receives surface water runoff from the industrialized/developed portions of the base and may have received AFFF-impacted water during previous releases during spray testing. The volume of AFFF released at both the golf course and the leach field area is unknown. A former AFFF spray test area mentioned in Section 2.3 is on the northern edge of the airfield ramp, as shown on Figure 6 in Appendix A, and was investigated as a part of Site 4.

Detention Pond #3

Pond #3 was constructed in 1979 as an unlined detention pond; in early 2002, the pond was upgraded and the current butyl rubber liner installed. The pond is in the southern portion of PAFB between Taxiway B and the golf course and receives surface/storm water runoff from the central and western portions of the base and all industrialized areas on base. Recently discovered 1997 photographs show AFFF on the surface of the pond and a cleanup effort in progress. Although no other information is available, it appears an unknown quantity of AFFF was released to the unlined pond.

Prior to the construction of Pond #3, there was another pond approximately 850 feet to the south (based on the 1961 USGS Elsmere Topographic Quadrangle map) that received surface runoff from the same areas that currently discharge to Pond #3, as shown on Figure 6 in Appendix A.

Untreated water from Pond #3 is used to fill Ponds 1 and 2 and to irrigate the adjacent golf course. When Pond #3 reaches its maximum capacity, overflow is routed to the adjacent unlined detention pond and allowed to infiltrate into the ground surface. The total volume of AFFF released at this location is unknown.

Site 5 (FT002)

Site 5, also known as FTA-1, is a former FTA near the intersections of Taxiways B and F and immediately south of the golf course. The FTA was active from the 1960s through 1977 and consisted of a shallow unlined burn pit. Originally at the same elevation as the golf course, the area has been filled during construction of Taxiway F and is now part of the COS. The FTA included a shallow unlined burn pit where JP-4, waste oils, and solvents were used for training fires (ASL, November 2016).

During construction of the PAFB golf course, soil excavated from the former FTA was placed in Landfill 3, approximately 1 mile south-southwest of the site, as shown on Figure 7 in Appendix A. The excavated material placed in Landfill 3 was subsequently excavated in 1989 during COS expansion and placed in a landfill south of Runway 17R/35L, also shown on Figure 7 in Appendix A.

2.6 CURRENT FTA – AFFF AREA 5

The current FTA (Figure 8 in Appendix A) is in the northwestern portion of the facility near the intersection of Ent Avenue and Goodfellow Street. The FTA is bordered by grassy areas associated with the airfield to the west and northwest and by paved developed areas to the east and southeast. The current FTA has been in use since 1989 and includes a burn pit, a dual high-density polyethylene (HDPE) liner, and a mock aircraft. Firefighting foams were used frequently in the past when flammable fuels were ignited for training; however, current fire training activities use water.

Water generated from training activities is pumped into an enclosed holding tank on the southern side of the training area. The holding tank previously had an OWS associated with it, but the OWS has been removed. The holding tank is occasionally drained into the sanitary sewer system, but such events are rare. A portion of the water would be sent to the sanitary sewer when the tank would get to capacity and more training was to occur. Approximately 10,000 to 20,000 gallons of water would be discharged during each event.

There were no releases of AFFF reported during the PA because the burn pit was lined and it was assumed that AFFF used during training was contained. The Colorado Department of Health and Environment (CDPHE), however, requested that the FTA be included in the SI process to confirm that previous use of AFFF had not resulted in releases to the environment.

Subsequent to sampling conducted during this SI, PAFB independently sampled three locations around the FTA; a leak detection well, an existing FTA well (outside the liner), and a firefighting solution holding tank at the FTA (Recker, November 2016). The leak detection well is a sump between the primary and secondary containment liners, the FTA well was installed during a 1997 investigation to assess the integrity of the liner system (Blanche, February 1998), and the holding tank is part of the fire suppression system used during training activities. PFAS were detected in each of the samples collected. Detections of PFOA at 7.4 µg/L and PFOS at 81 µg/L in the FTA well outside the liner confirm that AFFF releases have occurred at the FTA. These releases were apparently the result of overspray as the integrity of the secondary liner was shown to be intact during the 1997 investigation as well as during a second dye test conducted by PAFB in 2016 (PAFB, November 2016).

3.0 FIELD ACTIVITIES AND FINDINGS

ASL conducted SI field activities at PAFB between October 24 and November 12, 2016. Field activities included installing and sampling groundwater monitoring wells, collecting surface and subsurface soil samples, and collecting surface water and sediment samples. A readiness review was conducted for all field personnel prior to mobilizing to the site. The readiness review covered anticipated hazards, types and proper use of equipment needed for the field activities, sampling procedures, and procedures to be used to prevent cross-contamination of samples with PFAS-containing compounds. These procedures included

- not allowing equipment containing Teflon (polytetrafluoroethylene [PTFE]) components to come into contact with the samples (they can be a potential source of PFAS contamination);
- not allowing sampling personnel to don Gore-Tex® clothing, Tyvek® suits, or clothes treated with stain- or rain-resistant coatings; and
- requiring field personnel to wash their hands thoroughly before coming onsite after coming into contact with plastic wrappers, Post-It® notes, or Styrofoam® cups (these are also potential sources of PFAS contamination).

Samples were submitted via overnight courier to Maxxam Analytics International Corporation of Mississauga, Ontario, Canada, under chain of custody procedures. The samples were analyzed by modified EPA Method 537, "Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)." Eighteen PFAS compounds are included in this analysis; however, only the three analytes listed below have health-based screening levels associated with them.

Analyte	CAS Number
• Perfluorobutane sulfonate (PFBS)	375-73-5
• Perfluorooctanoic acid (PFOA)	335-67-1
• Perfluorooctane sulfonate (PFOS)	1763-23-1

CAS = Chemical Abstract Service

Third-party data validation was conducted on 100 percent of the analytical data for the PFAS compounds. The data validation report and laboratory data sheets are in Appendix C.

Field activities included collection of surface and subsurface soil samples, collection of groundwater samples (from both newly installed and existing monitoring wells), and collection of surface water and sediment samples. Sample locations were selected in areas most likely to have been impacted by known or suspected AFFF releases. Soil borings were advanced with a track-mounted, compact sonic drill rig.

Soil cores were collected by advancing a 4-inch, inner core barrel to the desired sample depth (typically in 5-foot or 10-foot intervals) and over-drilling with a 6-inch outer casing. The core barrel and soil core were retrieved, leaving the 6-inch outer casing to maintain the integrity of the borehole. Soil cores were then vibrated from the core barrel into plastic sleeves for logging, field screening, and sample collection. Prior to logging, slits were cut in the sample sleeve and the soil cores screened with a photoionization detector (PID). After recording the PID readings on the boring log, the soil core was measured and the recovered length recorded in the boring log. The sample sleeve was then opened and the core visually logged. All borings were logged by a trained geologist (with a degree from an accredited university) experienced in describing soil core and overseen by a senior geologist. The soil descriptions were in accordance with the Geology Supplement to the Scope of Services (revised June 2013) and followed the general format:

- Color (using Munsell soil color charts);
- Soil type (fat clay, lean clay, sand, silty gravel, etc.);
- Grading, grain size, consistency/density, moisture content, cementing;
- Other notable features (staining, organics, fossils, odors, etc.); and
- Unified Soil Classification System symbol (CH, CL, SP, GM, etc.).

Surface soil samples were collected from 0 to 6 inches below ground surface (bgs) with a combination of stainless steel hand augers and stainless steel spoons. Subsurface soil samples were collected immediately above the water saturated-unsaturated soil interface either with hand augers or from the soil core generated during sonic drilling.

A total of 17 new groundwater monitoring wells were installed during the field activities for this SI. All of the wells were constructed with 2-inch-diameter, schedule 40 polyvinyl chloride screens (continuous wrap 0.010" slot) and risers with flush mount threads. Screens were typically ten feet long; however in some instances, longer screens were installed to ensure the saturated zone was adequately penetrated and sufficient water was available for sampling. Sand filter packs were installed by tremieing the sand through the outer sonic casing and vibrating it in place. Boring logs and well construction diagrams are included in Appendix B. Bentonite seals in new wells were allowed to hydrate for at least 24 hours (and typically up to 48 hours before development). Each new monitoring well was developed until the column of water in the well was free of visible sediment and/or potential of hydrogen (pH), temperature, turbidity, and specific conductivity stabilized. All well development was completed after bentonite seal hydration and before grouting. Construction details for the 17 new wells are summarized in Table G-1 in Appendix G.

Sampling was conducted at least 24 hours after development. Groundwater samples were typically collected with electric submersible pumps and disposable polyvinyl tubing using low-flow sampling methodology. Groundwater samples collected from PETER02-003 and PETER04-002, however, were collected using polyethylene bailers due to poor recharge. Sediment samples were collected using a combination of dip samplers and stainless steel spoons. Surface water samples were collected directly from surface water bodies into the sample containers. Well development logs, groundwater sampling logs, and sample collection forms are included in Appendix B.

Land survey was used to establish the coordinates and surface elevations of the soil borings and the surface elevations and top-of-casing elevations of the groundwater monitoring wells. Survey data obtained from a licensed surveyor has been revised to show accuracy of one hundredth of a foot (horizontal and vertical) for the soil borings and monitor wells. Northing and easting coordinates were recorded in US survey feet using the US State Plane 1983 coordinate system, Colorado Central Zone. Elevations were recorded referenced to the North American Vertical Datum 1988. Surface water and sediment sample locations were recorded with a Trimble® Geo 7X handheld global positioning system (GPS) unit. Post processed horizontal data collected with the Trimble® Geo 7X is accurate to sub-meter intervals.

Sample locations, site-specific lithology, groundwater flow direction, analytical results, and conclusions for each AFFF area are presented below.

3.1 SITE 8 (FT003) – AFFF AREA 1

3.1.1 Sample Locations

Three soil borings/monitoring wells were installed at Site 8, as shown on Figure 3 in Appendix A. Soil boring/monitoring well PETER01-001 was installed within the burn pit boundary where AFFF spraying occurred, soil boring/monitoring well PETER01-003 was installed in the drainage area east of the burn pit, and soil boring/well PETER01-002 was installed downgradient of the site to the southwest. A surface soil sample and a subsurface soil sample were collected from each boring and a groundwater sample was collected from each monitoring well. There is no surface water present at Site 8; therefore, no surface water surface or sediment samples were collected.

3.1.2 Lithology and Soil Description

Borings PETER01-001, PETER01-002, and PETER01-003 were drilled to total depths of 92 feet bgs, 100 feet bgs, and 87 feet bgs, respectively, at Site 8. The Pierre Shale was encountered at depths of 89 feet bgs, 99.5 feet bgs, and 83.5 feet bgs, respectively. The overlying unconsolidated sediments varied from yellowish brown to grayish brown and brownish gray and primarily consisted of well graded sand (SW), silty sand (SM), sandy silt (ML) with trace to frequent gravel, sandy clay (CL), and clayey sand (SC). The Pierre Shale was described as gray to very dark gray, weathered, and fossiliferous. Detailed boring logs for AFFF Area 1 are included in Appendix B.

3.1.3 Groundwater Flow

Groundwater depths were measured at AFFF Area 1 on December 6, 2016, as summarized on Table F-1 in Appendix F. Groundwater was detected in monitoring wells PETER01-001, PETER01-002, and PETER01-003 at depths 85.50 feet below top of casing (btoc), 94.49 btoc, and 76.56 feet btoc, respectively, with groundwater flow to the southwest, as shown on Figure 3 in Appendix A.

3.1.4 Analytical Results

Surface Soil

Three primary surface soil samples and one duplicate sample were collected from three soil borings completed at Site 8. PFBS was detected in one primary sample and one duplicate sample, PFOA was detected in two primary samples and one duplicate sample, and PFOS was detected in all three primary samples and in the duplicate sample. All PFBS, PFOA, and PFOS detections were below their respective screening levels, as summarized in Table 3 and as shown on Figure 9 in Appendix A.

Table 3 AFFF Area 1 – Site 8 Former FTA – Surface Soil Analytical Results

Analyte	Sample ID	PETER01-001-SS-001	PETER01-001-SS-901 (dup)	PETER01-002-SS-001	PETER01-003-SS-001
	Depth (ft)	0–0.5	0–0.5	0–0.5	0–0.5
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	**0.41 J**	**0.48 J**	0.21 U	0.23 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	**3.7 J**	**9.7 J**	0.098 U	**3.1**
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**77 J**	**36 J**	**3.9**	**120**

Bold values indicate analyte detected at concentration indicated.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017]
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot dup = duplicate sample
J = reported concentration is an estimated value. U = analyte was not detected above the reported value.

Subsurface Soil

Three primary subsurface soil samples and one duplicate sample were collected from three soil borings completed at Site 8. PFBS was detected in two primary samples and one duplicate sample; PFOA was not detected in any of the samples, and PFOS was only detected in one primary sample. All PFBS and PFOS detections were below their respective screening levels, as summarized in Table 4 and as shown on Figure 9 in Appendix A.

Table 4 AFFF Area 1 – Site 8 Former FTA – Subsurface Soil Analytical Results

Analyte	Sample ID	PETER01-001-SO-083	PETER01-001-SO-983 (dup)	PETER01-002-SO-089	PETER01-003-SO-075
	Depth (ft)	82–83	82–83	88–89	74–75
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	**2.2 J**	**3.1 J**	0.25 U	**0.77 J**
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.11 U	0.11 U	0.12 U	0.11 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**0.16 J**	0.14 U	0.16 U	0.15 U

Bold values indicate analyte detected at concentration indicated.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017]
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot FTA = fire training area ID = identification
J = reported concentration is an estimated value. U = analyte was not detected above the reported value.

Soil Physiochemical Analyses

To provide basic soil parameter information, a composite surface soil sample and a composite subsurface soil sample were collected from soil borings completed at Site 8 and submitted for pH, total organic carbon (TOC), and grainsize analysis. The surface soil sample (PETER01-004-SS-001) was composed of equal aliquots of soil collected from borings PETER01-001 through PETER01-003 at a depth of six

inches. The subsurface soil sample (PETER01-004-SO-088) was composed of equal aliquots of soil collected from soil borings PETER01-001 through PETER01-003 at depths ranging from 74 feet bgs to 88 feet bgs. Table E-1 summarizing physiochemical data and laboratory data sheets are included in Appendix E.

Groundwater

Three primary groundwater samples and one duplicate sample were collected from three monitoring wells installed at Site 8 (PETER01-001, PETER01-002, and PETER01-003). PFBS was detected in all four samples, all at concentrations below the RSL of 400 µg/L. PFOA and PFOS were not detected in any of the four samples. Groundwater analytical results for PFBS, PFOA, and PFOS are presented in Table 5 below and are shown on Figure 10 in Appendix A.

Table 5 AFFF Area 1 – Site 8 Former FTA – Groundwater Analytical Results

	Sample ID	**PETER01-001-GW-087**	**PETER01-001-GW-987 (dup)**	**PETER01-002-GW-095**	**PETER01-003-GW-082**
Analyte	**Screening Level (µg/L)**	**Result (µg/L)**	**Result (µg/L)**	**Result (µg/L)**	**Result (µg/L)**
Perfluorobutane Sulfonate (PFBS)	400[a]	**0.27**	**0.27**	**0.10**	**0.020 J**
Perfluorooctanoic Acid (PFOA)	0.07[b]	0.0053 U	0.0053 U	0.0053 U	0.0053 U
Perfluorooctane Sulfonate (PFOS)	0.07[b]	0.0033 U	0.0033 U	0.0033 U	0.0033 U
PFOS + PFOA	0.07[c]	ND	ND	ND	ND

Bold values indicate analyte detected at concentration indicated. dup = duplicate sample

[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].

[b]Health Advisory limit listed in EPA 2016 Drinking Water Health Advisory for Perfluoroctanoic Acid (EPA Document # 822-R-16-005) and EPA 2016 Drinking Water Health Advisory for Perfluoroctane Sulfonate (EPA Document # 822-R-16-004).

[c]EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.

µg/L = micrograms per liter AFFF = aqueous film forming foam ID = identification

J = reported concentration is an estimated value ND = not detected

U = analyte was not detected above the reported value.

3.1.5 Conclusions

Although use of AFFF at Site 8 has resulted in detections of PFAS in surface soil, subsurface soil, and groundwater, all PFAS concentrations were below screening levels.

3.2 FIRE STATION # 1 (BUILDING 218) – AFFF AREA 2

3.2.1 Sample Locations

Three soil borings/monitoring wells (PETER02-001, PETER02-002, and PETER02-003) were installed at the volleyball court at Fire Station #1, as shown on Figure 4 in Appendix A. Although spray testing was generally conducted on paved surfaces at the fire station, testing was conducted on the volleyball court during freezing weather. A surface soil and a subsurface soil sample were collected from each boring, and groundwater samples were collected from PETER02-001 and PETER02-003. Monitoring well PETER02-002 was dry and could not be sampled. There is no surface water present at Fire Station #1; therefore, no surface water surface or sediment samples were collected.

3.2.2 Lithology and Soil Description

Boring PETER02-001 was drilled to a depth of 66 feet bgs and encountered the Pierre Shale at a depth of 65 feet bgs. Borings PETER02-002 and PETER02-003 were drilled to depths of 40 feet and 50 feet bgs, respectively, and were terminated above the Pierre Shale. Unconsolidated sediments encountered at AFFF Area 2 consisted primarily of well graded sand (SW), poorly graded sand (SP) with a trace to frequent gravel, silty sand (SM), sandy clay (CL). The Pierre Shale was described as yellowish brown, brittle, and sandy. Detailed boring logs for AFFF Area 2 are included in the Appendix B.

3.2.3 Groundwater Flow

Based on water level measurements collected at AFFF Area 2 on December 6, 2016, groundwater was detected in monitoring wells PETER02-001 and PETER02-003 at depths 51.20 feet btoc and 48.15 feet btoc. PETER02-002 was dry. Based on groundwater elevations at AFFF Area 2 and AFFF Area 4 groundwater flow at Area 2 is to the south-southwest, as shown on Figure 4 in Appendix A.

3.2.4 Analytical Results

Surface Soil

Three surface soil samples were collected from three soil borings completed at Fire Station #1. PFBS was not detected in any of the three samples, PFOA was detected in two samples, and PFOS was detected in all three samples. All PFOA and PFOS detections were below their respective screening levels, as summarized in Table 6 and as shown on Figure 11 in Appendix A.

Table 6 AFFF Area 2 – Fire Station #1 Building 218 Surface Soil Analytical Results

	Sample ID	PETER02-001-SS-001	PETER02-002-SS-001	PETER02-003-SS-001
	Depth (ft)	0–0.5	0–0.5	0–0.5
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.21 U	0.22 U	0.21 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.10 U	**0.61 J**	**0.51 J**
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**7.0**	**110**	**160**

Bold values indicate analyte detected at concentration indicated.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot ID = identification
J = reported concentration is an estimated value.
U = analyte was not detected above the reported value.

Subsurface Soil

Three subsurface soil samples were collected from three soil borings completed at Fire Station #1. PFBS and PFOA were not detected in any of the three samples. PFOS was detected in all three samples but at

concentrations below the screening level. Subsurface analytical results are summarized in Table 7 and are shown on Figure 11 in Appendix A.

Table 7 AFFF Area 2 – Fire Station #1 Building 218 Subsurface Soil Analytical Results

	Sample ID	PETER02-001-SO-024	PETER02-002-SO-024	PETER02-003-SO-034
	Depth (ft)	23–24	23–24	33–34
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.22 U	0.22 UJ	0.22 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.10 U	0.11 UJ	0.11 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**0.64 J**	**0.78 J**	**5.6**

Bold values indicate analyte detected at concentration indicated.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot ID = identification
J = reported concentration is an estimated value.
U = analyte was not detected above the reported value.
UJ = analyte was not detected at the reported value; the reported value is estimated.

Soil Physiochemical Analyses

To provide basic soil parameter information, a composite surface soil sample and a composite subsurface soil sample were collected from soil borings completed at Fire Station #1 and submitted for pH, TOC, and grainsize analysis. The surface soil sample (PETER02-004-SS-001) was composed of equal aliquots of soil collected from borings PETER02-001 through PETER02-003 at a depth of six inches. The subsurface soil sample (PETER02-004-SO-027) was composed of equal aliquots of soil collected from soil borings PETER02-001 through PETER02-003 at depths ranging from 23 feet bgs to 34 feet bgs. Table E-1 summarizing physiochemical data and laboratory data sheets are included in Appendix E.

Groundwater

Groundwater samples were collected from two monitoring wells installed at Fire Station #1 (PETER02-001 and PETER02-003). A third well (PETER02-002) was dry and could not be sampled. PFBS was detected in both samples at concentrations below the RSL of 400 µg/L. Combined PFOA/PFOS concentrations exceeded the screening level of 0.07 µg/L in both samples at estimated concentrations of 0.178 µg/L and 0.077 µg/L. Groundwater analytical results for PFBS, PFOA, and PFOS are summarized in Table 8 below and are shown on Figure 12 in Appendix A.

Table 8 AFFF Area 2 – Fire Station #1 Building 218
Groundwater Analytical Results

Analyte	Sample ID	PETER02-001-GW-056	PETER02-002	PETER02-003-GW-043
	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane Sulfonate (PFBS)	400[a]	**0.010 J**	**Dry**	**0.030**
Perfluorooctanoic Acid (PFOA)	0.07[b]	**0.12 J**	**Dry**	**0.065**
Perfluorooctane Sulfonate (PFOS)	0.07[b]	**0.058 J**	**Dry**	**0.012 J**
PFOS + PFOA	0.07[c]	**0.178 J**	**Dry**	**0.077 J**

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b]Health Advisory limit listed in EPA 2016 Drinking Water Health Advisory for Perfluoroctanoic Acid (EPA Document # 822-R-16-005) and EPA 2016 Drinking Water Health Advisory for Perfluoroctane Sulfonate (EPA Document # 822-R-16-004).
[c]EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.
µg/L = micrograms per liter AFFF = aqueous film forming foam ID = identification
J = reported concentration is an estimated value.

3.2.5 Conclusions

Spray testing at Fire Station #1 has resulted in releases of PFAS to the environment. Although PFAS concentrations in soil were below screening levels, combined PFOA/PFOS concentrations exceeded the EPA HA in two groundwater samples collected at the site.

3.3 FIRE STATION #2 (BUILDING 2032) – AFFF AREA 3

3.3.1 Sample Locations

Three soil borings/monitoring wells were installed at Fire Station #2, as shown on Figure 5 in Appendix A. PETER03-001 was installed north of Building 2032 where AFFF spray testing was conducted, PETER03-002 was installed southeast of Building 2032, and PETER03-003 was installed downgradient of the site to the west-southwest. A surface soil and subsurface soil sample were collected from each monitoring well boring and a groundwater sample was collected from each monitoring well. There is no surface water present at Fire Station #2; therefore, no surface water or sediment samples were collected.

3.3.2 Lithology and Soil Description

Borings PETER03-001, PETER03-002, and PETER03-003 were drilled to depths of 75 feet bgs, 76 feet, bgs and 75 feet bgs, respectively, and the Pierre Shale was encountered at depths of 73.9 feet bgs, 75.6 feet bgs, and 74 feet bgs. The overlying unconsolidated sediments encountered at AFFF Area 3 consisted of silty sand (SM), well graded sand (SW) with trace to abundant gravel, sandy silt (ML), silt (ML), and sandy clay (CL). The Pierre Shale was described as light olive gray to olive black, platy, and silty to sandy, with traces of embedded calcite. Detailed boring logs for AFFF Area 3 are included in Appendix B.

3.3.3 Groundwater Flow

Based on water level measurements collected at AFFF Area 3 on December 6, 2016, groundwater was detected in monitoring wells PETER03-001, PETER03-002, and PETER03-003 at depths 66.24 feet btoc, 66.59 feet btoc, and 69.31 feet btoc with groundwater flow to the southwest, as shown on Figure 5 in Appendix A.

3.3.4 Analytical Results

Surface Soil

Three surface soil samples were collected from three soil borings completed at Fire Station #2. PFBS was detected in one of the three samples and PFOA was detected in one of the three samples, both PFBS and PFOA below their respective screening levels. PFOS was detected in two of the three samples and exceeded the screening level of 1,260 µg/kg at a concentration of 2,400 µg/kg in PETER03-003-SS-001. Surface soil analytical results are summarized in Table 9 and shown on Figure 13 in Appendix A.

Table 9 AFFF Area 3 – Fire Station #2 Building 2032 Surface Soil Analytical Results

	Sample ID	**PETER03-001-SS-001**	**PETER03-002-SS-001**	**PETER03-003-SS-001**
	Depth (ft)	**0–0.5**	**0–0.5**	**0–0.5**
Analyte	**Screening Level (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	**0.29 J**	0.20 UJ	21 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.096 UJ	**0.22 J**	9.8 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	0.13 UJ	**2.0 J**	**2,400**

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot
J = reported concentration is an estimated value.
U = analyte was not detected above the reported value.
UJ = analyte was not detected at the reported value; the reported value is estimated.

Subsurface Soil

Three subsurface soil samples were collected from three soil borings completed at Fire Station #2. PFBS and PFOS were detected in one sample below their respective screening levels; PFOA was not detected in any of the three samples. Subsurface analytical results are summarized in Table 10 and shown on Figure 13 in Appendix A.

Table 10 AFFF Area 3 – Fire Station #2 Building 2032 Subsurface Soil Analytical Results

Analyte	Sample ID	PETER03-001-SO-064	PETER03-002-SO-065	PETER03-003-SO-069
	Depth (ft)	63–64	64–65	68–69
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.21 UJ	0.20 UJ	**0.76 J**
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.10 UJ	0.095 U	0.098 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	0.13 UJ	0.13 UJ	**0.49 J**

Bold values indicate analyte detected at concentration indicated.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot ID = identification
J = reported concentration is an estimated value. U = analyte was not detected above the reported value.
UJ = analyte was not detected at the reported value; the reported value is estimated.

Soil Physiochemical Analyses

To provide basic soil parameter information, a composite surface soil sample and a composite subsurface soil sample were collected from soil borings completed at Fire Station #2 and submitted for pH, TOC, and grainsize analysis. The surface soil sample (PETER03-004-SS-001) was composed of equal aliquots of soil collected from borings PETER03-001 through PETER03-003 at a depth of six inches. The subsurface soil sample (PETER03-004-SO-066) was composed of equal aliquots of soil collected from soil borings PETER03-001 through PETER03-003 at depths ranging from 63 feet bgs to 69 feet bgs. Table E-1 summarizing physiochemical data and laboratory data sheets are included in Appendix E.

Groundwater

Three primary groundwater samples were collected from three monitoring wells installed at Fire Station #2 (PETER03-001, PETER03-002, and PETER03-003). PFBS was detected in all three samples, all at concentrations below the RSL of 400 µg/L. PFOA and PFOS were detected in PETER03-002 and PETER03-003, also below the screening level of 0.07 µg/L. Groundwater analytical results for PFBS, PFOA, and PFOS are summarized in Table 11 below and are shown on Figure 14 in Appendix A.

Table 11 AFFF Area 3 – Fire Station #2 Building 2032 Groundwater Analytical Results

Analyte	Sample ID / Screening Level (µg/L)	PETER03-001-GW-064 Result (µg/L)	PETER03-002-GW-071 Result (µg/L)	PETER03-003-GW-070 Result (µg/L)
Perfluorobutane Sulfonate (PFBS)	400[a]	**0.0073 J**	**0.050 J**	**0.062 J**
Perfluorooctanoic Acid (PFOA)	0.07[b]	0.0053 UJ	**0.023 J**	**0.0084 J**
Perfluorooctane Sulfonate (PFOS)	0.07[b]	0.0033 UJ	**0.0064 J**	**0.028 J**
PFOS + PFOA	0.07[c]	ND	**0.0294 J**	**0.0364 J**

Bold values indicate analyte detected at concentration indicated.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b]Health Advisory limit listed in EPA 2016 Drinking Water Health Advisory for Perfluoroctanoic Acid (EPA Document # 822-R-16-005) and EPA 2016 Drinking Water Health Advisory for Perfluoroctane Sulfonate (EPA Document # 822-R-16-004).
[c]EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.
µg/L = micrograms per liter AFFF = aqueous film forming foam ID = identification
J = reported concentration is an estimated value.
UJ = analyte was not detected at the reported value; the reported value is estimated.

3.3.5 Conclusions

Spray testing at Fire Station #2 has resulted in detections of PFBS, PFOA, and PFOS in surface soil, subsurface soil, and groundwater. All detections of PFBS and PFOA were below screening levels. PFOS, however, was detected above the 1,260 µg/kg screening level in PETER03-003 at a concentration of 2,400 µg/kg. The detection was somewhat unexpected as the sample was collected outside the reported spray test area.

3.4 GOLF COURSE/LEACH FIELD (WP006), DETENTION POND #3, AND SITE 5 (FT002) – AFFF AREA 4

3.4.1 Sample Locations

The golf course/leach field, Pond #3, and Site 5 have been grouped together as AFFF Area 4 based on their proximity. Samples were collected from each of these areas and from two downgradient locations, as discussed below. Sample locations for AFFF Area 4 are shown on Figures 6 and 7 in Appendix A.

Golf Course/Leach Field (WP006)
Sampling was conducted at the golf course/leach field to evaluate use of potentially impacted irrigation water at the golf course and to evaluate impacts from past discharges of wastewater at the former leach field. Two surface soil samples (PETER04-010-SS-001 and PETER04-011-SS-001) were collected and six existing monitoring wells (MW2-1, MW2-2, MW2-3, MW2-4, MW2-5, and MW4-1) were sampled at the golf course/leach field. Co-located surface water and sediment samples (PETER04-006-SW-001 and PETER04-006-SD-001) were collected from Pond #2.

Pond #3
To evaluate potential AFFF impacts associated with Pond #3, two soil borings/monitoring wells were installed. Soil borings/monitoring wells PETER04-004 and PETER04-005 were installed southwest and

downgradient of Pond #3 in the grassed area between Taxiway B and the adjacent runway. A surface soil sample and a subsurface soil sample were collected from each boring and groundwater samples were collected from each monitoring well. An additional surface soil sample (PETER04-007-SS-001) was collected at Outfall 4 in lieu of planned co-located surface water and sediment samples since there was no water present during the SI. Co-located surface water and sediment samples PETER04-013-SW-001 and PETER04-013-SD-001 were collected from lined Pond #3 to assess current PFAS concentrations in the pond.

Site 5 (FT002)
Three soil borings/monitoring wells were installed on the south side of Site 5 (FT002) to evaluate possible impacts from use of AFFF during training exercises. PETER04-001 was installed in the grassed area just south of the former burn pit and Taxiway F. PETER04-002 and PETER04-003 were installed down gradient from Site 5 to the south and southwest. No surface soil samples were collected at Site 5 because the site has been filled during Taxiway F construction. There is no surface water at Site 5; therefore, no surface water or sediment samples were collected.

Spray Test Area
One surface soil sample (PETER04-012-SS-001) was collected from the northern edge of the airfield ramp southeast of Building 104 to assess possible impacts from historical spray testing conducted in the area. There is no surface water at the spray test area; therefore, no surface water or sediment samples were collected.

Downgradient Soil Borings/Monitoring Wells
Two soil borings/monitoring wells were installed downgradient of AFFF Area 4, as shown on Figure 7 in Appendix A. Soil boring/monitoring well PETER04-008 was installed in the COS long-term parking lot and soil boring/monitoring well PETER04-009 was installed south of Runway 17L/35R. A surface soil and subsurface soil sample were collected from each monitoring well boring and a groundwater sample was collected from each well.

3.4.2 Lithology and Soil Description

The total depth of the seven soil borings at AFFF Area 4 (five at the site and two downgradient) ranged from 53 feet bgs to 108 feet bgs. The Pierre Shale was encountered in six of the seven borings at depths ranging from 47 feet bgs (at PETER04-002) to 100 feet bgs (at PETER04-009); PETER04-005 was terminated at a depth of 70 feet bgs above the Pierre Shale. Unconsolidated sediments at AFFF Area 4 consisted primarily of well graded sand (SW), silty sand (SM) with gravel, silty sand (SM), clayey sand (SC), sandy silt (ML), silt (ML), and sandy clay (CL). The Pierre Shale was described as light olive gray and blueish gray to dark olive gray, weathered, and platy. Detailed boring logs for AFFF Area 4 are included in the Appendix B.

3.4.3 Groundwater Flow

Based on water level measurements collected at AFFF Area 4 from six existing monitoring wells and five newly installed monitoring wells on December 6, 2016, groundwater was detected at depths ranging from 42.56 feet btoc (at MW2-3) to 59.80 feet btoc (at MW4-1). Based on these measurements, ground flows to the southwest as shown on Figure 6. Groundwater was detected in downgradient monitoring wells PETER04-008 and PETER04-009 at depths of 91.19 feet btoc and 81.43 feet btoc and flows to the southwest, as shown on Figure 7.

3.4.4 Analytical Results

Surface Soil

Eight primary surface soil samples and one duplicate sample were collected from eight locations (six at AFFF Area 4 and two downgradient from Area 4). PFBS was detected in one sample; PFOA was detected in two samples, and PFOS was detected in eight of nine samples. All detected concentrations of PFBS, PFOA, and PFOS were below their respective screening levels, as summarized in Table 12 and as shown on Figures 15 and 17 in Appendix A.

Table 12 AFFF Area 4 – Golf Course/Leach Field, Detention Pond #3, and Site 5 Surface Soil Analytical Results

Analyte	Sample ID	PETER04-004-SS-001	PETER04-005-SS-001	PETER04-005-SS-901 (dup)	PETER04-007-SS-001
	Depth (ft)	0–0.5	0–0.5	0–0.5	0–0.5
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.24 U	0.22 U	0.23 UJ	0.23 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.12 U	0.11 U	0.11 U	0.11 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**0.32 J**	**1.4 J**	**0.49 J**	**0.80 J**

Analyte	Sample ID	PETER04-008-SS-001*	PETER04-009-SS-001*	PETER04-010-SS-001	PETER04-011-SS-001
	Depth (ft)	0–0.5	0–0.5	0–0.5	0–0.5
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.23 U	0.24 U	0.25 U	**0.27 J**
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.11 U	0.11 U	**1.5**	**0.49 J**
Perfluorooctane Sulfonate (PFOS)	1,260[b]	0.15 U	**0.28 J**	**61**	**57**

Table 12 AFFF Area 4 – Golf Course/Leach Field, Detention Pond #3, and Site 5 Surface Soil Analytical Results (continued)

Analyte	Sample ID (ft)	PETER04-012-SS-001
	Depth	0–0.5
	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.21 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.10 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**3.0**

Bold values indicate analyte detected at concentration indicated. *Downgradient location.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot dup = duplicate sample ID = identification
J = reported concentration is an estimated value.
U = analyte was not detected above the reported value.
UJ = analyte was not detected at the reported value; the reported value is estimated.

Subsurface Soil

Seven primary subsurface soil samples and one duplicate sample were collected from eight soil borings at AFFF Area 4. PFBS and PFOA were not detected in any of the samples; PFOS was detected in two samples (both at concentrations below the screening level of 1,260 µg/kg). Subsurface soil analytical results for AFFF Area 4 are summarized in Table 13 and are shown on Figures 15 and 17 in Appendix A.

Table 13 AFFF Area 4 – Golf Course/Leach Field, Detention Pond #3, and Site 5 Subsurface Soil Analytical Results

Analyte	Sample ID	PETER04-001-SO-049	PETER04-002-SO-041	PETER04-002-SO-941 (dup)	PETER04-003-SO-050
	Depth (ft)	48 - 49	40 - 41	40 - 41	49 - 50
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.24 U	0.23 UJ	0.22 U	0.23 UJ
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.11 U	0.11 UJ	0.10 U	0.11 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	0.15 U	0.14 UJ	0.14 U	0.15 UJ

Table 13 AFFF Area 4 – Golf Course/Leach Field, Detention Pond #3, and Site 5 Subsurface Soil Analytical Results (continued)

Analyte	Sample ID	PETER04-004-SO-058	PETER04-005-SO-054	PETER04-008-SO-088*	PETER04-009-SO-079*
	Depth (ft)	57 - 58	53 - 54	87 - 88	78 - 79
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.22 U	0.24 U	0.25 U	0.22 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.11 U	0.11 U	0.12 U	0.10 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**0.18 J**	**3.2**	0.16 U	0.14 U

Bold values indicate analyte detected at concentration indicated. *Downgradient location.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram ft = foot dup = duplicate sample
J = reported concentration is an estimated value.U = analyte was not detected above the reported value.
UJ = analyte was not detected at the reported value; the reported value is estimated.

Soil Physiochemical Analyses

To provide basic soil parameter information, a composite surface soil sample and a composite subsurface soil sample were collected from soil borings completed at AFFF Area 4 and submitted for pH, TOC, and grainsize analysis. The surface soil sample (PETER04-014-SS-001) was composed of equal aliquots of soil collected from borings PETER04-004, PETER04-005, and PETER04-007 through PETER04-009 at a depth of six inches. The subsurface soil sample (PETER04-014-SO-078) was composed of equal aliquots of soil collected from soil borings PETER04-001 through PETER04-005, PETER04-008, and PETER04-009 at depths ranging from 40 feet bgs to 88 feet bgs. Table E-1 summarizing physiochemical data and laboratory data sheets are included in Appendix E.

Groundwater

Thirteen primary samples and two duplicate samples were collected from seven newly installed monitoring wells and six existing monitoring wells at AFFF Area 4, as summarized in Table 14 and shown on Figure 16 in Appendix A. Five of the new wells and all six existing monitoring wells are in known or suspected AFFF source areas. The two remaining new wells (PETER04-008 and PETER04-009) were installed downgradient of AFFF Area 4, as shown on Figure 18 in Appendix A, to assess possible migration of PFAS offsite and are discussed as downgradient wells.

PFBS was detected in each of thirteen source area groundwater samples (11 primary samples and two duplicate samples) collected at AFFF Area 4; all detected concentrations were below the RSL of 400 µg/L. Concentrations of PFOA and/or PFOS were also found in each of the thirteen source area samples. Of the thirteen PFOA/PFOS detections, six (five primary samples and one duplicate sample) exceeded the screening level of 0.07 µg/L at estimated combined concentrations ranging from 0.079 µg/L to 0.98 µg/L. Three of the combined PFOA/PFOS exceedances occurred in existing wells at the golf course/leach field (MW2-1, MW2-3, and MW2-4), two exceedances (one primary and one duplicate) occurred in new well PETER04-002 at Site 5, and one exceedance occurred in new well PETER04-005, downgradient from detention Pond #3. PFBS was also detected in both down gradient wells (PETER04-008 and PETER04-009), both at concentrations below screening levels. PFOA and PFOS, however, were not detected in either downgradient well. Groundwater analytical results for PFBS, PFOA, and PFOS are presented in Table 14 below and are shown on Figures 16 and 18 in Appendix A.

Table 14 AFFF Area 4 – Golf Course/Leach Field, Detention Pond #3, and Site 5 Groundwater Analytical Results

Analyte	Sample ID	PETER04-001-GW-059	PETER04-002-GW-045	PETER04-002-GW-945 (dup)	PETER04-003-GW-056	PETER04-004-GW-085
	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane Sulfonate (PFBS)	400[a]	**0.035**	**0.087 J**	**0.083 J**	**0.18**	**0.012 J**
Perfluorooctanoic Acid (PFOA)	0.07[b]	**0.022**	**0.099 J**	**0.095 J**	**0.015 J**	0.0053 U
Perfluorooctane Sulfonate (PFOS)	0.07[b]	**0.0060 J**	**0.031 J**	**0.031 J**	0.0033 U	**0.0037 J**
PFOS + PFOA	0.07[c]	**0.0280 J**	**0.13 J**	**0.126 J**	**0.015 J**	**0.0037 J**

Analyte	Sample ID	PETER04-005-GW-065	PETER04-008-GW-096*	PETER04-009-GW-090*	PETER04-MW2-1-GW-059	PETER04-MW2-2-GW-050
	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane Sulfonate (PFBS)	400[a]	**0.032**	**0.037**	**0.011 J**	**0.021**	**0.079**
Perfluorooctanoic Acid (PFOA)	0.07[b]	**0.11**	0.0053 U	0.0053 U	**0.0090 J**	0.0053 U
Perfluorooctane Sulfonate (PFOS)	0.07[b]	**0.87 J**	0.0033 U	0.0033 U	**0.070**	**0.0046 J**
PFOS + PFOA	0.07[c]	**0.98 J**	ND	ND	**0.079 J**	**0.0046 J**

Analyte	Sample ID	PETER04-MW2-3-GW-050	PETER04-MW2-4-GW-053	PETER04-MW2-5-GW-069	PETER04-MW4-1-GW-074	PETER04-MW4-1-GW-974 (dup)
	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane Sulfonate (PFBS)	400[a]	**0.023**	**0.013 J**	**0.063**	**0.040**	**0.038**
Perfluorooctanoic Acid (PFOA)	0.07[b]	**0.027**	0.0053 U	**0.0087 J**	**0.0071 J**	**0.0067 J**
Perfluorooctane Sulfonate (PFOS)	0.07[b]	**0.52**	**0.085**	0.0033 U	**0.012 J**	**0.012 J**
PFOS + PFOA	0.07[c]	**0.547**	**0.085**	**0.0087 J**	**0.0191 J**	**0.0187 J**

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.
*Downgradient location.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b]Health Advisory limit listed in EPA 2016 Drinking Water Health Advisory for Perfluoroctanoic Acid (EPA Document # 822-R-16-005) and EPA 2016 Drinking Water Health Advisory for Perfluoroctane Sulfonate (EPA Document # 822-R-16-004).
[c]EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.
µg/L = micrograms per liter AFFF = aqueous film forming foam dup = duplicate sample ID = identification
J = reported concentration is an estimated value. ND = not detected
U = analyte was not detected above the reported value.

Sediment

Sediment samples were collected from Pond #2 on the golf course and from Detention Pond #3 immediately southwest of the golf course. PFBS was not detected in either sample; PFOA was detected in the sample collected from Detention Pond #3, and PFOS was detected in samples from both ponds. Sediment sample analytical results are summarized in Table 15 and shown on Figure 15 in Appendix A.

Table 15 AFFF Area 4 – Golf Course/Leach Field, Detention Pond #3, and Site 5 Sediment Analytical Results

Analyte	Sample ID	PETER04-006-SD-001	PETER04-0013-SD-001
	Location	Pond #2	Pond #3
	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	0.28 U	0.48 U
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.13 U	**0.74 J**
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**4.3**	**370**

Bold values indicate analyte detected at concentration indicated.

[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].

[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).

µg/kg = micrograms per kilogram AFFF = aqueous film forming foam ID = identification

J = reported concentration is an estimated value. U = analyte was not detected above the reported value.

Surface Water

Surface water samples were collected from Pond #2 on the golf course and from Detention Pond #3 immediately southwest of the golf course. PFBS was detected in both samples at concentrations below the screening level. PFOA and PFOS were detected in both surface water samples at combined concentrations of 0.826 µg/L in PETER04-006-SW-001 at Pond #2 and 0.73 µg/L in PETER04-0013-SW-001 at Detention Pond #3, both above the screening level. Surface water sample analytical results are summarized in Table 16 and shown on Figure 16 in Appendix A.

Table 16 AFFF Area 4 – Golf Course/Leach Field, Detention Pond #3, and Site 5 Surface Water Analytical Results

Analyte	Sample ID	PETER04-006-SW-001	PETER04-0013-SW-001
	Location	Pond #2	Pond #3
	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane Sulfonate (PFBS)	400[a]	**0.022**	**0.024**
Perfluorooctanoic Acid (PFOA)	0.07[b]	**0.096**	**0.10**
Perfluorooctane Sulfonate (PFOS)	0.07[b]	**0.73**	**0.63**
PFOS + PFOA	0.07[c]	**0.826**	**0.73**

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b]Health Advisory limit listed in EPA 2016 Drinking Water Health Advisory for Perfluoroctanoic Acid (EPA Document # 822-R-16-005) and EPA 2016 Drinking Water Health Advisory for Perfluoroctane Sulfonate (EPA Document # 822-R-16-004).
[c]EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.
µg/L = micrograms per liter AFFF = aqueous film forming foam ID = identification

3.4.5 Conclusions

Use of AFFF at PAFB has resulted in PFAS impacts to the environment at AFFF Area 4. Although PFAS concentrations in soil and sediment were below screening levels, combined PFOA/PFOS concentrations exceeded the EPA HA in six of 13 groundwater samples and in two surface water samples collected at the site. PFAS detections were below screening levels in two downgradient wells. PFBS was detected in both downgradient wells at concentrations below the screening level while PFOA and PFOS were not detected. The extent of PFAS downgradient migration is uncertain.

3.5 CURRENT FTA – AFFF AREA 5

3.5.1 Sample Locations

One soil boring/monitoring well (PETER05-001) was installed immediately downgradient of the current FTA and one existing monitoring well (MW1-2) was sampled at AFFF Area 5 to assess possible impacts from previous use of AFFF at the FTA. A subsurface soil sample was collected from the soil boring; surface soil was not sampled since the location is downgradient and not within the FTA where surface soil impacts would be likely. AFFF Area 5 sample locations are shown on Figure 8 in Appendix A.

3.5.2 Lithology and Soil Description

Boring PETER05-001 was drilled to a depth of 50 feet bgs and was terminated above the Pierre Shale. Unconsolidated sediments encountered consisted of silt (ML) with gravel, silty sand (SM), well graded sand (SW) with trace to abundant gravel, and sandy clay (CL). A detailed boring log for PETER05-001 is included in Appendix B.

3.5.3 Groundwater Flow

Based on water level measurements collected by Noblis on August 24, 2016 (Sembera, February 2017) (Table F-2 in Appendix F), groundwater was detected in existing wells surrounding AFFF Area 5 at depths ranging from 17.45 feet below top of casing (btoc) to 51.15 feet btoc with flow to the southeast, as shown on Figure 8 in Appendix A.

Water level measurements were also collected at newly installed monitoring well PETER05-001 and existing monitoring well MW1-2 at AFFF Area 5 on December 6, 2016. The depth to water at PETER05-001 was 39.12 feet bgs and the depth to water at MW1-2 was 38.12 feet bgs.

3.5.4 Analytical Results

Subsurface Soil

One subsurface soil sample was collected from one soil boring at the current FTA. PFBS and PFOS were detected in the sample both at concentrations below their respective screening levels. PFOA was not detected in the sample. Subsurface soil analytical results are summarized in Table 17 and are shown on Figure 19 in Appendix A.

Table 17 AFFF Area 5 – Current FTA Subsurface Soil Analytical Results

Analyte	Sample ID	PETER05-001-SO-035
	Depth (ft)	34–35
	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane Sulfonate (PFBS)	1,300,000[a]	**3.2**
Perfluorooctanoic Acid (PFOA)	1,260[b]	0.11 U
Perfluorooctane Sulfonate (PFOS)	1,260[b]	**0.38 J**

Bold values indicate analyte detected at concentration indicated.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b] Screening levels were calculated using the EPA Regional Screening Level Calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram AFFF = aqueous film forming foam ft = foot ID = identification
J = reported concentration is an estimated value.
U = analyte was not detected above the reported value.

Soil Physiochemical Analyses

To provide basic soil parameter information, a composite subsurface soil sample (PETER05-002-SO-035 collected at a depth of 35 feet bgs) was collected from soil boring PETER05-002 and submitted for pH, TOC, and grainsize analysis. Table E-1 summarizing physiochemical data and laboratory data sheets are included in Appendix E.

Groundwater

Groundwater samples were collected from one new monitoring well (PETER05-001) and one existing monitoring well (MW1-2) immediately downgradient from the current FTA. PFBS was detected in both samples at concentrations below the RSL of 400 µg/L. PFOA and PFOS were also detected in both

groundwater samples at estimated combined concentrations of 3.24 µg/L and 15 µg/L, above the screening level of 0.07 µg/L. Groundwater analytical results for PFBS, PFOA, and PFOS are summarized in Table 18 below and are shown on Figure 20 in Appendix A.

Table 18 AFFF Area 5 – Current FTA Groundwater Analytical Results

Analyte	Sample ID Screening Level (µg/L)	PETER05-001-GW-045 Result (µg/L)	PETER05-MW1-2-GW-056 Result (µg/L)
Perfluorobutane Sulfonate (PFBS)	400[a]	**1.7 J**	**17**
Perfluorooctanoic Acid (PFOA)	0.07[b]	**0.54 J**	**5.3**
Perfluorooctane Sulfonate (PFOS)	0.07[b]	**2.7 J**	**9.7 J**
PFOS + PFOA	0.07[c]	**3.24 J**	**15 J**

Bold values indicate analyte detected at concentration indicated. Shaded cells indicate analyte detected above screening level.
[a] EPA Regional Screening Levels (June 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-june-2017].
[b]Health Advisory limit listed in EPA 2016 Drinking Water Health Advisory for Perfluoroctanoic Acid (EPA Document # 822-R-16-005) and EPA 2016 Drinking Water Health Advisory for Perfluoroctane Sulfonate (EPA Document # 822-R-16-004).
[c]EPA recommends comparing the combined analytical results for PFOA and PFOS when both are present.
µg/L = micrograms per liter AFFF = aqueous film forming foam ID = identification
J = reported concentration is an estimated value.

3.5.5 Conclusions

Use of AFFF at the current FTA has resulted in releases of PFAS to the environment. Although PFAS concentrations in soil were below screening levels, combined PFOA/PFOS concentrations exceeded the EPA HA in two groundwater samples collected during this SI. In addition, the PFOA/PFOS concentration exceeded the EPA HA in a third groundwater sample collected by PAFB, as discussed in Section 2.6.

3.6 INVESTIGATION-DERIVED WASTE (IDW)

Waste Soil
Waste soil generated during the installation of soil borings was placed in Department of Transportation (DOT)-approved steel drums and staged in a secure location for waste sampling and proper disposal. A representative sample was collected from the waste soil, submitted to the project laboratory, and analyzed for PFAS and toxicity characteristic leaching procedure (TCLP) for volatile organic compounds, semivolatile organic compounds, pesticides, herbicides, metals, polychlorinated biphenyls, total petroleum hydrocarbons, flashpoint, corrosivity (pH), sulfide, and cyanide. The analytical results will be used to develop a waste profile and shipping manifest. Final disposition of IDW will be determined at that time. Waste manifests will be included in Appendix D.

Wastewater
Wastewater generated during groundwater sampling and decontamination activities were placed in DOT-approved steel drums and staged in a secure location for waste sampling and proper disposal. A representative sample was collected from the waste fluids and submitted to the project laboratory to be

analyzed for PFAS and the full TCLP list. The analytical results will be used to develop a waste profile and shipping manifest. Final disposition of IDW will be determined at that time.

Construction Waste
Construction waste such as paper, plastic, trash, and personal protective equipment was placed in plastic garbage bags and placed in an on-site dumpster for disposal at an off-site Resource Conservation and Recovery Act Subtitle D industrial landfill.

4.0 GROUNDWATER PATHWAY

4.1 PAFB HYDROGEOLOGY

Municipal and irrigation water wells near PAFB are screened in three aquifer systems: a surficial alluvial aquifer and the Arapahoe and the Laramie-Fox Hills aquifers of the Denver Basin system. The alluvial aquifer is commonly referred to as the Widefield aquifer or the Windmill Gulch aquifer, depending on which region is being described. The alluvial aquifer is generally shallow sands and gravels with loose unlayered silt and clayey sand deposited in and around rivers. The Widefield aquifer ranges in thickness from 0 to 100 feet with the deepest portions occurring below Security-Widefield in a former stream channel formed by Fountain Creek. Colorado Springs and PAFB are at the far southwestern edge of the Denver aquifer basin, allowing the local municipalities to screen water supply wells in multiple aquifers at relatively shallow depths with ease (ASL, November 2016).

Specific groundwater pathways for each AFFF area are discussed below; only PFOA/PFOS will be discussed, as they were the only PFAS detected in groundwater above screening levels at PAFB.

4.2 SITE 8 (FT003) – AFFF AREA 1

As indicated in Table 5 (Section 3.1.4) and shown on Figure 10 in Appendix A, PFOA and PFOS were not detected in any of four groundwater samples collected at Site 8. Lacking PFAS concentrations in groundwater above screening levels, the human receptor groundwater pathway at Site 8 (AFFF Area 1) is incomplete.

4.3 FIRE STATION # 1 (BUILDING 218) – AFFF AREA 2

As indicated in Table 8 (Section 3.2.4) and Figure 12 in Appendix A, PFOA and PFOS were detected in two groundwater samples collected at Fire Station #1 at combined concentrations of 0.178 µg/L and 0.077 µg/L, above the 0.070 µg/L screening level. Groundwater flows to the southwest at Fire Station #1 as shown on Figure 12 in Appendix A and impacted groundwater may be flowing off base. Both the on- and off-base population within a 4-mile radius of AFFF Area 2 relies on drinking water provided in part by local wells (ASL, November 2016). Based on the direction of groundwater flow and the presence of downgradient drinking water wells, a complete human receptor pathway from releases of AFFF at Fire Station #1 is possible.

4.4 FIRE STATION #2 (BUILDING 2032) – AFFF AREA 3

As indicated in Table 11 (Section 3.3.4) and Figure 14 in Appendix A, PFOA and PFOS were detected in two of three groundwater samples collected at Fire Station #2, both at concentrations below the screening level of 0.07 µg/L. Although PFAS concentrations in groundwater were below screening levels, a PFOS detection in surface soil above the 1,260 µg/kg screening level indicates the potential for possible impacts

to groundwater. As such, the human receptor groundwater pathway at Fire Station #2 (AFFF Area 3) is uncertain.

4.5 GOLF COURSE/LEACH FIELD (WP006), DETENTION POND #3, AND SITE 5 (FT002) – AFFF AREA 4

As indicated in Table 14 (Section 3.4.4) and Figure 16 in Appendix A, PFOA and PFOS were detected in six groundwater samples collected at AFFF Area 4 above the 0.070 µg/L screening level at estimated combined concentrations ranging from 0.079 µg/L to 0.98 µg/L. Groundwater flows to the southwest at AFFF Area 4 toward downgradient wells PETER04-008 and PETER04-009, as shown on Figure 18 in Appendix A. Although PFOA and PFOS were not detected in the downgradient wells, PFAS-impacted groundwater has not been fully delineated and may be flowing off base. Both the on- and off-base population within a 4-mile radius of AFFF Area 4 relies on drinking water provided in part by local wells (ASL, November 2016). Given the presence of PFAS-impacted groundwater above screening levels at AFFF Area 4 and the fact that impacted groundwater has not been fully delineated, there is the potential for a complete human receptor pathway.

4.6 CURRENT FTA – AFFF AREA 5

As indicated in Table 18 (Section 3.5.4) and Figure 20 in Appendix A, PFOA and PFOS were detected above the 0.070 µg/L screening level in two groundwater samples collected at the current FTA at estimated combined concentrations of 3.24 µg/L and 15 µg/L. Groundwater flows to the southeast at the current FTA, as shown on Figure 20 in Appendix A, and impacted groundwater may be flowing off base. Both the on- and off-base population within a 4-mile radius of the FTA relies on drinking water provided in part by local wells (ASL, November 2016). There is the potential, therefore, for a complete human receptor pathway from releases of AFFF at the current FTA.

5.0 SURFACE WATER PATHWAY

PAFB is in the Fountain Creek Drainage Basin, which helps comprise the Arkansas River drainage basin. Monument Creek and Fountain Creek drain the majority of the Fountain Creek basin. Fountain Creek is a perennial stream that originates 7 miles northwest of Pikes Peak and flows southeast through the city of Colorado Springs. Monument Creek merges with Fountain Creek near downtown Colorado Springs. Intermittent tributaries to Fountain Creek that are on or near PAFB include Sand Creek, East Fork Sand Creek, and Jimmy Camp Creek. These creeks provide local surface drainage for PAFB and its surrounding areas (ASL, November 2016). There are five outfalls at PAFB, as shown on Figure 2 in Appendix A: Outfalls 1, 2, and 3 are on the northwest end of the base; Outfalls 4 and 5 are south of the golf course near Detention Pond #3.

5.1 SITE 8 (FT003) – AFFF AREA 1

Surface water was not identified as a medium of concern at Site 8 as there are no surface water features near the site. Surface water at Site 8 appears to drain into surrounding grassed areas where it percolates into the subsurface. The nearest surface water feature is an intermittent tributary of Jimmy Camp Creek approximately 0.7 miles to the east.

5.2 FIRE STATION # 1 (BUILDING 218) – AFFF AREA 2

Surface water was not identified as a medium of concern at Fire Station #1 as there are no surface water features near the fire station. Surface water drainage from Fire Station #1 flows into the storm water system and ultimately discharges to either Pond #3 or to the adjacent COS detention pond via Outfall 5. Water in Pond #3 is stored and pumped to Ponds #1 and #2 or used for irrigation of the golf course (ASL, November 2016); water in the COS detention pond typically infiltrates into the ground surface or evaporates. The nearest surface water body is Pond #1 on the northwest side of the golf course, approximately 1,200 feet east of Fire Station #1.

5.3 FIRE STATION #2 (BUILDING 2032) – AFFF AREA 3

Surface water was not identified as a medium of concern at Fire Station #2 as there are no surface water features near the fire station. Surface water at Fire Station #2 appears to drain into surrounding grassed areas where it percolates into the subsurface. The nearest surface water feature is Jimmy Camp Creek, approximately 1.2 miles to the east.

5.4 GOLF COURSE/LEACH FIELD (WP006), DETENTION POND #3, AND SITE 5 (FT002) – AFFF AREA 4

Surface water was identified as a medium of concern at AFFF Area 4 due to the presence of irrigation Ponds #1 and #2 on the golf course and lined Detention Pond #3 at the southeast corner of the golf course. Combined PFOA/PFOS concentrations from surface water samples collected from Pond #2 and Pond #3 both exceeded the screening level of 0.07 µg/L at 0.826 µg/L and 0.73 µg/L, respectively. A complete human exposure pathway exists for golfers and golf course maintenance personnel exposed to surface water in Pond #2 on the golf course. Pond #3 is fenced; however, a complete human exposure pathway exists for base maintenance workers exposed to surface water at the pond. Pond #1 was not sampled; however, there is also the potential for a complete human exposure pathway for golfers and golf course maintenance personnel if the combined PFOA/PFOS concentration exceeds the screening level in the pond.

5.5 CURRENT FTA – AFFF AREA 5

Surface water was not identified as a medium of concern at the current FTA. The nearest surface water feature is East Fork Sand Creek, an intermittent tributary of Sand Creek approximately 500 feet to the northeast. No water was present in the stream during field activities conducted in October and November 2016.

6.0 SOIL EXPOSURE AND AIR PATHWAYS

The objective of soil sampling during the SI was to determine if soils in the individual areas had been impacted by the release of AFFF and whether concentrations of PFBS, PFOA, and PFOS remain in the soils exceeding the human health-based screening levels.

6.1 SITE 8 (FT003) – AFFF AREA 1

Where detected, PFAS concentrations in surface and subsurface soil samples collected at Site 8 were below screening levels, as indicated on Tables 3 and 4 in Section 3.1.4. Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 1.

6.2 FIRE STATION # 1 (BUILDING 218) – AFFF AREA 2

Where detected, PFAS concentrations in surface and subsurface soil samples collected at Fire Station #1 were below screening levels, as indicated on Tables 6 and 7 in Section 3.2.4. Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 2.

6.3 FIRE STATION #2 (BUILDING 2032) – AFFF AREA 3

Where detected, PFAS concentrations in subsurface soil samples collected at Fire Station #2 were below screening levels. PFOS, however, was detected above the screening level in one surface soil sample at a concentration of 2,400 µg/kg as indicated on Tables 9 and 10 in Section 3.3.4. Based on the PFOS exceedance, surface soil remains a medium of concern. A potential exposure pathway exists for base personnel or construction workers during excavations or other ground disturbing activities. There is also the potential for PFOS impacts to groundwater, however there is currently not a soil screening level protective of groundwater for PFOS.

6.4 GOLF COURSE/LEACH FIELD (WP006), DETENTION POND #3, AND SITE 5 (FT002) – AFFF AREA 4

Where detected, PFAS concentrations in surface soil, subsurface soil, and sediment samples collected at AFFF Area 4 were below screening levels, as indicated on Tables 12, 13, and 15 in Section 3.4.4. Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 4.

6.5 CURRENT FTA – AFFF AREA 5

As indicated in Table 17 (Section 3.5.4), PFBS and PFOS were detected in the one subsurface soil collected at AFFF Area 5. Both PFBS and PFOS were detected at concentrations below screening levels while PFOA was not detected in the sample. Lacking concentrations of PFAS above screening levels, the soil pathway is incomplete for subsurface soil at AFFF Area 5. Surface soil was not sampled at the current FTA during the SI; therefore, the air and soil pathways are unknown for surface soil.

7.0 UPDATES TO CONCEPTUAL SITE MODELS

The following sections contain updates to the conceptual site models (CSMs) for AFFF Areas 1 through 5 and address PFOA and PFOS in soil, groundwater, surface water, and sediment. PFBS has been eliminated as a contaminant of concern, based on analytical results presented in Section 3.0 (and discussed in Sections 4 through 6), and will not be discussed further.

7.1 SITE 8 (FT003) – AFFF AREA 1

The QAPP addendum CSM identified surface soil, subsurface soil, and groundwater as media potentially impacted by previous releases of AFFF at Site 8. Potential human receptors included base personnel exposed to impacted surface and subsurface soil and off-base residents through ingestion of impacted groundwater.

Based on findings discussed in Sections 3.1.4 and 6.1, surface soil and subsurface soil at Site 8 have not been impacted by PFOA/PFOS above screening levels; therefore, soil has been eliminated as a medium of concern. In addition, based on findings discussed in Section 3.1.4 and Section 4.2, groundwater at Site 8

has not been impacted by PFOA/PFOS at concentrations above the EPA HA; therefore, groundwater has also been eliminated as a medium of concern at Site 8.

7.2 FIRE STATION # 1 (BUILDING 218) – AFFF AREA 2

The QAPP addendum CSM identified surface soil, subsurface soil, and groundwater as media potentially impacted by previous releases of AFFF at Fire Station #1. Potential human receptors included airfield maintenance personnel and firefighters exposed to impacted surface and subsurface soil and off-base residents through ingestion of impacted groundwater.

Based on findings discussed in Sections 3.2.4 and 6.2, surface soil and subsurface soil at Fire Station #1 have not been impacted by PFOA/PFOS above screening levels; therefore, soil has been eliminated as a medium of concern at AFFF Area 2.

Based on findings discussed in Section 3.2.4 and Section 4.3, groundwater at Fire Station #1 has been impacted by PFOA/PFOS at concentrations above the EPA HA. Although there are no drinking water wells in the immediate vicinity of AFFF Area 2, migration of PFAS-impacted groundwater offsite is possible and downgradient drinking water wells could be impacted.

7.3 FIRE STATION #2 (BUILDING 2032) – AFFF AREA 3

The QAPP addendum CSM identified surface soil, subsurface soil, and groundwater as media potentially impacted by previous releases of AFFF at Fire Station #2. Potential human receptors included airfield maintenance personnel and firefighters exposed to impacted surface and subsurface soil and off-base residents through ingestion of impacted groundwater.

Based on findings discussed in Sections 3.3.4 and 6.3, subsurface soil at Fire Station #2 has not been impacted by PFOA/PFOS above screening levels; however, PFOS was detected in surface soil at a concentration of 2,400 µg/kg at PETER03-003 above the screening level. Surface soil remains a medium of concern at Fire Station #2. A potential exposure pathway exists for base personnel or construction workers during excavations or other ground disturbing activities. There is also the potential for PFOS impacts to groundwater.

Based on findings discussed in Section 3.3.4 and Section 4.4, groundwater at Fire Station #2 has not been impacted by PFOA/PFOS at concentrations above the EPA HA. However, based on the PFOS detection surface soil discussed above, surface soil could impact groundwater at concentrations above the EPA HA creating a potential human exposure pathway.

7.4 GOLF COURSE/LEACH FIELD (WP006), DETENTION POND #3, AND SITE 5 (FT002) – AFFF AREA 4

The QAPP addendum CSM identified surface soil, subsurface soil, sediment, surface water, and groundwater as media potentially impacted by previous releases of AFFF at Area 4. Potential human receptors included golfers, golf course maintenance personnel, and airfield maintenance personnel exposed to impacted surface soil, subsurface soil, and groundwater. In addition, off-base residents were identified as possible human receptors due to the potential for ingestion of impacted groundwater.

Based on findings discussed in Sections 3.4.4 and 6.4, surface soil, subsurface soil, and sediment at AFFF Area 4 have not been impacted by PFOA/PFOS above screening levels; therefore, soil and sediment have been eliminated as media of concern.

Based on findings discussed in Section 3.4.4, Section 4.5, and Section 5.4, groundwater and surface water at AFFF Area 4 have been impacted by PFOA/PFOS at concentrations above the EPA HA. A complete human exposure pathway exists for golfers and golf course maintenance personnel exposed to surface water in the golf course ponds. In addition, although there are no drinking water wells in the immediate vicinity of AFFF Area 4, migration of PFAS-impacted groundwater offsite is possible and downgradient drinking water wells could be impacted.

7.5 CURRENT FTA – AFFF AREA 5

The QAPP addendum CSM did not identify any media of concern at the current FTA based on information obtained during the PA indicating no releases had occurred at the FTA (ASL, November 2016). The CDPHE, however, requested that groundwater be sampled at the site to confirm that no PFAS impacts had occurred. One subsurface soil sample was also collected at the site.

Based on findings discussed in Section 3.5.4 and Section 6.5, subsurface soil has been eliminated as a medium of concern at the current FTA. Surface soil was not sampled, however, and remains a medium of concern.

Based on the findings discussed in Section 3.5.4 and Section 4.6 groundwater at the current FTA has been impacted above the EPA HA. Although there are no drinking water wells in the immediate vicinity of the FTA, migration of PFAS-impacted groundwater offsite is possible and downgradient drinking water wells could be impacted.

8.0 SUMMARY AND CONCLUSIONS

ASL completed SIs at five known or suspected areas of AFFF releases at PAFB as documented in the PA (ASL, November 2016) and as detailed in the subsequent site-specific QAPP addendum (ASL, October 2016). The areas inspected included

- Site 8 (FT003) – AFFF Area 1;
- Fire Station #1 Building 218 – AFFF Area 2;
- Fire Station #2 Building 2032 – AFFF Area 3;
- Golf Course/Leach Field (WP006), Detention Pond #3, and Site 5 (FT002) – AFFF Area 4; and
- Current FTA – AFFF Area 5.

The objectives of the SIs were to

- determine if a confirmed release of PFOS and PFOA has occurred at the areas selected for inspection,
- determine if PFOS and PFOA are present in groundwater or surface water at the inspection areas at concentrations exceeding the EPA lifetime HA for drinking water,
- determine if PFOA and PFOS are present in soil or sediment at the inspection areas at concentrations exceeding calculated screening levels, and
- identify potential receptor pathways with immediate impacts to human health.

Selected sample media varied for the five areas but included surface soil, subsurface soil, groundwater, sediment, and surface water. With the exception of AFFF Area 4, where offsite migration of PFAS was a

concern, sampling was primarily limited to the immediate release areas and biased toward locations most likely to have been impacted by releases of AFFF.

All samples were analyzed for PFBS, PFOA, and PFOS using modified EPA Method 537. Soil and sediment PFBS analytical results were compared to EPA RSLs (EPA, June 2017). Soil and sediment PFOA and PFOS analytical results were compared to the screening levels of 1,260 µg/kg for PFOA and 1,260 for PFOS. Groundwater and surface water PFBS analytical results were compared to the published EPA RSL of 400 µg/L. Combined PFOA/PFOS groundwater analytical results were compared to the EPA HA of 0.07 µg/L.

Table 19 summarizes detected concentrations of PFBS, PFOA, and PFOS for each media sampled at each area. A brief summary of key findings and conclusions for each site (focusing on PFOA/PFOS exceedances) are included below.

Table 19 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances[1]

AFFF Area	ERP ID	Parameter	Maximum Detected Concentration	Units	Screening Value	Number of Samples / Number of Exceedances[2]	Exceeds Screening Value
AFFF Area 1 Site 8	**FT003**	**Surface Soil**					
		PFBS	0.48 J	(µg/kg)	1,300,000	4/0	No
		PFOA	9.7 J	(µg/kg)	1,260	4/0	No
		PFOS	120	(µg/kg)	1,260	4/0	No
		Subsurface Soil					
		PFBS	3.1 J	(µg/kg)	1,300,000	4/0	No
		PFOA	ND	(µg/kg)	1,260	4/0	No
		PFOS	0.16 J	(µg/kg)	1,260	4/0	No
		Groundwater					
		PFBS	0.27	(µg/L)	400	4/0	No
		PFOA	ND	(µg/L)	0.07	4/0	No
		PFOS	ND	(µg/L)	0.07	4/0	No
		PFOA + PFOS	ND	(µg/L)	0.07	4/0	No
AFFF Area 2 Fire Station #1 Building 218	**N/A (New Site)**	**Surface Soil**					
		PFBS	ND	(µg/kg)	1,300,000	3/0	No
		PFOA	**0.61 J**	(µg/kg)	1,260	3/0	No
		PFOS	**160**	(µg/kg)	1,260	3/0	No
		Subsurface Soil					
		PFBS	ND	(µg/kg)	1,300,000	3/0	No
		PFOA	ND	(µg/kg)	1,260	3/0	No
		PFOS	5.6	(µg/kg)	1,260	3/0	No
		Groundwater					
		PFBS	0.030	(µg/L)	400	2/0	No
		PFOA	**0.12 J**	(µg/L)	0.07	**2/1**	**Yes**
		PFOS	0.058 J	(µg/L)	0.07	2/0	No
		PFOA + PFOS	**0.178 J**	(µg/L)	0.07	**2/2**	**Yes**
AFFF Area 3 Fire Station #2 Building 2032	**N/A (New Site)**	**Surface Soil**					
		PFBS	0.29 J	(µg/kg)	1,300,000	3/0	No
		PFOA	0.22 J	(µg/kg)	1,260	3/0	No
		PFOS	**2,400**	(µg/kg)	1,260	3/1	Yes
		Subsurface Soil					
		PFBS	0.76 J	(µg/kg)	1,300,000	3/0	No
		PFOA	ND	(µg/kg)	1,260	3/0	No

AFFF Area	ERP ID	Parameter	Maximum Detected Concentration	Units	Screening Value	Number of Samples / Number of Exceedances[2]	Exceeds Screening Value
		PFOS	0.49 J	(µg/kg)	1,260	3/0	No
		Groundwater					
		PFBS	0.062 J	(µg/L)	400	3/0	No
		PFOA	0.023 J	(µg/L)	0.07	3/0	No
		PFOS	0.028 J	(µg/L)	0.07	3/0	No
		PFOA + PFOS	0.0364[3] J	(µg/L)	0.07	3/0	No
AFFF Area 4 Golf Course /Leach Field, Pond #3, and Site 5	**WP006 (Leach Field) FT002 (Site 5)**	**Surface Soil**					
		PFBS	0.27 J	(µg/kg)	1,300,000	9/0	No
		PFOA	1.5	(µg/kg)	1,260	9/0	No
		PFOS	61	(µg/kg)	1,260	9/0	No
		Subsurface Soil					
		PFBS	ND	(µg/kg)	1,300,000	8/0	No
		PFOA	ND	(µg/kg)	1,260	8/0	No
		PFOS	3.2	(µg/kg)	1,260	8/0	No
		Groundwater					
		PFBS	0.18	(µg/L)	400	15/0	No
		PFOA	**0.11**	(µg/L)	0.07	15/3	**Yes**
		PFOS	**0.87 J**	(µg/L)	0.07	15/4	**Yes**
		PFOA + PFOS	**0.98 J**	(µg/L)	0.07	15/6	**Yes**
		Surface Water					
		PFBS	0.024	(µg/L)	400	2/0	No
		PFOA	**0.10**	(µg/L)	0.07	2/2	**Yes**
		PFOS	**0.73**	(µg/L)	0.07	2/2	**Yes**
		PFOA + PFOS	**0.826**[3]	(µg/L)	0.07	2/2	**Yes**
		Sediment					
		PFBS	ND	(µg/kg)	1,300,000	2/0	No
		PFOA	0.74 J	(µg/kg)	1,260	2/0	No
		PFOS	370	(µg/kg)	1,260	2/0	No
AFFF Area 5 Current FTA	**N/A (New Site)**	**Subsurface Soil**					
		PFBS	3.2	(µg/kg)	1,300,000	1/0	No
		PFOA	ND	(µg/kg)	1,260	1/0	No
		PFOS	0.38 J	(µg/kg)	1,260	1/0	No
		Groundwater					
		PFBS	17	(µg/L)	400	2/0	No
		PFOA	**5.3**	(µg/L)	0.07	2/2	**Yes**
		PFOS	**9.7 J**	(µg/L)	0.07	2/2	**Yes**
		PFOA + PFOS	**15 J**	(µg/L)	0.07	2/2	**Yes**

[1] 2014 screening-level investigation data is not included.
[2] Includes duplicate results.
[3]Maximum PFOA + PFOS concentration shown is the highest combined PFOA and PFOS concentration detected in a specific groundwater sample and in this instance is not the sum of the individual maximum PFOA and PFOS concentrations listed as they occurred in two separate samples.
Bold values exceed screening levels.

µg/kg = micrograms per kilogram
µg/L = micrograms per liter
ERP = environmental restoration program
FTA = fire training area
ID = identification
J = Reported concentration is an estimated value.
N/A = not applicable
ND = not detected
PFBS = perfluorobutane sulfonate
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate

8.1 SITE 8 (FT003) – AFFF AREA 1

Site 8, a former FTA, was active from 1977 until late 1991 or early 1992. AFFF was apparently used at the FTA, as evidenced by low detections of PFBS, PFOA, and PFOS in soil and groundwater. However, as indicated in Table 19, none of the analytes were detected at concentrations above screening values. Based on the low PFAS concentrations detected, all human exposure pathways at Site 8 – AFFF Area 1 are incomplete.

8.2 FIRE STATION # 1 (BUILDING 218) – AFFF AREA 2

AFFF was released to the environment at Fire Station #1 during spray testing conducted over a volleyball court during freezing weather (to avoid icing the concrete ramp). Although PFAS concentrations in soil were below screening levels at Fire Station #1, combined PFOA/PFOS concentrations in two groundwater samples both exceeded the EPA HA at estimated concentrations of 0.178 µg/L and 0.077 µg/L.

Groundwater flows to the southwest at Fire Station #1 and impacted groundwater may be flowing off-base. Since both the on- and off-base population within a 4-mile radius of AFFF Area 2 rely on drinking water provided in part by local wells, there is the potential for a complete groundwater pathway for human receptors.

8.3 FIRE STATION #2 (BUILDING 2032) – AFFF AREA 3

Time and distance tests were conducted periodically at Fire Station #2 from 1996 until 2016. Testing was typically conducted on the west side of the fire station along the airport access road. Concentrations of PFBS and PFOA in soil and groundwater were below screening levels as indicated in Table 19. PFOS, however, was detected in one surface soil sample (PETER03-003 at a concentration of 2,400 µg/kg) outside the limits of the spray test area. This detection was somewhat unexpected as the sample was collected outside the reported spray test area. Based on this PFOS exceedance in surface soil, a human exposure pathway exists for base personnel or construction workers during excavations or other ground disturbing activities. There is also the potential for PFOS impacts to groundwater, however there is currently not a soil screening level protective of groundwater for PFOS.

8.4 GOLF COURSE/LEACH FIELD (WP006), DETENTION POND #3, AND SITE 5 (FT002) – AFFF AREA 4

AFFF Area 4 includes the golf course/leach field, Detention Pond #3, and Site 5. PFAS releases at the sites included

- likely discharge of PFAS-impacted wastewater to the leach field,
- irrigation at the golf course using PFAS-impacted surface water from Detention Pond #3,
- historical discharge of PFAS-impacted storm water to the original unlined Pond #3,
- discharge of PFAS-impacted storm water from existing Detention Pond #3 to unlined COS detention pond, and
- use of AFFF during training exercises at Site 5 (a former FTA).

PFAS concentrations in soil and sediment were below screening levels at all AFFF Area 4 sites eliminating the soil exposure and air pathways. Combined PFOA/PFOS concentrations in groundwater samples collected from five well exceeded the EPA HA at estimated combined concentrations ranging from 0.079 µg/L to 0.98 µg/L. At least one well associated with each site at Area 4 has been impacted by

PFAS at concentrations above the EPA indicating releases have likely occurred at each site. Groundwater flows to the southwest at AFFF Area 4 and impacted groundwater may be flowing off base. Since both the on- and off-base population within a 4-mile radius of Area 4 relies on drinking water provided in part by local wells, there is the potential for a complete groundwater pathway for human receptors.

Combined PFOA/PFOS concentrations in surface water samples collected from Pond #2 on the golf course and nearby Detention Pond #3 also exceeded the EPA HA at concentrations of 0.826 µg/L and 0.73 µg/L respectively. A potential human exposure pathway exists for golfers and golf course maintenance personnel exposed to surface water in Pond #2. Although Pond #3 is fenced, preventing exposure to golfer, a potential exposure pathway exists for base maintenance workers exposed to surface water at the pond. It is also likely that golf course Pond #1 has been impacted by PFAS; however, the pond was not sampled.

8.5 CURRENT FTA – AFFF AREA 5

Although only water is used to extinguish fires now, AFFF was used frequently during past training exercises at the FTA. The FTA includes a burn pit with a dual HDPE liner and a mock aircraft. Although there were no releases of AFFF reported during the PA, the CDPHE requested that the FTA be included in the SI process to confirm that previous use of AFFF had not resulted in releases to the environment.

PFBS and PFOS were detected at concentrations below screening levels in subsurface soil at AFFF Area 5, indicating the soil pathway is incomplete for subsurface soil. Surface soil was not sampled at the FTA, however, and the status of air and soil pathways for surface soil is unknown.

Combined PFOA/PFOS concentrations exceeded the EPA HA in three groundwater samples collected at the current FTA. PFOA/PFOS exceeded the EPA HA in a sample collected from an existing well just outside the fire pit liner at a combined concentration of 88.4 µg/L. Samples collected from two downgradient wells exceeded the EPA HA at estimated combined concentrations of 3.24 µg/L and 15 µg/L. Impacted groundwater is migrating from the FTA to the southeast and may be flowing off-base. Since both the on- and off-base population within a 4-mile radius of AFFF Area 2 relies on drinking water provided in part by local wells, there is the potential for a complete groundwater pathway for human receptors.

9.0 REFERENCES

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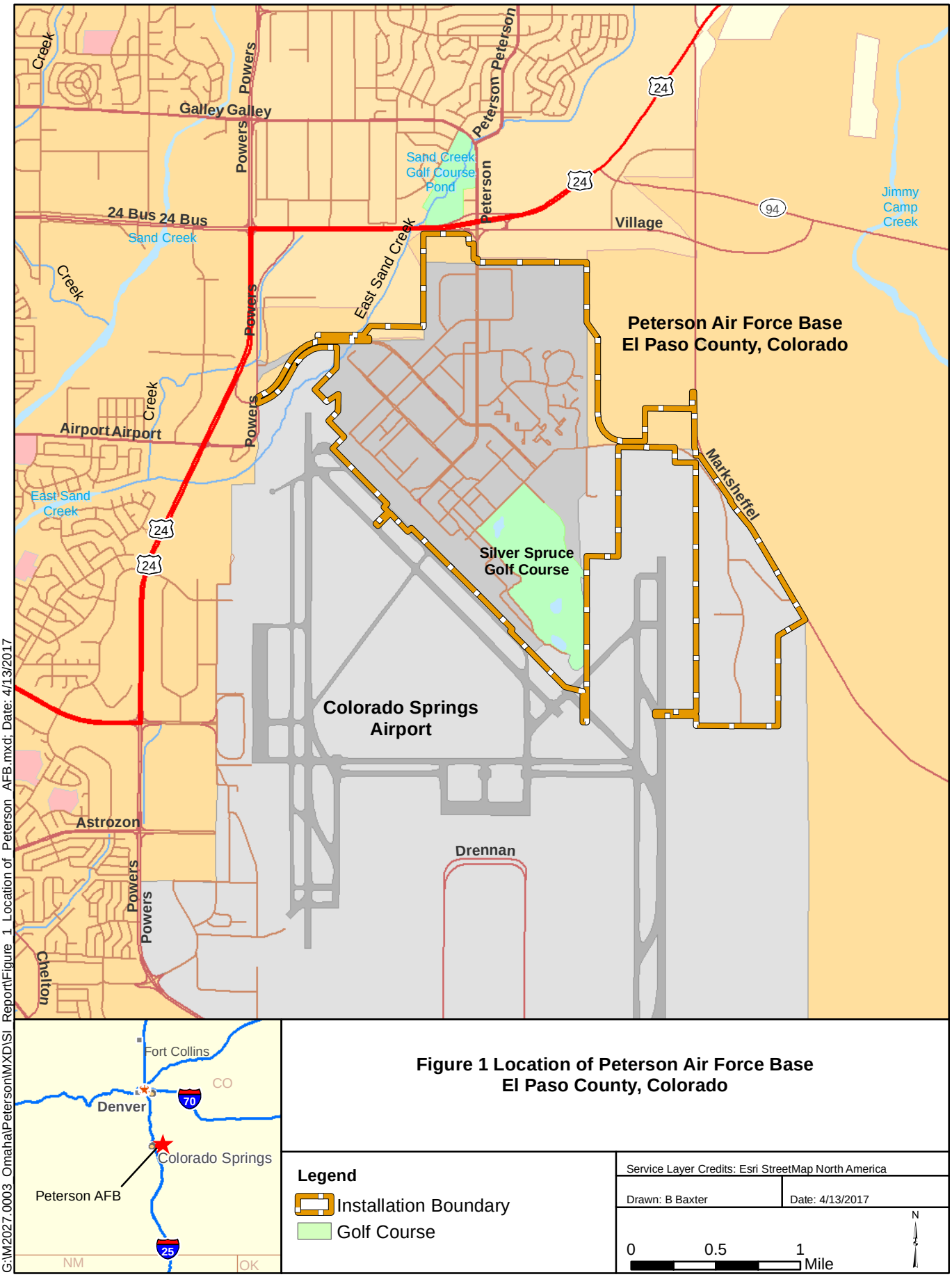
Appendix A

Figures



G:\M2027.0003 Omaha\Peterson\MXD\SI Report\Figure 1 Location of Peterson AFB.mxd; Date: 4/13/2017

Figure 1 Location of Peterson Air Force Base
El Paso County, Colorado

Legend

- Installation Boundary
- Golf Course

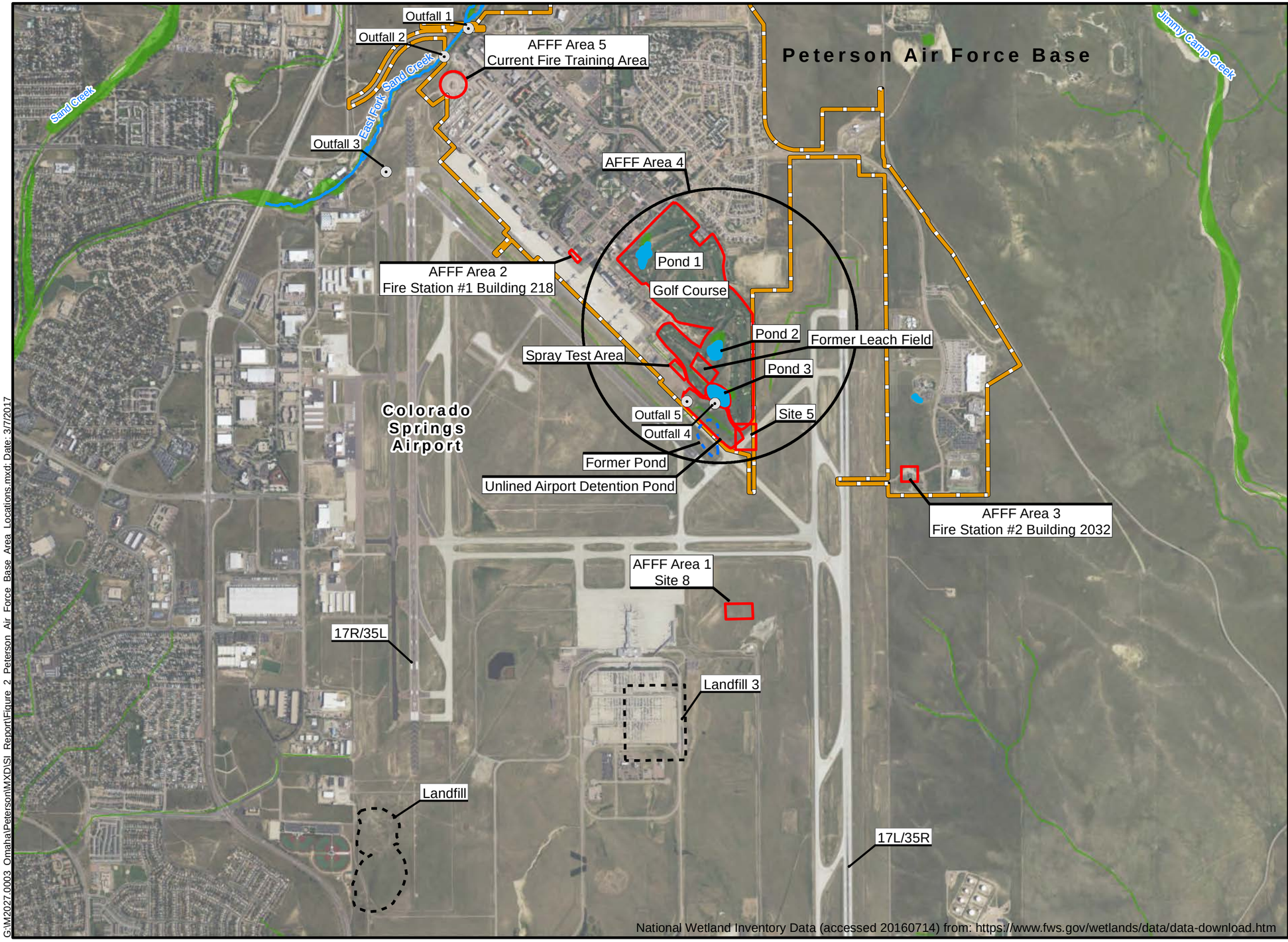
Service Layer Credits: Esri StreetMap North America

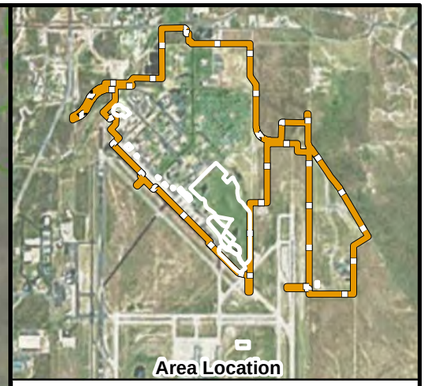
Drawn: B Baxter

Date: 4/13/2017

0 0.5 1 Mile

N





Legend

- Outfall
- Approximate Landfill Boundaries
- Former Pond
- AFFF Inspection Areas
- Surface Water
- National Wetland Inventory
- Installation Boundary

N

0 0.25 0.5

Miles

Peterson Air Force Base
El Paso County, Colorado

Figure 2 AFFF Area Locations

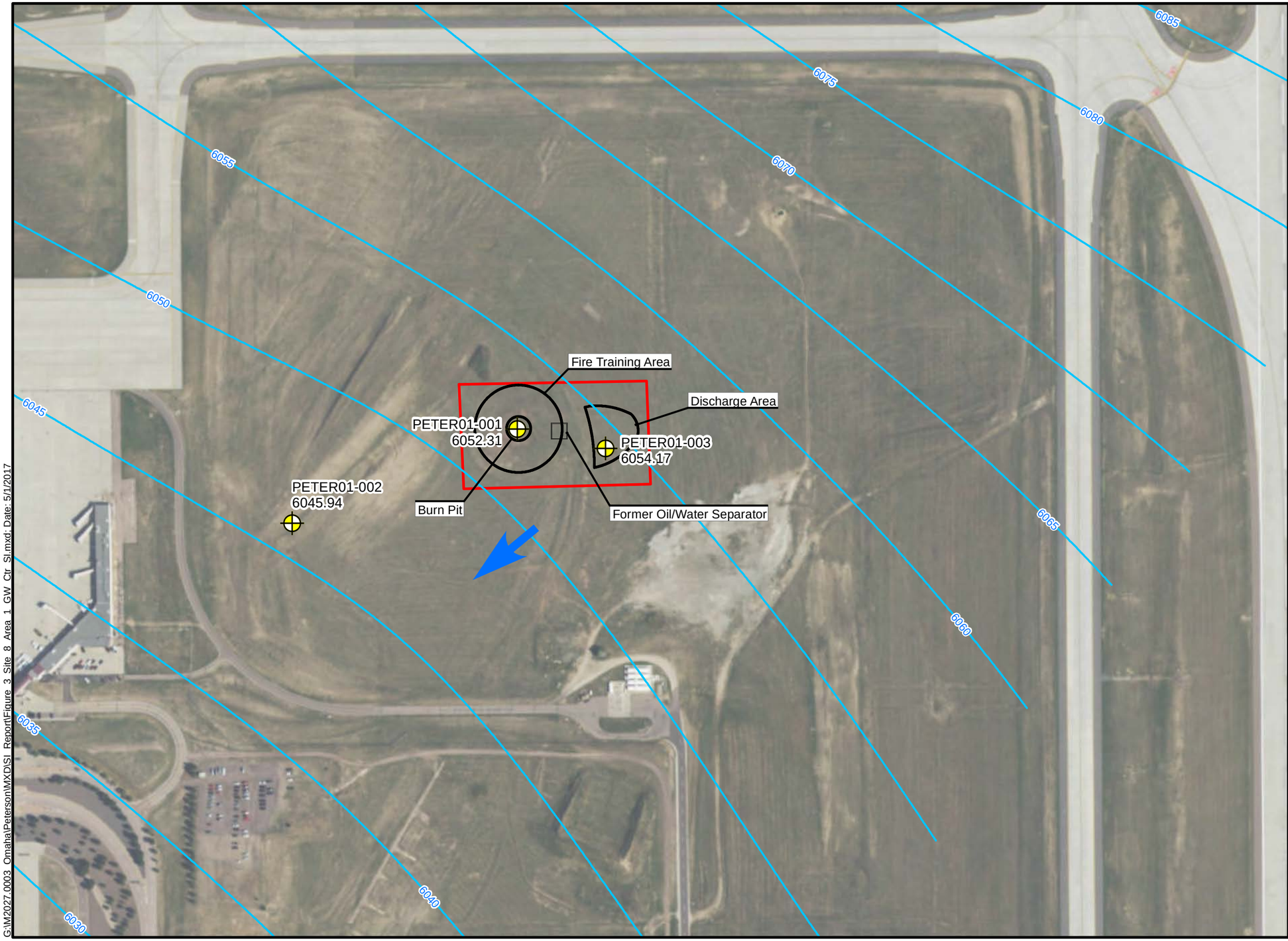
Aerostar SES LLC

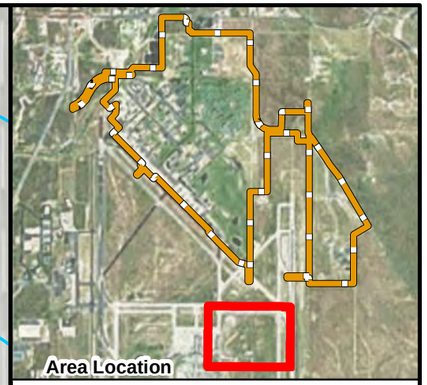
Drawn: B Baxter

Date: 3/7/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography and EDR

G:\M2027.0003 Omaha\Peterson\MXD\SI Report\Figure 2 Peterson Air Force Base Area Locations.mxd; Date: 3/7/2017





Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Groundwater Elevation Contour
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

PETER01-001
6052.31 = Groundwater Elevation (ft. NAVD88)
Water level data collected December 6, 2016

N

0 100 200 300 400 500
Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 3
Site 8 (FT003)
(AFFF Area 1) Sample Locations

Aerostar SES LLC

Drawn: B Baxter

Date: 5/1/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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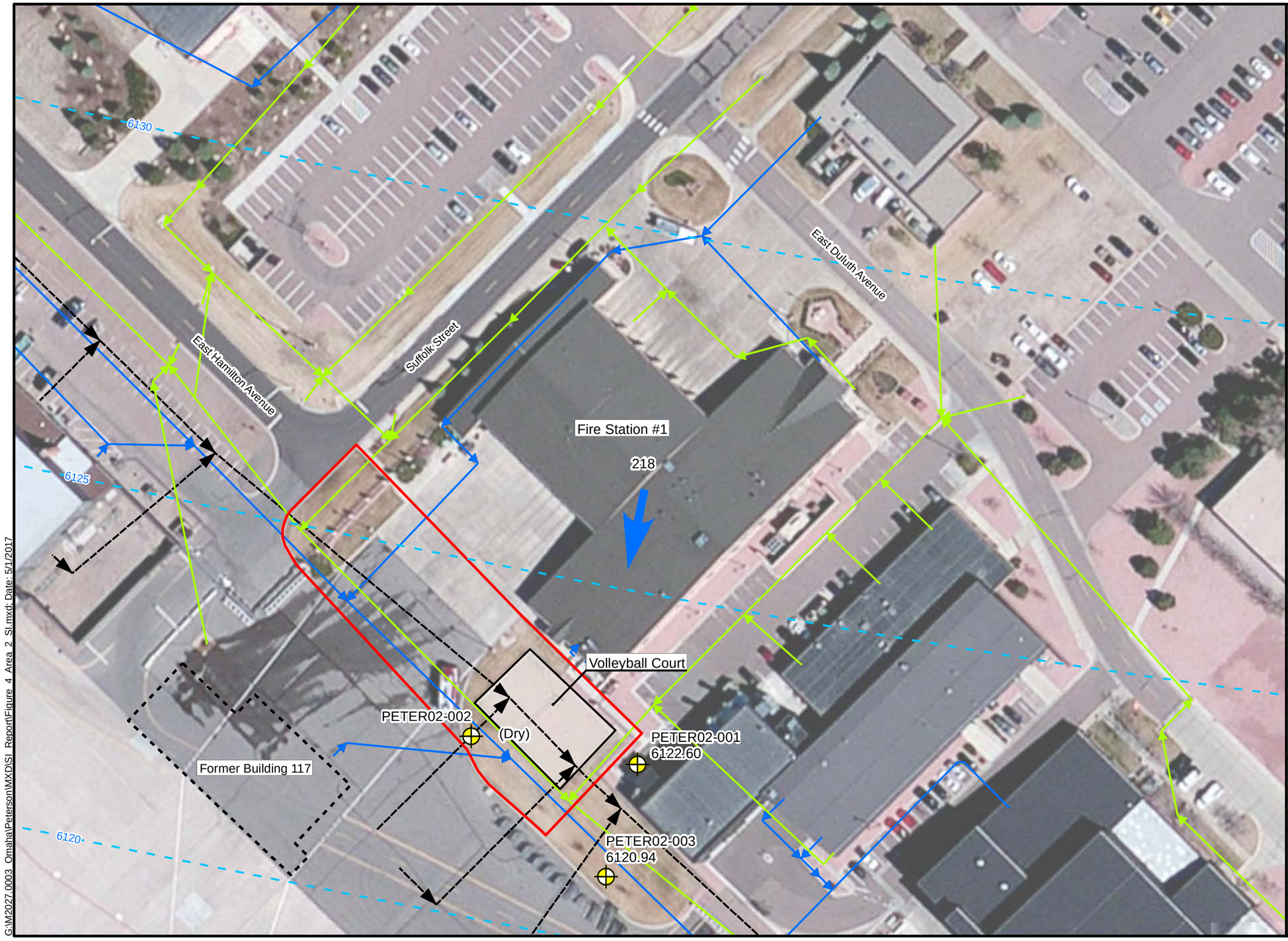

Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Storm Sewer (Underground)
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction
- Industrial Waste Line
- Wastewater Line
- AFFF Inspection Area
- Installation Boundary

PETER02-001
6122.6 = Groundwater Elevation (ft. NAVD88)
Water level data collected December 6, 2016

N

0 50 100
Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 4 Fire Station #1 - Building 218 (AFFF Area 2) Sample Locations

Aerostar SES LLC

Drawn: B Baxter

Date: 5/1/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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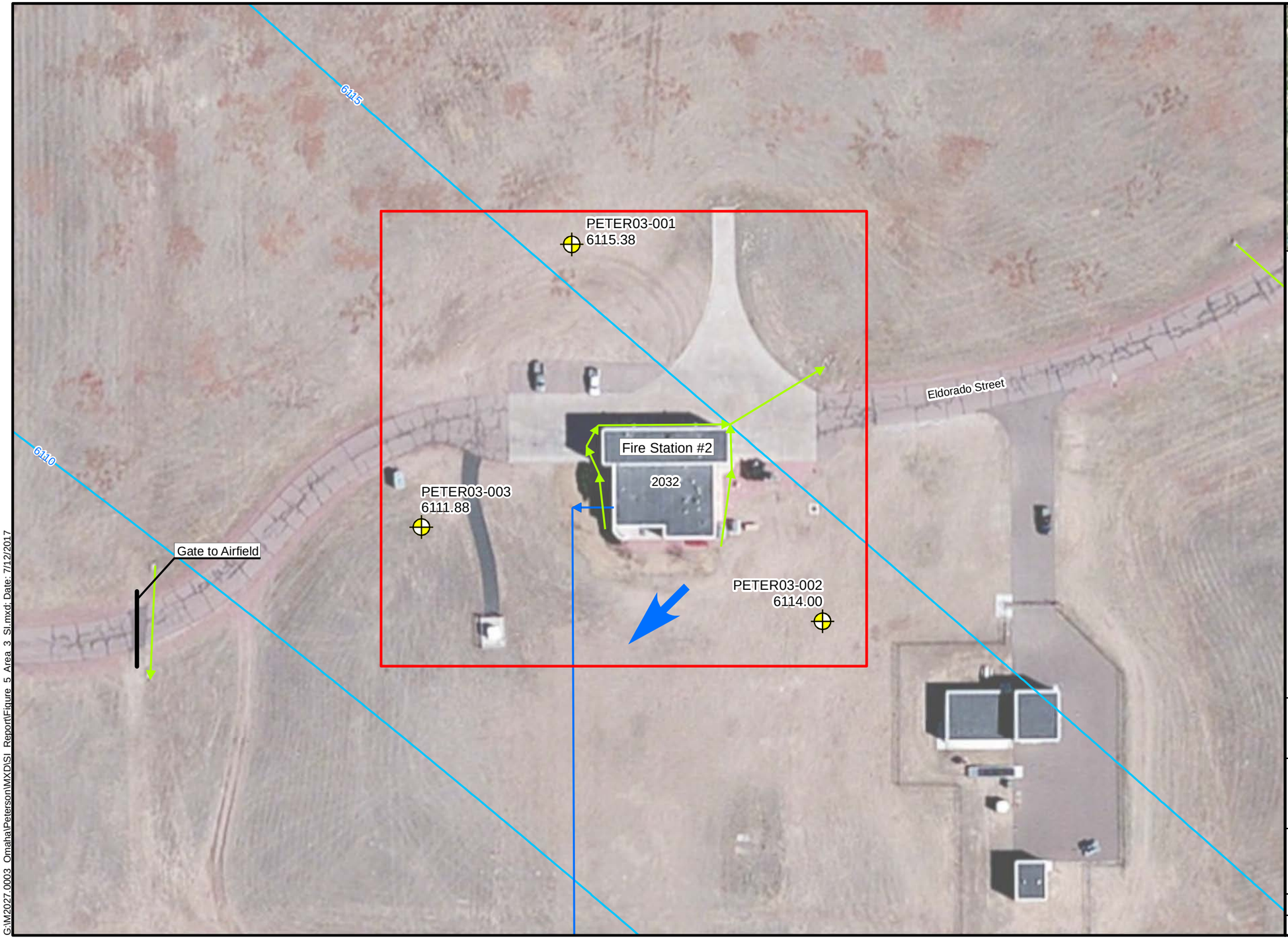

Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Storm Sewer (Underground)
- Wastewater Line (Underground)
- Groundwater Elevation Contour
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

PETER03-001
6115.38 = Groundwater Elevation (ft. NAVD88)
Water level data collected December 6, 2016

N

0 50 100

Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 5 Fire Station #2 Building 2032 (AFFF Area 3) Sample Locations

Aerostar SES LLC

Drawn: B Baxter

Date: 7/12/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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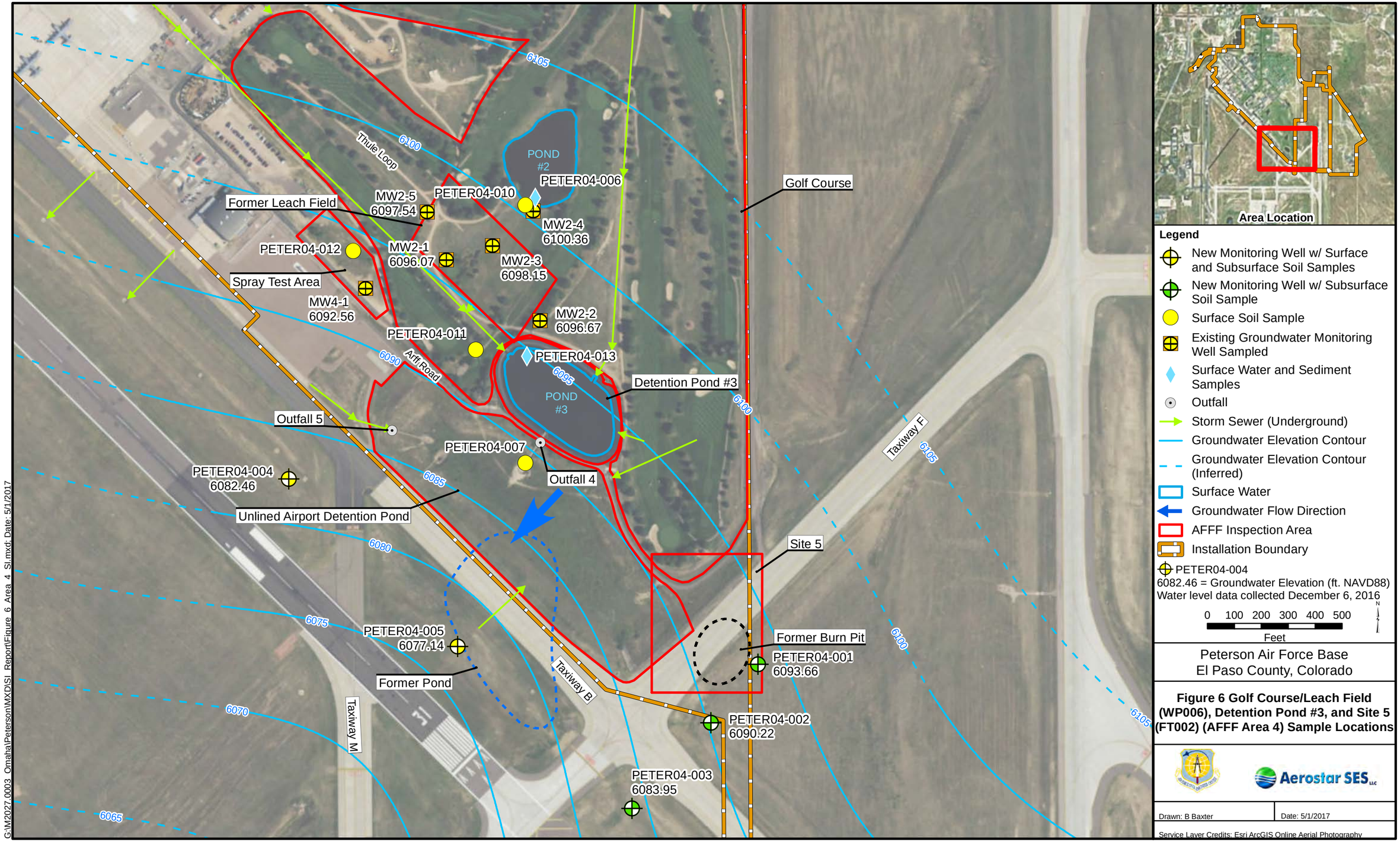

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Peterson Air Force Base
El Paso County, Colorado

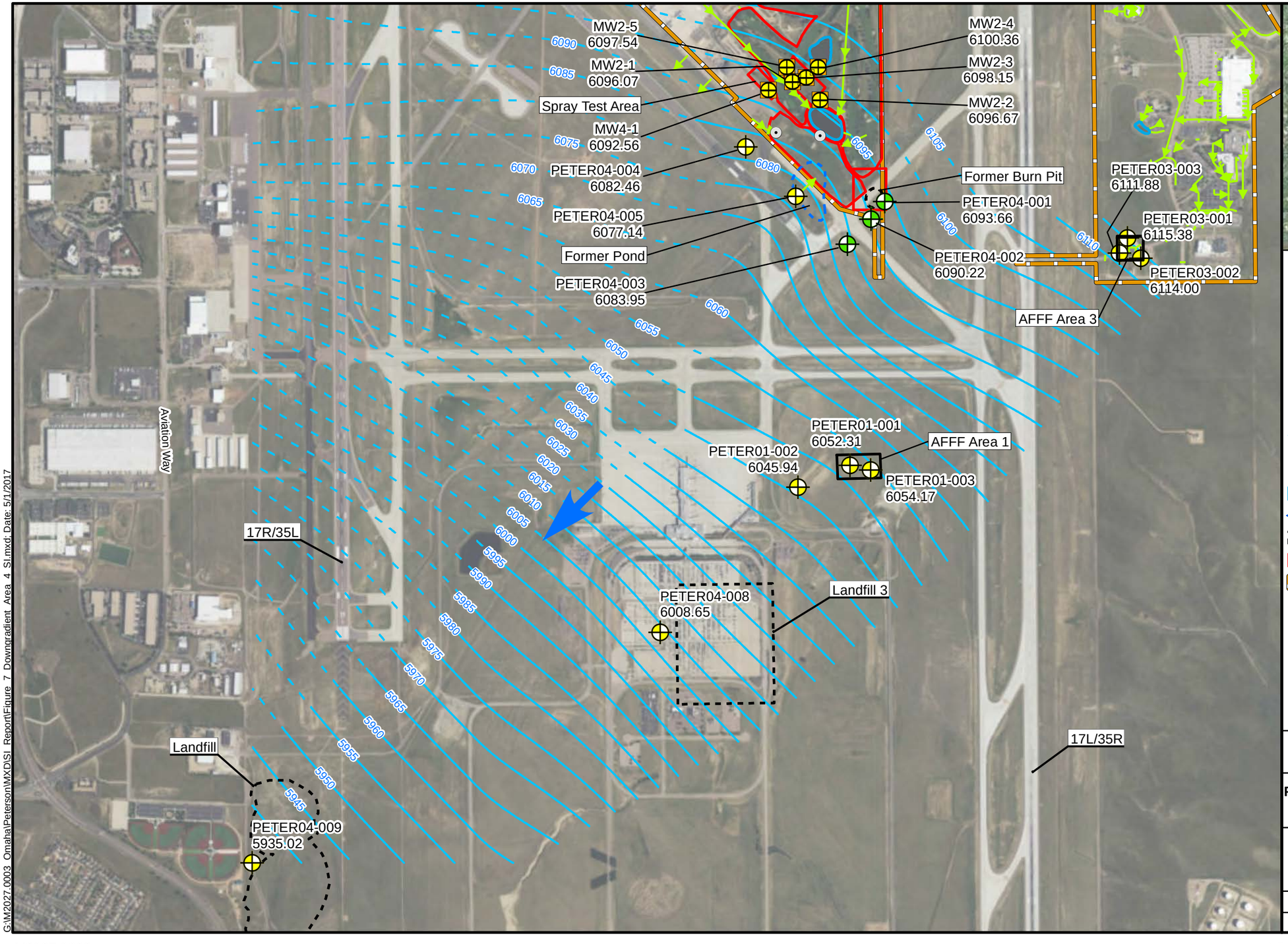
Figure 6 Golf Course/Leach Field (WP006), Detention Pond #3, and Site 5 (FT002) (AFFF Area 4) Sample Locations

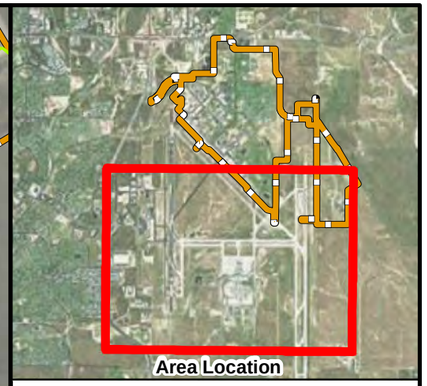
Aerostar SES LLC

Drawn: B Baxter

Date: 5/1/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography





Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- New Monitoring Well w/ Subsurface Soil Sample
- Existing Groundwater Monitoring Well Sampled
- Outfall
- Storm Sewer (Underground)
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Surface Water
- Groundwater Flow Direction
- Approximate Landfill Boundaries
- AFFF Inspection Area
- Installation Boundary

PETER04-004
6082.46 = Groundwater Elevation (ft. NAVD88)
Water level data collected December 6, 2016

N

0 500 1,000 1,500
Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 7 Downgradient Monitoring Wells (AFFF Area 4)

Aerostar SES LLC

Drawn: B Baxter

Date: 5/1/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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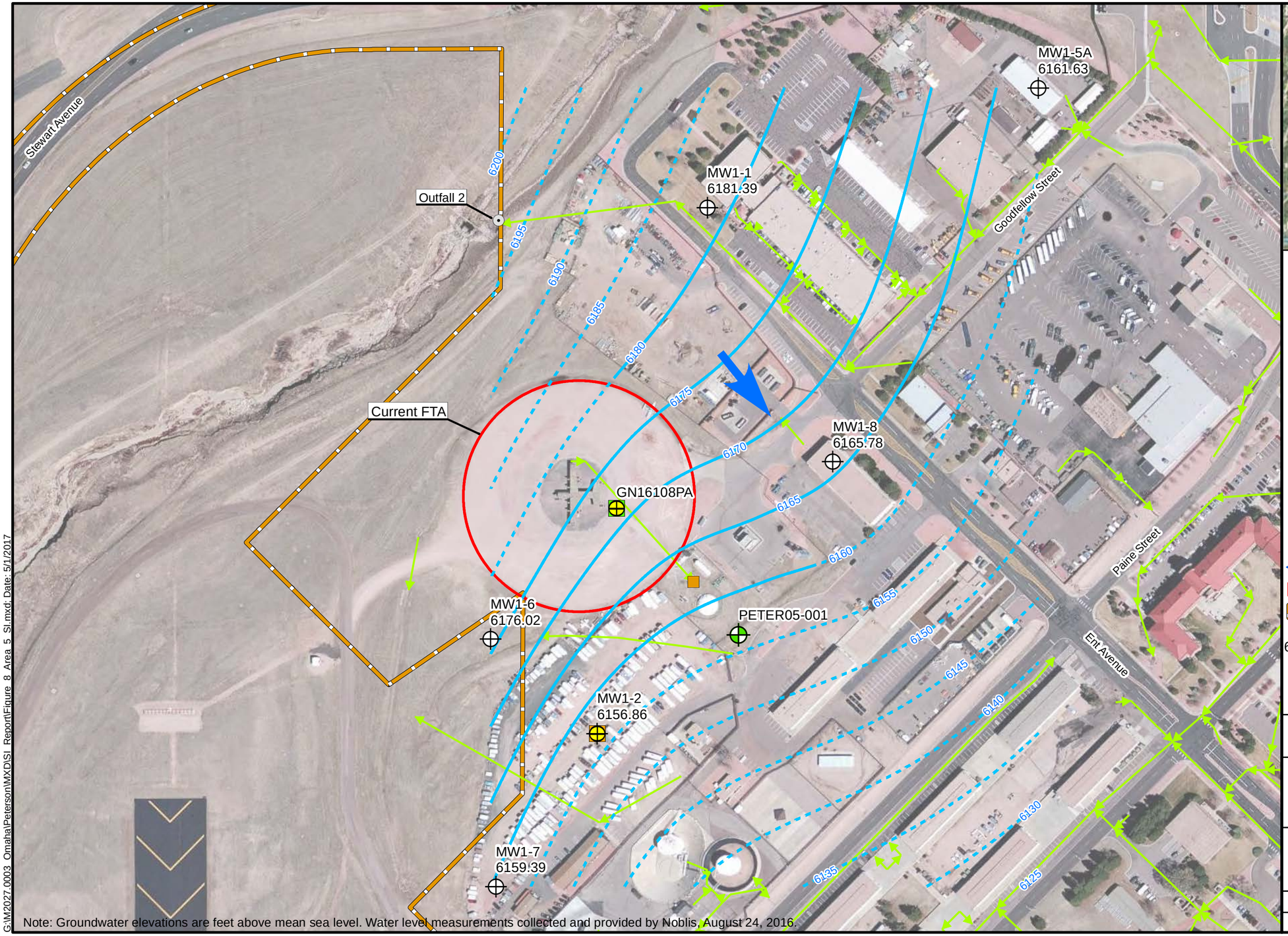

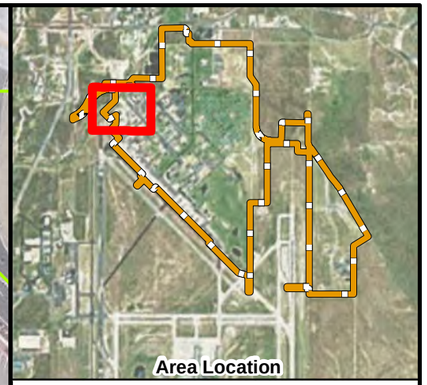

Legend

- New Monitoring Well w/ Subsurface Soil Sample
- Existing Monitoring Well Sampled 11/1/16 by Others
- Existing Groundwater Monitoring Well Sampled
- Existing Monitoring Well (Groundwater Level Measurement Only)
- Outfall
- Decommissioned Oil/Water Separator
- Storm Sewer (Underground)
- Groundwater Contour
- Groundwater Contour Inferred
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary
- Existing Monitoring Well

6165.78 = Groundwater Elevation (ft. amsl)

0 100 200 300 Feet

N

Peterson Air Force Base
El Paso County, Colorado

Figure 8 Current Fire Training Area (AFFF Area 5) Sample Locations

Aerostar SES LLC

Drawn: B Baxter | Date: 5/1/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

Note: Groundwater elevations are feet above mean sea level. Water level measurements collected and provided by Noblis, August 24, 2016.

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PETER01-001-SS-001	
Analyte	Result (µg/kg)
PFBS	0.41 J
PFOA	3.7 J
PFOS	77 J

PETER01-001-SO-083	
Analyte	Result (µg/kg)
PFBS	2.2 J
PFOA	0.11 U
PFOS	0.16 J

PETER01-001-SS-901 (dup)	
Analyte	Result (µg/kg)
PFBS	0.48 J
PFOA	9.7 J
PFOS	36 J

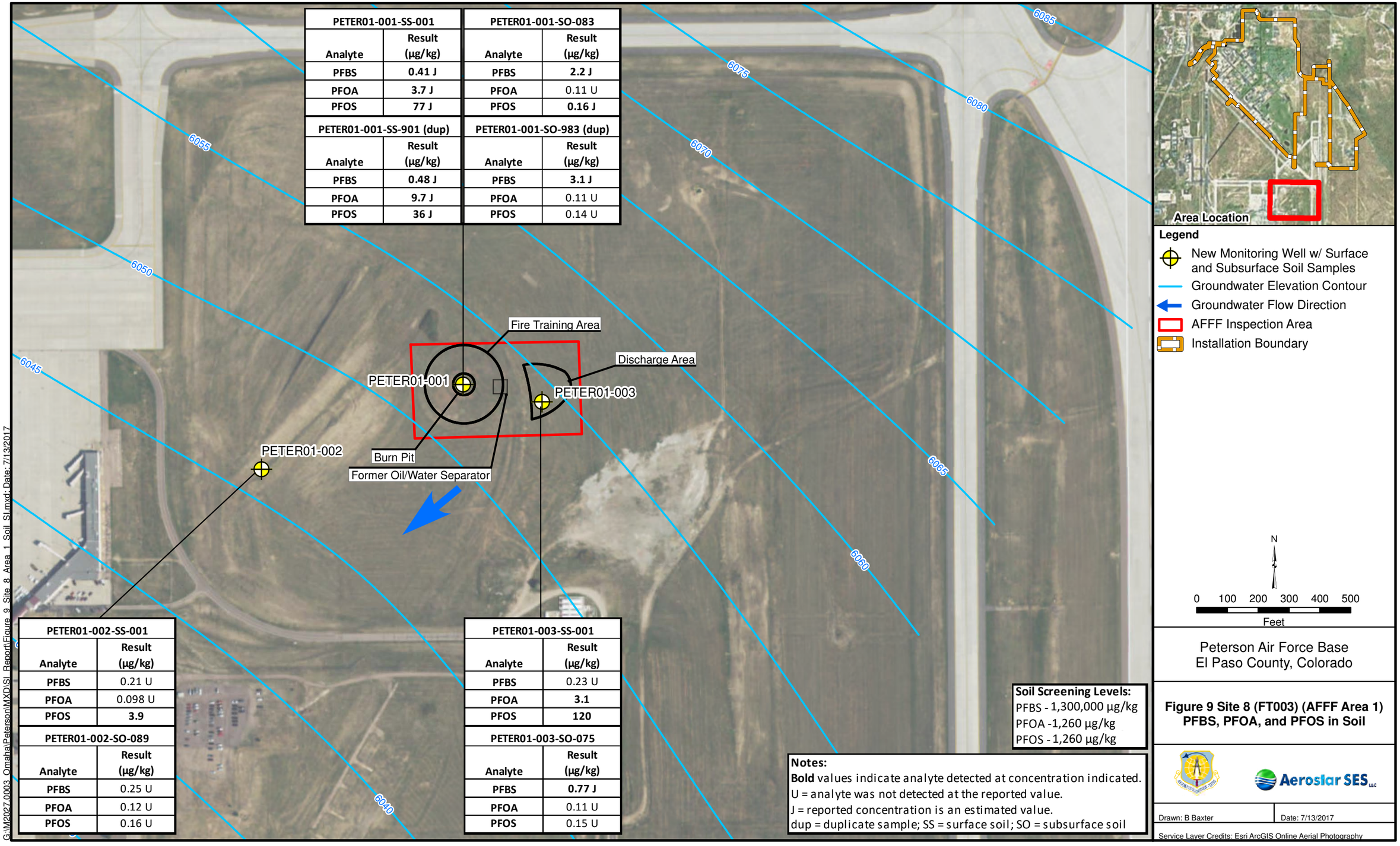
PETER01-001-SO-983 (dup)	
Analyte	Result (µg/kg)
PFBS	3.1 J
PFOA	0.11 U
PFOS	0.14 U

PETER01-002-SS-001	
Analyte	Result (µg/kg)
PFBS	0.21 U
PFOA	0.098 U
PFOS	3.9

PETER01-002-SO-089	
Analyte	Result (µg/kg)
PFBS	0.25 U
PFOA	0.12 U
PFOS	0.16 U

PETER01-003-SS-001	
Analyte	Result (µg/kg)
PFBS	0.23 U
PFOA	3.1
PFOS	120

PETER01-003-SO-075	
Analyte	Result (µg/kg)
PFBS	0.77 J
PFOA	0.11 U
PFOS	0.15 U



Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Groundwater Elevation Contour
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

N

0 100 200 300 400 500

Feet

Soil Screening Levels:
PFBS - 1,300,000 µg/kg
PFOA -1,260 µg/kg
PFOS - 1,260 µg/kg

Notes:
Bold values indicate analyte detected at concentration indicated.
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
dup = duplicate sample; SS = surface soil; SO = subsurface soil

Peterson Air Force Base
El Paso County, Colorado

Figure 9 Site 8 (FT003) (AFFF Area 1)
PFBS, PFOA, and PFOS in Soil

Aerostar SES LLC

Drawn: B Baxter

Date: 7/13/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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PETER01-001-GW-087	
Analyte	Result (µg/L)
PFBS	**0.27**
PFOA	0.0053 U
PFOS	0.0033 U
PFOA + PFOS	ND

PETER01-001-GW-987 (dup)	
Analyte	Result (µg/L)
PFBS	**0.27**
PFOA	0.0053 U
PFOS	0.0033 U
PFOA + PFOS	ND

PETER01-002-GW-095	
Analyte	Result (µg/L)
PFBS	**0.10**
PFOA	0.0053 U
PFOS	0.0033 U
PFOA + PFOS	ND

PETER01-003-GW-082	
Analyte	Result (µg/L)
PFBS	**0.020 J**
PFOA	0.0053 U
PFOS	0.0033 U
PFOA + PFOS	ND

Fire Training Area

Discharge Area

PETER01-001

PETER01-003

PETER01-002

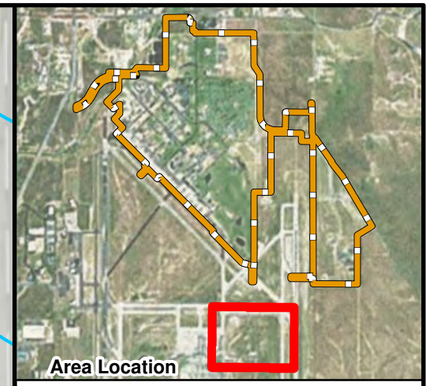
Burn Pit

Former Oil/Water Separator

6085 6075 6080 6070 6055 6050 6045 6065 6060 6035 6040

Groundwater Screening Levels:
PFBS - 400 µg/L
PFOA - 0.07 µg/L
PFOS - 0.07 µg/L
PFOA + PFOS - 0.07 µg/L

Notes:
Bold values indicate analyte detected at concentration indicated.
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
dup = duplicate sample
ND = not detected



Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Groundwater Elevation Contour
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

N

0 100 200 300 400 500

Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 10 Site 8 (FT003) (AFFF Area 1)
PFBS, PFOA, and PFOS in Groundwater

Aerostar SES LLC

Drawn: B Baxter

Date: 7/11/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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PETER02-002-SS-001	
Analyte	Result (µg/kg)
PFBS	0.22 U
PFOA	**0.61 J**
PFOS	**110**
PETER02-002-SO-024	
Analyte	Result (µg/kg)
PFBS	0.22 UJ
PFOA	0.11 UJ
PFOS	**0.78 J**

PETER02-001-SS-001	
Analyte	Result (µg/kg)
PFBS	0.21 U
PFOA	0.10 U
PFOS	**7.0**
PETER02-001-SO-024	
Analyte	Result (µg/kg)
PFBS	0.22 U
PFOA	0.10 U
PFOS	**0.64 J**

PETER02-003-SS-001	
Analyte	Result (µg/kg)
PFBS	0.21 U
PFOA	**0.51 J**
PFOS	**160**
PETER02-003-SO-034	
Analyte	Result (µg/kg)
PFBS	0.22 U
PFOA	0.11 U
PFOS	**5.6**

Soil Screening Levels:
PFBS - 1,300,000 µg/kg
PFOA - 1,260 µg/kg
PFOS - 1,260 µg/kg

Notes:
Bold values indicate analyte detected at concentration indicated.
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
dup = duplicate sample; SS = surface soil; SO = subsurface soil

Legend
- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Storm Sewer (Underground)
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction
- Industrial Waste Line
- Wastewater Line
- AFFF Inspection Area
- Installation Boundary

N

0 50 100
Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 11 Fire Station #1 - Building 218 (AFFF Area 2) PFBS, PFOA, and PFOS in Soil

Aerostar SES LLC

Drawn: B Baxter | Date: 7/13/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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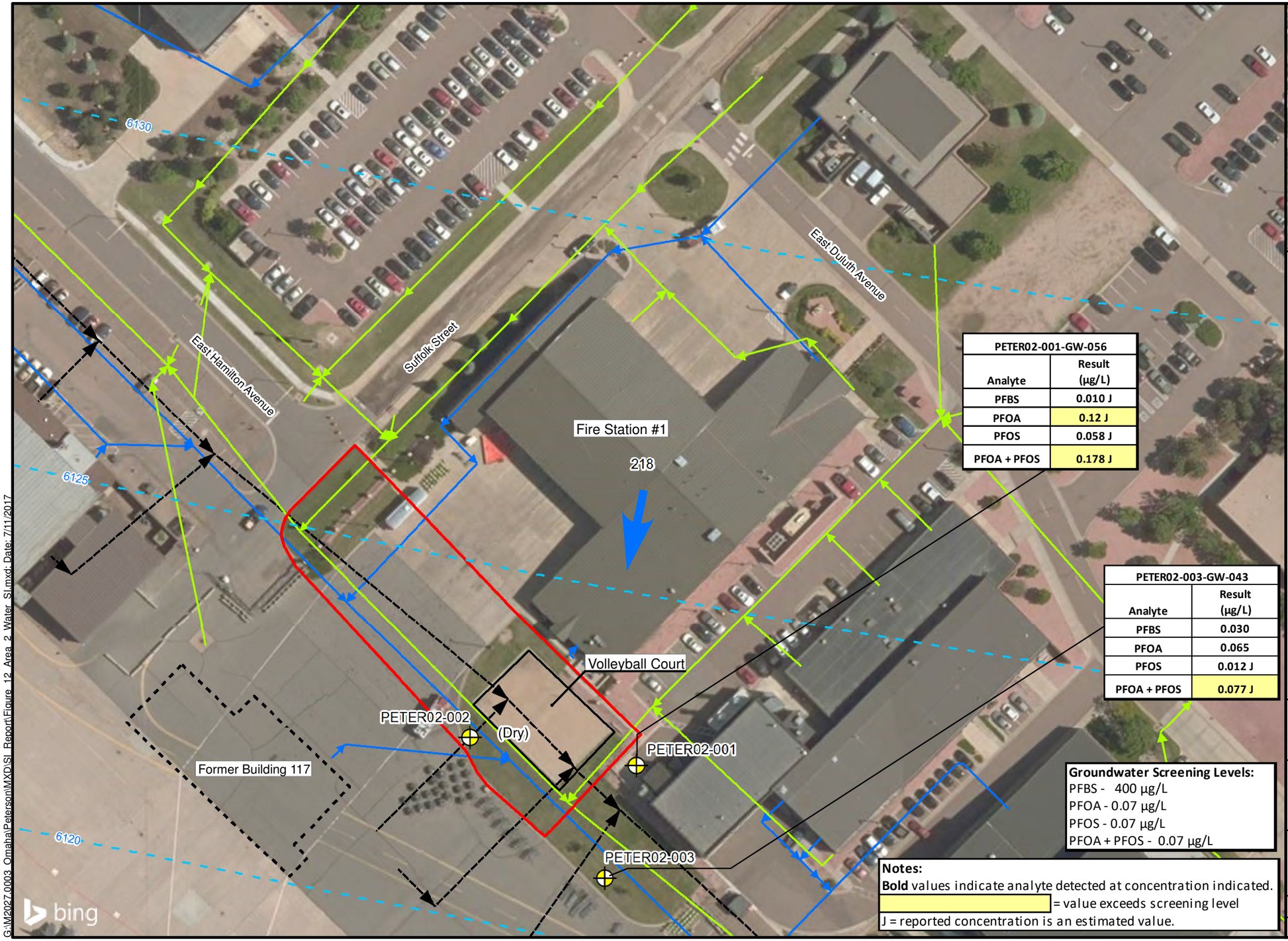

PETER02-001-GW-056	
Analyte	Result (µg/L)
PFBS	0.010 J
PFOA	0.12 J
PFOS	0.058 J
PFOA + PFOS	0.178 J

PETER02-003-GW-043	
Analyte	Result (µg/L)
PFBS	0.030
PFOA	0.065
PFOS	0.012 J
PFOA + PFOS	0.077 J

Groundwater Screening Levels:
PFBS - 400 µg/L
PFOA - 0.07 µg/L
PFOS - 0.07 µg/L
PFOA + PFOS - 0.07 µg/L

Notes:
Bold values indicate analyte detected at concentration indicated.
= value exceeds screening level
J = reported concentration is an estimated value.

Legend
- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Storm Sewer (Underground)
- Groundwater Elevation Contour (Inferred)
- Groundwater Flow Direction
- Industrial Waste Line
- Wastewater Line
- AFFF Inspection Area
- Installation Boundary

N

0 50 100
Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 12 Fire Station #1 - Building 218 (AFFF Area 2) PFBS, PFOA, and PFOS in Groundwater

Aerostar SES LLC

Drawn: B Baxter | Date: 7/11/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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PETER03-001-SS-001	
Analyte	Result (µg/kg)
PFBS	**0.29 J**
PFOA	0.096 UJ
PFOS	0.13 UJ

PETER03-001-SO-064	
Analyte	Result (µg/kg)
PFBS	0.21 UJ
PFOA	0.10 UJ
PFOS	0.13 UJ

PETER03-002-SS-001	
Analyte	Result (µg/kg)
PFBS	0.20 UJ
PFOA	**0.22 J**
PFOS	**2.0 J**

PETER03-002-SO-065	
Analyte	Result (µg/kg)
PFBS	0.20 UJ
PFOA	0.095 U
PFOS	0.13 UJ

PETER03-003-SS-001	
Analyte	Result (µg/kg)
PFBS	21 U
PFOA	9.8 U
PFOS	**2,400**

PETER03-003-SO-069	
Analyte	Result (µg/kg)
PFBS	**0.76 J**
PFOA	0.098 U
PFOS	**0.49 J**

PETER03-001
PETER03-002
PETER03-003
Fire Station #2
2032
Eldorado Street
Gate to Airfield
6115
6110

Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Storm Sewer (Underground)
- Wastewater Line (Underground)
- Groundwater Elevation Contour
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

N

0 50 100

Feet

Soil Screening Levels:
PFBS - 1,300,000 µg/kg
PFOA - 1,260 µg/kg
PFOS - 1,260 µg/kg

Notes:
Bold value indicates analyte detected at concentration indicated.
= value exceeds screening level
J = The reported concentration is an estimated value.
U = The analyte was not detected above the reported value.
SO = subsurface soil SS = surface soil

Peterson Air Force Base
El Paso County, Colorado

Figure 13 Fire Station #2 Building 2032 (AFFF Area 3) PFBS, PFOA, and PFOS in Soil

Aerostar SES LLC

Drawn: B Baxter | Date: 7/13/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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PETER03-001-GW-064	
Analyte	Result (µg/L)
PFBS	**0.0073 J**
PFOA	0.0053 UJ
PFOS	0.0033 UJ
PFOA + PFOS	ND

PETER03-003-GW-070	
Analyte	Result (µg/L)
PFBS	**0.062 J**
PFOA	**0.0084 J**
PFOS	**0.028 J**
PFOA + PFOS	**0.0364 J**

PETER03-002-GW-071	
Analyte	Result (µg/L)
PFBS	**0.050 J**
PFOA	**0.023 J**
PFOS	**0.0064 J**
PFOA + PFOS	**0.0294 J**

PETER03-001

PETER03-003

PETER03-002

Fire Station #2

2032

Gate to Airfield

Eldorado Street

6115

6110

Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- Storm Sewer (Underground)
- Wastewater Line (Underground)
- Groundwater Elevation Contour
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

N

0 50 100

Feet

Groundwater Screening Levels:
PFBS - 400 µg/L
PFOA - 0.07 µg/L
PFOS - 0.07 µg/L
PFOA + PFOS - 0.07 µg/L

Notes:
Bold values indicate analyte detected at concentration indicated.
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
ND = not detected

Peterson Air Force Base
El Paso County, Colorado

Figure 14 Fire Station #2 Building 2032 (AFFF Area 3) PFBS, PFOA, and PFOS in Groundwater

Aerostar SES LLC

Drawn: B Baxter | Date: 7/11/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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PETER04-012-SS-001	
Analyte	Result (µg/kg)
PFBS	0.21 U
PFOA	0.10 U
PFOS	**3.0**

PETER04-010-SS-001	
Analyte	Result (µg/kg)
PFBS	0.25 U
PFOA	**1.5**
PFOS	**61**

PETER04-006-SD-001	
Analyte	Result (µg/kg)
PFBS	0.28 U
PFOA	0.13 U
PFOS	**4.3**

PETER04-011-SS-001	
Analyte	Result (µg/kg)
PFBS	**0.27 J**
PFOA	**0.49 J**
PFOS	**57**

PETER04-0013-SD-001	
Analyte	Result (µg/kg)
PFBS	0.48 U
PFOA	**0.74 J**
PFOS	**370**

PETER04-004-SS-001	
Analyte	Result (µg/kg)
PFBS	0.24 U
PFOA	0.12 U
PFOS	**0.32 J**

PETER04-007-SS-001	
Analyte	Result (µg/kg)
PFBS	0.23 U
PFOA	0.11 U
PFOS	**0.80 J**

PETER04-004-SO-058	
Analyte	Result (µg/kg)
PFBS	0.22 U
PFOA	0.11 U
PFOS	**0.18 J**

PETER04-001-SO-049	
Analyte	Result (µg/kg)
PFBS	0.24 U
PFOA	0.11 U
PFOS	0.15 U

PETER04-005-SS-001	
Analyte	Result (µg/kg)
PFBS	0.22 U
PFOA	0.11 U
PFOS	**1.4 J**

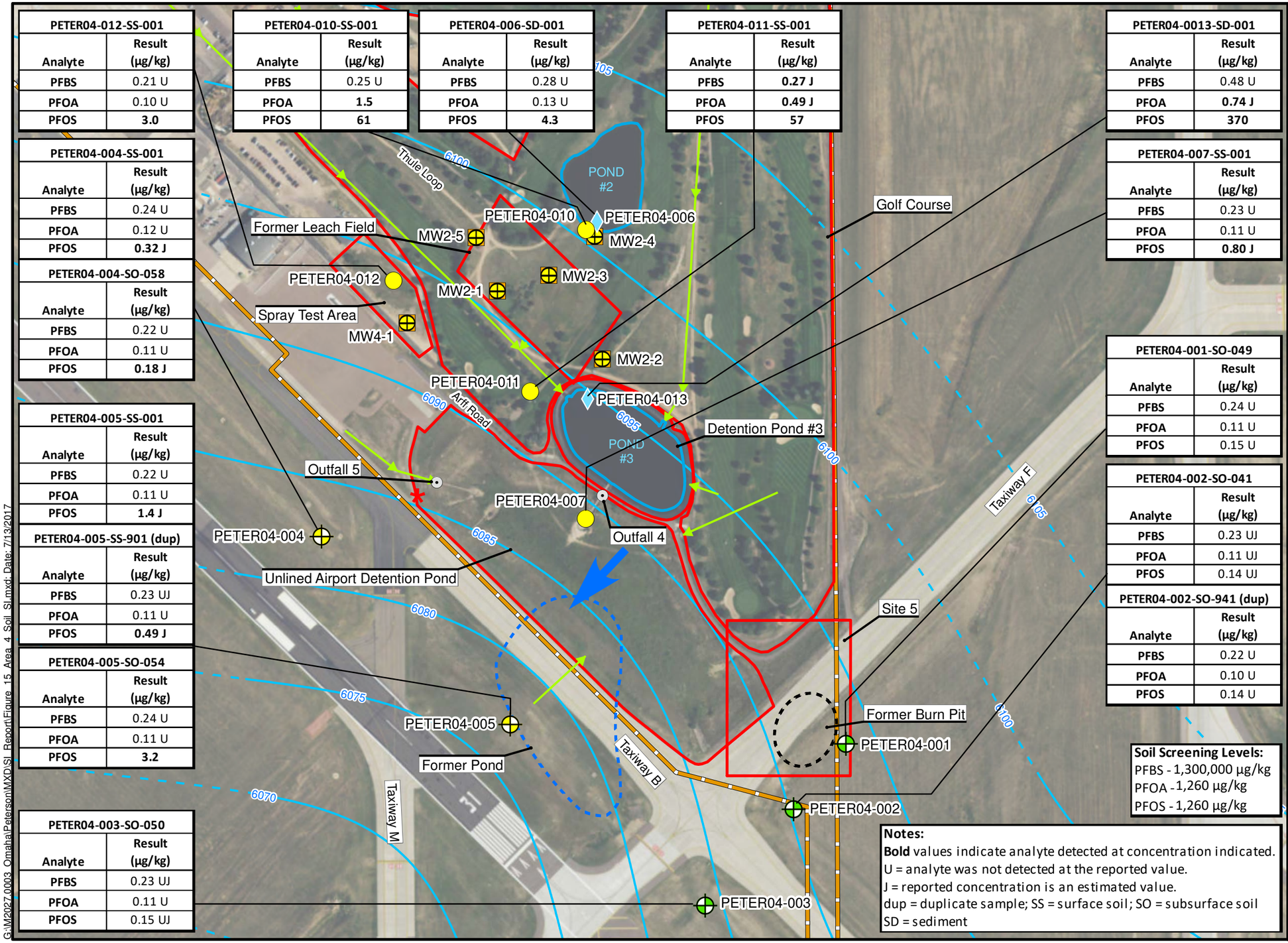
PETER04-002-SO-041	
Analyte	Result (µg/kg)
PFBS	0.23 UJ
PFOA	0.11 UJ
PFOS	0.14 UJ

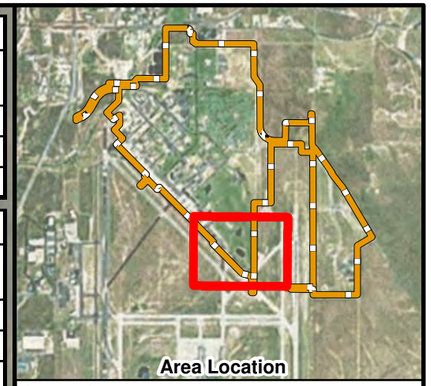
PETER04-005-SS-901 (dup)	
Analyte	Result (µg/kg)
PFBS	0.23 UJ
PFOA	0.11 U
PFOS	**0.49 J**

PETER04-002-SO-941 (dup)	
Analyte	Result (µg/kg)
PFBS	0.22 U
PFOA	0.10 U
PFOS	0.14 U

PETER04-005-SO-054	
Analyte	Result (µg/kg)
PFBS	0.24 U
PFOA	0.11 U
PFOS	**3.2**

PETER04-003-SO-050	
Analyte	Result (µg/kg)
PFBS	0.23 UJ
PFOA	0.11 U
PFOS	0.15 UJ





Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- New Monitoring Well w/ Subsurface Soil Sample
- Surface Soil Sample
- Existing Groundwater Monitoring Well Sampled
- Surface Water and Sediment Samples
- Outfall
- Storm Sewer (Underground)
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Surface Water
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

N

0 100 200 300 400 500

Feet

Soil Screening Levels:
PFBS - 1,300,000 µg/kg
PFOA - 1,260 µg/kg
PFOS - 1,260 µg/kg

Notes:
Bold values indicate analyte detected at concentration indicated.
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
dup = duplicate sample; SS = surface soil; SO = subsurface soil
SD = sediment

Peterson Air Force Base
El Paso County, Colorado

Figure 15 Golf Course/Leach Field (WP006), Detention Pond #3, and Site 5 (FT002) (AFFF Area 4) PFBS, PFOA, and PFOS in Soil and Sediment

Aerostar SES LLC

Drawn: B Baxter

Date: 7/13/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

G:\M2027.0003_Omaha\Peterson\MXD\SI_Report\Figure_15_Area_4_Soil_SI.mxd; Date: 7/13/2017

PETER04-MW4-1-GW-074	
Analyte	Result (µg/L)
PFBS	0.040
PFOA	0.0071 J
PFOS	0.012 J
PFOA + PFOS	0.0191 J

PETER04-MW4-1-GW-974 (dup)	
Analyte	Result (µg/L)
PFBS	0.038
PFOA	0.0067 J
PFOS	0.012 J
PFOA + PFOS	0.0187 J

PETER04-MW2-5-GW-069	
Analyte	Result (µg/L)
PFBS	0.063
PFOA	0.0087 J
PFOS	0.0033 U
PFOA + PFOS	0.0087 J

PETER04-MW2-1-GW-059	
Analyte	Result (µg/L)
PFBS	0.021
PFOA	0.0090 J
PFOS	0.070
PFOA + PFOS	0.079 J

PETER04-006-SW-001	
Analyte	Result (µg/L)
PFBS	0.022
PFOA	0.096
PFOS	0.73
PFOA + PFOS	0.826

PETER04-MW2-4-GW-053	
Analyte	Result (µg/L)
PFBS	0.013 J
PFOA	0.0053 U
PFOS	0.085
PFOA + PFOS	0.085

PETER04-MW2-3-GW-050	
Analyte	Result (µg/L)
PFBS	0.023
PFOA	0.027
PFOS	0.52
PFOA + PFOS	0.547

PETER04-MW2-2-GW-050	
Analyte	Result (µg/L)
PFBS	0.079
PFOA	0.0053 U
PFOS	0.0046 J
PFOA + PFOS	0.0046 J

PETER04-0013-SW-001	
Analyte	Result (µg/L)
PFBS	0.024
PFOA	0.10
PFOS	0.63
PFOA + PFOS	0.73

PETER04-001-GW-059	
Analyte	Result (µg/L)
PFBS	0.035
PFOA	0.022
PFOS	0.0060 J
PFOA + PFOS	0.028 J

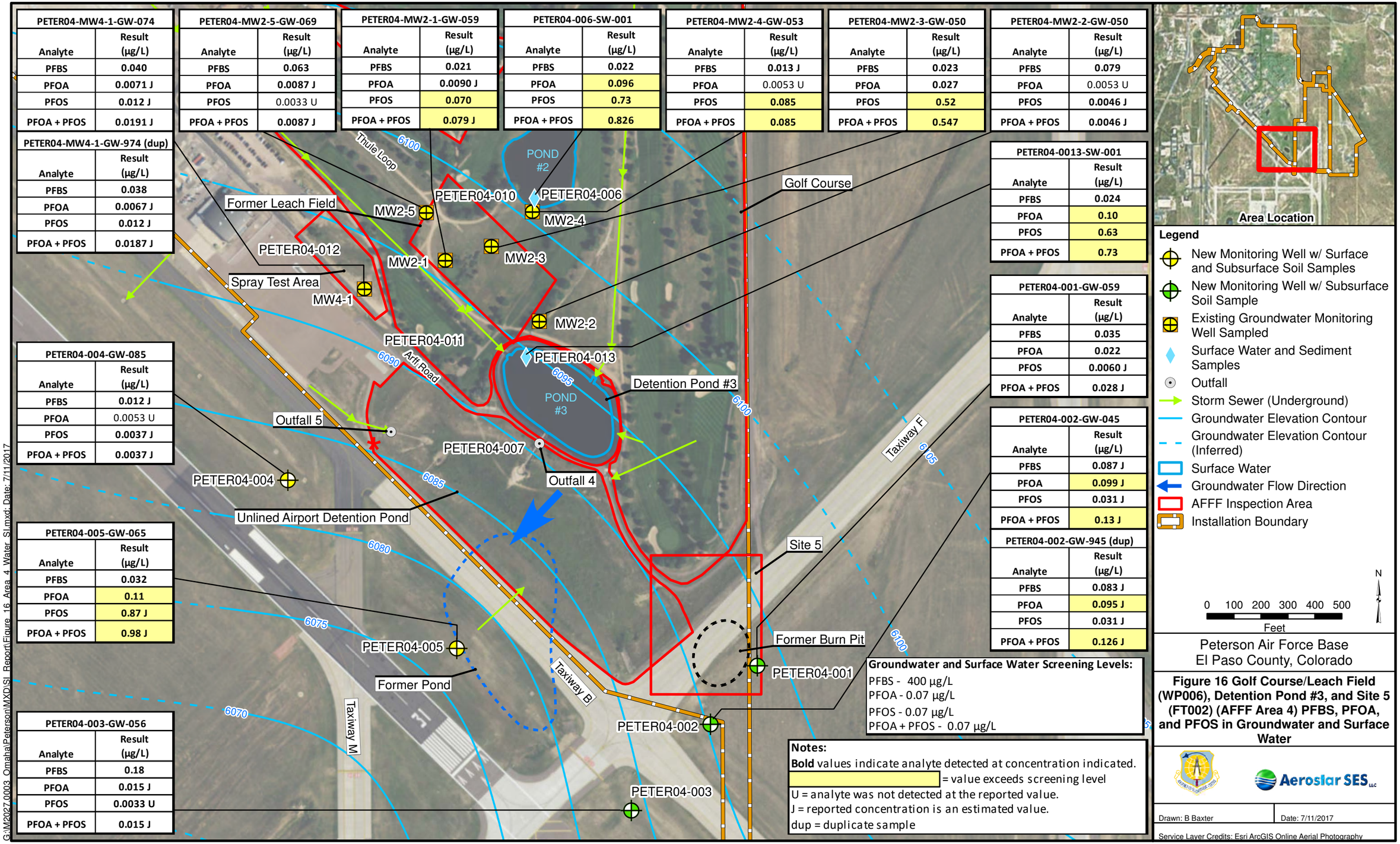
PETER04-002-GW-045	
Analyte	Result (µg/L)
PFBS	0.087 J
PFOA	0.099 J
PFOS	0.031 J
PFOA + PFOS	0.13 J

PETER04-002-GW-945 (dup)	
Analyte	Result (µg/L)
PFBS	0.083 J
PFOA	0.095 J
PFOS	0.031 J
PFOA + PFOS	0.126 J

PETER04-004-GW-085	
Analyte	Result (µg/L)
PFBS	0.012 J
PFOA	0.0053 U
PFOS	0.0037 J
PFOA + PFOS	0.0037 J

PETER04-005-GW-065	
Analyte	Result (µg/L)
PFBS	0.032
PFOA	0.11
PFOS	0.87 J
PFOA + PFOS	0.98 J

PETER04-003-GW-056	
Analyte	Result (µg/L)
PFBS	0.18
PFOA	0.015 J
PFOS	0.0033 U
PFOA + PFOS	0.015 J



Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- New Monitoring Well w/ Subsurface Soil Sample
- Existing Groundwater Monitoring Well Sampled
- Surface Water and Sediment Samples
- Outfall
- Storm Sewer (Underground)
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Surface Water
- Groundwater Flow Direction
- AFFF Inspection Area
- Installation Boundary

N

0 100 200 300 400 500

Feet

Groundwater and Surface Water Screening Levels:

PFBS - 400 µg/L
PFOA - 0.07 µg/L
PFOS - 0.07 µg/L
PFOA + PFOS - 0.07 µg/L

Notes:

Bold values indicate analyte detected at concentration indicated.
= value exceeds screening level
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
dup = duplicate sample

Peterson Air Force Base
El Paso County, Colorado

Figure 16 Golf Course/Leach Field (WP006), Detention Pond #3, and Site 5 (FT002) (AFFF Area 4) PFBS, PFOA, and PFOS in Groundwater and Surface Water

Aerostar SES LLC

Drawn: B Baxter

Date: 7/11/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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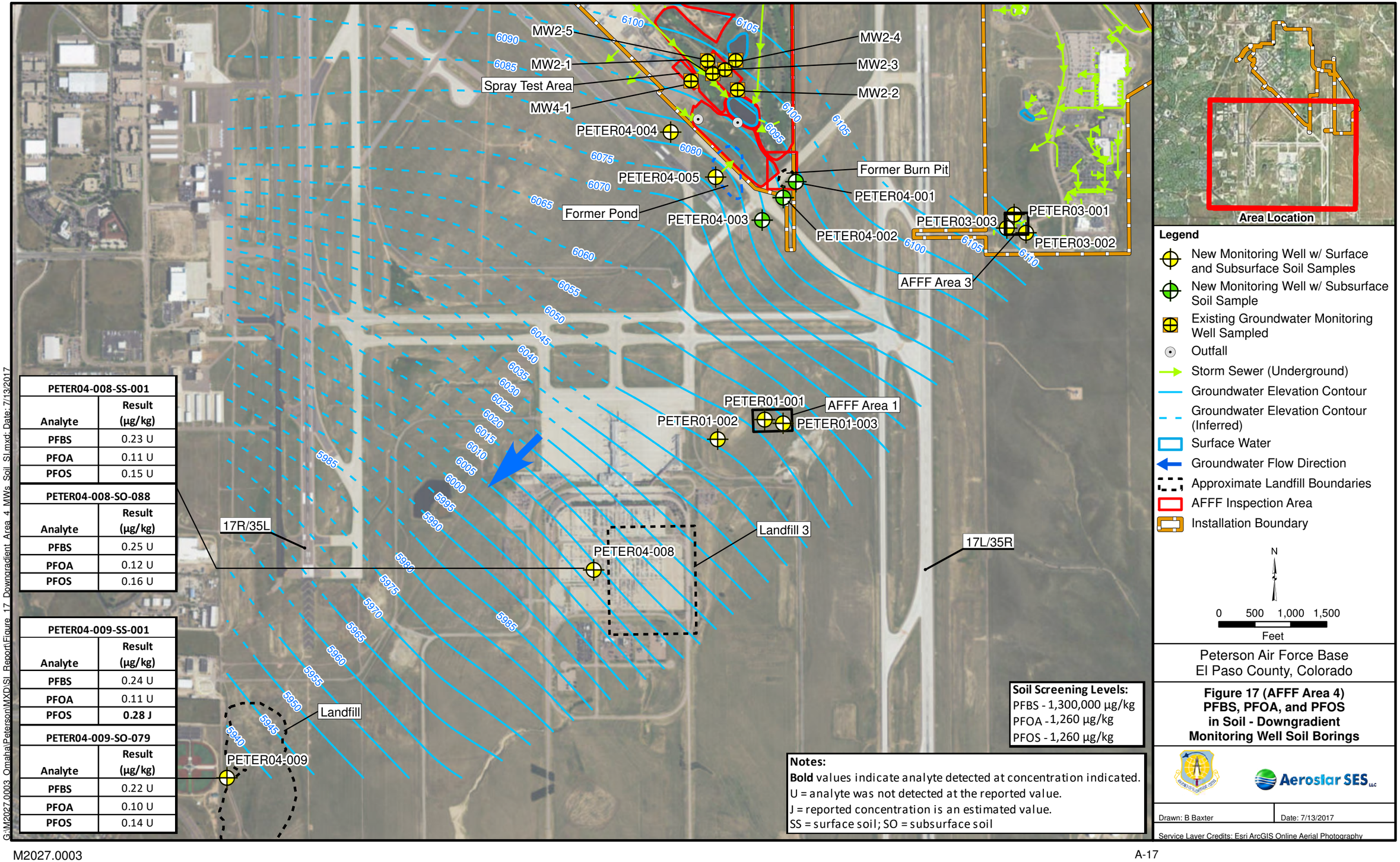

PETER04-008-SS-001	
Analyte	Result (µg/kg)
PFBS	0.23 U
PFOA	0.11 U
PFOS	0.15 U

PETER04-008-SO-088	
Analyte	Result (µg/kg)
PFBS	0.25 U
PFOA	0.12 U
PFOS	0.16 U

PETER04-009-SS-001	
Analyte	Result (µg/kg)
PFBS	0.24 U
PFOA	0.11 U
PFOS	**0.28 J**

PETER04-009-SO-079	
Analyte	Result (µg/kg)
PFBS	0.22 U
PFOA	0.10 U
PFOS	0.14 U

Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- New Monitoring Well w/ Subsurface Soil Sample
- Existing Groundwater Monitoring Well Sampled
- Outfall
- Storm Sewer (Underground)
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Surface Water
- Groundwater Flow Direction
- Approximate Landfill Boundaries
- AFFF Inspection Area
- Installation Boundary

N

0 500 1,000 1,500

Feet

Soil Screening Levels:
PFBS - 1,300,000 µg/kg
PFOA - 1,260 µg/kg
PFOS - 1,260 µg/kg

Notes:
Bold values indicate analyte detected at concentration indicated.
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
SS = surface soil; SO = subsurface soil

Peterson Air Force Base
El Paso County, Colorado

Figure 17 (AFFF Area 4)
PFBS, PFOA, and PFOS in Soil - Downgradient Monitoring Well Soil Borings

Aerostar SES LLC

Drawn: B Baxter

Date: 7/13/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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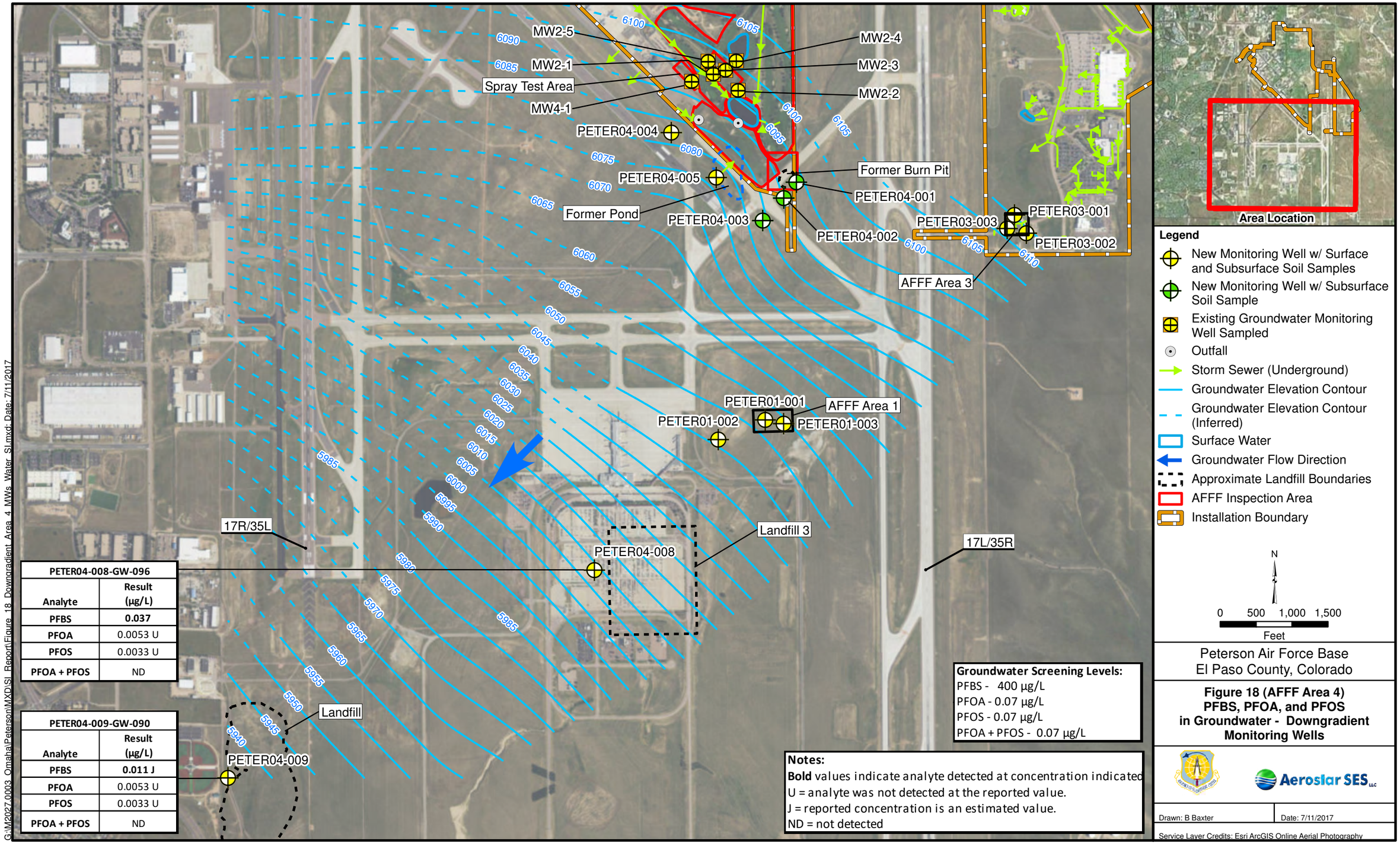

PETER04-008-GW-096	
Analyte	Result (µg/L)
PFBS	**0.037**
PFOA	0.0053 U
PFOS	0.0033 U
PFOA + PFOS	ND

PETER04-009-GW-090	
Analyte	Result (µg/L)
PFBS	**0.011 J**
PFOA	0.0053 U
PFOS	0.0033 U
PFOA + PFOS	ND

Groundwater Screening Levels:
PFBS - 400 µg/L
PFOA - 0.07 µg/L
PFOS - 0.07 µg/L
PFOA + PFOS - 0.07 µg/L

Notes:
Bold values indicate analyte detected at concentration indicated
U = analyte was not detected at the reported value.
J = reported concentration is an estimated value.
ND = not detected

Legend

- New Monitoring Well w/ Surface and Subsurface Soil Samples
- New Monitoring Well w/ Subsurface Soil Sample
- Existing Groundwater Monitoring Well Sampled
- Outfall
- Storm Sewer (Underground)
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Surface Water
- Groundwater Flow Direction
- Approximate Landfill Boundaries
- AFFF Inspection Area
- Installation Boundary

N

0 500 1,000 1,500

Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 18 (AFFF Area 4)
PFBS, PFOA, and PFOS in Groundwater - Downgradient Monitoring Wells

Aerostar SES LLC

Drawn: B Baxter | Date: 7/11/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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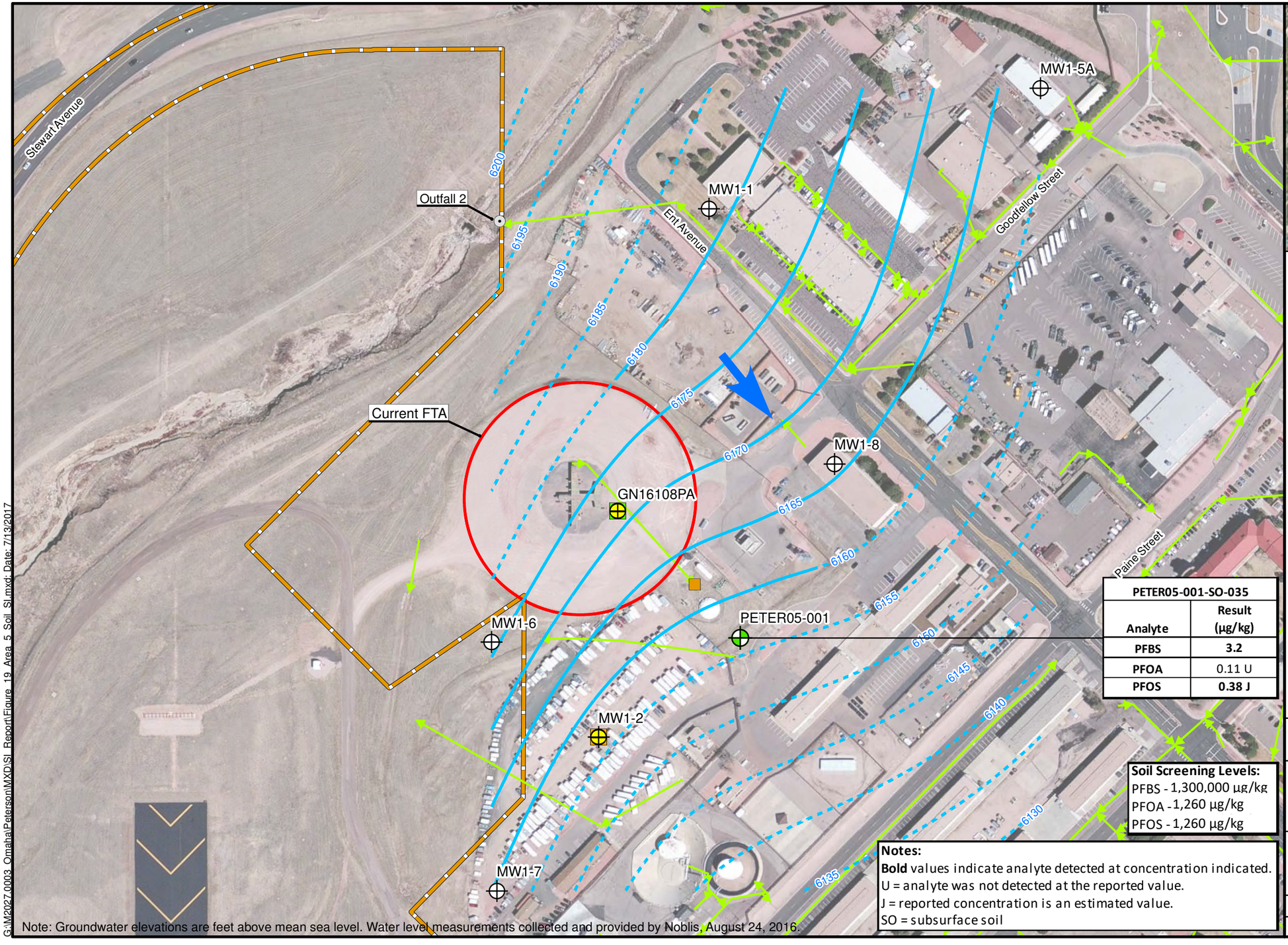

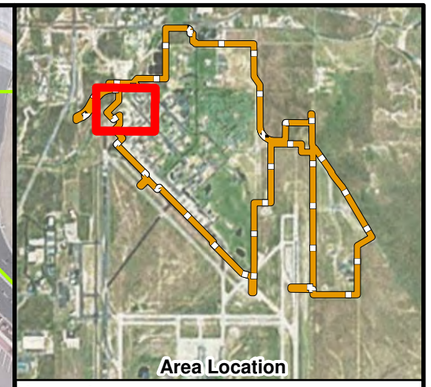

Legend

- New Monitoring Well w/ Subsurface Soil Sample
- Existing Monitoring Well Sampled 11/1/16 by Others
- Existing Groundwater Monitoring Well Sampled
- Existing Monitoring Well (Groundwater Level Measurement Only)
- Outfall
- Decommissioned Oil/Water Separator
- Storm Sewer (Underground)
- Groundwater Contour
- Groundwater Contour Inferred
- Groundwater Flow Direction
- AFFF Inspection
- Installation Boundary

N

0 100 200 300

Feet

Peterson Air Force Base
El Paso County, Colorado

Figure 19 Current Fire Training Area (AFFF Area 5) PFBS, PFOA, and PFOS in Soil

Aerostar SES LLC

Drawn: B Baxter

Date: 7/13/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

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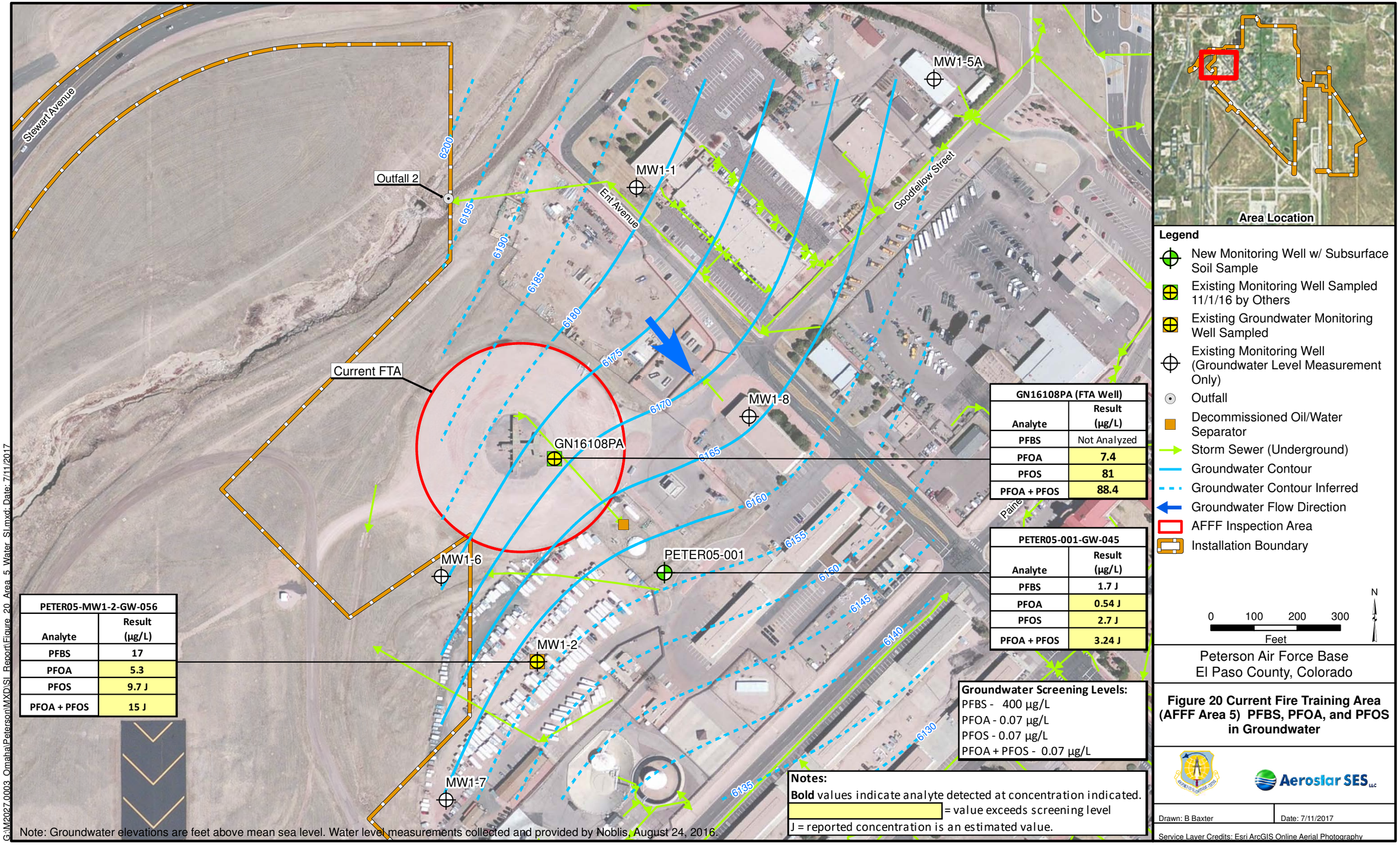

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El Paso County, Colorado

Figure 20 Current Fire Training Area (AFFF Area 5) PFBS, PFOA, and PFOS in Groundwater

Aerostar SES LLC

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