Memo

To **Ms. Jody Murata**
Program Manager
ANG/A4OR
3501 Fetchet Avenue
Shepperd Hall
Andrews AFB, MD 20762-5157

AMEC # **2-9133-0006**

From **Kerry Tull**

cc

Date **June 11, 2019**

Subject **Final Report - FY16 Phase I Regional Site Inspections for PFCs at West Virginia Air National Guard 130th Air Lift Wing, McLaughlin Air National Guard Base, Yeager Airport, Charleston, West Virginia**

Ms. Murata:

Attached is one electronic copy of the Final Report – FY 16 Phase I Regional Site Inspections for PFCs at **at** West Virginia Air National Guard **130**th Air Lift Wing, McLaughlin Air National Guard Base, Yeager Airport, Charleston, West Virginia. This report has been completed as part of Contract No. W9133L-14-D-0002, Task Order 0006.

Please contact me at (207) 828-3514 if you have any questions.

Sincerely,

Kerry Tull
Project Manager

AMEC Environment & Infrastructure, Inc.
46850 Magellan Drive
Suite 190
Novi, MI 48377-2448
Tel +(810) 220-8941
Fax +(810) 220-8947
www.amec.com

FINAL REPORT
FY16 PHASE I REGIONAL SITE INSPECTIONS FOR PERFLUORINATED COMPOUNDS
VOLUME I OF VI

WEST VIRGINIA AIR NATIONAL GUARD
130TH AIRLIFT WING
MCLAUGHLIN AIR NATIONAL GUARD BASE
YEAGER AIRPORT
CHARLESTON, WEST VIRGINIA

Contract #: W9133L-14-D-0002
Delivery Order 0006

Amec Foster Wheeler Project #: 2-9133-0006
June 2019

THIS PAGE INTENTIONALLY LEFT BLANK.

FY16 Phase I Regional Site Inspections
For Perfluorinated Compounds

West Virginia Air National Guard – 130th Airlift Wing
McLaughlin Air National Guard Base at Yeager Airport
Charleston, West Virginia

Prepared for:
National Guard Bureau
Operations Division, Restoration Branch
Joint Base Andrews, MD 20762-5157

Prepared by:
Amec Foster Wheeler
Environment & Infrastructure, Inc.
4021 Stirrup Creek Drive STE. 100
Durham, NC 27703

Project No.: 291330006.011
June 2019

Prepared by:

Bonani Langan

Bonani Langan, PE
Regional Base Lead

Reviewed by:

Kerry Tull, LSP
Project Manager

Jean Firth
Technical Reviewer

THIS PAGE INTENTIONALLY LEFT BLANK.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS & ABBREVIATIONS

%	Percent
130th ALW	130th Airlift Wing
AFFF	Aqueous Film Forming Foam
Amec Foster Wheeler	Amec Foster Wheeler Environmental & Engineering, Inc.
ANG	Air National Guard
ANGB	Air National Guard Base
amsl	above mean sea level
BB&E	BB&E, Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
CWVRAA	Central West Virginia Regional Airport Authority
°C	Degrees Celsius
°F	Degrees Fahrenheit
DoD	Department of Defense
DPT	direct-push technology
DQO	Data Quality Objective
ft	feet/foot
FD	Fire Department
FSP	Field Sampling Plan
FSS	Fire Suppression System
FTA	Fire Training Area
GW	Groundwater (sample designation)
HA	Health Advisory
IRP	Installation Restoration Program
IDW	Investigative-derived waste
MANGB	McLaughlin Air National Guard Base
M&E	Metcalf & Eddy, Inc.
mph	miles per hour
MS/MSD	matrix spike/matrix spike duplicate
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
NFA	No Further Action
NGB	National Guard Bureau
NL	Not Listed

ORP	Oxidation-Reduction Potential
OWS	Oil-Water Separator
PA	Preliminary Assessment
PEER	PEER Consultants, P.C.
PFBS	Perfluorobutanesulfonic acid
PFC	Perfluorinated Compound
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
POL	Petroleum, Oil, and Lubricant
PRL	Potential Release Location
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QC	Quality Control
RSL	Regional Screening Level
SD	Sediment (sample designation)
SHSP	Site Health and Safety Plan
SI	Site Inspection
SUE	soft utility excavation
SW	Surface Water (sample designation)
TW	Temporary Monitoring Well (sample designation)
UCMR 3	Unregulated Contaminant Monitoring Rule
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
Vista	Vista Analytical Laboratories, Inc.
WP	Work Plan
WVANG	West Virginia Air National Guard
WVDEP	West Virginia Department of Environmental Protection
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was contracted by the National Guard Bureau Operations Restoration Branch under Contract # W9133L-14-D-0002, Delivery Order 0006 to conduct Phase I Regional Site Inspections (SIs) for Perfluorinated Compounds (PFCs) at multiple Air National Guard (ANG) Installations. This report has been prepared for SIs conducted at on-Base Potential Release Locations (PRLs) identified on the 130th Airlift Wing, West Virginia Air National Guard, McLaughlin Air National Guard Base (MANGB) at Yeager Airport, in the City of Charleston, West Virginia. This Report presents the results and recommendations from the 2018 SI field activities conducted in January and July 2018 at the MANGB. The objectives of the SI were to determine the presence or absence of PFCs at each PRL and based on the findings:

1) Determine if the PRL is eligible for a decision of No Further Action (NFA);
2) Assess if PFCs are migrating off-Base; and
3) Provide data which can be used for developing Data Quality Objectives if further investigations are recommended.

To meet the objectives, Amec Foster Wheeler performed SIs at the following eight PRLs:

- PRL 01: Former Fire Training Area (Installation Restoration Program (IRP) Site 3)
- PRL 02: Hangar 107
- PRL 03: Hangar 121
- PRL 04: North Fire Department (FD) Equipment Testing Area
- PRL 05: South FD Equipment Testing Area
- PRL 06: Former Building 120 (Former FD)
- PRL 07: Building 420 (Current FD)
- PRL 09: Former Waste Water Treatment Plant (Including IRP Site 2)

Based on recommendations from the Preliminary Assessment (PA) conducted by BB&E, Inc. (BB&E) in August 2015 soil, groundwater, surface water, and sediment samples were collected. Samples were analyzed for the PFCs listed on the United States Environmental Protection Agency's (USEPA) Third Unregulated Contaminant Monitoring Rule (UCMR 3) list (USEPA,

2012); however, the SI focus was limited to evaluation and discussion of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and perfluorobutanesulfonic acid (PFBS). The detected PFC concentrations were compared against screening criteria for PFOA, PFOS, and PFBS including: the USEPA lifetime drinking water Health Advisory (HA) for PFOS (USEPA, May 2016a) and HA for PFOA (USEPA, May 2016b); the USEPA Regional Screening Level (RSL) for PFBS in residential soil (USEPA, 2018); the USEPA RSL for PFBS in tap water; and based on United States Air Force Guidance (USAF, 2012), calculated screening levels using the USEPA screening level calculator for PFOA and PFBS in soil and sediment. These screening criteria are presented in **Table ES-1** below:

Table ES-1: USEPA and USAF SI Screening Criteria

Parameter	Chemical Abstract Number	USEPA Regional Screening Level Table (May 2018)[a]		Air Force Guidance for Soils and Sediments[b] (µg/kg)	USEPA Health Advisory Drinking Water (Surface Water or Groundwater) (µg/L)[c]
		Residential Soil (µg/kg)	Tap Water (µg/L)		
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,300,000[d]	400[f]	NL	NL
Perfluorooctanoic acid (PFOA)	335-67-1	NL	NL	1,260	0.07[e]
Perfluorooctane sulfonate (PFOS)	1763-23-1	NL	NL	1,260	

Notes and Abbreviations:
NL – Not listed
USAF – U.S. Air Force
USEPA – U.S. Environmental Protection Agency
µg/L - micrograms per liter
µg/kg - micrograms per kilogram

[a] USEPA Regional Screening Levels (USEPA, 2018).

[b] Screening levels calculated using the USEPA Regional Screening Level calculator [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search]. A toxicity hazard quotient (THQ) of 1.0 was used. The toxicity value input for the calculator is the Tier 3 value reference dose of 0.00002 mg/kg/day derived by USEPA in their Drinking Water Health Advisories for both PFOS (USEPA, 2016a) and PFOA (USEPA, 2016b).

[c] USEPA, 2016b. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)* and USEPA, 2016a. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS).*

[d] PFBS RSL for Residential Soil (based on a target hazard quotient [THQ] of 1.0) concentration presented in the SI Work Plan (Amec Foster Wheeler, 2017) was 1,600,000 µg/kg based on the May 2016 RSL values. This table has been updated to include the more recent RSL values published in May 2018.

[e] Note: When PFOA and PFOS are both present, the combined detected concentrations of the compounds are compared with the 0.07 µg/L health advisory value for groundwater and surface water.

[f] PFBS RSL for Tap Water presented in the SI Work Plan (Amec, 2017) was 380 µg/L based on the May 2016 RSL values. This table has been updated to include the more recent RSL values published in May 2018.

Although groundwater was not encountered in borings at seven of the eight PRLs. the SI results show PFCs are present in soils at each of the PRLs. PFC concentrations detected in soils may not represent the highest concentration present and therefore could be an ongoing source of contaminants to the groundwater. Based on the northeastern direction of groundwater flow at the Base, and that groundwater results exceed the USEPA Drinking Water HA screening guidance at PRL 9, there is a potential for PFC migration downgradient of each PRL and at the Base Boundary.

The Environmental Data Resources Radius Map™ Report with Geocheck® dated July 20, 2015, identified 24 United States Geological Survey wells within a 1-mile radius of the McLaughlin ANG Base (Appendix C-2 [BB&E, 2015]). Review of a 2001 Environmental Baseline Survey identified a total of 23 domestic, industrial, irrigation, recreation, commercial, and public water supply wells located within a 1-mile radius of the McLaughlin ANG site boundary. One of these wells, G19, was reported to be a public supply well. This well is 1,863 feet deep, and the depth to groundwater is recorded at 12 feet below ground surface (bgs). Of the remaining wells, one well was reported to be for irrigation, one for industrial use, one for commercial use, one for recreational use, one is unused, and 17 are for domestic use (Appendix C-3 [BB&E, 2015]). Based on the interpreted groundwater flow direction, many of these wells, including the public supply well, are upgradient or side gradient from the base; the twelve-remaining domestic, industrial, or unused wells appear to be potential downgradient receptors from the Base.

Based on comparison of analytical data to the screening criteria in **Table ES-1** above, Amec Foster Wheeler recommends further investigations at the eight PRLs investigated (PRL 1, PRL 2, PRL 3, PRL 4, PRL 5, PRL 6, PRL 7, and PRL 9). Amec Foster Wheeler also recommends that further investigations include analysis of additional compounds, including precursor compounds, to supplement the UCMR 3 list at each of the PRLs and media recommended for further investigation in **Table ES-2**. Precursor compounds have potential to result in increased concentrations downgradient and can serve as a lingering source. An overview of conclusions from SI activities and recommendations for future investigations, are provided in **Table ES-2** below. Additionally, drilling methods employed in the SI were incapable of penetrating into the groundwater table which was deeper than the 20-34 feet bgs reached, therefore, future drilling activities should be conducted using more robust drilling methods such as hollow stem auger or rotary sonic drilling methods to achieve the required depths to reach the groundwater table.

Table ES-2: Screening Criteria Exceedances and Recommendations

PRL	Screening Criteria Exceedance				Recommendations
	Soil	GW	SW	SD	
1*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
2*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
3*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
4*	X				Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
5*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
6			X		SW investigation to evaluate the migration pathway of PFCs.
7*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
9		X	X		Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.

Notes:

GW – Groundwater
PFC – Perfluorinated Compound
PRL – Potential Release Area
SD – Sediment
SW – Surface water
X – Screening criteria exceedance
*Groundwater was not evaluated during the SI due to insufficient water in the installed temporary well.

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was contracted by the National Guard Bureau (NGB) Operations Restoration Branch under Contract # W9133L-14-D-0002, Delivery Order 0006 to conduct Phase I Regional Site Inspections (SIs) for Perfluorinated Compounds (PFCs) at multiple Air National Guard (ANG) Installations. The scope of the Contract includes performance of a SI at on-Base potential release locations (PRLs) identified at the 130th Airlift Wing (130th ALW), West Virginia Air National Guard (WVANG), McLaughlin Air National Guard Base (MANGB) at Yeager Airport, in the City of Charleston, West Virginia. This SI Report describes the objectives, procedures, and activities which were completed, and presents Amec Foster Wheeler's findings and recommendations. The Base location is shown in **Figure 1**, and the Base and area features are shown on **Figure 2**.

The SI was conducted in general accordance with the standards and practices of the West Virginia Department of Environmental Protection (WVDEP).

1.1 Background

Yeager Airport was constructed from 1943 to 1947. MANGB began occupying Yeager Airport in 1947 and has undergone a series of reorganizations (as discussed in **Section 2.2**). Base activities were typical of those at most airports and military air bases, including fueling, maintenance, and training operations.

BB&E, Inc. (BB&E) conducted a Preliminary Assessment (PA) site visit for WVANG at MANGB on 12 and 13 August 2015, to identify potential locations of historic environmental releases of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), and perfluorobutanesulfonic acid (PFBS), specifically from Aqueous Film Forming Foam (AFFF) usage and storage. The PA site visit process included a review of Fire Training Areas (FTAs) in operation since 1970, any other use or release of AFFF, and the completion of a site reconnaissance. The goal of the PA site visit was to determine if a site poses a threat to human health and the environment and requires additional inspection. Nine PRLs, as identified on **Table 1**, where AFFF (Ansulite Mil-spec (3 percent [%]) and Ansul Class A (1%)) had been stored, used, or released were identified at MANGB, including a former FTA, hangars, fire departments, firefighting equipment testing areas, a Base supply, and a former Waste Water Treatment Plant (WWTP). Due to findings of no known AFFF releases at PRL 8 (Building 143—Base Supply) documented in the PA, this PRL was determined by BB&E to not require further action (categorized as No Further Action [NFA])

(BB&E, 2015). The remaining eight of nine PRLs were recommended for further inspection. **Figure 3** depicts the eight PRLs that were inspected and as part of this SI (BB&E, 2015). A summary of PRL inspection activities is presented in **Table 2**.

1.2 Purpose and Scope

The purpose of the SI was to determine the presence/absence of PFCs at each of the PRLs, and in the groundwater at or near the Base boundary. This data has been used to develop recommendations for appropriate paths forward to either provide an NFA conclusion or recommendations for developing further investigations. SI investigative tasks included:

- Advancing direct-push technology (DPT) soil borings at the PRLs (21 DPT borings) up to a maximum depth of 10 feet (ft) below ground surface (bgs) and collect one or more soil sample(s) from each boring;
- Installing five temporary monitoring wells
- Collecting four groundwater samples from one existing downgradient monitoring well (one initial sample and one confirmation sample) and two of the temporary monitoring wells installed;
- Collecting two sediment and two surface water samples from the Former Building 120 – Former Fire Department (FD) (PRL 6) and the Former WWTP (PRL 9).

Field activities were conducted in accordance with the Final SI Work Plan (WP), Quality Assurance Project Plan (QAPP), Field Sampling Plan (FSP), and Site Health and Safety Plan (SHSP) (Amec Foster Wheeler, 2017). The scope of the SI is outlined in the following sections.

2.0 INSTALLATION DESCRIPTION

Section 2.1 describes the location and environs of MANGB. A brief history of MANGB is provided in **Section 2.2**.

2.1 Location

The MANGB is located at Yeager Airport, approximately 4 miles northeast of downtown Charleston, Kanawha County, West Virginia (**Figure 1**). Yeager Airport, previously known as Kanawha Airport, is operated by the Central West Virginia Regional Airport Authority (CWVRAA). The MANGB facilities encompass approximately 75 acres of land in the northeastern portion of Yeager Airport (**Figure 2**). The eight PRLs included in the scope of this SI are shown on **Figure 3**.

2.2 Organization and History

Yeager Airport was constructed from 1943 to 1947 with the clearing of 360 acres of forest and moving of 9 million cubic yards of earth to level the Coonskin Ridge Mountaintops and create two runways (AECOM, 2015). MANGB occupancy at the airport began in 1947 with the newly established 167th Fighter Squadron. The 167th Fighter Squadron was reorganized into the 130th Troop Carrier Squadron in 1955, and in 1975 became the 130th Tactical Airlift Group, currently titled the 130th Airlift Wing, with the subsequent changes in aircraft. Both the Charleston Air National Guard Base (ANGB) and the United States Air Force (USAF) initially occupied a 25-acre airfield area and the Charleston ANGB property was eventually expanded to approximately 75 acres leased from the CWVRAA. In 1991, the USAF purchased 33 acres along Coonskin Drive from the Kanawha County Parks and Recreation Commission to construct a new headquarters and supply warehouse. In 1996, the USAF purchased a 1-acre parcel containing the water tower and pump station (AECOM, 2015). Base activities were typical of those at most airports and military air bases, including fueling, maintenance, and training operations. These activities include the usage, transportation, storage, and disposal of various products, including potentially hazardous materials.

THIS PAGE INTENTIONALLY LEFT BLANK.

3.0 ENVIRONMENTAL SETTING

The following sections provide information on the environmental setting at MANGB. This information is summarized from the December 2015, Final PA/SI Report (AECOM, 2015).

3.1 Climate

The climate in Charleston is defined as temperate and is influenced by the surrounding mountains. Summers tend to be moderately warm and winters are cool and relatively short. The average daily high temperature in July is 85.7 degrees Fahrenheit (ºF). The highest afternoon temperatures occur from June through August and range from the mid- to high-80s with temperatures above 90ºF occurring approximately 21 days per year. The average daily low temperature of 23ºF occurs in January (AECOM, 2015).

Prevailing winds in Kanawha County are generally out of the southwest and average 6 miles per hour (mph). The windiest month is March, with a mean speed of 9 mph. The average annual precipitation in Charleston is 42.53 inches. The wettest months are July and August, during which more than 4 inches of rain fall per month. The driest months are usually September and October, with rainfall less than 3 inches per month. Including evapotranspiration, the average net precipitation is 13 inches per year (AECOM, 2015).

3.2 Topography

The topography of the installation slopes steeply north-northeastward down from the level airfield. Surface elevations range from 730 ft above mean sea level (amsl) at the main gate to the installation on Coonskin Drive, to 850 to 900 ft amsl in the water tower area, and 970 ft amsl in the airfield area. The installation is located on a mountain that is part of the Appalachian Plateau Physiographic Province. The hills on which the airport was constructed were originally 125 to 192 ft higher before grading for airport construction. The change in elevation from the airfield area to the surface water drainage features is approximately 300 ft (AECOM, 2015).

3.3 Geology

The surface geology at the MANGB is bedrock which has been mapped by the West Virginia Geological Survey as the middle unit of the Conemaugh Group. The upper unit of the Conemaugh Group is not represented at MANGB. The Conemaugh Group is Upper Pennsylvanian in age. Regionally, the Conemaugh Formation is approximately 500 ft thick consisting of red and purple

shales with calcareous zones, mudstones, capped by a massive sandstone. The middle unit is approximately 193 ft thick, and its base is marked by a 6.5-ft-thick carbonate mudstone. Below the Conemaugh Formation is the Charleston Sandstone. The contact between the two is marked by a dark greenish-gray shale bed (BB&E, 2015).

3.4 Soils

Soils at the site are mapped as the Udorthents-Smoothed-Urban land complex (level to steep) in the areas of higher elevation (i.e. airport runway), while lower-lying areas are composed of both the Clymer-Dekalb complex (steep) and the Gilpin complex (20 to 30 percent slopes). The Udorthents is composed of heterogenous fill material derived from cutting higher areas and filling lower areas. The Clymer-Dekalb complex is composed of steep, well drained, deep to moderately deep soils with slopes ranging from 30 to 40 percent; and 45 percent of soils of Clymer channery loam, 30 percent of Dekalb channery sandy loam, and 25 percent composed of minor soils. The Gilpin complex is moderately steep, well drained, moderately deep, silty loam. (National Resources Conservation Service Web Soil Survey, accessed 2/15/18).

Soils observed during the SI activities were generally fill materials consisting primarily of reddish brown to gray silts and clays with abundant large boulders of mudstone, siltstone, and sandstone. Soils observed at the boundary well locations, in lower elevation areas of the site, were composed of reddish yellow elastic silt overlying light gray to reddish brown low plasticity clay. Soil boring logs are included in **Appendix A**.

3.5 Surface Water Hydrology

With the exception of the southern extremity of the Base, surface drainage on Base is directed via interconnecting storm sewers and ditches, or by overland runoff, to the two major topographic draws east of the Base. These two groundwater-recharged draws, which contain flow throughout most of the year, empty into the northward flowing unnamed tributary of Coonskin Branch. This drainage then flows less than 3,000 ft to the confluence with Coonskin Branch.

3.6 Hydrogeology

Generally, groundwater on Base and the immediate vicinity recharges to shallow surface water drainage features, discharges northward and northeastward as springs, and may recharge the Elk River System (ANG, 1989). Precipitation is the major source of aquifer recharge. Groundwater flows from the hilltops to the valleys through horizontal and vertical tensile fractures. Shallow

groundwater in fill or perched zones discharges to small springs, which are abundant on the Base. Deeper groundwater eventually reaches bedding planes in the valley floor, from which it may discharge to the Elk River or otherwise move downgradient (BB&E, 2015).

Two aquifer types are present in the vicinity of the MANGB: unconsolidated alluvial deposits and sedimentary bedrock. The alluvial aquifers tend to have limited areal extent and a maximum thickness of less than 30 ft and are, therefore, a relatively minor water source in the region. Movement of groundwater in the bedrock is primarily through fractures, joints, and along bedding planes. It is likely that groundwater flow direction tends to follow topography in unconsolidated fill, but is dominantly controlled by fracture orientation in bedrock (BB&E, 2015).

Soil boring data from field operations during April 1985 indicates that the MANGB rests on top of a shallow, unconfined aquifer, generally within 5 to 10 ft of the land surface. This shallow aquifer probably occurs both as an unconsolidated aquifer zone composed of fill materials and as the weathered upper 100 to 200 ft of the upper Conemaugh sandstone. The amount of seasonal fluctuation of the water table is not known. Historically within the area, groundwater levels are highest in late winter and early spring when recharge to the aquifers is highest. Groundwater levels decline to their lowest levels in late summer and early autumn due to 50% or more evapotranspiration rates (ANG, 1989).

During late autumn and early winter, more water reaches the water table because evapotranspiration at this time is at a minimum. Therefore, water levels begin to rise and continue to rise until late winter and early spring, when this groundwater level fluctuation cycle beings again. Shallow groundwater flow patterns probably still follow the general pre-airport construction flow routes where original topography was the dominant flow factor. It appears that this shallow aquifer system recharges local surface water drainages in the Base vicinity. Where the depth of fill material is restricted by the presence of the less permeable Conemaugh sandstone “bedrock” aquifers (as opposed to the more permeable, unconsolidated fill material water zones), the water table is within 5 ft or less of the land surface. These areas discharge laterally northwest toward the Elk River in the form of springs at a maximum estimated rate of 5 gallons per minute. Depth-to-water data presented from 17 soil borings drilled at MANGB indicates a shallow, wet-season water table may be situated 4 to 18 ft bgs (ANG, 1989).

3.7 Critical Habitat and Threatened/Endangered Species

According to the U.S. Fish and Wildlife Service (USFWS), there are six endangered species found

in Kanawha County: the red knot, pink mucket, clubshell, fanshell, northern riffleshell, and Indiana bat (USFWS, 2014). The red knot is a species of bird whose status is proposed threatened. The pink mucket, clubshell, fanshell, and northern riffleshell are all species of fresh water mussels whose statuses are endangered. The Indiana bat is a species of mammal whose status is endangered. Although these species are found in Kanawha County, they are not likely to be found near the MANGB.

3.8 Water Wells

MANGB personnel indicated that no drinking water supply wells are located at the Base. Review of the Environmental Data Resources Radius Map™ Report with Geocheck® dated 20 July 2015, identified 24 United States Geological Survey wells within a 1-mile radius of the MANGB (Appendix C-2 [BB&E, 2015]). Additionally, a 2001 Environmental Baseline Survey identified a total of 23 domestic, industrial, irrigation, recreation, commercial, and public water supply wells located within a 1-mile radius of the McLaughlin ANG site boundary. One of these wells, G19, was reported to be a public supply well. This well is 1,863 ft deep, and the depth to groundwater is recorded at 12 ft bgs. Of the remaining wells, one well was reported to be for irrigation, one for industrial use, one for commercial use, one for recreational use, one is unused, and 17 are for domestic use (Appendix C-3 [BB&E, 2015]).

Six monitoring wells are currently present at the MANGB. The wells are located in the former WWTP leach field at former Building 123 (PRL 9) and in/near Installation Restoration Program (IRP) Site 2 (also included in PRL 9) at/near an oil-water separator (OWS) associated with the Petroleum, Oil, and Lubricant (POL) Area. According to the inventory, the wells are 20 to 32 ft in depth, constructed of 2-inch polyvinyl chloride (PVC) with 10 ft well screens, and were completed as flush mount wells. Groundwater depth information was not provided on the inventory (TEC-Weston, 2016 and 2017).

4.0 PRELIMINARY ASSESSMENT

The Department of Defense (DoD) began investigations at military bases under the IRP with the goal of identifying, evaluating, and remediating areas of contamination (the program is now referred to as the Environmental Restoration Program). Under this program, investigations began at the MANGB in 1988. These investigations included a PA and a SI. In 1988, PEER Consultants, P.C. (PEER) conducted a PA at MANGB under the Hazardous Waste Remedial Actions Program to evaluate the presence or absence of potential soil, sediment, surface water and groundwater contamination that might be associated with waste disposal practices and historical use of petroleum products and pesticides at the Base. PEER identified and investigated four areas that were referred to as, “Site No. 1 – Waste Disposal Site No. 1,” “Site No. 2—Waste Disposal Site No. 2,” “Site No. 3—Former Fire Training Area,” and, “Site No. 4—Past Chemical Disposal at Engine Test Stand.” The PEER PA was not intended to assess or evaluate potential contamination by PFOA/PFOS/PFBS.

Between 1994 and 1995, Metcalf & Eddy, Inc. (M&E) performed a Site Investigation at the MANGB under the IRP to evaluate the presence or absence of contamination at Sites one through four, identified in the aforementioned PA. The M&E Site Investigation was not intended to assess or evaluate potential contamination by PFOA/PFOS/PFBS.

BB&E conducted a PA site visit for WVANG at the MANGB on 12 and 13 August 2015, to identify potential locations of historic environmental releases of PFOA, PFOS, and PFBS, specifically from AFFF usage and storage. The PA site visit process included a review of FTAs in operation since 1970, any other use or release of AFFF, and the completion of a site reconnaissance. The goal of the PA site visit was to determine if a site poses a threat to human health and the environment and requires additional inspection. Nine PRLs where AFFF (Ansulite Mil-spec (3 %) and Ansul Class A (1%)) had been stored, used or released were identified at the MANGB, including a former FTA, hangars, fire departments, firefighting equipment testing areas, a Base supply, and a former WWTP (BB&E, 2015). Eight of the nine PRLs were recommended for further inspection, and one PRL warranted NFA. The findings of AFFF use and storage at each of the PRLs are documented in BB&E’s December 2015 PA Report, and summarized below. **Figure 3** depicts the eight PRLs proposed for inspection**. Sections 4.1** through **4.8** describe the PA findings for each of the eight locations evaluated during the PA.

4.1 PRL 1: Former FTA (IRP Site 3)

According to the PA, the former FTA was activated around 1970. A 1996 Site Investigation Report stated that foam was used at this FTA, but it did not indicate the type of foam. The former FTA was located approximately 100 ft south of former Building 126, Munitions Storage. The site consisted of a round pit with a dike around the perimeter. The pit was approximately 50 ft in diameter and 1 ft deep with an approximate area of 1,960 square ft. The bottom of the pit was lined with crushed stone/gravel and contained a drain pipe which drained to an OWS that discharged to the east over the nearby hillside. The former location of the OWS and the drain pipe are unknown (BB&E, 2015).

Runoff from the former FTA flows east overland toward the plateau escarpment and ultimately into Elk Two Mile Creek (Metcalf & Eddy, 1996).

Fire training exercises usually consisted of adding water to the pit (to "float" the fuel), applying fuel, igniting the fuel, and then the fire would be extinguished with water and/or foam. These exercises were conducted about four times a year using mostly aviation gasoline and jet propellant - 4 to fuel the fire; however, other flammable liquids were used, including motor oil and solvents. Roughly 3,000 gallons of flammable liquids were reportedly applied to the pit per year between 1970 and 1979. The former FTA was abandoned around 1979 due to the addition of Taxiway "C" (Metcalf & Eddy, 1996). From 1979 to 1991, fire training activities were conducted at a county owned and operated burn pit located off-Base on the Airport Authority property.

During the 1996 site investigation, it was discovered that the soil was contaminated with low levels of volatile organic carbons and semi-volatile organic carbons in shallow soil samples. The site investigation concluded that groundwater was unlikely to be contaminated due to the depth to the water table and the shallow depth of the contaminated soil. The site investigation recommended NFA, and the WVDEP issued their concurrence with the decision on 10 June 1996. However, PFOA, PFOS, and PFBS were not contaminants of concern during IRP investigations, therefore, soil and/or groundwater samples were not analyzed for these constituents (BB&E, 2015).

4.2 PRL 2: Hangar 107

Hangar 107 was constructed in 1951 and was believed to be equipped with an AFFF Fire Suppression System (FSS) from 1986 until 2014. The exact date of the AFFF system installation was not known by Base personnel and it is possible that installation predates 1986. The FSS was designed to contain, store, and in the case of system engagement, ultimately discharge the AFFF

inside the hangar. The AFFF system was removed from Hangar 107 in 2014 when the hanger was taken out of service (BB&E, 2015).

According to personnel interviewed, there were no known releases of AFFF from Hangar 107 except to the floor drains during infrequent AFFF system testing. It was estimated by Base personnel that an AFFF system test in the hangars took place approximately every 3 to 5 years. Approximately 100 to 200 gallons of AFFF was estimated to be released during each test. The floor was hosed down with water and the AFFF was discharged to the floor drains. From 1972 until 1989, the floor drains from Hangar 107 discharged to an OWS and then to the on-Base WWTP. However, there is a potential that releases could have impacted soil and groundwater in the vicinity of the hangar doors, or near the OWS from overflow. Effluent discharges from the Base WWTP travelled to an on-Base unnamed intermittent tributary of the Coonskin Branch. After 1989, the Base connected to the city sewer system and discharged their wastewater to the Charleston WWTP (BB&E, 2015).

4.3 PRL 3: Hangar 121

Hangar 121 was constructed in 1970 and was believed to be equipped with an AFFF FSS from 1986 until 2014. The exact date of the AFFF system installation was not known by Base personnel and it is possible that the AFFF system install predates 1986. The FSS was designed to contain, store, and in the case of system engagement, ultimately discharge the AFFF inside the hangar. In 2014, Hangar 121 was retrofitted to high expansion foam and the AFFF system removed. The only part of the AFFF system that remains in Building 121 is the empty former AFFF storage tank (BB&E, 2015).

According to personnel interviewed, there were no known releases of AFFF from Hangar 121 except to the floor drains during infrequent AFFF system testing. It was estimated by Base personnel that an AFFF system test in the hangars took place approximately every 3 to 5 years. Approximately 100 to 200 gallons of AFFF was estimated to be released during each test. The floor was hosed down with water and the AFFF was discharged to the floor drains. From 1972 until 1989, the floor drains from Hangar 107 discharged to an OWS and then to the on-Base WWTP. However, there is a potential that releases could have impacted soil and groundwater in the vicinity of the hangar doors, or near the OWS from overflow. Effluent discharges from the Base WWTP travelled to an on-Base unnamed intermittent tributary of the Coonskin Branch. After 1989, the Base connected to the city sewer system and discharged their wastewater to the Charleston WWTP (BB&E, 2015).

4.4 PRL 4: North FD Equipment Testing Area

The North FD Nozzle Testing Area is located south of Taxiway "A" and north of Building 125. According to the Fire Chief, nozzle tests were performed at the Base annually. No specific date could be given as to when nozzle tests using AFFF began and it is assumed that they began in the 1970s or 1980s when AFFF was introduced at the Base. Foam discharged in this testing area was either allowed to naturally dissipate/evaporate or an anti-foam agent was applied. Nozzle tests using AFFF ended at the Base prior to the Building 120 demolition in 2006/2007 (BB&E, 2015).

4.5 PRL 5: South FD Equipment Testing Area

The South FD Nozzle Testing Area was located north-northwest of the former FD, Building 120 (now Building 407) in the grassy area beyond the Run-up Pad. According to the Fire Chief, nozzle tests were performed at the Base annually. No specific date could be given as to when nozzle tests using AFFF began and it is assumed that they began in the 1970s or 1980s when AFFF was introduced at the Base. Foam discharged in this area was either allowed to naturally dissipate/evaporate or an anti-foam agent was applied. Nozzle tests using AFFF ended at the Base prior to the Building 120 demolition in 2006/2007 (BB&E, 2015).

4.6 PRL 6: Former Building 120 (Former Fire Department)

Building 120, the former FD, was constructed in 1970 and demolished in 2006/2007. The area where the former FD was located has been regraded. According to Fire Chief, one foam spill of approximately 130 gallons occurred in the former Building 120. The foam line from a P4 Fire Truck broke inside Building 120 and the AFFF drained into the storm sewer system. The storm sewer from former Building 120 discharged into an on-Base, unnamed intermittent tributary of the Coonskin Branch. Personnel interviewed were not aware of any other releases of AFFF at former Building 120 (BB&E, 2015).

Base personnel indicated that fire equipment was washed inside of Building 120 and the wash water discharged to the storm sewer system. However, they were not aware of AFFF being washed off of the fire equipment with the possible exception of dried residual AFFF (BB&E, 2015).

4.7 PRL 7: Building 420 (Current Fire Department)

Building 420 houses the Base's current fire station which was constructed in 2006/2007. This is the only building on Base that currently stores AFFF. AFFF is stored in 5-gallon containers that

are manually loaded into fire trucks equipped with a bayonet system that punctures the container within the fire truck's containment tank. There is an overhead fill system which is rarely used. A trench drain connected to the storm drain system within the concrete floor has a valve kept in the closed position to act as containment should there be a spill of AFFF. There have been no documented releases of AFFF from this building (BB&E, 2015).

4.8 PRL 9: Former WWTP (Including IRP Site 2)

The former WWTP (Building 123) was constructed in 1972 and ceased operation in 1989 when the Base connected to the City of Charleston's sanitary sewer system.

The WWTP consisted of two wastewater package plants at Building 123 which were used to treat sanitary and industrial wastewater from the Base. The effluent discharged to an on-Base unnamed intermittent tributary of the Coonskin Branch. Discharges of AFFF into the sanitary sewer prior to 1989 from hangars or fire stations would have been treated through this system and discharged to this unnamed intermittent tributary of the Coonskin Branch. The integrity of the sewer conveyance pipe at the time of the WWTP operation is unknown. While there is no documentation that AFFF discharged to the sanitary sewer had leaked out along the old sewer lines, it remains a possibility. The two WWTPs were demolished in 2007/2008 (BB&E, 2015).

Sludge generated from the WWTP was disposed of on-Base at the former Waste Disposal Site 2 (which became IRP Site 2). Waste Disposal Site 2 was used from 1950 to 1989 to dispose of construction debris, fuels, waste oils, solvents, and nonhazardous sewage sludge. While there was no record of when sewage sludge disposal began and ended in this disposal area, the dates of the WWTP operation were from 1972 to 1989 (BB&E, 2015). The 1996 Site Investigation Report concluded that the groundwater is unlikely to be contaminated due to the depth to the water table and the shallow depth of the contaminated soil. The Site Investigation Report recommended NFA, and the WVDEP issued their concurrence with the decision on 10 June 1996 (Metcalf & Eddy, 1996).

Review of a recent Monitoring Well Inventory dated 31 January 2017 indicates there are six monitoring wells located in or near PRL 9. The wells are located in/near the former WWTP leach field at former Building 123 and in/near IRP Site 2 near an OWS associated with the POL Area (TEC-Weston, 2016). According to the Monitoring Well Inventory, the wells are 20 to 32 ft in depth, constructed of 2-inch PVC with 10 ft well screens, and were completed as flush mount wells. Groundwater depth information was not provided on the inventory (TEC-Weston, 2017).

THIS PAGE INTENTIONALLY LEFT BLANK.

5.0 FIELD PROGRAM METHODS

The following subsections summarize utility clearance and permitting activities; soil boring installation, sampling, and abandonment; temporary groundwater monitoring well construction, development, sampling, and abandonment; surface water sampling, sediment sampling, and investigation derived waste (IDW) management. SI activities were conducted in accordance with the WP (Amec Foster Wheeler, 2017) and the *ANG Investigation Guidance* (ANG, 2009). The standard operating procedure AFW-01, located in the WP, was followed to eliminate cross contamination and the introduction of contaminants from external sources. The SI field activities were conducted during 9 January through 20 January 2018. Groundwater confirmation samples were collected in July 2018. Field data records can be found in **Appendix A** through **Appendix E**. Photographs of field activities can be found in **Appendix F**.

5.1 Utility Location and Clearance

Prior to initiating the SI field activities, details of the proposed borehole locations were provided to the West Virginia One Call utility notification center, "West Virginia 811", on 4 January 2017. The locations of underground utilities within the investigation area were estimated by MANGB staff, and additional assistance locating onsite utilities was provided by Miss Utility of West Virginia. Furthermore, on 9 January and 10, 2018, a third party private utility locator, Enviroprobe, mobilized to the Site under Amec Foster Wheeler guidance for boring-specific utility clearance in each PRL. Geophysical techniques including ground penetrating radar and electromagnetic technologies were utilized; each boring and temporary well location was marked or modified, as needed, to avoid potential subsurface obstructions. Additionally, in areas where private utility clearance could not confidently identify subsurface utilities, soft utility excavation (SUE) technologies (i.e. Air Knife, Hand Auger) were implemented to clear the top five ft of each boring, prior to utilization of Geoprobe DPT.

5.2 Permits

At the direction of MANGB personnel, the ANG 130th ALW dig permit for SI activities was prepared by MANGB personnel with input from Amec Foster Wheeler.

5.3 Soil Boring Installation

Between 16 January and 20, 2018, a total of 21 soil borings were advanced and nine temporary

monitoring wells were installed to investigate soil and groundwater PFC impacts at MANGB PRLs and at the Base boundary. The borings were advanced by Cascade using DPT drilling techniques. Soil borings were specifically located where third-party utility locate clearances were identified and in areas where known subsurface utilities did not exist; additionally, SUE clearance was performed at locations where subsurface utilities were not clearly defined. Boreholes were advanced from 4 to 25 ft bgs, until groundwater was reached, or until Geoprobe refusal was encountered. Individual borehole depths are provided in the soil boring logs in **Appendix A**.

Soil boring locations were selected based on PRL use and physical characteristics to target the most probable release and migration areas for AFFF. A total of 28 borings were advanced in and around the eight PRLs using DPT drilling methods (20 borings for soil sampling, and eight for temporary monitoring well installation). Soil cores were collected continuously for field screening in 5-ft intervals using new, dedicated acetate liners. Drilling rods/tools were decontaminated between borings in accordance with protocol described in the WP.

5.4 Soil Sampling

Soil cores were collected in acetate sleeves within the DPT core barrel. Each sleeve was opened lengthwise and the soil was examined. Soil characteristics were logged in accordance with the Unified Soil Classification System. IDW generated during drilling activities was containerized in 55-gallon steel drums, staged onsite, and labeled for disposal.

Shallow soil samples were generally collected from the upper 2 ft of soil, directly beneath asphalt or pavement, if present. Deep soil samples were generally collected from 8 to 10 ft bgs. If refusal was encountered prior to encountering groundwater, the deep sample was collected from the bottom 2 ft of the soil boring. If gravel or boulders were encountered during boring advancement, soil intervals were adjusted, if needed, to acquire adequate soil volumes for laboratory analysis. Soil samples were transferred into laboratory provided bottle-ware, and immediately cooled with ice to less than 4 degrees Celsius (°C).

5.5 Soil Boring Abandonment

Following the completion of drilling activities, each boring was backfilled with soil cuttings and bentonite chips to grade, and hydrated to seal the boring. Temporary monitoring well riser and screen lengths were removed during abandonment activities. Surface completions were patched with like materials (topsoil/seed, asphalt, or concrete) in accordance with ANG specifications.

5.6 Temporary Monitoring Well Installation and Development

A total of nine temporary monitoring wells were installed to investigate groundwater impacts at the MANGB PRLs and at the base boundary. One additional existing well was sampled near PRL 9. The primary purpose of installing the temporary monitoring wells was to assess for the presence or absence of PFCs in groundwater on the estimated downgradient side of the PRLs, including groundwater quality at or near the base boundary to evaluate the potential for off-Base migration of PFCs. Temporary monitoring well locations were determined based on one or more of the following criteria: field soil conditions observed, biased selected locations, estimated groundwater flow direction, historical groundwater data and contours if available, and historical indications of possible impact. In general, temporary monitoring wells were installed at locations believed to have potential for the greatest impact from PFCs.

Soil cores were collected continuously to verify soil lithology, then inspected, logged, and field screened in accordance with Section 2.1.1 of the FSP. Temporary monitoring wells were installed in accordance with Amec Foster Wheeler's PFC-specific Standard Operating Procedure for installation of monitoring wells (AFW-04). It should be noted that saturated soils were not immediately observed at certain locations. Groundwater in clayey conditions was not always encountered or clearly defined using the Geoprobe® DPT. In instances where strategic temporary monitoring well locations were identified and saturated soils were not observed in the soil column, temporary monitoring wells were allowed sufficient time to recharge (at times overnight) to ensure enough groundwater was available for sample collection.

The temporary monitoring wells were installed in DPT borings using temporary one-inch diameter, schedule 40 PVC pipe with a 10-ft, 0.010-inch slot screen bisecting the water table. Dedicated piping was installed at each temporary monitoring well location. The annulus surrounding each well screen and riser was backfilled with No.1 filter sand, which was placed from the bottom of the borehole to two ft above the screened interval. A 1 to 2-ft annular seat, composed of bentonite chips, was installed at each well to prevent the potential confluence of surface moisture (i.e. snow melt) with groundwater.

Following temporary monitoring well completion, static water levels were measured with an electronic water level indicator and recorded on a field data sheet, however, seven of the nine temporary wells installed were dry. The two temporary monitoring wells with measurable water were developed using a pump to purge the screened interval and remove fine particles that had accumulated. Water quality parameters were monitored and recorded at periodic intervals in

accordance with the WP. Temporary monitoring wells were considered adequately developed when water quality parameters had stabilized and turbidity was low (i.e., <50 Nephelometric Turbidity Units or if the well was pumped dry.

Well development water was containerized in steel 55-gallon drums and managed in accordance with protocol set forth in the WP and FSP. Equipment and pumps inserted into the well were decontaminated following each use. Temporary monitoring well development logs are provided in **Appendix B**.

5.7 Water Level Measurements

Prior to well purging, static water levels measurements were collected with an electronic water level meter. Water levels were measured as a distance below the top of the PVC riser and recorded on field data sheets, however, seven of the nine wells installed were dry.

5.8 Groundwater Sampling

Three groundwater samples were collected during the SI and one groundwater confirmation sample was collected following review of the analytical results. The initial water level was recorded using a water level meter prior to sampling activities, and was collected and recorded throughout purging at approximately 3 to 5-minute intervals. Low flow sampling methodology with a peristaltic pump was performed to collect groundwater samples from temporary monitoring wells. The initial water level was recorded using a water level meter prior to sampling activities. Low-density polyethylene tubing was inserted into the temporary monitoring well to the depth recorded in the sampling logs above the bottom of the well to prevent disturbances and re-suspension of sediment present in the bottom of the well. The tubing was connected to a multi-parameter water quality probe flow-through cell and then to the peristaltic pump. The pump rate prior to sampling was maintained between 100 and 500 milliliters per minute with a steady flow rate maintained, such that drawdown of the water level within the well did not exceed a maximum allowable drawdown of 0.3 ft, when possible. The following parameters were monitored: temperature, pH, Oxidation-Reduction Potential (ORP), dissolved oxygen, turbidity, and specific conductivity every three to five minutes; depth to water was monitored during this same time interval.

The well was considered stabilized after three consecutive readings as follows:

- +/-0.1 for pH,
- +/-3% for specific conductance (conductivity),

- +/-10 millivolt for ORP,
- +/-10% for dissolved oxygen, and
- +/-10% for turbidity.

Due to low yield rates and insufficient water quantities at BW01 and BW02, groundwater parameters were unable to reach equilibrium, therefore, the well was purged dry during development, and the temporary monitoring well was sampled the following days(s), when sufficient water volume was present.

Groundwater sampling logs and water quality instrument calibration logs are included in **Appendix C** and **Appendix D**, respectively.

5.9 Temporary Monitoring Well Abandonment

Following the completion of sampling activities, each temporary monitoring well was pulled from the ground allowing the formation to collapse into the borehole. Remaining void space in each well boring was filled with a liquid grout mixture up to a few inches below ground surface. Surface completions were patched with like materials (topsoil/seed, asphalt, or concrete) in accordance with ANG specifications.

5.10 Surface Water Sampling

A total of two surface water samples were collected at PRLs 6 and 9. Prior to sample collection, the following parameters were monitored as per the WP: temperature, pH, ORP, dissolved oxygen, turbidity, and specific conductivity. Surface water samples were collected from mid-depth in the center of the water column. Surface water samples were collected using a decontaminated bottle sampler attached to a pole (e.g., stainless steel pole and dipper) or directly into the sample container itself. After retrieval from the sampling device, the surface water samples were inspected for visual evidence of impact. Surface water samples were immediately cooled with ice to less than 4°C. Re-usable sampling equipment was decontaminated in accordance with the WP.

Surface water sampling logs are included in **Appendix E**.

5.11 Sediment Sampling

A total of two sediment samples, collocated with the surface water samples, were collected at PRLs 6 and 9 following collection of the surface water samples to prevent suspension of sediment in the water column. Samples were collected from the upper two ft of sediment utilizing a hand

auger, or similar sampling device constructed of stainless steel. After retrieval from the sampling device, sediment was transferred to a clean stainless-steel bowl. Sediment samples were homogenized using clean stainless-steel bowls and trowels before being placed in laboratory-supplied containers, then immediately cooled with ice to less than 4°C. Re-usable sampling equipment was decontaminated in accordance with the WP.

Sediment sampling logs are included in **Appendix E**.

5.12 Decontamination

Field sampling and drilling equipment (e.g. water level indicators, pumps, bowls, trowels, shovels, DPT rods, and other downhole equipment) was decontaminated prior to initial use, and between sampling locations. Liquinox® or Alconox® soap diluted with PFC-free bottled water was used to wash sampling equipment with a clean high-density polyethylene brush used to remove debris and particulates. PFC-free bottled water was used to rinse soapy water from the sampling equipment. Drilling equipment was pressure-washed using Liquinox® or Alconox® soap diluted with PFC-free water on a bermed decontamination pad, to capture rinse water. The PFC-free water was obtained from the current FD on Base located in PRL 7. Prior to use, a sample of the water was submitted to Vista Analytical Laboratories, Inc. (Vista) for analysis of the six PFCs on the Unregulated Contaminant Monitoring Rule (UCMR 3) Rule list. Concentrations were reviewed to ensure Amec Foster Wheeler's internal PFC-free criteria were met. All decontamination rinse water was containerized in steel 55-gallon drums and managed in accordance with protocol set forth in the WP and FSP.

5.13 Investigation Derived Waste Management

Soil boring cuttings generated during drilling activities were contained in 55-gallon drums. Purge water generated during temporary monitoring well development and groundwater sampling activities were contained in 55-gallon drums. Rinse water generated during drilling and sampling equipment decontamination were contained with purge water in 55-gallon drums. The drums were temporarily staged in PRL 9, as directed by MANGB management. The IDW drums were clearly marked with a description of contents and contact information. A drum inventory was recorded in the daily field activities summary submitted to the project manager. Composite soil and water IDW samples were collected following the completion of sampling activities, and were sent to TestAmerica Laboratories, Inc. for analysis. Upon receipt of IDW analytical results, waste disposal characterization and documentation for the containerized IDW was prepared by Amec Foster

Wheeler and presented to the MANGB environmental office for signature as the waste generator. The IDW was disposed as non-hazardous waste based on characterization. Two 55-gallon drums of liquid and one 55-gallon drum of solid non-hazardous waste were removed, transported for disposal on 18 February 2018 by Veolla Es Technical Solutions, LLC, of West Carrollton, Ohio. IDW disposal documentation is included in **Appendix G**.

5.14 Laboratory

Samples were submitted to Vista, in El Dorado Hills, California. Vista is DoD Environmental Laboratory Accreditation Program accredited, and maintains a National Environmental Laboratory Accreditation Program Certification via reciprocity in the State of West Virginia.

5.15 Field Quality Assurance/Quality Control Sample Results

Quality Assurance and Quality Control (QC) samples, including field duplicates, matrix spike/matrix spike duplicates (MS/MSD), equipment rinsate samples, and field blanks were analyzed for the same PFC parameters as the associated project samples. The analytical results for the field duplicates are presented in **Table 3** through **Table 6**.

5.16 Data Validation and Usability

Amec Foster Wheeler collected 40 soil samples (including four field duplicates), three sediment samples (including one field duplicate), and 14 water samples (including three field duplicates, one field blank, and three equipment blanks).

The laboratory analytical data generated during the SI were reviewed by a qualified analytical chemist for conformance with the project Data Quality Objectives (DQOs) specified in the QAPP (Amec 2017). Amec Foster Wheeler performed United States Environmental Protection Agency (USEPA) Stage 4 validation on 10 % of the samples and USEPA Stage 2B validation on the remaining samples associated with this sampling event. The Stage 4 validation includes review of the QC results in the laboratory's report and reported on QC summary forms as well as recalculation checks and review of the instrument raw data outputs. The Stage 2B validation includes review of the QC results in the laboratory's report and reported on QC summary forms with no review of the raw data. Data from equipment and field blanks did not undergo validation because results from these samples are only used to assess data usability for field samples. The validation was performed in general accordance with: Amec Foster Wheeler Final QAPP (Amec, 2017); DoD Quality Systems Manual for Environmental Laboratories (DOD, 2017); and USEPA

Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (USEPA, 2009).

Amec Foster Wheeler evaluated a total of 300 data records from field samples during the validation. Amec Foster Wheeler J qualified 68 records (22.6%) as estimated values because of high MS recovery, imprecision between laboratory control sample/ laboratory control sample duplicate results, imprecision between MS/MSD results, imprecision between field duplicate results, high internal standard recoveries, and/or analyte concentrations outside the instrument's calibration range. The Data Validation Report, including qualified data, is included as **Appendix H**. Laboratory analytical reports and chains of custody forms are provided in **Appendix I.**

6.0 PRL INVESTIGATIONS

This SI field program was designed to collect data needed to evaluate the presence/absence of PFCs at each of the eight PRLs. The scope of the SI was designed using recommendations presented in the PA Report (BB&E, 2015). The following sections describe the investigation approach that was used to fulfill the objectives of the SI. The work was conducted in accordance with the QAPP, SHSP, and FSP presented in the approved WP.

6.1 Field Activities Summary

A summary of SI field activities is provided in **Table 2**. Individual sampling locations are shown on **Figure 4** through **Figure 12.** Soil boring and temporary monitoring well construction, well development, groundwater sampling, water quality sampling calibration records, surface water sampling logs, and sediment sampling logs are included in **Appendices A**, **B, C**, **D**, and **E** respectively.

6.2 General Work Plan Deviations

Deviations from the general work plan included one or more of the following conditions:

- Borings may have been relocated within 5-20 ft of original marked location if overhead or underground utilities were observed or if premature refusal was reached during pre-clearing activities; however, this remains in-line with the DQOs.
- Deep soil samples were not collected if boring advancement reached premature refusal after two attempts to offset the boring location, or if deep lithology was composed primarily of pulverized rock.
- The May 2018 USEPA residential soil Regional Screening Level (RSL) value for PFBS (1,300,000 micrograms per kilogram [µg/kg]) was used as the screening value in place of the May 2016 USEPA residential soil RSL value for PFBS (1,600,000 µg/kg). The updated RSL value was not published at the time the Work Plan was finalized.
- The May 2018 USEPA Tap Water RSL value for PFBS [400 micrograms per liter (µg/L)] was used as the screening value in place of the May 2016 USEPA Tap Water RSL value for PFBS (380 µg/L). The updated RSL value was not published at the time the Work Plan was finalized.

WP deviations specific to an individual PRL are discussed in the following sub sections.

6.3 PRL 1: Former FTA (IRP Site 3)

6.3.1 PRL Deviations

There were four deviations from the WP at PRL 1. No deep soil sample was collected from soil boring 01SB02 as refusal in rocky fill was encountered at 4 ft bgs. Temporary Monitoring Well (TW)-01 was advanced to a depth of 30 ft bgs, in an effort to intercept the groundwater table. No groundwater sample was collected from TW-01 due to a lack of groundwater present in fill at this PRL. Additionally, due to shallow fill boulders at the PRL, two attempts were made to advance soil boring 01SB02.

No other deviations, apart from the general WP deviations occurred at this PRL.

6.3.2 Soil Sampling

A total of three soil borings (01SB01 through 01SB03) were advanced at PRL 1. Soil boring 01SB01 was advanced to a target depth of 10 ft bgs on 18 January 2018. Soil boring 01SB02 was advanced to refusal in rocky fill at 4 ft bgs on 17 January 2018. Soil boring 01SB03 was advanced to a target depth of 10 ft bgs on 16 August 2017. While completing soil boring advancements, a total of five soil samples were collected. Temporary monitoring well TW-01 was drilled to a total depth of 30 ft bgs (10 ft below target depth) on 16 January 2018 in an effort to encounter the groundwater table.

Soil boring and temporary monitoring well locations within PRL 1 are shown on **Figure 4.**

6.3.3 Groundwater Sampling

Temporary monitoring well TW-01 was advanced on 16 January 2018; no evidence of groundwater was observed in the soil column during drilling. The temporary monitoring well boring was left open and gauged for potential groundwater recharge until 20 January 2018. No groundwater recharge occurred, therefore, no groundwater sample was collected from TW-01.

Temporary monitoring well locations within PRL 1 are shown on **Figure 4.**

6.4 PRL 2: Hangar 107

6.4.1 PRL Deviations

Three deviations from the WP occurred at PRL 2. No deep soil sample was collected from soil boring 02SB01 due to inadequate soil volume (primarily pulverized rock) from 5 to 10 ft bgs. TW-02 was advanced to a refusal in rocky fill at 9 ft bgs; and site conditions (e.g. utilities, steep slopes,

etc.) prevented the advancement of offset borings. No groundwater sample was collected from TW-02 due to a lack of groundwater present in fill at this PRL.

No other deviations, apart from the general WP deviations occurred at this PRL.

6.4.2 Soil Sampling

A total of three soil borings (02SB01 through 02SB03) were advanced at PRL 2. Soil boring 02SB01 was advanced to the target depth of 10 ft bgs on 19 January 2018. Soil boring 02SB02 was advanced to a target depth of 10 ft bgs on 19 January 2018. Soil boring 02SB03 was advanced to a target depth of 10 ft bgs on 19 January 2018. While completing soil boring advancements, a total of five soil samples were collected. The boring for temporary monitoring well TW-02 was advanced to a depth of refusal in rocky fill of 9 ft bgs on 18 January 2018.

Soil boring locations within PRL 2 are illustrated on **Figure 5.**

6.4.3 Groundwater Sampling

The boring for temporary monitoring well TW-02 was advanced on 18 January 2018; refusal in rocky fill materials prevented the advancement of TW-02 to its target depth of 20 ft bgs. No evidence of groundwater was observed in the soil column during drilling. The site conditions surrounding TW-02 (e.g. utilities, steep slopes) prevented the advancement of offset borings in this location. No groundwater recharge occurred in the temporary well boring, therefore, no sample was collected from TW-02.

Temporary monitoring well locations within PRL 2 are illustrated on **Figure 5.**

6.5 PRL 3: Hangar 121

6.5.1 PRL Deviations

Three deviations from the WP occurred at PRL 3. A deep soil sample was not collected at 03SB01 due to early refusal at 9 ft bgs, and inadequate soil volume (primarily pulverized rock) from 5 to 9 ft bgs. TW-03 advanced beyond the target depth of 20 ft bgs in an effort to intercept the groundwater table. No groundwater sample was collected from TW-03 due to a lack of groundwater present in fill at this PRL.

No other deviations, apart from the general WP deviations occurred at this PRL.

6.5.2 Soil Sampling

A total of three soil borings (03SB01 through 03SB03) were advanced at PRL 3. Soil boring

03SB01 was advanced to refusal in rocky fill at 9 ft bgs on 20 January 2018. Soil boring 03SB02 was advanced to a target depth of 10 ft on 20 January 2018. Soil boring 03SB03 was advanced to a target depth of 10 ft bgs on 20 January 2018. While completing soil boring advancements, a total of five soil samples were collected. The boring for TW-03 was advanced to a depth of 24 ft bgs (4 ft beyond target depth) on 19 January 2018 in an effort to encounter the groundwater table.

Soil boring locations within PRL 3 are illustrated on **Figure 6.**

6.5.3 Groundwater Sampling

Temporary monitoring well TW-03 was installed on 19 January 2018. TW-03 was screened from 14 to 24 ft bgs. Potential evidence of groundwater was observed in the soil column at approximately 15 ft bgs during drilling. Following the installation of TW-03, no groundwater was initially observed, thus 24 hours was allotted for potential recharge. However, no groundwater recharge occurred in TW-03, therefore, no sample was collected.

Temporary monitoring well locations within PRL 3 are illustrated on **Figure 6.**

6.6 PRL 4: North FD Equipment Testing Area

6.6.1 PRL Deviations

Three deviations from the WP occurred at PRL 4. The deep soil sample for 04SB01 was collected three ft above target depth due to refusal in rocky fill at 6 ft bgs. TW-04 was installed three ft above target depth, due to refusal in rocky fill at 17 ft bgs. No groundwater sample was collected from TW-04 due to a lack of groundwater present in fill at this PRL.

No other deviations, apart from the general WP deviations occurred at this PRL.

6.6.2 Soil Sampling

A total of three soil borings (04SB01 through 04SB03) were advanced at PRL 4. Soil boring 04SB01 was advanced to refusal in rocky fill at 6 ft bgs on 19 January 2018. Soil boring 04SB02 was advanced to a target depth of 10 ft bgs on 19 January 2018. Soil boring 04SB03 was drilled to a target depth of 10 ft bgs on 19 January 2018. While completing soil boring advancements, a total of six soil samples were collected. The boring for temporary monitoring well TW-04 was advanced to a refusal depth of 17 ft bgs on 18 January 2018, and no evidence of groundwater was observed.

Soil boring locations within PRL 4 are illustrated on **Figure 7**.

6.6.3 Groundwater Sampling

Temporary monitoring well TW-04 was installed on 18 January 2018. TW-04 was screened from 7 to 17 ft bgs. No significant evidence of groundwater was observed in the soil column during drilling. Following the installation of TW-04, no groundwater was initially observed, thus 24 hours was allotted for potential recharge. However, no groundwater recharge occurred in TW-04, therefore, no sample was collected.

Temporary monitoring well locations within PRL 4 are illustrated on **Figure 7**.

6.7 PRL 5: South FD Equipment Testing Area

6.7.1 PRL Deviations

Six deviations from the WP occurred at PRL 5. A deep soil sample was not collected at 05SB01 due to refusal in rocky fill at 7 ft bgs, and inadequate soil volume (primarily pulverized rock) from 5 to 7 ft bgs. A deep soil sample was not collected at 05SB02 due to refusal in rocky fill at 4 ft bgs. A deep soil sample was not collected at 05SB03 due to refusal in rocky fill at 9 ft bgs, and inadequate soil volume (primarily pulverized rock) from 5 to 9 ft bgs. TW-05 was advanced to 4 ft bgs (16 ft above target depth). Additionally, due to the presence of rocky fill, three attempts were made to advance 05SB02 and TW-05. No groundwater sample was collected from TW-05 due to a lack of groundwater present in fill at this PRL.

No other deviations, apart from the general WP deviations occurred at this PRL.

6.7.2 Soil Sampling

A total of three soil borings (05SB01 through 05SB03) were advanced at PRL 5. Soil boring 05SB01 was advanced to refusal in rocky fill at 7 ft bgs on 19 January 2018. Soil boring 05SB02 was advanced to refusal in rocky fill at 4 ft bgs on 18 January 2018, after 3 attempts. Soil boring 05SB03 was advanced to refusal in rocky fill at 9 ft bgs on 19 January 2018. While completing soil boring advancements, a total of three soil samples were collected. The boring for temporary monitoring well TW-05 was advanced to refusal in rocky fill at 4 ft bgs on 18 January 2018, after 3 attempts; no evidence of groundwater was observed.

Soil boring locations within PRL 5are illustrated on **Figure 8.**

6.7.3 Groundwater Sampling

The temporary monitoring well boring for TW-05 was advanced on 18 January 2017. No evidence

of groundwater was observed in TW-05 and rocky fill prevented the advancement of any boring deep enough to encounter groundwater; therefore, no groundwater sample was collected.

Temporary monitoring well locations within PRL 5 are illustrated on **Figure 8.**

6.8 PRL 6: Former Building 120 (Former Fire Department)

6.8.1 PRL Deviations

No deviations, apart from the applicable general WP deviations occurred at this PRL.

6.8.2 Surface Water Sampling

One surface water sample was collected at PRL 6 on 17 January 2018. Prior to sample collection, temperature, pH, ORP, dissolved oxygen, turbidity, and specific conductivity parameters were recorded. The surface water sample 06SW01 was collected mid-depth in the center of the water column directly into laboratory-provided bottle ware.

Surface Water sample locations for PRL 6 are illustrated on **Figure 9**.

6.8.3 Sediment Sampling

One sediment sample was collected at PRL 6 on 17 January 2018. The sediment sample 06SD01 was collected using a stainless steel decontaminated hand auger from the upper two ft of sediment in the storm water drainage basin.

Sediment sample locations for PRL 6 are illustrated on **Figure 9**.

6.9 PRL 7: Building 420 (Current Fire Department)

6.9.1 PRL Deviations

One deviations from the WP occurred at this PRL. No groundwater sample was collected from TW-07/07SB03 due to a lack of groundwater present in fill at this PRL.

No other deviations, apart from the general WP deviations occurred at this PRL.

6.9.2 Soil Sampling

A total of three soil borings (07SB01 through 07SB03) were advanced at PRL 7. Soil boring 07SB01 was advanced to a target depth of 10 ft bgs on 19 January 2018. Soil boring 07SB02 was advanced to a target depth of 10 ft bgs on 19 January 2018. The combined soil boring and temporary well boring TW-07/07SB03 was advanced to a target depth of 20 ft bgs on 19 January 2018; No significant evidence of groundwater was observed in the soil column during drilling.

While completing soil boring advancements, a total of six soil samples were collected.

Soil boring locations within PRL 7 are illustrated on **Figure 10.**

6.9.3 Groundwater Sampling

Temporary monitoring well TW-07 was installed on 19 January 2018. TW-07 was screened from 10 to 20 ft bgs. No significant evidence of groundwater was observed in the soil column during drilling. Following the installation of TW-07, no groundwater was initially observed, thus 24 hours was allotted for potential recharge. However, no groundwater recharge occurred in TW-07, therefore, no sample was collected.

Temporary monitoring well locations within PRL 7 are illustrated on **Figure 10.**

6.10 PRL 9: Former WWTP (Including IRP Site 2)

6.10.1 PRL Deviations

No deviations, apart from the applicable general WP deviations occurred at PRL 9.

6.10.2 Soil Sampling

A total of three soil borings (09SB01 through 09SB03) were advanced at PRL 9 on 16 January 2018. Soil boring 09SB01 was advanced to a target depth of 10 ft bgs. Soil boring 09SB02 was advanced to a target depth of 10 ft bgs. Soil boring 09SB31 was advanced to a target depth of 10 ft bgs. No Temporary monitoring well was installed in PRL 9, because an existing well (MW-04) was in an adequate position and condition to collect a representative groundwater sample from this PRL.

Soil boring locations within PRL 9 are illustrated on **Figure 11.**

6.10.3 Groundwater Sampling

No Temporary monitoring well was installed in PRL 9, because an existing well (MW-04) was in an adequate position and condition to collect a representative groundwater sample for PRL 9. One groundwater sample was collected per the WP in this PRL. In addition, a confirmation sample was collected from MW-04 due to PFC detections exceeding guidance values.

The existing monitoring well location within PRL 9 is illustrated on **Figure 11.**

6.10.4 Surface Water Sampling

One surface water sample was collected at PRL 9 on 17 January 2018. Prior to sample collection,

temperature, pH, ORP, dissolved oxygen, turbidity, and specific conductivity parameters were recorded. The surface water sample 06SW01 was collected mid-depth in the center of the water column directly into laboratory-provided bottle ware.

The surface water sample location within PRL 9 is illustrated on **Figure 11.**

6.10.5 Sediment Sampling

One sediment sample was collected at PRL 9 on 17 January 2018. The sediment sample 06SD01 was collected using a stainless steel decontaminated hand auger from the upper two ft of sediment in the storm water drainage basin.

The sediment sample location within PRL 9 is illustrated on **Figure 11.**

6.11 Base Boundary Wells

6.11.1 PRL Deviations

No deviations, apart from the applicable general WP deviations occurred at this PRL.

6.11.2 Groundwater Sampling

Temporary monitoring well BW-01 was installed on 16 January 2018 and screened from 10 to 20 ft bgs. Evidence of groundwater was observed in the soil column from 10 to 16 ft bgs during drilling. Temporary monitoring well BW-02 was installed on January 18, 2018 and screened from 10 to 20 ft bgs. Evidence of groundwater was observed in the soil column from 16 to 18 ft bgs during drilling. One groundwater sample was collected from each boundary well, per the WP.

Soil boring and temporary monitoring well locations are illustrated on **Figure 12.**

7.0 SOIL AND GROUNDWATER STANDARDS

A soil or groundwater standard is an environmental and/or public health statute or rule used in identifying Base contamination that may pose a risk to human health or the environment. Soil and groundwater standards are federal and state human health and environment-based regulations used to:

- Determine the appropriate levels of Base clean-up;
- Define and formulate remedial action alternatives; and,
- Govern implementation and operation of the selected remedial action.

Currently no promulgated Standards exist for these compounds.

In accordance with *Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and Base Realignment and Closure (BRAC) Installations (*USAF, August 2012) and USEPA lifetime drinking water Health Advisories (Has) for PFOS (USEPA, May 2016a) and PFOA (USEPA, May 2016b), a release is considered confirmed if the following concentrations are exceeded (as shown on **Table 7**):

PFOS:

- 0.07 µg/L in groundwater/surface water that is used as or contributes to a drinking water source (combined with PFOA value).
- 1,260 µg/kg in soil (calculated in the absence of RSL value[1]).
- 1,260 µg/kg in sediment (calculated in the absence of RSL values[1]).

PFOA:

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

USEPA has also derived RSL values for PFBS, for which there is a Tier 2 toxicity value (USEPA,

[1] Air Force Guidance screening levels calculated using the EPA Regional Screening Level calculator [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search]. The toxicity value input for the calculator is the Tier 3 value reference dose of 0.00002 mg/kg/day derived by USEPA in their Drinking Water Health Advisories for both PFOS (USEPA, 2016a) and PFOA (USEPA, 2016b).

June 2017). The USAF will also consider a release to be confirmed if the following concentrations are exceeded:

PFBS:

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

The HA, RSLs, and USAF Guidance values are collectively referred to as screening criteria in this Report. **Table 7** presents the screening criteria for comparing the analytical results for PFBS, PFOA, and PFOS.

8.0 PRL INVESTIGATION RESULTS

This section presents the soil, groundwater, surface water, and sediment data collected during the SI activities and a comparison of detections. Detections of PFBS, PFOA and PFOS are compared to the screening criteria as defined in the WP, and presented in **Table 7**. The PFBS RSL for Tap Water presented in the WP was 380 µg/L based on the May 2016 RSL values. This table has been updated to include the more recent RSL value of 400 µg/L published in May 2018. Locations of detected analytes are shown on **Figure 4** through **Figure 11**.

8.1 PRL 1: Former FTA (IRP Site 3)

8.1.1 Soil Analytical Results

Five soil samples were collected and analyzed from three soil borings as described in **Section 6.3.2**; 01SB01 from 0-2 ft bgs and 8-10 ft bgs, 01SB02 from 0-2 ft bgs, and 01SB03 from 0-2 ft bgs and from 8-10 ft bgs. Analytical results from soil samples indicate that six PFCs were detected above the laboratory reporting limit in two of the five samples collected; however, no compounds exceeded the USEPA screening criteria in the samples collected from PRL 1. A field duplicate was collected at 01SB01 from 8-10 ft bgs and concentrations are similar to the parent sample.

Comparisons of analytical results to applicable screening criteria are presented on **Table 3**. The soil boring locations showing detected compounds are depicted on **Figure 4**.

8.2 PRL 2: Hangar 107

8.2.1 Soil Analytical Results

Five soil samples were collected and analyzed from three soil borings as described in **Section 6.4.2**; 02SB01 from 1-3 ft bgs, 02SB02 from 2-4 ft bgs and 8-10 ft bgs, and 02SB03 from 0-2 ft bgs and 8-10 ft bgs. Analytical results from soil samples indicate that two of the six PFCs were detected above the laboratory reporting limit in three of the five samples collected; however, no compounds exceeded the USEPA screening criteria in the samples collected from PRL 2.

Comparisons of analytical results to applicable screening criteria are presented on **Table 3**. The soil boring locations showing detected compounds are depicted on **Figure 5**.

8.3 PRL 3: Hangar 121

8.3.1 Soil Analytical Results

Five soil samples were collected and analyzed from three soil borings as described in **Section 6.5.2**; 03SB01 from 1-3 ft bgs, 03SB02 from 3-5 ft bgs and 8-10 ft bgs, and 03SB03 from 2-4 ft bgs and 8-10 ft bgs. Analytical results from soil samples indicate that the one of six PFCs were detected above laboratory reporting limits in two of the five samples collected; however, no compounds exceeded the USEPA screening criteria in the samples collected from PRL 3. A field duplicate was collected at 03SB03 from 2-4 ft bgs and concentrations are similar to the parent sample.

Comparisons of analytical results to applicable screening criteria are presented on **Table 3**. The soil boring locations showing detected compounds are depicted on **Figure 6**.

8.4 PRL 4: North FD Equipment Testing Area

8.4.1 Soil Analytical Results

Six soil samples were collected and analyzed from three soil borings as described in **Section 6.6.2**; 04SB01 from 0-2 ft bgs and 5-6 ft bgs, 04SB02 from 0-2 ft bgs and 8-10 ft bgs, and 04SB03 from 0-2 ft bgs and 8-10 ft bgs. Analytical results from soil samples indicate that the six PFCs were detected above the laboratory reporting limit in five of the six samples collected with one sample (04SB03-0-2) exceeding the USEPA screening criteria for PFOS of 1,260 µg/kg; PFOS was detected at a concentration of 2,160 µg/kg. A field duplicate was collected at 04SB02 from 0-2 ft bgs and concentrations are similar to the parent sample.

Comparisons of analytical results to applicable screening criteria are presented on **Table 3**. The soil boring locations showing detected compounds are depicted on **Figure 7**.

8.5 PRL 5: South FD Equipment Testing Area

8.5.1 Soil Analytical Results

Three soil samples were collected and analyzed from three soil borings as described in **Section 6.7.2**: 05SB01 from 0-2 ft bgs, 05SB02 from 0-2 ft bgs, and 05SB03 from 0-2 ft bgs. Analytical results from soil samples indicate that six PFCs were detected above the laboratory reporting limit in the three samples collected; however, no compounds exceeded the USEPA screening criteria in the samples collected from PRL 5. A field duplicate was collected at 05SB02 from 0-2 ft bgs

and concentrations are similar to the parent sample.

Comparisons of analytical results to applicable screening criteria are presented on **Table 3**. The soil boring locations showing detected compounds are depicted on **Figure 8**.

8.6 PRL 6: Former Building 120 (Former Fire Department)

8.6.1 Surface Water Analytical Results

One surface water sample (06SW01) was collected from one location outfall in PRL-6 and analyzed as described in **Section 6.8.2**. Analytical results from the surface water sample indicates that the six PFCs were detected at concentrations above the laboratory detection limit, with two compounds exceeding the USEPA Drinking Water HA of 0.07 µg/L. PFOA was detected at a concentration of 0.344 µg/L in the parent sample and 0.333 µg/L in the duplicate sample, and PFOS was detected at a concentration of 6.65 µg/L in the parent sample and 5.88 µg/L in the duplicate sample. The combined PFOS and PFOA concentration is 6.99 µg/L in the parent sample and 6.21 µg/L in the duplicate sample.

Comparisons of analytical results to applicable screening criteria are presented on **Table 4**. The surface water sampling location showing detected compounds is illustrated on **Figure 9.**

8.6.2 Sediment Analytical Results

One sediment sample was collected and analyzed from one location as described in **Section 6.8.3**; 06SD01 from 0-0.5 ft bgs. Analytical results from this sediment sample indicates that the two PFCs were detected above the laboratory reporting limit; however, no compounds exceeded the USEPA screening criteria from the sample collected from PRL 6. A field duplicate was collected at 06-SD01 from 0-0.5 ft bgs and concentrations are similar to the parent sample.

Comparisons of analytical results to applicable screening criteria are presented on **Table 5**. The sediment sampling location showing detected compounds is depicted on **Figure 9**.

8.7 PRL 7: Building 420 (Current Fire Department)

8.7.1 Soil Analytical Results

Six soil samples were collected and analyzed from three soil borings as described in **Section 6.9.2**; 07SB01 from 1-3 ft bgs and 8-10 ft bgs, 07SB02 from 2-4 ft bgs and 8-10 ft bgs, and 07SB03 from 1-3 ft bgs and 8-10 ft bgs. Analytical results from soil samples indicate that two of the six PFCs were detected above the laboratory reporting limits in one of the six samples collected;

however, no compounds exceeded the USEPA screening criteria in the samples collected from PRL 7.

Comparisons of analytical results to applicable screening criteria are presented on **Table 3**. The soil boring locations showing detected compounds are depicted on **Figure 10**.

8.8 PRL 9: WWTP (Including IRP Site 2)

8.8.1 Soil Analytical Results

Six soil samples were collected and analyzed from three borings as described in **Section 6.10.2**; 09SB01 from 0-2 ft bgs and 8-10 ft bgs, 09SB02 from 0-2 ft bgs and 8-10 ft bgs, and 09SB03 from 1-3 ft bgs and 8-10 ft bgs. Analytical results from soil samples indicate that four of the six PFCs were detected above the laboratory reporting limit in one of the six samples collected; however, no compounds exceeded the USEPA screening criteria in the samples collected from PRL 9.

Comparisons of analytical results to applicable screening criteria are presented on **Table 3**. The soil boring locations showing detected compounds are depicted on **Figure 11**.

8.8.2 Groundwater Analytical Results

One groundwater sample was collected from the existing on-site well MW-04 and analyzed as described in **Section 6.10.3**. Analytical results from the groundwater sample indicates that the six PFCs were detected at concentrations above the laboratory detection limit, with two compounds exceeding the USEPA Drinking Water HA of 0.07 µg/L. PFOA was detected at a concentration of 0.914 µg/L in the parent sample and 1.17 µg/L in the duplicate sample, and PFOS was detected at a concentration of 6.38 µg/L in the parent sample and 6.93 µg/L in the duplicate sample. The combined PFOS and PFOA concentration is 7.29 µg/L at this location in the parent sample and 8.1 µg/L in the duplicate sample.

A confirmation sample was collected on 27 July 2018. Analytical results indicate that the six PFCs were detected at concentrations above the laboratory detection limit, with two compounds exceeding the USEPA Drinking Water HA of 0.07 µg/L. PFOA was detected at a concentration of 0.895 µg/L in the parent sample and 0.889 µg/L in the duplicate sample, and PFOS was detected at a concentration of 6.56 µg/L in the parent sample and 6.05 µg/L in the duplicate sample. The combined PFOS and PFOA concentration is 7.46 µg/L at this location in the parent sample and 6.94 µg/L in the duplicate sample.

Comparisons of analytical results to applicable screening criteria are presented on **Table 6**. The existing monitoring well location showing detected compounds is illustrated on **Figure 11**.

8.8.3 Surface Water Analytical Results

One surface water sample was collected from one location (09SW01) at an outfall in PRL-9 and analyzed as described in **Section 6.10.4**. Analytical results from the surface water sample indicates that the six PFCs were detected at concentrations above the laboratory detection limit, with two compounds exceeding the USEPA Drinking Water HA of 0.07 µg/L. PFOA was detected at a concentration of 0.136 µg/L, and PFOS was detected at a concentration of 1.86 µg/L. The combined PFOS and PFOA concentration is 2.0 µg/L at this location.

Comparisons of analytical results to applicable screening criteria are presented on **Table 4**. The surface water sampling location showing detected compounds is illustrated on **Figure 11**.

8.8.4 Sediment Analytical Results

One sediment sample was collected and analyzed from one location as described in **Section 6.10.5**; 09SD01 from 0-0.5 ft bgs. Analytical results from this sediment sample indicates that the two PFCs were detected above the laboratory reporting limit; however, no compounds exceeded the USEPA screening criteria from the sample collected from PRL 9.

Comparisons of analytical results to applicable screening criteria are presented on **Table 5**. The sediment sampling location showing detected compounds is depicted on **Figure 11**.

8.9 Base Boundary Wells

8.9.1 Groundwater Analytical Results

Two groundwater samples were collected from BW-01 and BW-02 and were analyzed as described in **Section 6.11.2**. Analytical results from the groundwater samples indicate that two of six PFCs were detected at concentrations above the laboratory detection limit; however, no compounds exceeded the USEPA Drinking Water HA of 0.07 µg/L in base background locations.

Comparisons of analytical results to applicable screening criteria are presented on **Table 6**. The temporary monitoring well location showing detected compounds is illustrated on **Figure 12**.

THIS PAGE INTENTIONALLY LEFT BLANK.

9.0 CONCLUSIONS/RECOMMENDATIONS

This section presents the SI conclusions and recommendations at each PRL. The recommendations are based on data collected by Amec Foster Wheeler during this SI, and an evaluation of results compared to applicable screening criteria.

A review of soil analytical data compared to soil screening criteria indicates there are no USEPA RSL exceedances for PFBS. However, data does indicate an USEPA RSL exceedance of PFOS at 1 of 21 soil boring locations (04SB03). No exceedances of the USAF Guidance screening level were observed for PFOA. However, the exact location of spill within the PRL is not known and the results may not indicate the highest concentration present in soil at any given PRL, therefore, soil may be an ongoing source of contaminants to groundwater.

A review of groundwater data compared to screening criteria indicates exceedances of the USEPA Drinking Water HA screening criteria at one existing monitoring well within PRL 9 for PFOS and PFOA (No groundwater was encountered within the temporary monitoring wells installed on-Base).

Based on the groundwater results from PRL 9 exceeding the USEPA Drinking Water HA screening criteria and detections if PFCs in the two Base boundary wells sampled, there is a potential for PFC migration downgradient of each PRL and at the Base Boundary. Although groundwater was not encountered at six of seven PRLs the SI results show PFCs are present in soils at each of the PRLs. PFC concentrations detected in soils may not represent the highest concentration present and therefore could be an ongoing source of contaminants to the groundwater.

A review of surface water analytical data compared to screening criteria indicates there are no USEPA RSL exceedances for PFBS, however, there are exceedances of the USAF Guidance screening level for PFOS and PFOA at both surface water sampling locations.

A review of sediment analytical data compared to screening criteria indicates there are no USEPA RSL exceedances for PFBS, and no USAF Guidance screening level exceedances for PFOS or PFOA at either sediment sampling location.

Based on the SI results, the following are recommended for the nine PRLs:

- Additional investigations to further evaluate concentrations of PFCs in soil within PRL 4. This should include a source evaluation and delineation to determine the nature and extent

of the release at each PRL.

- Although concentrations of PFCs in soil in PRLs 1, 2, 3, 5, 6, 7, and 9 did not exceed the screening criteria, they may be a source of PFCs to the groundwater. Additional soil investigations are recommended at each PRL. Where impacts are identified, a source evaluation and delineation (horizontal and vertical) should be performed to determine the nature and extent of each release.
- Additional investigations to further evaluate concentrations of PFCs in groundwater at PRL 9. A groundwater evaluation should also be conducted downgradient of the remaining PRLs to evaluate concentrations related to the PFCs detected in soils. .
- Additional investigations to further evaluate concentrations of PFCs in surface water. This should include a source evaluation and delineation to determine the nature and extent of the release at PRLs 6 and 9.
- Although sediment samples did not exceed the screening criteria, they may be a source of PFCs to the surface water. Additional sediment investigations are recommended at PRL 6 and 9.

Amec Foster Wheeler recommends that further investigations include analysis of additional compounds, including precursor compounds, to supplement the UCMR 3 list at each of the PRLs and media recommended for further investigation in **Table 8**. Precursor compounds have potential to result in increased concentrations downgradient and can serve as a lingering source. Drilling methods employed in the SI were incapable of penetrating into the groundwater table which was deeper than the 20-34 ft bgs reached, therefore, future drilling activities should be conducted using more robust drilling methods such as hollow stem auger or rotary sonic drilling methods to achieve the required depths to reach the groundwater table.

9.1 PRL Sites Summary

In summary, additional investigations are recommended for each of the eight PRLs.

These recommendations are summarized in **Table 8** below.

Table 8: Screening Criteria Exceedances and Recommendations

PRL	Screening Criteria Exceedance				Recommendations
	Soil	GW	SW	SD	
1*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
2*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
3*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
4*	X				Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
5*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
6			X		SW investigation to evaluate the migration pathway of PFCs.
7*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
9		X	X		Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.

Notes:

GW – Groundwater
PFC – Perfluorinated Compound
PRL – Potential Release Area
SD – Sediment
SW – Surface water
X – Screening criteria exceedance
*Groundwater was not evaluated during the SI due to insufficient water in the installed temporary well.

THIS PAGE INTENTIONALLY LEFT BLANK.

10.0 REFERENCES

AECOM, 2015. Regional Compliance Restoration Program, Final Preliminary Assessment/Site Inspection, McLaughlin (Charleston) Air National Guard Base, Charleston, West Virginia, July, 2015.

Amec Foster Wheeler, 2017. *Final Work Plan: FY16 Phase I Regional Site Inspections for Perfluorinated Compounds*, October, 2017.

ANG 1989. Preliminary Assessment, 130th Tactical Airlift Group, West Virginia Air National Guard, McLaughlin Airport, Charleston, West Virginia. March 1989.

Air National Guard Readiness Center Environmental Restoration Program, 2009. *"Air National Guard Environmental Restoration Program Investigation Guidance,"* September 2009.

BB&E, Inc. (BB&E), 2015. Final Perfluorinated Compound (PFC) Preliminary Assessment Work Plan, Prepared for Headquarters Air National Guard Andrews Air Force Base, Maryland. July.

DoD, 2017. *DoD Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories. Version 5.1,* January 2017Environmental Data Resources (EDR), 2015. EDR Radius Map™ Report with Geocheck®. July.

Metcalf & Eddy, Inc., 1996. Final Site Investigation Report, prepared for 130th Airlift Group, West Virginia Air National Guard, McLaughlin Airport, Charleston, West Virginia. April, 1996.

TEC-Weston Joint Venture (TEC-Weston), 2016. Final Remedial Action Work Plan, Uniform Federal Policy Quality Assurance Project Plan, FL014, OW010, and SS006 at McLaughlin Air National Guard Base, Charleston, Virginia. March, 2016.

TEC-Weston, 2017. Monitoring Well Inventory McLaughlin Air National Guard Base, Charleston, Virginia. March, 2016.

USAF, 2012. *Interim Air Force Guidance on Sampling and Response Actions for Perfluorinated Compounds at Active and BRAC Installations.*

USEPA, 2009. *Method 537. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry Version 1.1. EPA Document #: EPA/600/R-08/092.* September 2009.

USEPA, 2012. *Federal Register, Volume 77, No. 85, Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 3) for Public Water Systems; Final Rule.* May 2, 2012.

USEPA, 2016a. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS), EPA 822-R-16-004, Unites States Environmental Protection Agency, May 2016.

USEPA, 2016b. Drinking Water Health Advisory for Perfluotooctanoic Acid (PFOA), EPA 822-R-16-005, Unites States Environmental Protection Agency, May 2016.

USEPA, 2018. *EPA Regional Screening Levels [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2018],* May 2018.

U. S. Fish and Wildlife Service (USFWS), 2014. Endangered, Threatened, Proposed, and Candidate Species, West Virginia Counties, September, 2014.

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK.

Table 1
Preliminary Assessment Potential Release Location Summary
FY16 Phase I Regional Site Inspections for Perfluorinated Compounds
130th Airlift Wing, West Virginia Air National Guard

Potential Release Location	Use	Recommendation
1. Former FTA (Installation Restoration Program [IRP] Site 3)	Former FTA	Soil and groundwater inspection
2. Hangar 107	Hangar with AFFF Fire Suppression System (FSS)	Soil and groundwater inspection
3. Hangar 121	Hangar with AFFF FSS	Soil and groundwater inspection
4. North Fire Department (FD) Equipment Testing Area	FD Nozzle Testing	Soil and groundwater inspection
5. South FD Equipment Testing Area	FD Nozzle Testing	Soil and groundwater inspection
6. Former Building 120	Former FD	Sediment inspection
7. Building 420	Current FD	Soil and groundwater inspection
8. Building 143	Base Supply	NFA
9. Former Wastewater Treatment Plant (WWTP) (Building 123)	Former WWTP	Soil, groundwater, surface water, and sediment inspection

Notes:
AFFF – aqueous film forming foam
FSS – fire suppression system
WWTP – waste water treatment plant

Table 2
Summary of PRL Inspection Activities
FY16 Phase I Regional Site Inspections for Perfluorinated Compounds
130th Airlift Wing, West Virginia Air National Guard

PRL Name	Analyzed Parameters[1]	Soil Borings	Soil Samples	Groundwater Samples Existing Wells	Groundwater Samples Temporary Wells	Surface Water Samples	Sediment Samples
1. Former FTA (IRP Site 3)	PFCs	3	5	0	0	0	0
2. Hangar 107	PFCs	3	5	0	0	0	0
3. Hangar 121	PFCs	3	5	0	0	0	0
4. North FD Equipment Testing Area	PFCs	3	6	0	0	0	0
5. South FD Equipment Testing Area	PFCs	3	3	0	0	0	0
6. Former Building 120 (Former Fire Department)	PFCs	0	0	0	0	1	1
7. Building 420 (Current Fire Department)	PFCs	3	6	0	0	0	0
9. Former WWTP (Including Fire Department)	PFCs	3	6	2	0	1	1
Base Boundary Wells					2		

Notes:

[1] Soil, groundwater, surface water, and sediment samples were collected and analyzed for the PFCs listed on the USEPA's Third Unregulated Contaminant Monitoring Rule (UCMR3) list.

Bldg. - Building

FD - Fire department

IRP – Installation Restoration Program

PFCs – Perfluorinated compounds

PRL – potential release location

WWTP-Waste Water Treatment Plant

Table 3
Summary of Soil Analytical Testing Results
FY16 Phase I Regional Site Inspections for Perfluorinated Compounds
130th Airlift Wing, West Virginia Air National Guard

						Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	Perfluorobutanesulfonic acid (PFBS)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorononanoic acid (PFNA)
					Analyte:						
					Screening Level:	1.26[1]	1.26[1]	1300[2]	NA	NA	NA
PRL	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft.)**	**Sample Type**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	01SB01	YEAGR-01-SB01-00-02	17-Jan-18	0.0-2.0	N	0.0847	0.00607	0.000632 J	0.000504 J	0.0442	0.000584 J
		YEAGR-01-SB01-08-10	18-Jan-18	8.0-10.0	N	0.00916	0.0207	0.00124 J	0.000678 J	0.0559	0.000823 U
		YEAGR-SO-DUP03-011818	18-Jan-18	8.0-10.0	FD	0.00866	0.0234	0.00124 J	0.000751 J	0.0683	0.000958 U
	01SB02	YEAGR-01-SB02-00-02	17-Jan-18	0.0-2.0	N	0.0646	0.00487	0.00116 J	0.000793 J	0.0351	0.000865 J
	01SB03	YEAGR-01-SB03-00-02	16-Jan-18	0.0-2.0	N	0.0155	0.000975 U	0.000975 U	0.000975 U	0.00197	0.000975 U
		YEAGR-01-SB03-08-10	16-Jan-18	8.0-10.0	N	0.0516	0.000722 J	0.00151 J	0.00097 U	0.00777	0.00097 U
2	02SB01	YEAGR-02-SB01-01-03	19-Jan-18	1.0-3.0	N	0.00244	0.000914 U	0.000914 U	0.000914 U	0.000914 U	0.000914 U
	02SB02	YEAGR-02-SB02-02-04	19-Jan-18	2.0-4.0	N	0.0357	0.000862 U	0.000862 U	0.000862 U	0.000516 J	0.000862 U
		YEAGR-02-SB02-08-10	19-Jan-18	8.0-10.0	N	0.00274	0.000911 U	0.000911 U	0.000911 U	0.00185	0.000911 U
	02SB03	YEAGR-02-SB03-00-02	19-Jan-18	0.0-2.0	N	0.00724 J	0.000998 U	0.000998 U	0.000998 U	0.00357	0.000998 U
		YEAGR-02-SB03-08-10	19-Jan-18	8.0-10.0	N	0.000939 J	0.00105 U	0.00105 U	0.00105 U	0.00105 U	0.00105 U
3	03SB01	YEAGR-03-SB01-01-03	20-Jan-18	1.0-3.0	N	0.00113 U	c U	0.00113 U	0.00113 U	0.00113 U	0.00113 U
	03SB02	YEAGR-03-SB02-03-05	20-Jan-18	3.0-5.0	N	0.000994 U	0.000994 U	0.000994 U	0.000994 U	0.000994 U	0.000994 U
		YEAGR-03-SB02-08-10	20-Jan-18	8.0-10.0	N	0.000894 U	0.000894 U	0.000894 U	0.000894 U	0.000894 U	0.000894 U

Table 3

Summary of Soil Analytical Testing Results

FY16 Phase I Regional Site Inspections for Perfluorinated Compounds

130th Airlift Wing, West Virginia Air National Guard

						Analyte:	Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	Perfluorobutanesulfonic acid (PFBS)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorononanoic acid (PFNA)
						Screening Level:	1.26[1]	1.26[1]	1300[2]	NA	NA	NA
3	03SB03	YEAGR-03-SB03-02-04	20-Jan-18	2.0-4.0	N		0.00108 U	0.00108 U	0.00108 U	0.00108 U	0.000459 J	0.00108 U
		YEAGR-SO-DUP04-012018	20-Jan-18	2.0-4.0	FD		0.000494 J	0.00104 U	0.00104 U	0.00104 U	0.000557 J	0.00104 U
		YEAGR-03-SB03-08-10	20-Jan-18	8.0-10.0	N		0.000383 J	0.000999 U	0.000999 U	0.000999 U	0.000999 U	0.000999 U
4	04SB01	YEAGR-04-SB01-00-02	18-Jan-18	0.0-2.0	N		0.161	0.00338 J	0.0045 J	0.000737 J	0.0379 J	0.00119 J
		YEAGR-04-SB01-05-06	19-Jan-18	5.0-6.0	N		0.191	0.00404	0.00155 J	0.000505 J	0.0209	0.00127 J
	04SB02	YEAGR-04-SB02-00-02	18-Jan-18	0.0-2.0	N		0.67 J	0.00212	0.00419	0.000386 J	0.0474	0.00151 J
		YEAGR-SO-DUP02-011818	18-Jan-18	0.0-2.0	FD		0.41 J	0.00142 J	0.00362	0.000948 U	0.036	0.00114 J
		YEAGR-04-SB02-08-10	19-Jan-18	8.0-10.0	N		0.00992	0.0116	0.00908	0.00948	0.0109	0.0096
	04-SB03	YEAGR-04-SB03-00-02	18-Jan-18	0.0-2.0	N		2.16	0.0136	0.0186	0.00266	0.144	0.00377
		YEAGR-04-SB03-08-10	18-Jan-18	8.0-10.0	N		0.00661	0.00322	0.0176	0.00514	0.0752	0.000947 U
5	05SB01	YEAGR-05-SB01-00-02	19-Jan-18	0.0-2.0	N		0.958	0.00332	0.000922 J	0.00116 J	0.0191	0.00269
	05SB02	YEAGR-05-SB02-00-02	18-Jan-18	0.0-2.0	N		0.0943 J	0.00125 J	0.000494 J	0.000373 J	0.00768	0.000905 J
		YEAGR-SO-DUP01-011818	18-Jan-18	0.0-2.0	FD		0.134 J	0.00143 J	0.000404 J	0.000303 J	0.00688	0.000834 J
	05SB03	YEAGR-05-SB03-00-02	18-Jan-18	0.0-2.0	N		0.165	0.000677 J	0.00062 J	0.000339 J	0.0076	0.000351 J
7	07SB01	YEAGR-07-SB01-01-03	19-Jan-18	1.0-3.0	N		0.000603 J	0.000945 U	0.000945 U	0.000945 U	0.000945 U	0.000945 U
		YEAGR-07-SB01-08-10	19-Jan-18	8.0-10.0	N		0.000815 J	0.000884 U	0.000884 U	0.000884 U	0.000884 U	0.000884 U
	07SB02	YEAGR-07-SB02-02-04	20-Jan-18	2.0-4.0	N		0.00279	0.00103 U	0.00103 U	0.00103 U	0.00103 U	0.00103 U
		YEAGR-07-SB02-08-10	20-Jan-18	8.0-10.0	N		0.00194 J	0.00101 U	0.00101 U	0.00101 U	0.00101 U	0.00101 U

Table 3

Summary of Soil Analytical Testing Results

FY16 Phase I Regional Site Inspections for Perfluorinated Compounds

130th Airlift Wing, West Virginia Air National Guard

						Analyte:	Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	Perfluorobutanesulfonic acid (PFBS)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorononanoic acid (PFNA)
						Screening Level:	1.26[1]	1.26[1]	1300[2]	NA	NA	NA
7	07SB03	YEAGR-07-SB03-01-03	19-Jan-18	1.0-3.0	N		0.00266	0.000941 U	0.000941 U	0.000941 U	0.000941 U	0.000941 U
		YEAGR-07-SB03-08-10	19-Jan-18	8.0-10.0	N		0.00208	0.000872 U	0.000872 U	0.000872 U	0.0004 J	0.000872 U
9	09SB01	YEAGR-09-SB01-00-02	16-Jan-18	0.0-2.0	N		0.0146	0.00046 J	0.000996 U	0.000996 U	0.00205	0.000996 U
		YEAGR-09-SB01-08-10	16-Jan-18	8.0-10.0	N		0.0255	0.00167 J	0.000413 J	0.000997 U	0.0089	0.000997 U
	09SB02	YEAGR-09-SB02-00-02	16-Jan-18	0.0-2.0	N		0.00558	0.00101 U	0.00101 U	0.00101 U	0.00204	0.00101 U
		YEAGR-09-SB02-08-10	16-Jan-18	8.0-10.0	N		0.00056 J	0.000934 U	0.000934 U	0.000934 U	0.000934 U	0.000934 U
	09SB03	YEAGR-09-SB03-01-03	16-Jan-18	1.0-3.0	N		0.00445	0.00139 J	0.000953 U	0.000953 U	0.00653	0.000953 U
		YEAGR-09-SB03-08-10	16-Jan-18	8.0-10.0	N		0.001 U	0.001 U	0.001 U	0.001 U	0.00149 J	0.001 U

Notes:

FD - Field Duplicate Sample

ft - feet

ID - Identification

J - The analyte was positively identified and the associated numerical value is the approximate concentration in the sample.

mg/kg - milligrams per kilogram

N - Normal Field Sample

NA - Not applicable

PRL - Potential Release Location

U - The analyte was analyzed for, but was not detected above the reported limit of detection.

PFAS analysis by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry

[1] Screening levels calculated using the USEPA Regional Screening Level calculator [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search]

[2] USEPA Residential Screening Levels (May 2018) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2018]

Table 4

Summary of Surface Water Analytical Testing Results

FY16 Phase I Regional Site Inspections for Perfluorinated Compounds

130th Airlift Wing, West Virginia Air National Guard

						Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	PFOS+PFOA	Perfluorobutanesulfonic acid (PFBS)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorononanoic acid (PFNA)
					Analyte:							
					Health Advisory:	0.07	0.07	0.07	NA	NA	NA	NA
					EPA RSL Tapwater[1]:	NA	NA	NA	400	NA	NA	NA
PRL	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft.)**	**Sample Type**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
6	06-SW01	YEAGR-06-SW01-011718	17-Jan-18	0.0-0.2	N	6.65 J	0.344	6.994	0.306	0.155	2.76	0.0352
		YEAGR-SW-DUP01-011718	17-Jan-18	0.0-0.2	FD	5.88	0.333	6.213	0.287	0.151	2.8	0.047 J
9	09-SW01	YEAGR-09-SW01-012018	20-Jan-18	0.2-0.2	N	1.86	0.136	1.996	0.136	0.0817	1	0.0214

Notes:

Light Shaded Blue - Exceeds Health Advisory

FD - Field Duplicate Sample

ft - feet

ID - Identification

N - Normal Field Sample

NA - Not applicable

PRL - Potential Release Location

µg/L - micrograms per liter

PFAS analysis by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry

Health Advisory from USEPA Office of Water, 2016a and 2016b, Health Advisories (Has) for drinking water.

[1] USEPA Residential Screening Levels (November 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2018]

Table 5
Summary of Sediment Analytical Testing Results
FY16 Phase I Regional Site Inspections for Perfluorinated Compounds
130th Airlift Wing, West Virginia Air National Guard

					Analyte:	Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	Perfluorobutanesulfonic acid (PFBS)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorononanoic acid (PFNA)
					Screening Level:	1.26[1]	1.26[1]	NA	NA	NA	NA
PRL	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft.)**	**Sample Type**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
6	06-SD01	YEAGR-06-SD01-0-0.5	17-Jan-18	0.0-0.5	N	0.00724 J	0.00085 U	0.00085 U	0.00085 U	0.000953 J	0.00085 U
		YEAGR-SD-DUP01-011718	17-Jan-18	0.0-1.0	FD	0.0099 J	0.000985 U	0.000985 U	0.000985 U	0.00106 J	0.000985 U
9	09-SD01	YEAGR-09-SD01-0-0.5	20-Jan-18	0.0-0.5	N	0.00553	0.0011 U	0.0011 U	0.0011 U	0.000544 J	0.0011 U

Notes:

FD - Field Duplicate Sample
ft - feet
ID - Identification
J - The analyte was positively identified and the associated numerical value it the approximate concentration in the sample.
mg/kg - milligrams per kilogram
N - Normal Field Sample
NA - Not applicable
PRL - Potential Release Location
U - The analyte was analyzed for, but was not detected above the reported limit of detection.
USEPA - U.S. Environmental Protection Agency
PFAS analysis by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry
[1] Screening levels calculated using the USEPA Regional Screening Level calculator [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search]

Table 6
Summary of Groundwater Analytical Testing Results
FY16 Phase I Regional Site Inspections for Perfluorinated Compounds
130th Airlift Wing, West Virginia Air National Guard
Yeager Airport, Charleston, West Virginia

						Analyte:	Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanoic acid (PFOA)	PFOS+PFOA	Perfluorobutanesulfonic acid (PFBS)	Perfluoroheptanoic acid (PFHpA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluorononanoic acid (PFNA)
						Health Advisory:	0.07	0.07	0.07	NA	NA	NA	NA
						EPA RSL Tapwater[1]:	NA	NA	NA	400	NA	NA	NA
PRL	**Location**	**Sample ID**	**Sample Date**	**Sample Depth (ft.)**	**Sample Type**		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
9	ML-FL014-MW004	YEAGR-GW-ML-FL014-MW004-011918	19-Jan-18	30.0-30.0	N		6.38	0.914	7.29	1.81	0.689	9.01	0.0611
		YEAGR-GW-DUP01-011918	19-Jan-18	30.0-30.0	FD		6.93	1.17	8.1	1.99	0.638	10.1	0.0696
		YEAGR-ML-FL014-MW004-072718	27-Jul-18	26.0-26.0	N		6.56	0.895	7.46	1.6	0.581	8.61	0.0762
		YEAGR-DUP1-072718	27-Jul-18	26.0-26.0	FD		6.05	0.889	6.94	1.62	0.553	8.6	0.0659
BW	BW01	YEAGR-GW-BW01-011918	19-Jan-18	19.0-19.0	N		0.00517 U	0.00517 U	ND	0.0238	0.00517 U	0.0622	0.00517 U
	BW02	YEAGR-GW-BW02-011918	19-Jan-18	20.0-20.0	N		0.00658 J	0.00525 U	NA	0.00525 U	0.00525 U	0.00733 J	0.00525 U

Notes:

Light Shaded Blue - Exceeds Health Advisory

FD - Field Duplicate Sample

ft - feet

ID - Identification

J - The analyte was positively identified and the associated numerical value is the approximate concentration in the sample.

N - Normal Field Sample

NA - Not applicable

PRL - Potential Release Location

U - The analyte was analyzed for, but was not detected above the reported limit of detection.

µg/L - micrograms per liter

PFOS+PFOA - Co-occurance of PFOA and PFOS (PFOA + PFOS) in aqueous samples is reported using the following guidelines:

1. If both PFOA and PFOS are detected at of above the detection limit (DL), then the sum of PFOA + PFOS is reported.
2. If either PFOA or PFOS is detected at or above the DL and the other is below the DL, then PFOA + PFOS is reported as "NA" respresent Not Applicable.
3. If neither PFOA nor PFOS is detected at or above the DL, then PFOA + PFOS is reported as "ND" representing Not Detected.

PFAS analysis by Modified USEPA Method 537 using Liquid Chromatography and Tandem Mass Spectrometry

Health Advisory from USEPA Office of Water, 2016a and 2016b, Health Advisories (Has) for drinking water.

[1] USEPA Residential Screening Levels (May 2018) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2018]

Table 7
USEPA and USAF SI Screening Criteria
FY16 Phase I Regional Site Inspections for Perfluorinated Compounds
130th Airlift Wing, West Virginia Air National Guard
Yeager Airport, Charleston, West Virginia

Parameter	Chemical Abstract Number	USEPA Regional Screening Level Table (May 2018)[a]		Air Force Guidance for Soils and Sediments[b] (µg/kg)	USEPA Health Advisory Drinking Water (Surface Water or Groundwater) (µg/L)[c]
		Residential Soil (µg/kg)	Tap Water (µg/L)		
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1,300,000[d]	400[f]	NL	NL
Perfluorooctanoic acid (PFOA)	335-67-1	NL	NL	1,260	0.07[e]
Perfluorooctane sulfonate (PFOS)	1763-23-1	NL	NL	1,260	

Notes and Abbreviations:

NL – Not listed

USAF – U.S. Air Force

USEPA – U.S. Environmental Protection Agency

µg/L - micrograms per liter

µg/kg - micrograms per kilogram

[a] USEPA Regional Screening Levels (USEPA, 2018).

[b] Screening levels calculated using the USEPA Regional Screening Level calculator [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search].]. A toxicity hazard quotient of 1.0 was used. The toxicity value input for the calculator is the Tier 3 value reference dose of 0.00002 mg/kg/day derived by USEPA in their Drinking Water Health Advisories for both PFOS (USEPA, 2016a) and PFOA (USEPA, 2016b).

[c] USEPA, 2016b. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)* and USEPA, 2016a. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS).*

[d] PFBS RSL for Residential Soil concentration presented in Work Plan was 1,600,000 µg/kg based on the May 2016 RSL values. This table has been updated to include the more recent RSL values published in May 2018.

[e] Note: When PFOA and PFOS are both present, the combined detected concentrations of the compounds are compared with the 0.07 µg/L health advisory value for groundwater and surface water.

[f] PFBS RSL for Tap Water presented in the SI Work Plan (Amec, 2017) was 380 µg/L based on the May 2016 RSL values. This table has been updated to include the more recent RSL values published in May 2018.

Table 8: Screening Criteria Exceedances and Recommendations

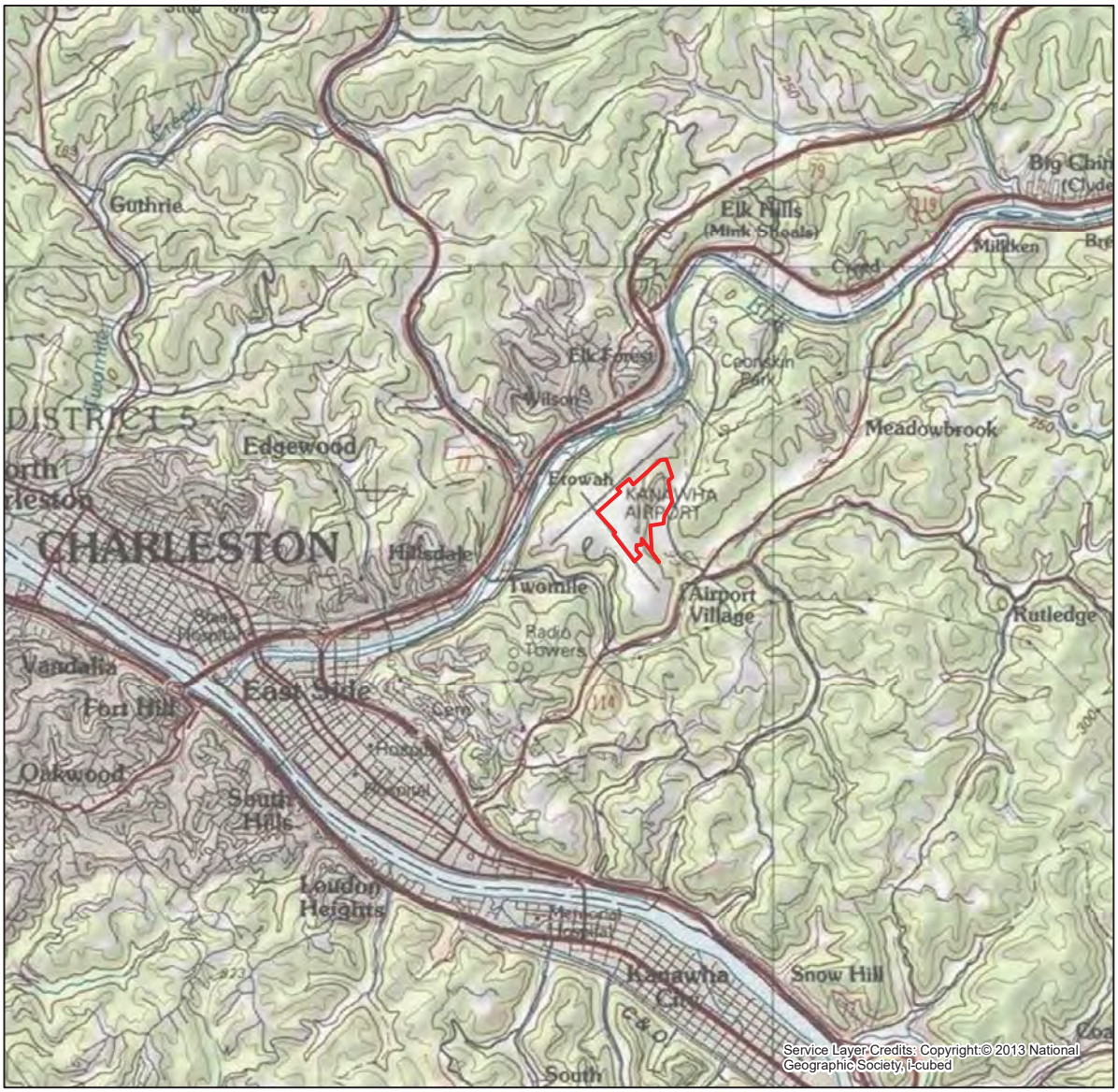
PRL	Screening Criteria Exceedance				Recommendations
	Soil	GW	SW	SD	
1*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
2*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
3*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
4*	X				Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
5*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
6			X		SW investigation to evaluate the migration pathway of PFCs.
7*					Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.
9		X	X		Investigation to evaluate the extent of PFCs in groundwater at the Base. Evaluate the extent of soil contamination, to determine if the soil may be a contributing source to groundwater, including soils in the saturated zone.

Notes:

GW – Groundwater
PFC – Perfluorinated Compound
PRL – Potential Release Area
SD – Sediment
SW – Surface water
X – Screening criteria exceedance
*Groundwater was not evaluated during the SI due to insufficient water in the installed temporary well.

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK.



SITE LOCATION MAP

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

Installation Area (Approximate)

Location of Site

Notes & Sources

Source: Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

0 0.5 1 Miles

N

amec foster wheeler

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

FIGURE

1

P:\Projects\ANG Phase I-29133000617.0_Sites\Yeager\GIS\MapDocuments\Fig1_Site_Location.mxd 4/26/2018 DWN: brian.peters CHKD: JMF

SITE AND AREA FEATURES

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Installation Area (approximate)
- Lakes and Ponds
- Rivers and Streams

Location of Site

Notes & Sources

Sources: Installation Area datalayer obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015. Rivers and Streams and Lakes and Ponds (USGS National Hydrography Dataset WV) datalayers obtained from the USGS TNM Download website at https://nhd.usgs.gov/data.html

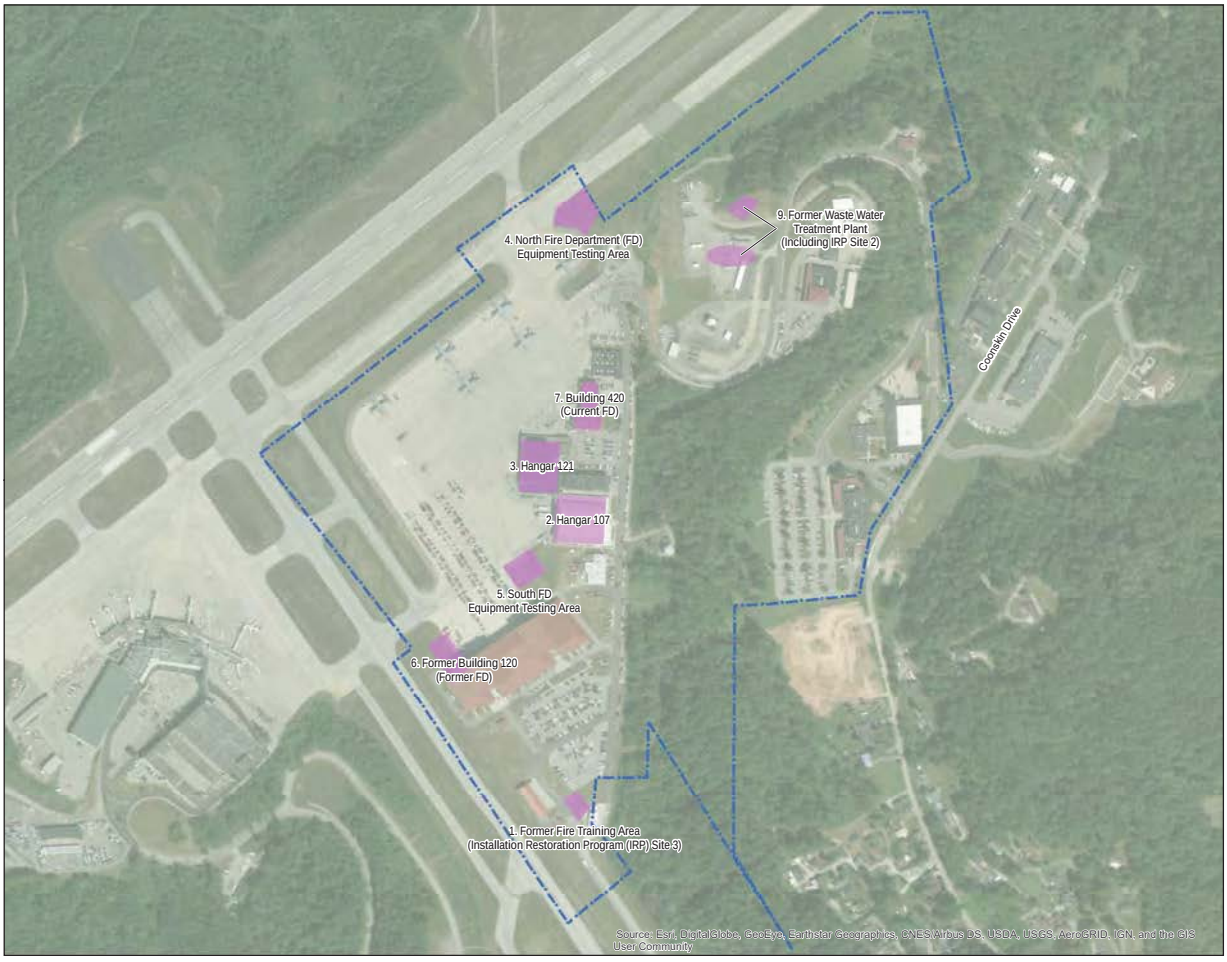
0 1,000 2,000 Feet

N

amec foster wheeler
Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

FIGURE 2

Document: P:\Projects\ANG Phase I-2913300086\7.0_Sites\Yeager\GIS\MapDocuments\Fig2_SiteAreaFeatures.mxd PDF: P:\Projects\ANG Phase I-2913300086\7.0_Sites\Yeager\Figures\Figure 2 - Site and Area Features.pdf 04/26/2018 8:49 AM brian.peters



PRL LOCATIONS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Potential AFFF PFC PRL (approximate)
- Installation Area (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
PRL - potential release location
PFC - perfluorinated compounds

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

0 200 400 Feet

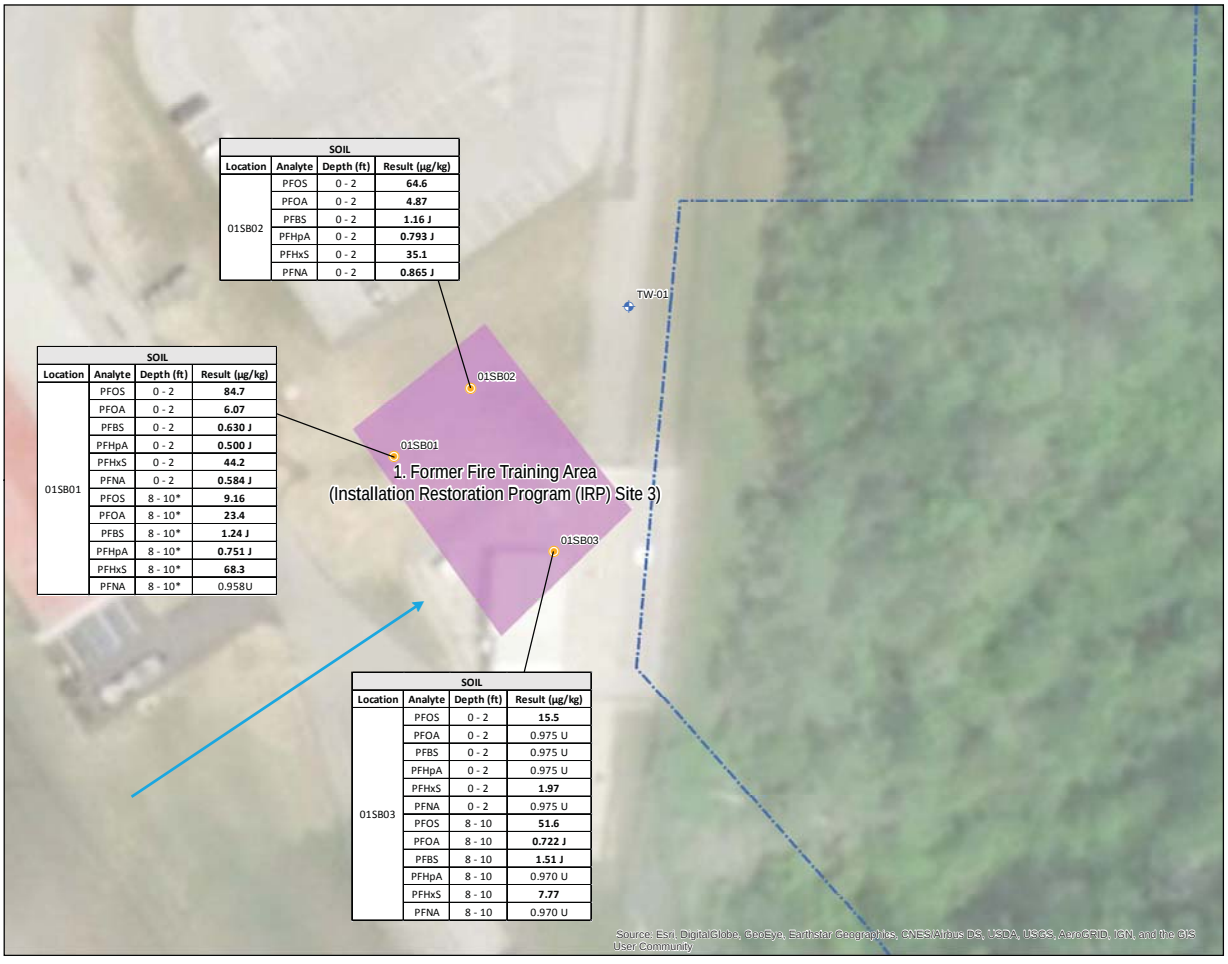
N

amec foster wheeler

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

FIGURE
3

Document: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\GIS\MapDocuments\Fig3_PRL_Locations.mxd PDF: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\Figures\Figure 3 - PRL Locations.pdf 05/03/2018 1:31 PM brian.peters



PRL 1
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Soil Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)
- Installation Area (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
* - Field duplicate collected at this location; the result presented is the highest concentration.
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

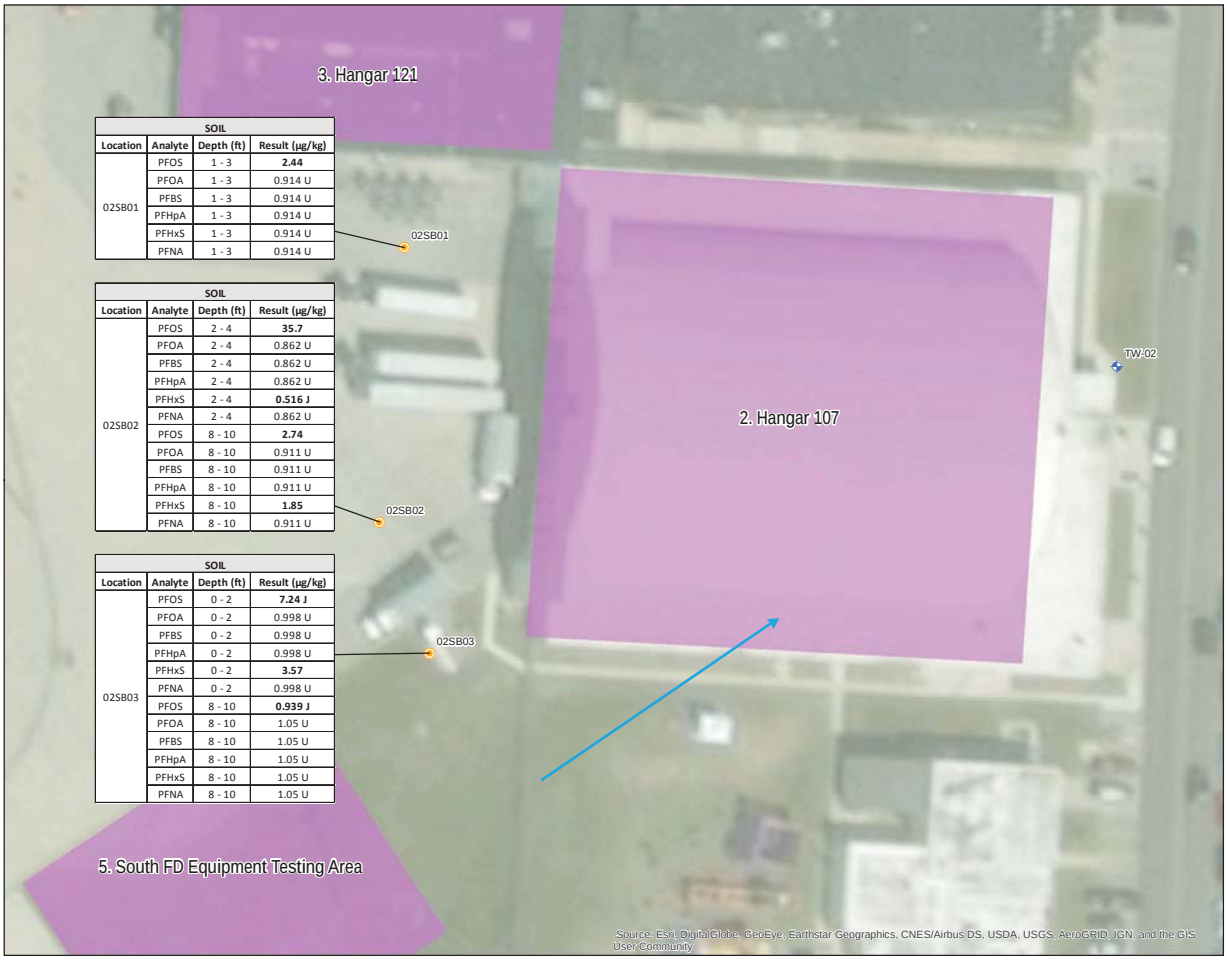
0 20 40 Feet

N

FIGURE
4

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

Document: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\GIS\MapDocuments\Fig4_PRL1_SampleResults.mxd PDF: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\Figures\Figure 4 - PRL 1 Sample Results.pdf 02/05/2019 12:57 PM brian.peters



SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
02SB01	PFOS	1 - 3	**2.44**
	PFOA	1 - 3	0.914 U
	PFBS	1 - 3	0.914 U
	PFHpA	1 - 3	0.914 U
	PFHxS	1 - 3	0.914 U
	PFNA	1 - 3	0.914 U

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
02SB02	PFOS	2 - 4	**35.7**
	PFOA	2 - 4	0.862 U
	PFBS	2 - 4	0.862 U
	PFHpA	2 - 4	0.862 U
	PFHxS	2 - 4	**0.516 J**
	PFNA	2 - 4	0.862 U
	PFOS	8 - 10	**2.74**
	PFOA	8 - 10	0.911 U
	PFBS	8 - 10	0.911 U
	PFHpA	8 - 10	0.911 U
	PFHxS	8 - 10	**1.85**
	PFNA	8 - 10	0.911 U

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
02SB03	PFOS	0 - 2	**7.24 J**
	PFOA	0 - 2	0.998 U
	PFBS	0 - 2	0.998 U
	PFHpA	0 - 2	0.998 U
	PFHxS	0 - 2	**3.57**
	PFNA	0 - 2	0.998 U
	PFOS	8 - 10	**0.939 J**
	PFOA	8 - 10	1.05 U
	PFBS	8 - 10	1.05 U
	PFHpA	8 - 10	1.05 U
	PFHxS	8 - 10	1.05 U
	PFNA	8 - 10	1.05 U

PRL 2
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Soil Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

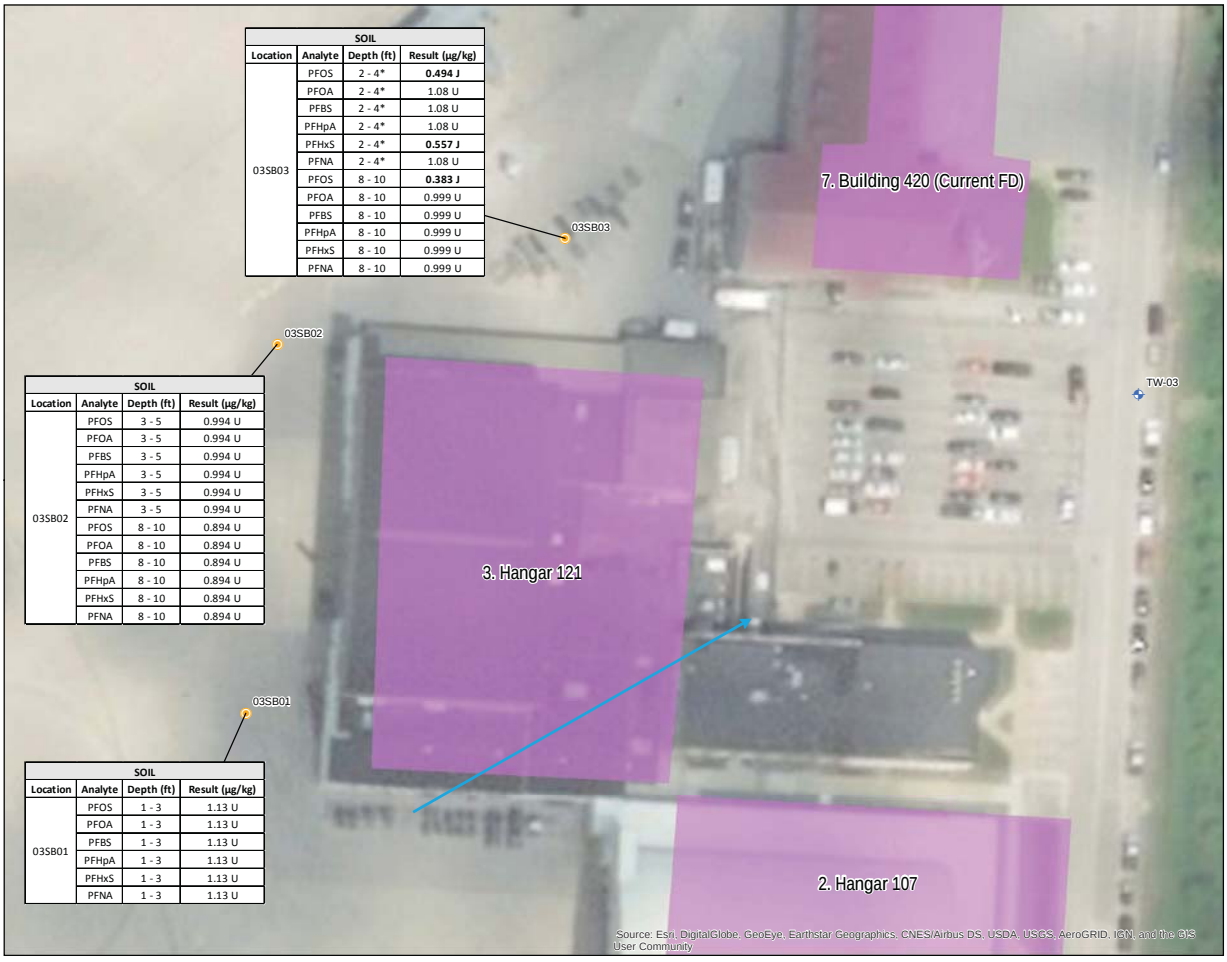
0 20 40 Feet

N

FIGURE 5

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

Document: P:\Projects\ANG Phase I-2913300061.0_Sites\Yeager\GIS\MapDocuments\Fig5_PRL2_SampleResults.mxd PDF: P:\Projects\ANG Phase I-2913300061.0_Sites\Yeager\Figures\Figure 5 - PRL 2 Sample Results.pdf 05/03/2018 1:16 PM brian.peters



SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
03SB03	PFOS	2 - 4*	**0.494 J**
	PFOA	2 - 4*	1.08 U
	PFBS	2 - 4*	1.08 U
	PFHpA	2 - 4*	1.08 U
	PFHxS	2 - 4*	**0.557 J**
	PFNA	2 - 4*	1.08 U
	PFOS	8 - 10	**0.383 J**
	PFOA	8 - 10	0.999 U
	PFBS	8 - 10	0.999 U
	PFHpA	8 - 10	0.999 U
	PFHxS	8 - 10	0.999 U
	PFNA	8 - 10	0.999 U

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
03SB02	PFOS	3 - 5	0.994 U
	PFOA	3 - 5	0.994 U
	PFBS	3 - 5	0.994 U
	PFHpA	3 - 5	0.994 U
	PFHxS	3 - 5	0.994 U
	PFNA	3 - 5	0.994 U
	PFOS	8 - 10	0.894 U
	PFOA	8 - 10	0.894 U
	PFBS	8 - 10	0.894 U
	PFHpA	8 - 10	0.894 U
	PFHxS	8 - 10	0.894 U
	PFNA	8 - 10	0.894 U

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
03SB01	PFOS	1 - 3	1.13 U
	PFOA	1 - 3	1.13 U
	PFBS	1 - 3	1.13 U
	PFHpA	1 - 3	1.13 U
	PFHxS	1 - 3	1.13 U
	PFNA	1 - 3	1.13 U

PRL 3
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Soil Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
* - Field duplicate collected at this location; the result presented is the highest concentration.
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

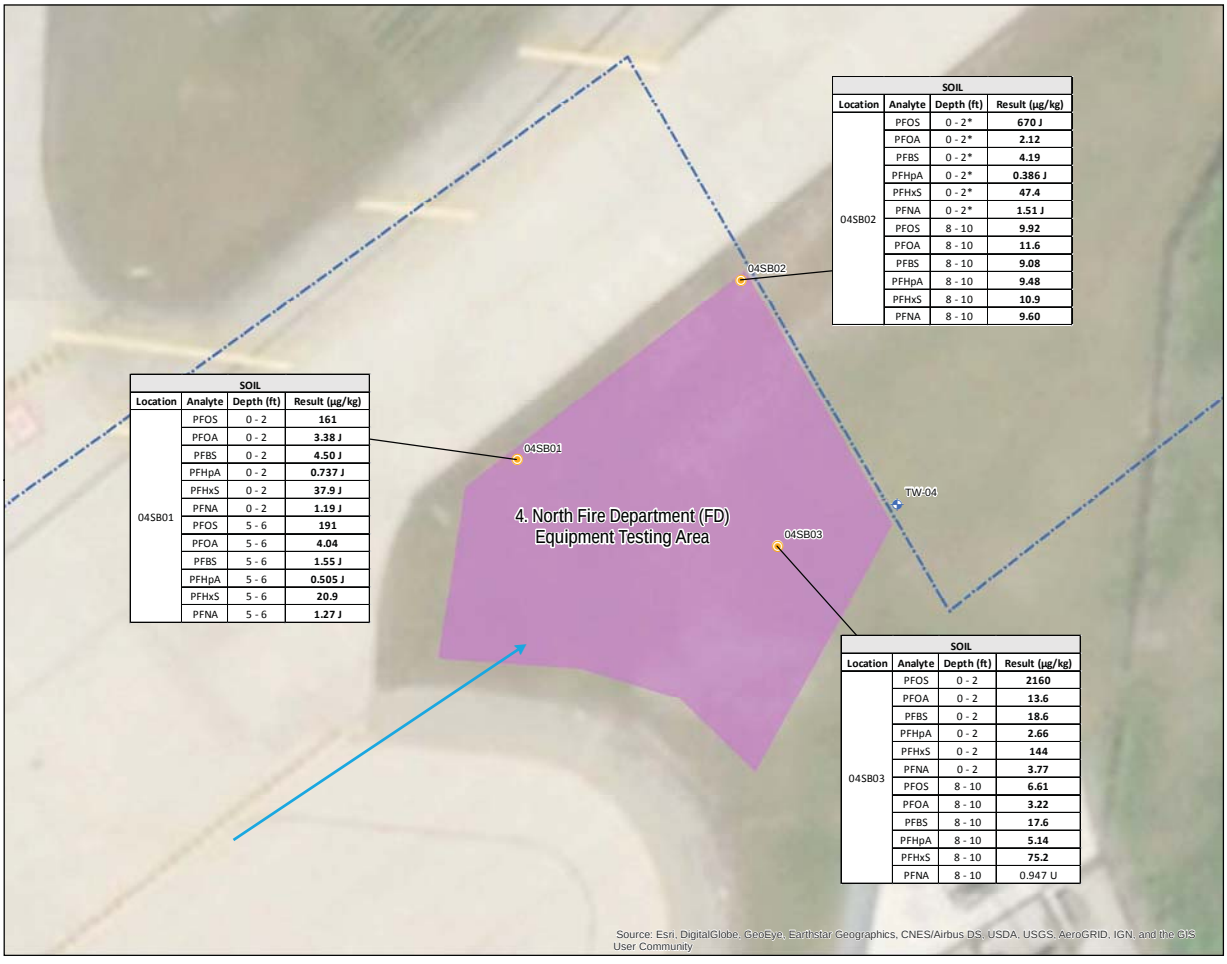
0 25 50 Feet

N

amec foster wheeler
Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

FIGURE
6

Document: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\GIS\MapDocuments\Fig6_PRL3_SampleResults.mxd PDF: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\Figures\Figure 6 - PRL 3 Sample Results.pdf 02/05/2019 1:12 PM brian.peters



SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
04SB02	PFOS	0 - 2*	**670 J**
	PFOA	0 - 2*	**2.12**
	PFBS	0 - 2*	**4.19**
	PFHpA	0 - 2*	**0.386 J**
	PFHxS	0 - 2*	**47.4**
	PFNA	0 - 2*	**1.51 J**
	PFOS	8 - 10	**9.92**
	PFOA	8 - 10	**11.6**
	PFBS	8 - 10	**9.08**
	PFHpA	8 - 10	**9.48**
	PFHxS	8 - 10	**10.9**
	PFNA	8 - 10	**9.60**

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
04SB01	PFOS	0 - 2	**161**
	PFOA	0 - 2	**3.38 J**
	PFBS	0 - 2	**4.50 J**
	PFHpA	0 - 2	**0.737 J**
	PFHxS	0 - 2	**37.9 J**
	PFNA	0 - 2	**1.19 J**
	PFOS	5 - 6	**191**
	PFOA	5 - 6	**4.04**
	PFBS	5 - 6	**1.55 J**
	PFHpA	5 - 6	**0.505 J**
	PFHxS	5 - 6	**20.9**
	PFNA	5 - 6	**1.27 J**

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
04SB03	PFOS	0 - 2	**2160**
	PFOA	0 - 2	**13.6**
	PFBS	0 - 2	**18.6**
	PFHpA	0 - 2	**2.66**
	PFHxS	0 - 2	**144**
	PFNA	0 - 2	**3.77**
	PFOS	8 - 10	**6.61**
	PFOA	8 - 10	**3.22**
	PFBS	8 - 10	**17.6**
	PFHpA	8 - 10	**5.14**
	PFHxS	8 - 10	**75.2**
	PFNA	8 - 10	0.947 U

PRL 4
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Soil Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)
- Installation Area (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
* - Field duplicate collected at this location; the result presented is the highest concentration.
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

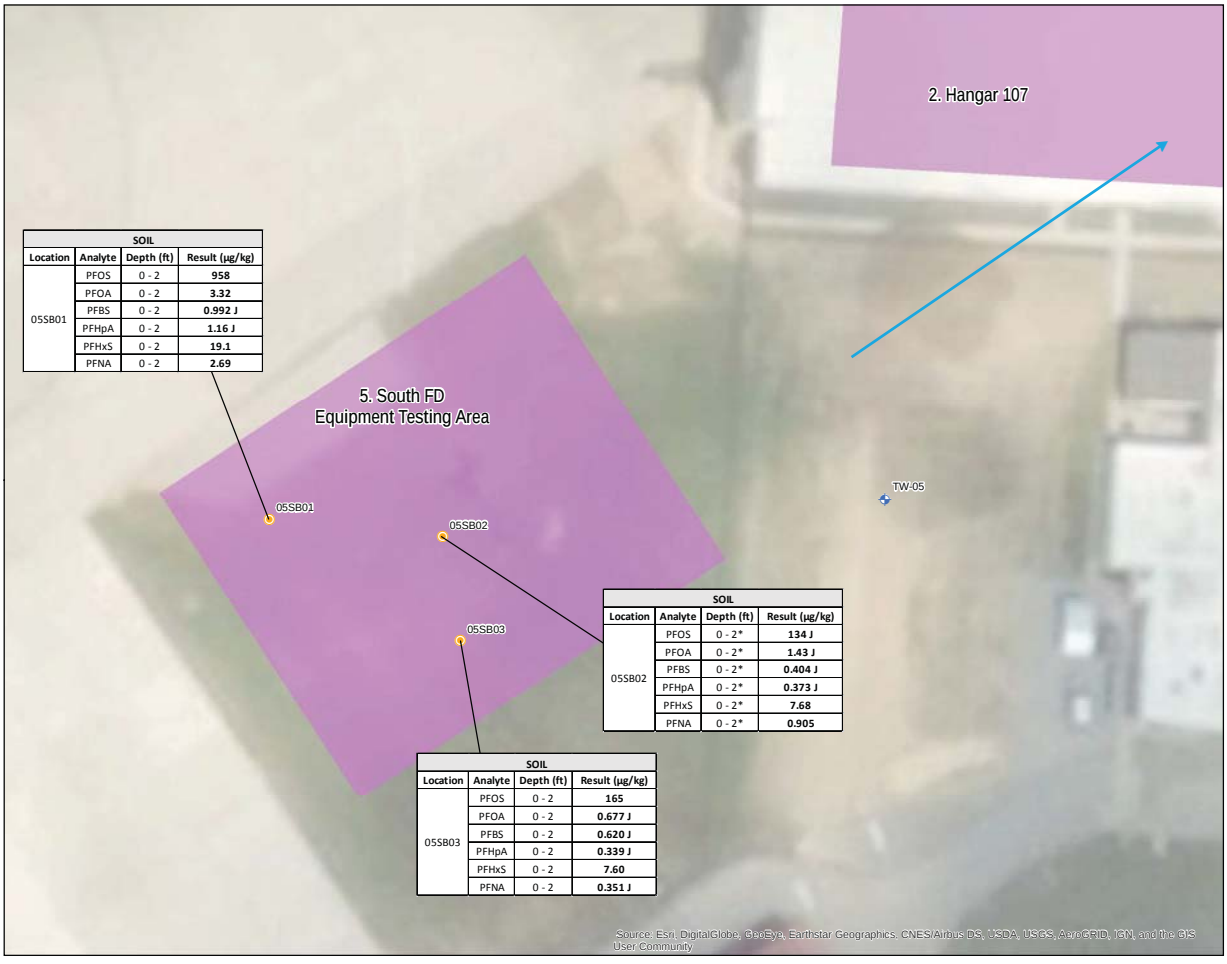
0 20 40 Feet

N

FIGURE 7

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

Document: P:\Projects\ANG Phase I-2913300061.0_Sites\Yeager\GIS\MapDocuments\Fig7_PRL4_SampleResults.mxd PDF: P:\Projects\ANG Phase I-2913300061.0_Sites\Yeager\Figures\Figure 7 - PRL 4 Sample Results.pdf 02/05/2019 1:07 PM brian.peters



SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
05SB01	PFOS	0 - 2	**958**
	PFOA	0 - 2	**3.32**
	PFBS	0 - 2	**0.992 J**
	PFHpA	0 - 2	**1.16 J**
	PFHxS	0 - 2	**19.1**
	PFNA	0 - 2	**2.69**

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
05SB02	PFOS	0 - 2*	**134 J**
	PFOA	0 - 2*	**1.43 J**
	PFBS	0 - 2*	**0.404 J**
	PFHpA	0 - 2*	**0.373 J**
	PFHxS	0 - 2*	**7.68**
	PFNA	0 - 2*	**0.905**

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
05SB03	PFOS	0 - 2	**165**
	PFOA	0 - 2	**0.677 J**
	PFBS	0 - 2	**0.620 J**
	PFHpA	0 - 2	**0.339 J**
	PFHxS	0 - 2	**7.60**
	PFNA	0 - 2	**0.351 J**

PRL 5
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Soil Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
* - Field duplicate collected at this location; the result presented is the highest concentration.
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

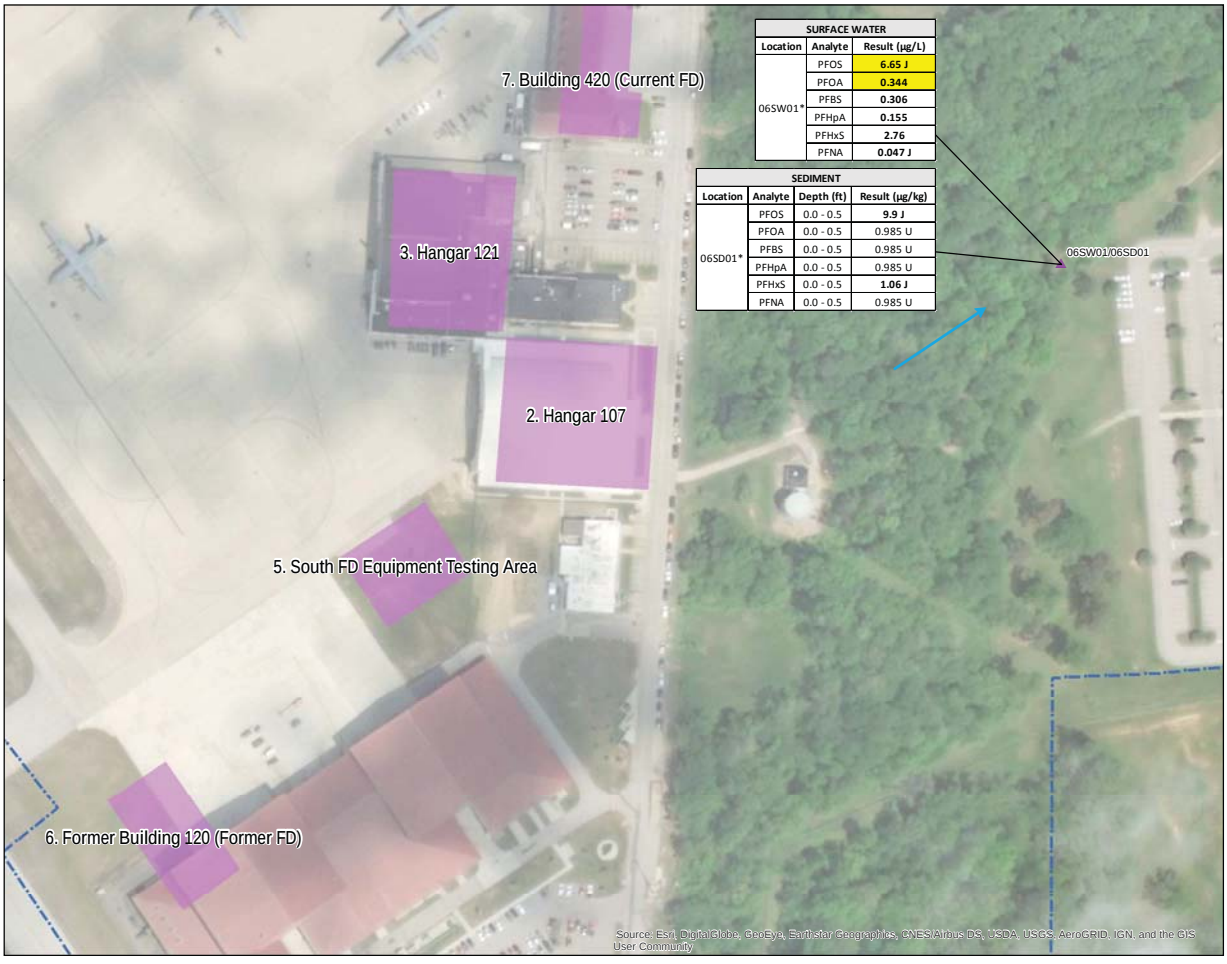
0 15 30 Feet

N

FIGURE 8

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

Document: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\GIS\MapDocuments\Fig8_PRL5_SampleResults.mxd PDF: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\Figures\Figure 8 - PRL 5 Sample Results.pdf 02/05/2019 1:05 PM brian.peters



SURFACE WATER

Location	Analyte	Result (µg/L)
06SW01*	PFOS	**6.65 J**
	PFOA	**0.344**
	PFBS	**0.306**
	PFHpA	**0.155**
	PFHxS	**2.76**
	PFNA	**0.047 J**

SEDIMENT

Location	Analyte	Depth (ft)	Result (µg/kg)
06SD01*	PFOS	0.0 - 0.5	**9.9 J**
	PFOA	0.0 - 0.5	0.985 U
	PFBS	0.0 - 0.5	0.985 U
	PFHpA	0.0 - 0.5	0.985 U
	PFHxS	0.0 - 0.5	**1.06 J**
	PFNA	0.0 - 0.5	0.985 U

PRL 6
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Surface Water/Sediment Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)
- Installation Area (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
* - Field duplicate collected at this location; the result presented is the highest concentration.
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

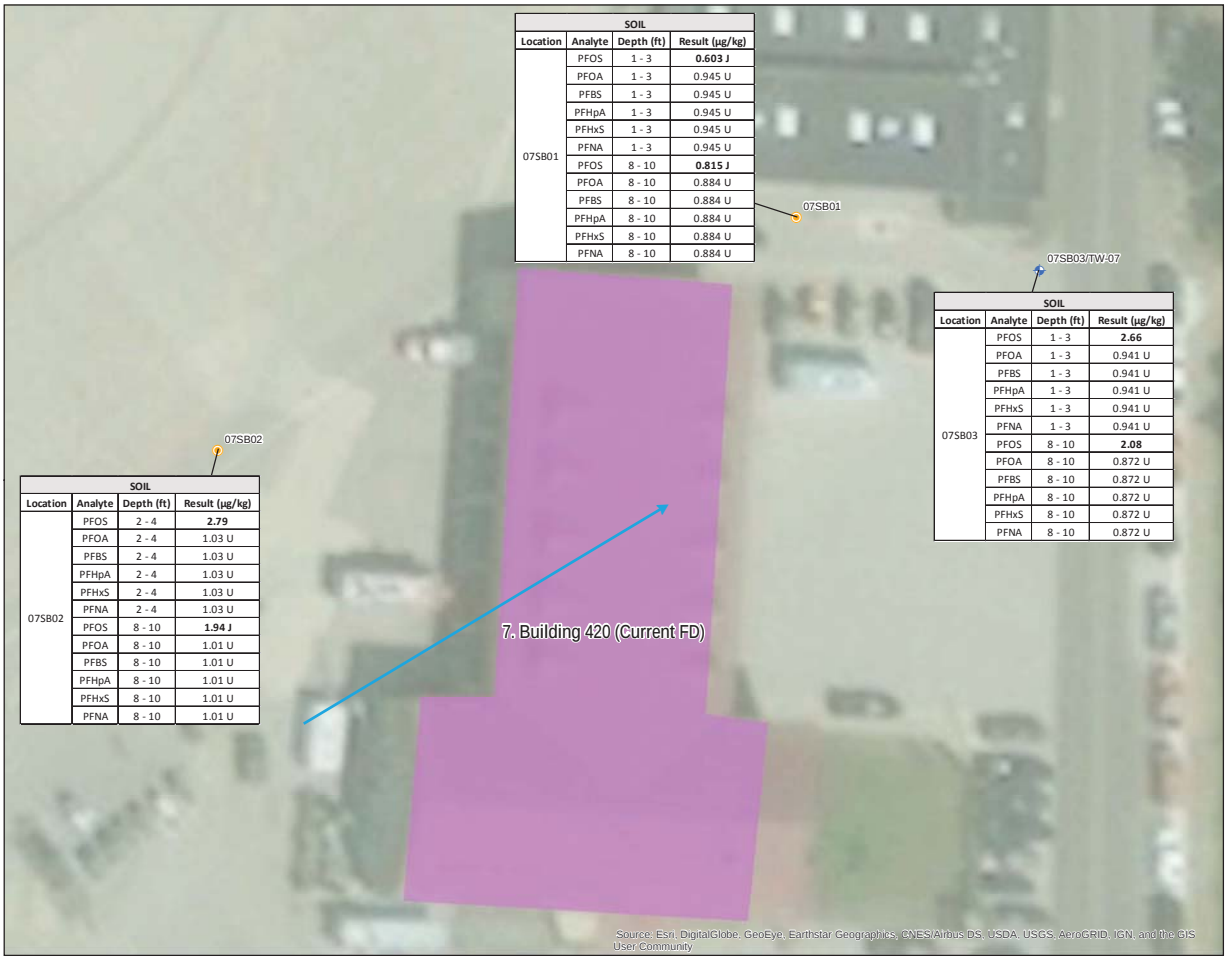
0 65 130 Feet

N

FIGURE 9

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

Document: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\GIS\MapDocuments\Fig9_PRL6_SampleResults.mxd PDF: P:\Projects\ANG Phase I-2913300061\7.0_Sites\Yeager\Figures\Figure 9 - PRL 6 Sample Results.pdf 02/05/2019 1:17 PM brian.peters



SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
07SB01	PFOS	1 - 3	**0.603 J**
	PFOA	1 - 3	0.945 U
	PFBS	1 - 3	0.945 U
	PFHpA	1 - 3	0.945 U
	PFHxS	1 - 3	0.945 U
	PFNA	1 - 3	0.945 U
	PFOS	8 - 10	**0.815 J**
	PFOA	8 - 10	0.884 U
	PFBS	8 - 10	0.884 U
	PFHpA	8 - 10	0.884 U
	PFHxS	8 - 10	0.884 U
	PFNA	8 - 10	0.884 U

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
07SB03	PFOS	1 - 3	**2.66**
	PFOA	1 - 3	0.941 U
	PFBS	1 - 3	0.941 U
	PFHpA	1 - 3	0.941 U
	PFHxS	1 - 3	0.941 U
	PFNA	1 - 3	0.941 U
	PFOS	8 - 10	**2.08**
	PFOA	8 - 10	0.872 U
	PFBS	8 - 10	0.872 U
	PFHpA	8 - 10	0.872 U
	PFHxS	8 - 10	0.872 U
	PFNA	8 - 10	0.872 U

SOIL			
Location	Analyte	Depth (ft)	Result (µg/kg)
07SB02	PFOS	2 - 4	**2.79**
	PFOA	2 - 4	1.03 U
	PFBS	2 - 4	1.03 U
	PFHpA	2 - 4	1.03 U
	PFHxS	2 - 4	1.03 U
	PFNA	2 - 4	1.03 U
	PFOS	8 - 10	**1.94 J**
	PFOA	8 - 10	1.01 U
	PFBS	8 - 10	1.01 U
	PFHpA	8 - 10	1.01 U
	PFHxS	8 - 10	1.01 U
	PFNA	8 - 10	1.01 U

PRL 7
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Soil Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

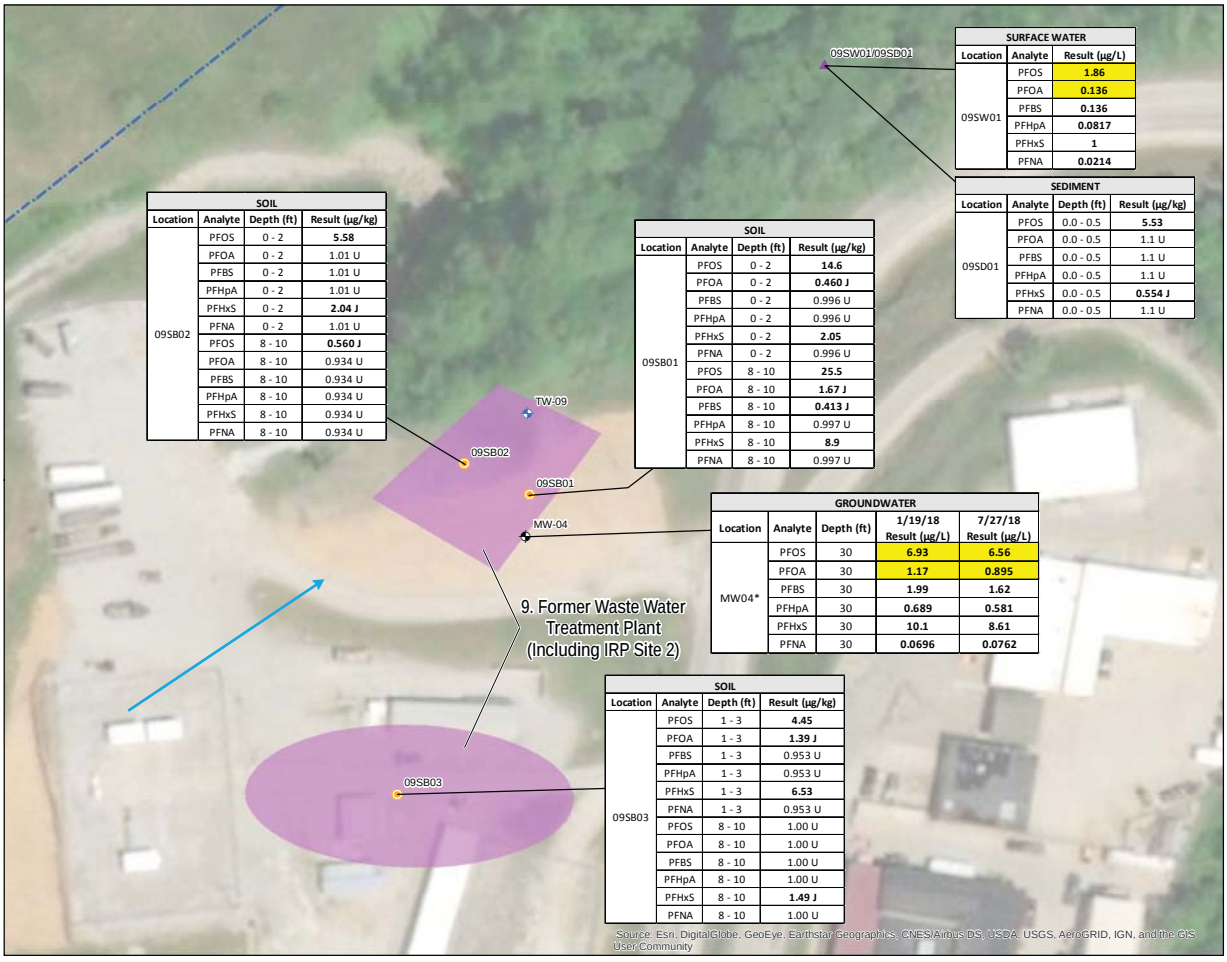
0 15 30 Feet

N

FIGURE 10

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

Document: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\GIS\MapDocuments\Fig10_PRL7_SampleResults.mxd PDF: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\Figures\Figure 10 - PRL 7 Sample Results.pdf 05/03/2018 1:25 PM brian.peters



SURFACE WATER

Location	Analyte	Result (µg/L)
09SW01	PFOS	**1.86**
	PFOA	**0.136**
	PFBS	**0.136**
	PFHpA	**0.0817**
	PFHxS	**1**
	PFNA	**0.0214**

SEDIMENT

Location	Analyte	Depth (ft)	Result (µg/kg)
09SD01	PFOS	0.0 - 0.5	**5.53**
	PFOA	0.0 - 0.5	1.1 U
	PFBS	0.0 - 0.5	1.1 U
	PFHpA	0.0 - 0.5	1.1 U
	PFHxS	0.0 - 0.5	**0.554 J**
	PFNA	0.0 - 0.5	1.1 U

SOIL

Location	Analyte	Depth (ft)	Result (µg/kg)
09SB02	PFOS	0 - 2	**5.58**
	PFOA	0 - 2	1.01 U
	PFBS	0 - 2	1.01 U
	PFHpA	0 - 2	1.01 U
	PFHxS	0 - 2	**2.04 J**
	PFNA	0 - 2	1.01 U
	PFOS	8 - 10	**0.560 J**
	PFOA	8 - 10	0.934 U
	PFBS	8 - 10	0.934 U
	PFHpA	8 - 10	0.934 U
	PFHxS	8 - 10	0.934 U
	PFNA	8 - 10	0.934 U

SOIL

Location	Analyte	Depth (ft)	Result (µg/kg)
09SB01	PFOS	0 - 2	**14.6**
	PFOA	0 - 2	**0.460 J**
	PFBS	0 - 2	0.996 U
	PFHpA	0 - 2	0.996 U
	PFHxS	0 - 2	**2.05**
	PFNA	0 - 2	0.996 U
	PFOS	8 - 10	**25.5**
	PFOA	8 - 10	**1.67 J**
	PFBS	8 - 10	**0.413 J**
	PFHpA	8 - 10	0.997 U
	PFHxS	8 - 10	**8.9**
	PFNA	8 - 10	0.997 U

GROUNDWATER

Location	Analyte	Depth (ft)	1/19/18 Result (µg/L)	7/27/18 Result (µg/L)
MW04*	PFOS	30	**6.93**	**6.56**
	PFOA	30	**1.17**	**0.895**
	PFBS	30	**1.99**	**1.62**
	PFHpA	30	**0.689**	**0.581**
	PFHxS	30	**10.1**	**8.61**
	PFNA	30	**0.0696**	**0.0762**

SOIL

Location	Analyte	Depth (ft)	Result (µg/kg)
09SB03	PFOS	1 - 3	**4.45**
	PFOA	1 - 3	**1.39 J**
	PFBS	1 - 3	0.953 U
	PFHpA	1 - 3	0.953 U
	PFHxS	1 - 3	**6.53**
	PFNA	1 - 3	0.953 U
	PFOS	8 - 10	1.00 U
	PFOA	8 - 10	1.00 U
	PFBS	8 - 10	1.00 U
	PFHpA	8 - 10	1.00 U
	PFHxS	8 - 10	**1.49 J**
	PFNA	8 - 10	1.00 U

PRL 9
SAMPLE RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Existing Well
- Soil Sample
- Surface Water/Sediment Sample
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)
- Installation Area (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
* - Field duplicate collected at this location; the result presented is the highest concentration.
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

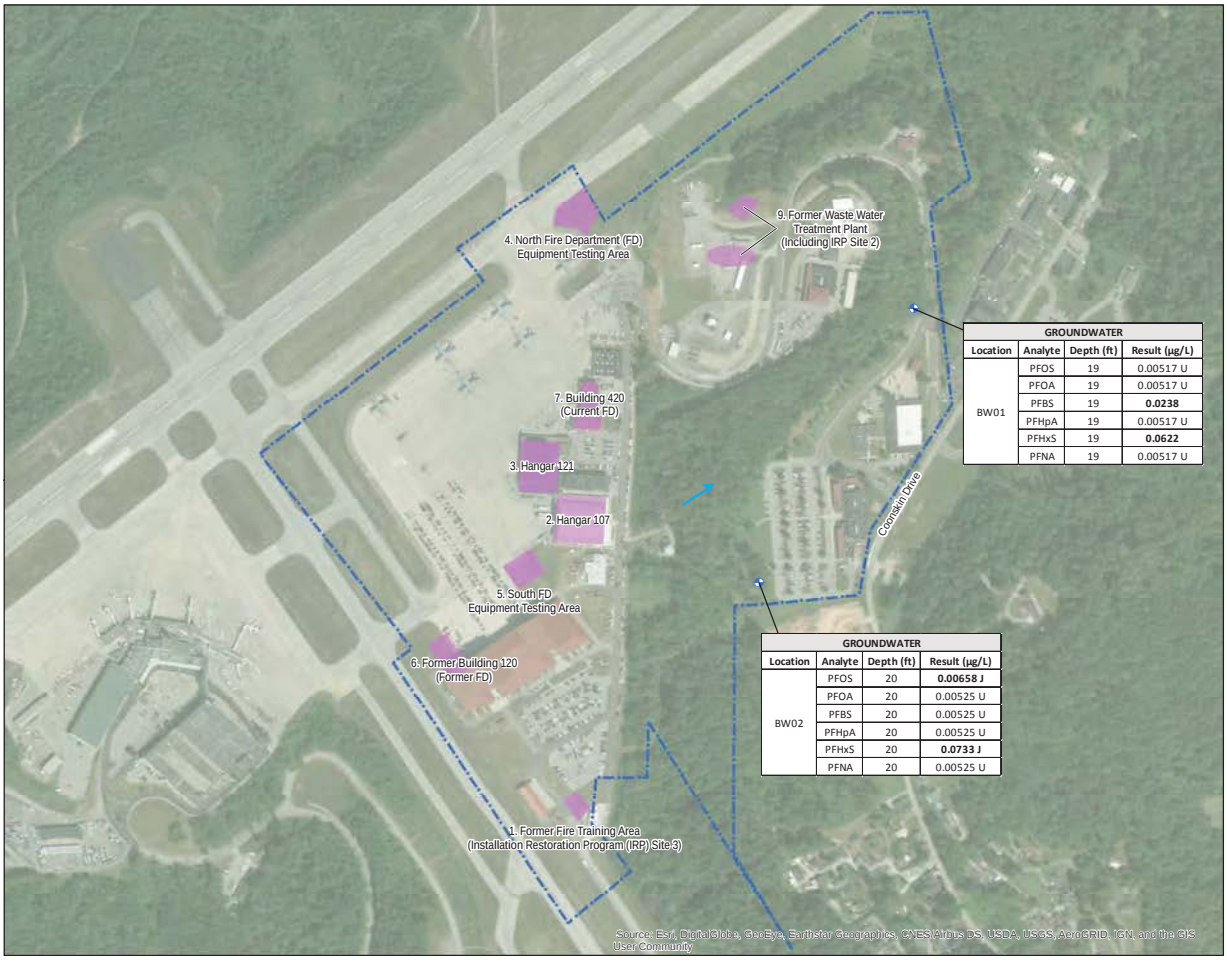
0 30 60 Feet

N

amec foster wheeler
Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

FIGURE
11

Document: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\GIS\MapDocuments\Fig11_PRL9_SampleResults.mxd PDF: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\Figures\Figure 11 - PRL 9 Sample Results.pdf 02/05/2019 2:57 PM brian.peters



GROUNDWATER			
Location	Analyte	Depth (ft)	Result (µg/L)
BW01	PFOS	19	0.00517 U
	PFOA	19	0.00517 U
	PFBS	19	**0.0238**
	PFHpA	19	0.00517 U
	PFHxS	19	**0.0622**
	PFNA	19	0.00517 U

GROUNDWATER			
Location	Analyte	Depth (ft)	Result (µg/L)
BW02	PFOS	20	**0.00658 J**
	PFOA	20	0.00525 U
	PFBS	20	0.00525 U
	PFHpA	20	0.00525 U
	PFHxS	20	**0.0733 J**
	PFNA	20	0.00525 U

BASE BOUNDARY WELL RESULTS

Mclaughlin
Air National Guard Base
Charleston, West Virginia

Legend

- Temporary Monitoring Well
- Approximate Groundwater Flow
- Potential AFFF PFC PRL (approximate)
- Installation Area (approximate)

Notes & Sources

Notes:
AFFF - aqueous film forming foam
ft - feet
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
PRL - potential release location
PFC - perfluorinated compounds
PFOS - Perfluorooctanesulfonic acid
PFOA - Perfluorooctanoic acid
PFBS - Perfluorobutanesulfonic acid
PFHpA - Perfluoroheptanoic acid
PFHxS - Perfluorohexanesulfonic acid
PFNA - Perfluorononanoic acid
B - The analyte was found in an associated blank, as well as in the sample.
J - The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
Q - The analyte is both B qualified because of blank detection and J qualified because of an additional QC issue.
U - The analyte was analyzed for, but was not detected above the reported limit of detection (LOD).
BOLD text indicates a detection.
YELLOW highlighted cells indicate 0.07 µg/L Health Advisory Exceedance in water or 1,260 µg/kg Air Force Calculated Screening Level Exceedance in soil.

Sources: Potential AFFF PFC PRLs and Installation Area datalayers obtained from Figure 2 of the Final Perfluorinated Compounds Preliminary Assessment Site Visit Report prepared by BB&E and dated July 2015.

0 200 400 Feet

N

FIGURE 12

Amec Foster Wheeler
Environment & Infrastructure, Inc.
800 North Bell Avenue, Suite 200
Pittsburgh, PA 15106

Document: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\GIS\MapDocuments\Fig12_BoundaryWellResults.mxd PDF: P:\Projects\ANG Phase I-291330006\7.0_Sites\Yeager\Figures\Figure 12 - Base Boundary Well Results.pdf 05/03/2018 1:31 PM brian.peters

APPENDIX A

SOIL BORING AND MONITORING WELL CONSTRUCTION LOGS

THIS PAGE INTENTIONALLY LEFT BLANK.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Brown clayey SILT with fine to course gravel, dry [FILL]			YEAGR-01-SB01-0-2		0.0		0
5	Light yellowish brown gravelly SILT with some clay, dry [FILL]					256.0		5
10	Gray staining and gasoline odor from 8' to 9' bgs Bottom of boring at 10 ft bgs. Not refusal.			YEAGR-01-SB01-8-10 YEAGR-SO-DUP03				10
15								15
20								20
25								25

START DATE: 1/17/2018
END DATE: 1/18/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448449.7 ft.
EASTING: 4246944.4 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 01-SB01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Brown clayey SILT with fine to course gravel, dry, no odor [FILL]			YEAGR-01-SB02-0-2		0.0		0
5	Bottom of boring at 4 ft bgs. Refusal. Two additional step out borings were attempted in proximity; one boring reached refusal at 2 ft bgs; the other boring reached refusal at 1 ft bgs							5
10								10
15								15
20								20
25								25

START DATE: 1/17/2018
END DATE: 1/18/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448454.9 ft.
EASTING: 4246948 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 01-SB02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Light yellowish brown SILT with sand, intermittent cobbles of siltstone [FILL]			YEAGR-01-SB03-0-2		0.0		0
5	Gray to light yellowish brown SANDSTONE and siltstone [FILL]			YEAGR-01-SB03-8-10		0.0		5
10	Brown lean CLAY, No Odor [FILL] Bottom of boring at 10 ft bgs. Not refusal.							10
15								15
20								20
25								25

START DATE: 1/16/2018
END DATE: 1/16/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448478.5 ft.
EASTING: 4246939.3 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 01-SB03

amec foster wheeler
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES SAMPLE ID	TYPE	PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Black ASPHALT							0
	Gray clayey SAND overlying light yellowish brown silt and pulverized siltstone [FILL]			YEAGR-02-SB01-1-3		0.0		
5	Gray to red to yellowish brown pulverized SILTSTONE and mudstone, trace clayey silt lenses [FILL]			No sample collected from 5-10 ft bgs due to absense of adequate soil volume; fill composed primarily of pulverized boulders		0.0		5
10	Bottom of boring at 10 ft bgs. Not refusal.							10
15								15
20								20
25								25

START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: SL

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448372.5 ft.
EASTING: 4247311.5 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 02-SB01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	ASPHALT and gravel							0
	Light yellowish brown SILT with gravel and pulverized siltstone, soft to hard, dry [FILL]			YEAGR-02-SB02-2-4		0.0		
5	Light yellowish brown clayey SILT and pulverized siltstone and mudstone [FILL]			YEAGR-02-SB02-8-10		0.0		5
10	Bottom of boring at 10 ft bgs. Not refusal.							10
15								15
20								20
25								25

START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: SL

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448373.1 ft.
EASTING: 4247272.9 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 02-SB02

amec foster wheeler
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Yellowish brown clayey SILT with gravel, stiff to hard, dry [FILL]			YEAGR-02-SB03-0-2 MS/MSD collected		0.0		0
5	Very light yellowish brown pulverized SILTSTONE and mudstone, silt lense from 9'-10' bgs, dry [FILL]					0.0		5
10	Bottom of boring at 10 ft bgs. Not refusal.			YEAGR-02-SB03-8-10				10
15								15
20								20
25								25

START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448382.7 ft.
EASTING: 4247259.1 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 02-SB03

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Dark gray to black ASPHALT							0
	Gray to reddish gray sand and clayey SILT and light gray to light yellowish brown pulverized siltstone and mudstone, firm to hard, dry [FILL]			YEAGR-03-SB01-1-3		0.0		
5				Not enough soil below 5 ft bgs to collect a lower soil grab sample; primarily composed of pulverized boulder		0.0		5
	Bottom of boring at 9 ft bgs. Refusal.							
10								10
15								15
20								20
25								25

START DATE: 1/20/2018
END DATE: 1/20/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448324.6 ft.
EASTING: 4247331.1 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 03-SB01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	ASPHALT							0
	Light gray to gray pulverized SILTSTONE and sandstone boulders, lenses of light reddish brown gravelly silt with clay, firm to hard, dry [FILL]			YEAGR-03-SB02-3-5		0.0		
5	Light gray to gray pulverized SILTSTONE and sandstone boulders, lenses of light yellowish brown gravelly silt and sand with clay, firm to hard, dry [FILL]			YEAGR-03-SB02-8-10		0.0		5
10	Bottom of boring at 10 ft bgs. Refusal.							10
15								15
20								20
25								25

START DATE: 1/20/2018
END DATE: 1/20/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: SL

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448325 ft.
EASTING: 4247388.2 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 03-SB02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Dark gray to black ASPHALT							0
	Light gray to light red pulverized SILTSTONE and mudstone to light yellowish brown gravelly silt with clay, firm to hard, dry [FILL]			YEAGR-03-SB03-2-4 YEAGR-SO-DUP04		0.0		
5						0.0		5
				YEAGR-03-SB03-8-10				
10	Bottom of boring at 10 ft bgs. Not Refusal.							10
15								15
20								20
25								25

START DATE: 1/20/2018
END DATE: 1/20/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448364.4 ft.
EASTING: 4247409.9 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 03-SB03

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES SAMPLE ID	TYPE	PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Light reddish brown gravelly SILT with clay, patches of gray and yellow silt, fine to medium gravel, firm, low plasticity, no odor, moist [FILL]			YEAGR-04-SB01-0-2		0.0		0
5	Dark grayish brown gravelly SILT with clay, patches of gray and yellow silt, intermixed with large cobbles of mudstone to sandstone, stiff, low plasticity, no odor, dry [FILL]			YEAGR-04-SB01-5-6		0.0		5
	Bottom of boring at 6 ft bgs. Refusal.							
10								10
15								15
20								20
25								25

START DATE: 1/18/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: SL

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448382.7 ft.
EASTING: 4247669 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 04-SB01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Reddish brown clayey SILT with gravel and intermittent large siltstone boulders, root fibers and moisture from 0-2 ft bgs, firm to hard, dry [FILL]			YEAGR-04-SB02-0-2 YEAGR-SO-DUP02		0.0		0
5	Light yellowish brown to red to gray SILT and pulverized siltstone boulders, firm to very hard, dry [FILL]			YEAGR-04-SB02-8-10		0.0		5
10	Bottom of boring at 10 ft bgs. Not Refusal.							10
15								15
20								20
25								25

START DATE: 1/18/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448409.9 ft.
EASTING: 4247692.3 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 04-SB02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Reddish brown, clayey SILT with gravel; intermixed with large siltstone boulders, dry, root fibers and moisture present from 0-2 ft bgs [FILL]			YEAGR-04-SB03-0-2		0.0		0
5	Gray to light yellowish brown SILT with intermittent siltstone boulders [FILL]			YEAGR-04-SB03-8-10		0.0		5
10	Bottom of boring at 10 ft bgs. Not refusal.							10
15								15
20								20
25								25

START DATE: 1/18/2018
END DATE: 1/18/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448404.5 ft.
EASTING: 4247673.5 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 04-SB03

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Yellowish brown clayey SILT, some topsoil, root fibers, moist [FILL]			YEAGR-05-SB01-0-2				0
	Light gray pulverized SILTSTONE boulder [FILL]					0.0		
5						0.0		5
	Bottom of boring at 7 ft bgs. Refusal.							
10								10
15								15
20								20
25								25

START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448341.4 ft.
EASTING: 4247224.5 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 05-SB01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	SILT with fine to coarse gravel, no odor, presence of roots from 0-3 inches [FILL]			YEAGR-05-SB02-0-2 YEAGR-SO-DUP01		0.0		0
	SILT with predominately fine to coarse rock (pulverized boulders/cobbles) [FILL]							
5	Bottom of boring at 4 ft bgs. Refusal. Two additional step out borings were attempted in proximity, and reached refusal above 4 ft bgs.							5
10								10
15								15
20								20
25								25

START DATE: 1/18/2018
END DATE: 1/18/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: SL

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448358.9 ft.
EASTING: 4247225.2 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 05-SB02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Llight yellowish brown clayey SILT with fine to coarse gravel, yellow/red mottling, root fibers from 0-2 inches, firm, low plasticity, no odor, moist [FILL]			YEAGR-05-SB03-0-2		0.0		0
5	Light gray pulverized SILTSTONE [FILL]					0.0		5
10	Bottom of boring at 9 ft bgs. Refusal.							10
15								15
20								20
25								25

START DATE: 1/18/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: SL

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448358.8 ft.
EASTING: 4247217.9 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 05-SB03

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Black ASPHALT							0
	Light brown to light reddish brown pulverized SILTSTONE and gravel, some clayey silt [FILL]			YEAGR-07-SB01-1-3		0.0		
5						0.0		5
				YEAGR-07-SB01-8-10				
10	Bottom of boring at 10 ft bgs. Not Refusal.							10
15								15
20								20
25								25

START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448433 ft.
EASTING: 4247475.6 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 07-SB01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Dark gray to black ASPHALT							0
	Gray to light yellowish brown gravelly SILT and sand, with clay, light gray to light red pulverized silstone and mudstone boulders, firm to hard, dry [FILL]			YEAGR-07-SBO2-2-4		0.0		
5						0.0		5
				YEAGR-07-SB02-8-10				
10	Bottom of boring at 10 ft bgs. Not Refusal.							10
15								15
20								20
25								25

START DATE: 1/20/2018
END DATE: 1/20/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448387.4 ft.
EASTING: 4247449.8 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 07-SB02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Reddish brown clayey SILT with sand and gravel, dry			YEAGR-09-SB01-0-2		0.0		0
5						0.0		5
10	Bottom of boring at 10 ft bgs. Not refusal.			YEAGR-09-SB01-8-10				10
15								15
20								20
25								25

START DATE: 1/16/2018
END DATE: 1/16/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448597.7 ft.
EASTING: 4247692.1 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 09-SB01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Brownish red clayey SILT with sand and gravel, dry [FILL]			YEAGR-09-SB02-0-2		0.0		0
5						0.0		5
10	Bottom of boring at 10 ft bgs. Not refusal.			YEAGR-09-SB02-8-10				10
15								15
20								20
25								25

START DATE: 1/16/2018
END DATE: 1/16/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448579.3 ft.
EASTING: 4247691.3 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 09-SB02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Concrete							0
	Reddish brown, clayey SILT with fine sand and gravel, dry [FILL]			YEAGR-09-SB03-1-3		0.0		
5	SILT with clay and gravel, dry [FILL]					0.0		5
10	Bottom of boring at 10 ft bgs. Not refusal.							10
15								15
20								20
25								25

START DATE: 1/16/2018
END DATE: 1/16/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448590.4 ft.
EASTING: 4247638.9 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

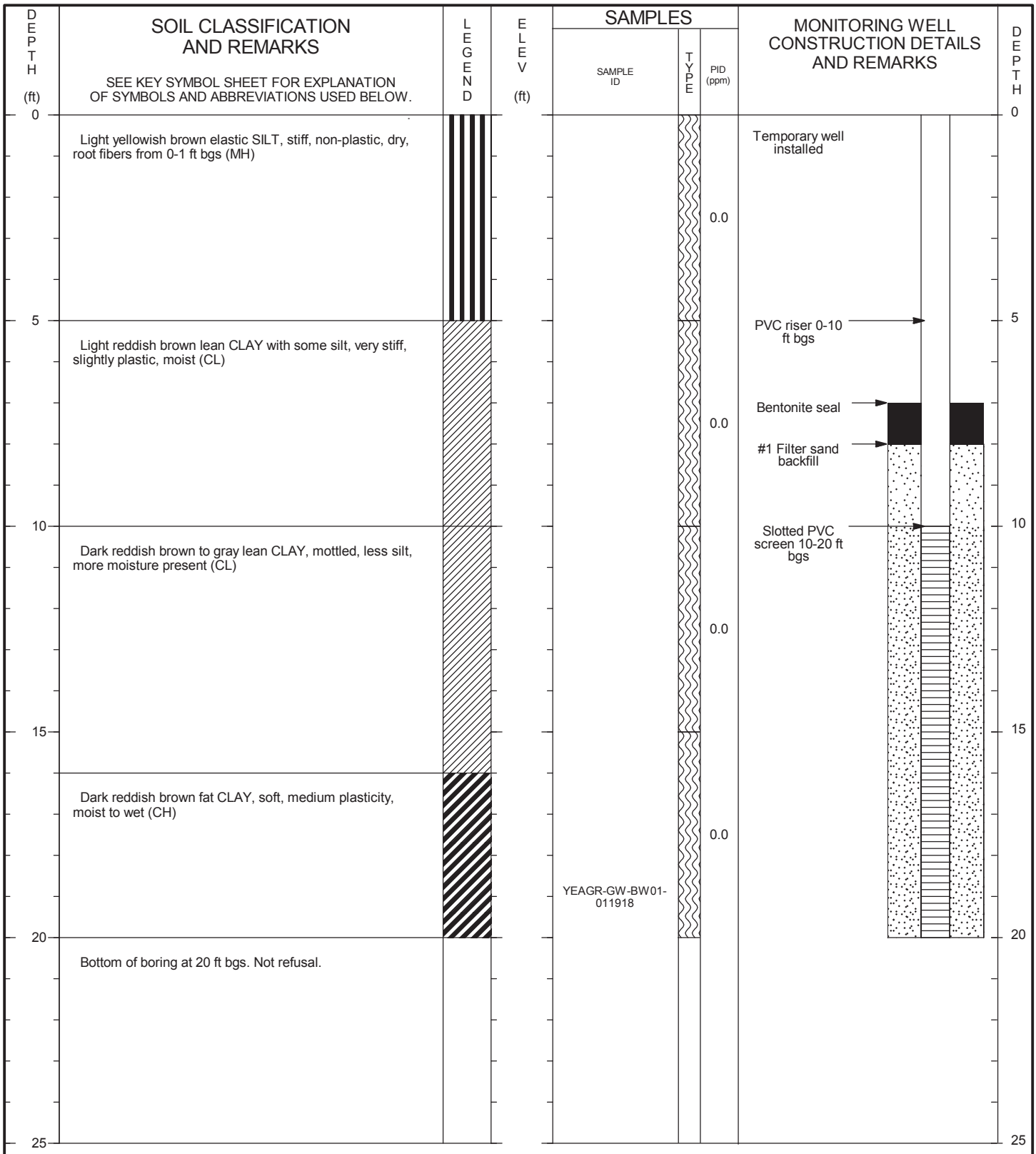
SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. 09-SB03

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18



START DATE: 1/18/2018
END DATE: 1/18/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448834.3 ft.
EASTING: 4247538.8 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

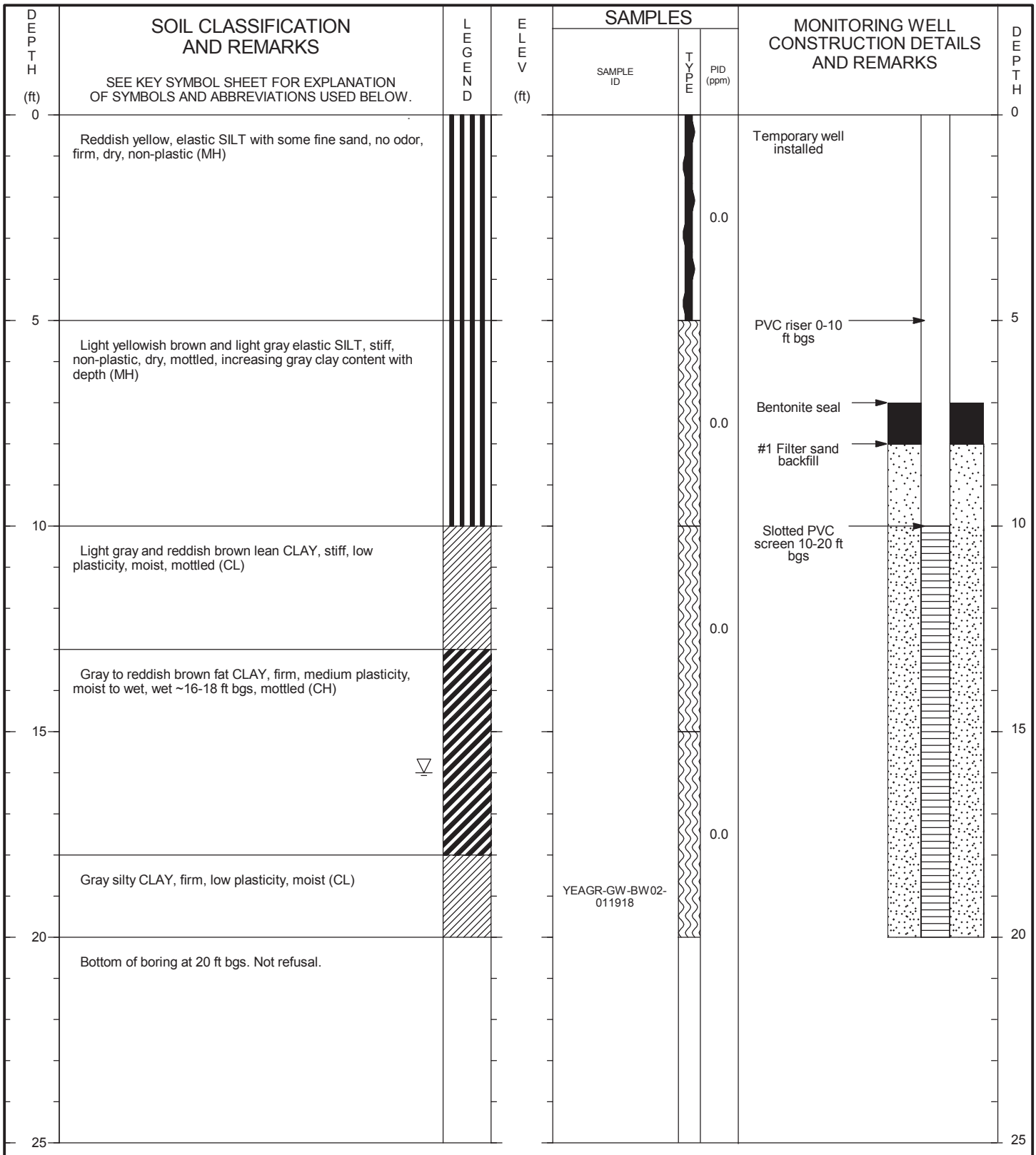
SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. BW-01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18



AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

START DATE:	1/17/2018	GROUND ELEVATION: ft.	(Source:
END DATE:	1/18/2018		USDA, Service Center Agencies 10m
DRILLER:	Cascade		Digital Elevation Model)
EQUIPMENT:	Geoprobe 7822DT	VERTICAL DATUM:	NAVD88
METHOD:	Geoprobe Direct Push	NORTHING:	448653.2 ft.
HOLE DIA.:	2 1/4" ID	EASTING:	4247222.5 ft.
SITE:		HORIZONTAL DATUM:	
LOGGED BY:	AC		

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC

Project No: 291330006.011

Checked By: TH

Boring No. BW-02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Dark grayish brown clayey SILT with fine to course gravel, lenses of siltstone and mudstone boulders, dry, asphalt layer from ~3'-5' bgs [FILL]					0.0		0
5	Orange, brown, black, intermixed SILT with clay and silstone/mudstone boulders, dry [FILL]					0.0		5
10	Orange, brown, and black, intermixed layers of SILT with clay, clayey sands, course gravel, and weathered asphalt, dry [FILL]					0.0		10
15	Orange and brown, intermixed layers of SILT with clay, clayey sands, course gravels, and boulders, dry [FILL]					0.0		15
20	Orange, brown, intermixed silt with clay, clayey Sands, course gravel, gray siltstone boulder (~21-24'), dry [FILL]					0.0		20
25								25

(CONTINUED ON FOLLOWING FIGURE)

START DATE: 1/16/2018
END DATE: 1/16/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448479.4 ft.
EASTING: 4246952.7 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. TW-01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
25	Brown and gray, clayey SILT with course gravel and intermittent zones of large siltstone and mudstone boulders [FILL]					0.0		25
30	Bottom of boring at 30 ft bgs. Not refusal. No groundwater encountered. No well installed.							30
35								35
40								40
45								45
50								50

START DATE: 1/16/2018
END DATE: 1/16/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448479.4 ft.
EASTING: 4246952.7 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. TW-01

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES SAMPLE ID	TYPE	PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Grayish yellow gravelly SILT, increase in clay content with depth [FILL]					0.0		0
5	Dark red SILT with some clay, dry [FILL]					0.0		5
	Light yellowish brown SILT and siltstone [FILL]							
10	Bottom of boring at 9 ft bgs. Refusal. No groundwater encountered. No well installed.							10
15								15
20								20
25								25

START DATE: 1/17/2018
END DATE: 1/18/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448486.7 ft.
EASTING: 4247279.7 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

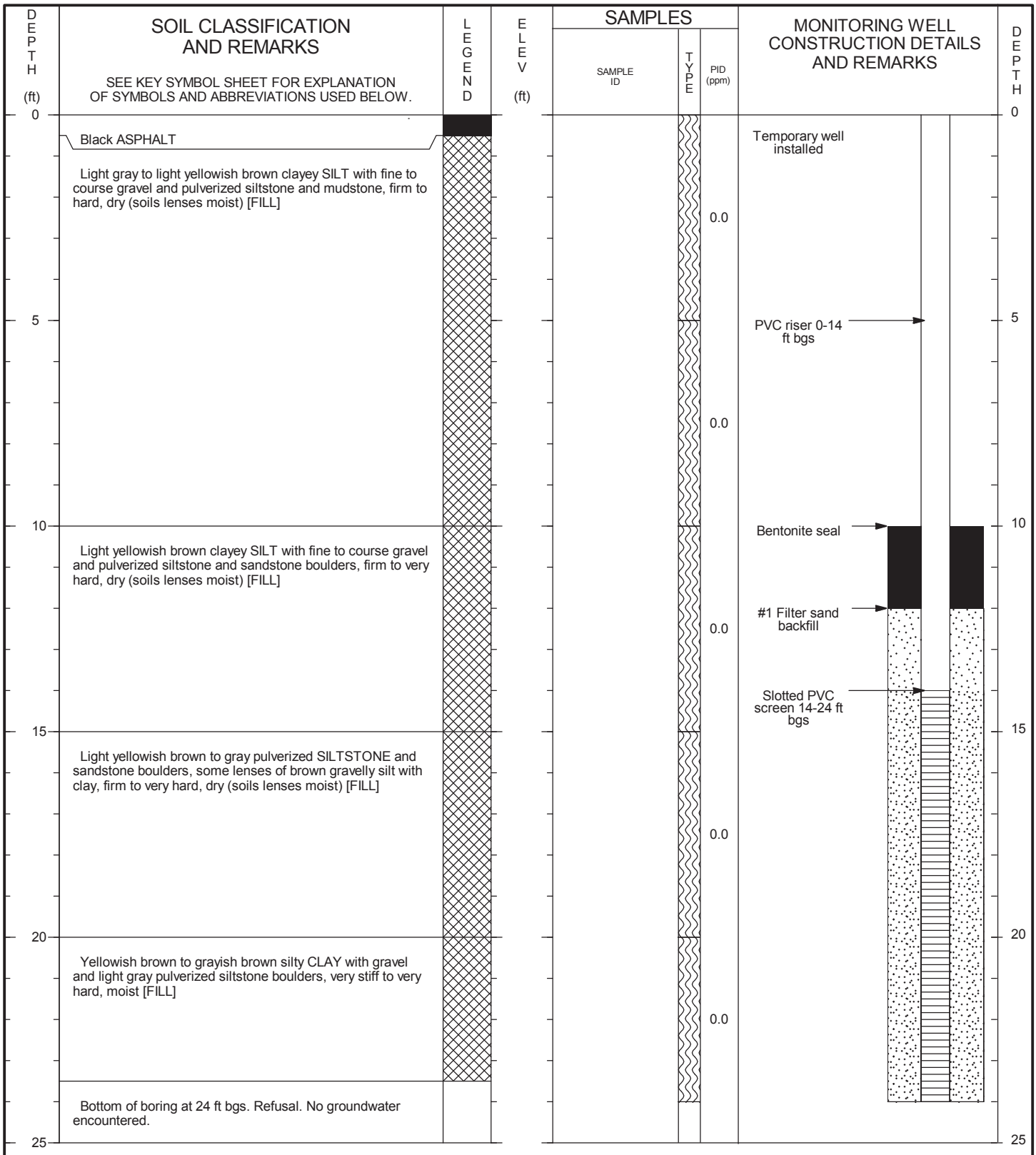
SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. TW-02

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18



START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448449 ft.
EASTING: 4247381.6 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. TW-03

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: SAMPLE ID	SAMPLES: TYPE	SAMPLES: PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	Red, brown, gray, clayey SILT with gravel, moist to dry, root fibers and moisture present from 0'-2' bgs [FILL]					0.0	Temporary well installed PVC riser 0-7 ft bgs Bentonite seal	0
5	Gray to light yellowish brown SILT with intermittent siltstone and mudstone boulders, dry [FILL]					0.0	#1 Filter sand backfill Slotted PVC screen 7-17 ft bgs	5
10						0.0		10
15						0.0		15
20	Bottom of boring at 17 ft bgs. Refusal. No groundwater encountered.							20
25								25

START DATE: 1/18/2018
END DATE: 1/18/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448419.4 ft.
EASTING: 4247683.8 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. TW-04

amec foster wheeler D
271 Mill Road
Chelmsford, MA 01824

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES SAMPLE ID	TYPE	PID (ppm)	MONITORING WELL CONSTRUCTION DETAILS AND REMARKS	DEPTH
0	SILT with fine to coarse gravel, no odor, presence of roots from 0-3 inches [FILL]							0
	SILT with predominately fine to coarse rock (pulverized boulders/cobbles) [FILL]					0.0		
5	Bottom of boring at 4 ft bgs. Refusal. No temporary well installed. Additional borings were attempted in proximity, and reached refusal above groundwater.							5
10								10
15								15
20								20
25								25

START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448392.1 ft.
EASTING: 4247234.7 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

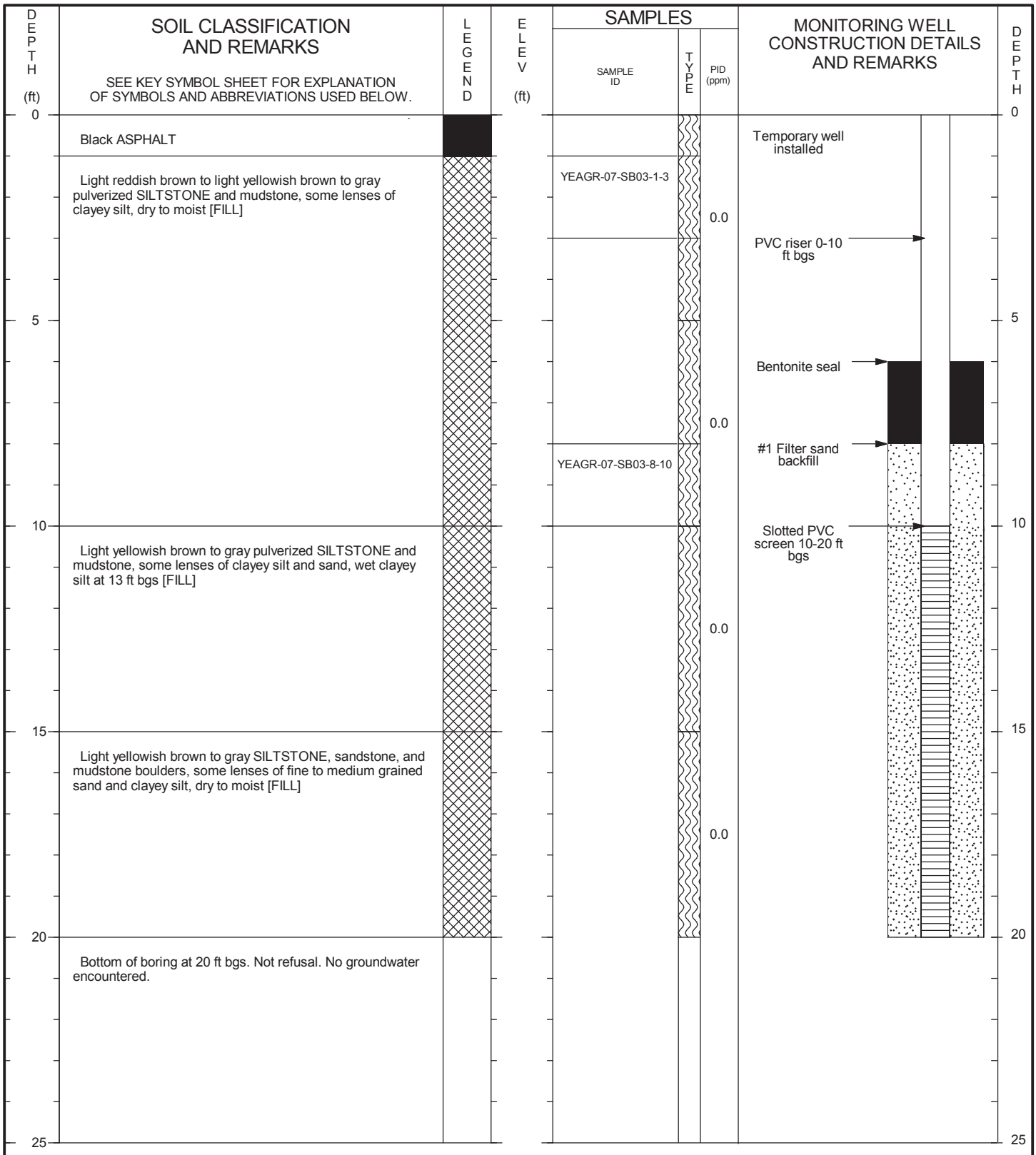
SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. TW-05

amec foster wheeler
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18



START DATE: 1/19/2018
END DATE: 1/19/2018
DRILLER: Cascade
EQUIPMENT: Geoprobe 7822DT
METHOD: Geoprobe Direct Push
HOLE DIA.: 2 1/4" ID
SITE:
LOGGED BY: AC

GROUND ELEVATION: ft. (Source: USDA, Service Center Agencies 10m Digital Elevation Model)
VERTICAL DATUM: NAVD88
NORTHING: 448454.7 ft.
EASTING: 4247458.6 ft.
HORIZONTAL DATUM:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL BORING / MONITORING WELL RECORD

Project: Yeager Airport FY16 Site Inspection for PFC
Project No: 291330006.011
Checked By: TH

Boring No. TW-07/07-SB03

amec foster wheeler
271 Mill Road
Chelmsford, MA 01824

AMEC SOIL-ROCK-MWELL ENVI 02 YEAGR BORING LOGS.GPJ PFC TEMPLATE.GDT 3/2/18

APPENDIX B

WELL DEVELOPMENT LOGS

THIS PAGE INTENTIONALLY LEFT BLANK.

WELL DEVELOPMENT LOG

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations	**Project Number:**	291330006
Contract:	W9133L-14-D-0002	**Task Order:**	0011
Installation:	YEAGR	**Date Started/Date Completed:**	01/16/18/01/16/18
Well ID:	ML-FL014-MW004	**Initial Depth to Water (ft):**	22.58
Measuring Point:	Top of Casing	**Total Depth of Well (ft):**	32.0
Development Method:	PUMPED	**Depth to Water After Purging (ft):**	27.89
Total Volume Purged (gal):	4.7	**1 Casing Volume (gal):**	1.5
Technician(s):	Sarah Levine	**3 Casing Volumes (gal):**	4.6

Date/Time	Intake Depth (feet)	Water Level (feet)	Rate (Gpm)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Cum. Volume (gal.)	Comments/Observations During Purging (color, sediment, etc.)
01/16/18 11:50			.10								Pumping Started
01/16/18 12:05	30	22.81	.10	-	-	-	-	-	-	1.5	Clear
01/16/18 12:11	30	23.80	.10	14.97	6.16	0.435	1.27	149.2	9.74	2.1	Clear
01/16/18 12:16	30	24.76	.10	15.07	6.15	0.445	1.14	144.4	7.13	2.6	Clear
01/16/18 12:21	30	25.54	.10	14.95	6.13	0.478	0.98	139.0	6.23	3.1	Clear
01/16/18 12:26	30	26.32	.10	14.90	6.12	0.538	0.90	130.6	5.64	3.6	Clear
01/16/18 12:31	30	27.04	.10	14.83	6.17	0.547	0.99	125.1	7.95	4.1	Clear
01/16/18 12:36	30	27.66	.10	14.27	6.17	0.569	0.82	117.2	8.02	4.6	Clear

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): Yes Calibrated Within Criteria (Y/N): Yes

Turbidity Meter, Water Quality Meter, Water Level Meter, Peristaltic Pump
Hanna 98703 08513371,
YSI 556 MPS 12L101300

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V = Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
=Π * (2.0 (in)/12 (in/ft))/2)^2 * 9.42 * 7.48 gal/ft^3
= 1.5 gal.

Signature:

Notes:

None

Name (print):

Sarah Levine

QA/QC'd by: **Tyler Henningsen** **QA/QC Date:** **1/18/2018**

WELL DEVELOPMENT LOG

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations	**Project Number:**	291330006
Contract:	W9133L-14-D-0002	**Task Order:**	011
Installation:	YEAGR	**Date Started/Date Completed:**	01/19/18/01/19/18
Well ID:	BW-01	**Initial Depth to Water (ft):**	10.02
Measuring Point:	Top of Casing	**Total Depth of Well (ft):**	20.0
Development Method:	PUMPED	**Depth to Water After Purging (ft):**	Na
Total Volume Purged (gal):	1 gal	**1 Casing Volume (gal):**	0.4
Technician(s):	Sarah Levine	**3 Casing Volumes (gal):**	1.2

Date/Time	Intake Depth (feet)	Water Level (feet)	Rate (Gpm)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Cum. Volume (gal.)	Comments/Observations During Purging (color, sediment, etc.)
01/19/18 14:20			0.0625								Pumping Started
01/19/18 14:23	19	12.08		14.37	6.58	0.174	14.40	133.1	Out of range		Brown, turbid
01/19/18 14:27	19	15.05		15.12	6.15	0.169	8.37	112.4	OoR		"
01/19/18 14:31	19	18.62		15.39	5.86	0.129	6.04	93.2	OoR		
01/19/18 14:32											Well dry. Stop pump
01/19/18 14:40											Recharging
01/19/18 14:52		13.60									Pump start
01/19/18 14:56	19	15.45		13.35	5.60	0.127	14.79	69.6	OoR		Light brown, turbid
01/19/18 15:00		17.44		14.77	5.42	0.104	16.02	70.9	OoR		
01/19/18 15:03											Well dry

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): Yes — Calibrated Within Criteria (Y/N): Yes

Turbidity Meter, Water Quality Meter, Water Level Meter, Peristaltic Pump
Hanna 98703 08513371,
YSI 556 MPS 12L101300

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V = Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
=Π * (1.0 (in)/12 (in/ft))/2)^2 * 9.98 * 7.48 gal/ft^3
= 0.4 gal.

Signature:

Notes:

Well recharges very slowly. Unable to stabilize parameters due to pumping well dry and stopping pump to allow recharge. Pumped well dry twice (1 gal total) and sampled at 1515.

Name (print):

Sarah Levine

QA/QC'd by: **Tyler Henningsen** **QA/QC Date:** **1/19/2018**

APPENDIX C

GROUNDWATER SAMPLING LOGS

THIS PAGE INTENTIONALLY LEFT BLANK.

GROUNDWATER SAMPLING RECORD

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations	**Project Number:**	291330006
Contract:	W9133L-14-D-0002	**Task Order:**	011
Installation:	YEAGR	**Technician(s):**	Sarah Levine
Well ID:	BW-01	**Date:**	01/19/18
Initial Depth to Water (ft):	18.2	**Well Diameter (in):**	1.0
Total Depth of Well (ft):	20.0	**1 Casing Volume (gal):**	0.1
Method of Purging:	Peri-pump	**3 Casing Volumes (gal):**	0.2
Measuring Point (toc, tor, etc.):	Top of Casing	**Pump Intake Depth (feet):**	19

Time	Water Level (feet)	Flow Rate (Gpm)	Cum. Volume (gal.)	Temp. (°C)	pH (SU)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments/Observations During Purging (color, sediment, odor, etc.)
Stabilization Criteria				±0.5°C	±0.1	±3%	±10%	±10%	±10% and <10 NTU	
15:15		0.0625								Pumping/Purging Started

Stability Reached (Y/N): No — If No, Provide Explanation: No - See development log - insufficient recharge

	Final Values:	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	

Sample ID:	YEAGR-GW-BW01-011918	**Method of Sampling:**	Peri-pump
QA/QC Samples (Yes/No):	No	**Sample Date:**	01/19/18
Duplicate ID:	NA	**Sample Collection Time:**	15:15
Sample Container Type(s):	125 ml HDPE	**Total Volume Purged (gal):**	Na
Preservative(s):	Ice (4 °C)	**Sample Depth (ft):**	19
Analysis/Method(s):	UCMR3 List	**Depth to Water After Sampling (ft):**	18.92

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): Yes — Calibrated Within Criteria (Y/N): Yes

Turbidity Meter, Water Quality Meter, Water Level Meter, Peristaltic Pump
Hanna 98703 08513371, YSI 556 MPS 12L101300

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V=Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
= Π * (1.0 (in)/12 (in/ft))/2)^2 * 1.80 * 7.48 gal/ft^3
= 0.1 gal.

Signature:

Notes:

Sample collected after pumping well dry twice (1 gallon)

Name (print): Sarah Levine

QA/QC'd by: Tyler Henningsen — **QA/QC Date:** 1/19/2018

GROUNDWATER SAMPLING RECORD

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations	**Project Number:**	291330006
Contract:	W9133L-14-D-0002	**Task Order:**	011
Installation:	YEAGR	**Technician(s):**	Sarah Levine
Well ID:	ML-FL014-MW004	**Date:**	01/19/18
Initial Depth to Water (ft):	21.08	**Well Diameter (in):**	2.0
Total Depth of Well (ft):	32.0	**1 Casing Volume (gal):**	1.8
Method of Purging:	Peri-pump	**3 Casing Volumes (gal):**	5.4
Measuring Point (toc, tor, etc.):	Top of Casing	**Pump Intake Depth (feet):**	30

Time	Water Level (feet)	Flow Rate (Gpm)	Cum. Volume (gal.)	Temp. (°C)	pH (SU)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments/Observations During Purging (color, sediment, odor, etc.)
Stabilization Criteria				±0.5°C	±0.1	±3%	±10%	±10%	±10% and <10 NTU	
16:04		0.0625								Pumping/Purging Started
16:08	22.27			14.04	5.56	0.492	12.33	115.3	42.4	Clear
16:12	22.74			14.27	5.68	0.488	8.72	107.0	22.4	Clear
16:16	22.93			14.41	5.65	0.484	4.74	100.7	25.0	Clear
16:20	23.21			14.35	5.64	0.480	4.67	98.4	27.7	Clear
16:24	23.46			14.37	5.63	0.477	4.55	97.0	28.2	Clear
16:28	23.71			14.34	5.62	0.475	4.50	94.5	28.3	Clear

Stability Reached (Y/N): Yes — If No, Provide Explanation: NA

Final Values:	**14.34**	**5.62**	**0.475**	**4.50**	**94.5**	**28.3**

Sample ID:	YEAGR-GW-ML-FL014-MW004-011918	**Method of Sampling:**	Peri-pump
QA/QC Samples (Yes/No):	Yes DUP, MS/MSD	**Sample Date:**	01/19/18
Duplicate ID:	YEAGR-GW-DUP01-011918	**Sample Collection Time:**	16:35
Sample Container Type(s):	125 ml HDPE	**Total Volume Purged (gal):**	1.5
Preservative(s):	Ice (4 °C)	**Sample Depth (ft):**	30
Analysis/Method(s):	UCMR3 List	**Depth to Water After Sampling (ft):**	23.82

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): Yes — Calibrated Within Criteria (Y/N): Yes

Turbidity Meter, Water Quality Meter, Water Level Meter, Peristaltic Pump
Hanna 98703 08513371, YSI 556 MPS 12L101300

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V=Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
= Π * (2.0 (in)/12 (in/ft))/2)^2 * 10.92 * 7.48 gal/ft^3
= 1.8 gal.

Signature:

Notes:

None

Name (print): Sarah Levine

QA/QC'd by: Tyler Henningsen — **QA/QC Date:** 1/19/2018

GROUNDWATER SAMPLING RECORD

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations	**Project Number:**	291330006
Contract:	W9133L-14-D-0002	**Task Order:**	011
Installation:	YEAGR	**Technician(s):**	Sarah Levine
Well ID:	BW-02	**Date:**	01/19/18
Initial Depth to Water (ft):	19.53	**Well Diameter (in):**	1.0
Total Depth of Well (ft):	20.0	**1 Casing Volume (gal):**	0.0
Method of Purging:	Peri-pump	**3 Casing Volumes (gal):**	0.1
Measuring Point (toc, tor, etc.):	Top of Casing	**Pump Intake Depth (feet):**	20

Time	Water Level (feet)	Flow Rate (Gpm)	Cum. Volume (gal.)	Temp. (°C)	pH (SU)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments/Observations During Purging (color, sediment, odor, etc.)
Stabilization Criteria				±0.5°C	±0.1	±3%	±10%	±10%	±10% and <10 NTU	
13:00		Na								Pumping/Purging Started

Stability Reached (Y/N): No — If No, Provide Explanation: No - Insufficient water to purge

	Final Values:	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	

Sample ID:	YEAGR-GW-BW02-011918	**Method of Sampling:**	Peri-pump
QA/QC Samples (Yes/No):	No	**Sample Date:**	01/19/18
Duplicate ID:	NA	**Sample Collection Time:**	13:00
Sample Container Type(s):	125 ml HDPE	**Total Volume Purged (gal):**	Na
Preservative(s):	Ice (4 °C)	**Sample Depth (ft):**	20
Analysis/Method(s):	UCMR3 List	**Depth to Water After Sampling (ft):**	Na

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N): - Calibrated Within Criteria (Y/N): -

Water Level Meter, Peristaltic Pump

,

Calculations:

Saturated well casing volume: V= Π(R^2)H*7.48 gal/ft^3

V=Volume (gal/ft)
Π = 3.14
R = well radius (ft) = (well diameter (in)/12 (in/ft))/2)
H = height of water column (ft)

V= Π(R^2)H*7.48 gal/ft^3
= Π * (1.0 (in)/12 (in/ft))/2)^2 * 0.47 * 7.48 gal/ft^3
= 0.0 gal.

Signature:

Notes:

Collected half of 1 container at 1300. Collected half a container on 012018 at 0900, collected 1/3 of a container around 1250.

Name (print):

Sarah Levine

QA/QC'd by: Tyler Henningsen **QA/QC Date:** 1/26/2018

LOW-FLOW GROUNDWATER SAMPLING RECORD

PROJECT #: 291330006 - 011 (NW) DATE: 7-27-18

SITE NAME: MCLAUGHLIN ANG BASE WELL NAME: ML-FLOI4-MW00[illegible] AD

SITE ADDRESS: NA (NW) AMBIENT TEMPERATURE (°F): 80° (NW)

SAMPLE COLLECTED BY: ADAM DAVIS TOP OF CASING ELEVATION:

OBSERVERS: WATER LEVEL BELOW CASING: 20.27 (NW)

SAMPLING EQUIPMENT:

☒ Peristaltic Pump ☐ Submersible Pump (pump #_____)
☐ Dedicated Pump System ☐ Other_____
Tubing Type: ☐ Vinyl ☒ HDPE Length of tubing used: _____ (ft)

FIELD MEASUREMENTS (measured from top of casing):

20.27 (NW)	Static Water Level Meter	0935	Time Well Opened
NA (NW)	Previous Water Level (ft.)	0940 (NW)	Time Of Water Level Measurement
31.77 ~~30.43~~ ~~30.35~~ AD	Total Depth of Well (ft.)	1007	Time Purge Started
20.27 ~~27.43~~ AD	Depth to Water (ft.)	~ 200	Purge Rate (mL/min)
1.9 (NW)	Water Vol. in Well (gal.)	~ 2.1 (NW)	Actual Volume Removed (mL)
NA (NW)	Screened Interval from TOC	1110	SAMPLE TIME

Weather Conditions: HUMID, 80'S & OVERCAST

Purged Water Disposal Method: ~~Containerized and placed in 55-gal drums~~ TO GROUND (NW)

TUBING DIAMETERS and VOLUMES:

3/16 -in ID = 6.37 ml/ft (0.0014 gal/ft)
¼ -in ID = 11.82 ml/ft (0.0026 gal/ft)
3/8 -in ID = 22.71 ml/ft (0.006 gal/ft)
Flow Cell = 200ml (0.053 gal)

CALCULATE PURGE VOLUME:

(Length of Tubing) X _____ (ml/ft.) = _____ Tubing Vol.
Tubing Vol. + Flow Cell Vol. (ml) = _____ ml/volume
Total Vol. X 3 = _____ ml: Volume to Purge

FIELD METER USED: YSI 556 (NW)

FIELD READINGS

FIELD PARAMETERS:	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Time	1027	1032	1037	1042	1047	1052	1057	1102	1107
Volume Purged (mL)									
Water Level (Below top of casing)									
Temperature (°C)	18.01	17.83	17.47	17.74	18.30	18.67	18.53	18.53	18.44
Specific Conductivity (µS)	0.474	0.468	0.465	0466	0.471	0.477	0.475	0.473	0.469
Dissolved Oxygen (mg/L)	10.93	10.40	9.62	8.83	8.00	7.48	7.22	6.94	6.69
ph (Standard Units):	3.96	3.87	3 25	3 62	4.71	5.56	5.51	5.39	5.44
O_2 Saturation (%)	115.6	109.5	100.3	92.9	84.9	80.1	76.7	74.1	71.3
ORP (mV)	148.2	153.3	191.5	168.5	104.9	57.1	78.3	75.3	71.8
Turbidity (NTU)	17.6	14.5	12.7	12.3	12.6	9.44	8.75	6.96	6.47
Purge Rate (mL/min)	200 (NW)	200 (NW)	200 (NW)	200 (NW)	200 (NW)	200 (NW)	200 (NW)	200 (NW)	200 (NW)

SAMPLE COLLECTION:

Time Sample Collected: 1110 Analysis Requested: PFAS
Bottles: no., type, preservative:
Field Filtered? ☐ Yes ☒ No Packed in cooler with ice? ☒ Yes ☐ No

COMMENTS: (NW) 8/14/18 - no water levels due to water level probe in non standard operating mode (bare wire measurements)

Checked By: NW 8/14/18

APPENDIX D

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORMS

THIS PAGE INTENTIONALLY LEFT BLANK.

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORM

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations			**Project Number:**	291330006.07
Contract:	W9133L-14-D-0002	**Task Order:**	0006	**Date:**	11/06/17
Installation:	RICHM			**Calibration Start Time:**	09:47
Sample Technician(s):	Sarah Levine			**Calibration End Time:**	11:23

Readings Before Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/06/17	09:47	Na	3.70	0	1.309	86.7	Na	212.8	760	None
			7.46	15						
			9.86	100						
				750						

Readings After Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/06/17	09:47	Na	4.00	0	1.413	100	Na	240	760	None
			7.00	15						
			10.00	100						
				750						

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)	7GF303	06/01/19
pH (7)	7GF779	06/01/19
pH (10)	7GF743	06/01/19

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance	7GH1079	08/01/18
Salinity	Na	11/06/17
D.O.	Na	11/06/17
ORP	1720	06/01/22

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10	2444	04/01/18
20	2455	10/01/17
100	2456	10/01/17
800	2457	10/01/17

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter:	YSI 556 MPS	08J101227
Turbidity Meter:	Hanna 98703	H0006328

Calibrated Within Acceptance Criteria (Y/N): Yes

If No, Provide Explanation: NA

Notes: None

Signature: 

Name (print): Sarah Levine

QA/QC'd by: dry

QA/QC Date: 1/2/2018

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORM

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations			**Project Number:**	291330006.07
Contract:	W9133L-14-D-0002	**Task Order:**	0006	**Date:**	11/07/17
Installation:	RICHM			**Calibration Start Time:**	10:23
Sample Technician(s):	Sarah Levine			**Calibration End Time:**	10:51

Readings Before Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/07/17	10:32	Na	4.09	0	1.210	109.6	Na	261.0	760	None
			6.65	15						
			9.91	100						
				750						

Readings After Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/07/17	10:32	Na	4.00	<0.1	1.413	100	Na	240	760	None
			7.00	15						
			10.00	100						
				750						

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)	7GF303	06/01/19
pH (7)	7GF779	06/01/19
pH (10)	7GF743	06/01/19

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance	7GH1079	08/01/18
Salinity	Na	11/07/17
D.O.	Na	11/07/17
ORP	1720	06/01/22

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10	2444	04/01/18
20	2455	10/01/17
100	2456	10/01/17
800	2457	10/01/17

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter:	YSI 556 MPS	08J101227
Turbidity Meter:	LaMotte 2020	H0006328

Calibrated Within Acceptance Criteria (Y/N): Yes

If No, Provide Explanation: NA

Notes: None

Signature: 

Name (print): Sarah Levine

QA/QC'd by: dry

QA/QC Date: 1/2/2018

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORM

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations			**Project Number:**	291330006.07
Contract:	W9133L-14-D-0002	**Task Order:**	0006	**Date:**	11/08/17
Installation:	RICHM			**Calibration Start Time:**	08:06
Sample Technician(s):	Sarah Levine			**Calibration End Time:**	08:32

Readings Before Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/08/17	08:15	Na	3.90	0	1.318	113.5	Na	258	760	None
			6.82	15						
			10.21	100						
				750						

Readings After Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/08/17	08:15	Na	4.00	<0.1	1.413	100	Na	240	760	None
			7.00	15						
			10.00	100						
				750						

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)	7GF303	06/01/19
pH (7)	7GF779	06/01/19
pH (10)	7GF743	06/01/19

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance	7GH1079	08/01/18
Salinity	Na	11/08/17
D.O.	Na	11/08/17
ORP	1720	06/01/22

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10	2444	04/01/18
20	2455	10/01/17
100	2456	10/01/17
800	2457	10/01/17

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter:	YSI 556 MPS	08J101227
Turbidity Meter:	LaMotte 2020	H0006328

Calibrated Within Acceptance Criteria (Y/N): Yes

If No, Provide Explanation: NA

Notes: None

Signature: 

Name (print): Sarah Levine

QA/QC'd by: dry **QA/QC Date:** 1/2/2018

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORM

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations			**Project Number:**	291330006.07
Contract:	W9133L-14-D-0002	**Task Order:**	0006	**Date:**	11/09/17
Installation:	RICHM			**Calibration Start Time:**	07:49
Sample Technician(s):	Sarah Levine			**Calibration End Time:**	08:13

Readings Before Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/09/17	07:49	Na	4.07	0	1.293	114.7	Na	259.5	760	None
			6.74	15						
			9.91	100						
				750						

Readings After Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/09/17	07:49	Na	4.00	<0.1	1.413	100	Na	240.0	760	None
			7.00	15						
			10.00	100						
				750						

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)	7GF303	06/01/19
pH (7)	7GF779	06/01/19
pH (10)	7GF743	06/01/19

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance	7GH1079	08/01/18
Salinity	Na	11/09/17
D.O.	Na	11/09/17
ORP	1720	06/01/22

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10	2444	04/01/18
20	2455	10/01/17
100	2456	10/01/17
800	2457	10/01/17

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter:	YSI 556 MPS	08J101227
Turbidity Meter:	LaMotte 2020	H0006328

Calibrated Within Acceptance Criteria (Y/N): Yes

If No, Provide Explanation: NA

Notes: None

Signature: 

Name (print): Sarah Levine

QA/QC'd by: dry

QA/QC Date: 1/2/2018

WATER QUALITY SAMPLING INSTRUMENT CALIBRATION FORM

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations			**Project Number:**	291330006.07
Contract:	W9133L-14-D-0002	**Task Order:**	0006	**Date:**	11/10/17
Installation:	RICHM			**Calibration Start Time:**	07:28
Sample Technician(s):	Sarah Levine			**Calibration End Time:**	07:48

Readings Before Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/10/17	07:46	Na	3.90	0	1.395	115.3	Na	258.4	760	None
			6.86	20						
			9.90	100						
				750						

Readings After Calibration

Date	Time (24hr)	Temperature (°C)	pH (SU)	Turbidity (NTUs)	Specific Electrical Conductance (mS/cm)	D.O. (%)	Salinity (%)	ORP/Eh (mV)	Barometric Pressure (mm Hg)	Comments
11/10/17	07:46	Na	4.00	<0.1	1.413	100	Na	240	760	None
			7.00	20						
			10.00	100						
				750						

Calibration Materials Record:

pH Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
pH (4)	7GF303	06/01/19
pH (7)	7GF779	06/01/19
pH (10)	7GF743	06/01/19

Specific Electrical Conductance, Salinity, Dissolved Oxygen (DO) and Oxidation Reduction Potential (ORP) Calibration Standards

Standard	Cal. Standard Lot #	Expiration Date
Spec. Conductance	7GH1079	08/01/18
Salinity	Na	11/10/17
D.O.	Na	11/10/17
ORP	1720	06/01/22

Turbidity Standards

Standard	Cal. Standard Lot #	Expiration Date
10	2444	04/01/18
20	2455	10/01/17
100	2456	10/01/17
800	2457	10/01/17

Instruments (Manufacturer, Model, and Serial No.):

	Manufacturer/Model	Serial No
Water Quality Meter:	YSI 556 MPS	08J101227
Turbidity Meter:	LaMotte 2020	H0006328

Calibrated Within Acceptance Criteria (Y/N): Yes

If No, Provide Explanation: NA

Notes: None

Signature: 

Name (print): Sarah Levine

QA/QC'd by: dry

QA/QC Date: 1/2/2018

APPENDIX E

SURFACE WATER AND SEDIMENT SAMPLING LOGS

THIS PAGE INTENTIONALLY LEFT BLANK.

SAMPLE COLLECTION LOG
SEDIMENT / SURFACE SOIL / SURFACE WATER

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations	**Project Number:**	291330006
Contract:	W9133L-14-D-0002	**Task Order:**	0011
Installation:	YEAGR	**Date:**	01/17/18
Location ID:	PRL 6	**Northing/Easting:**	See/Figure
Technician(s):	Sarah Levine, Austin Conklin		

SEDIMENT SAMPLE

Description

NAME (USCS Symbol): color, moisture, % by wt, plasticity, dilatancy, toughness, dry strength,consistency

Brown gravelly clay with sand, small to large gravel, non-plastic, wet, very soft-soft, low toughness

Sample Depth (ft):	0 - 0.5	**Sample ID:**	YEAGR-06-SD01-0-0.5
MS/MSD Collected:	Yes	**Sample Date:**	01/17/18
Duplicate ID:	YEAGR-SD-DUP01-011718	**Sample Collection Time:**	13:40
Sample Container Type(s):	4oz HDPE	**Sample Collection Methods:**	Hand auger
Preservative(s):	Ice (4 °C)	**Analysis/Method(s):**	UCMR3 List

SURFACE SOIL SAMPLE

Description

NAME (USCS Symbol): color, moisture, % by wt, plasticity, dilatancy, toughness, dry strength,consistency

NA

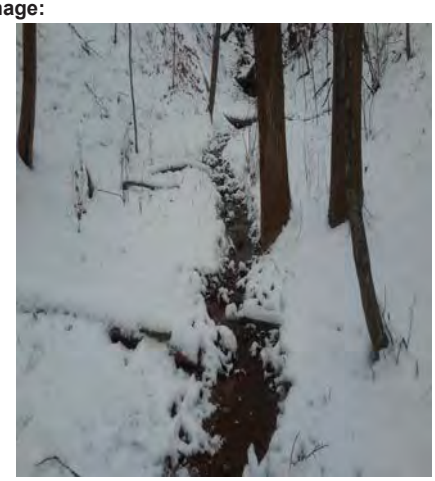
Sample Depth (ft):	NA	**Sample ID:**	NA
MS/MSD Collected:	NA	**Sample Date:**	NA
Duplicate ID:	NA	**Sample Collection Time:**	NA
Sample Container Type(s):	NA	**Sample Collection Methods:**	NA
Preservative(s):	NA	**Analysis/Method(s):**	NA

SURFACE WATER SAMPLE

Time	Intake Depth (in)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments/Observations During Purging (color, sediment, etc.)
13:30	3	4.91	7.60	0.755	10.60	154.4	8.13	Clear

Sample Depth (ft):	0 - 0.25	**Sample Date:**	01/17/18
Sample ID:	YEAGR-06-SW01-011718	**Sample Collection Time:**	13:30
MS/MSD Collected:	Yes	**Sample Collection Methods:**	Sample bottle
Duplicate ID:	YEAGR-SW-DUP01-011718	**Surface Water Depth (ft):**	0.5ft
Sample Container Type(s):	125ML HDPE	**Water Body and Water Quality Characteristics:**	
Preservative(s):	Ice (4 °C)	Stream, Flowing, Clear	
Analysis/Method(s):	UCMR3 List		

Location Image:



Caption: Sample location

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N):	Yes
Calibrated Within Criteria (Y/N):	Yes

Turbidity Meter, Water Quality Meter, Manual Hand Tools, Other(s): Sample container
Hanna 98703 08513371,
YSI 556 MPS 12L101300

Notes:

None

Signature:

Name (print):

Sarah Levine

QA/QC'd by:	**Tyler Henningsen**	**QA/QC Date:**	**1/18/2018**

SAMPLE COLLECTION LOG
SEDIMENT / SURFACE SOIL / SURFACE WATER

Project Name:	Phase 1 Regional Site Inspections for Per-Fluorinated Compounds at Multiple Air National Guard Installations	**Project Number:**	291330006
Contract:	W9133L-14-D-0002	**Task Order:**	011
Installation:	YEAGR	**Date:**	01/20/18
Location ID:	YEAGR-09-SWSD	**Northing/Easting:**	See/Figure
Technician(s):	Sarah Levine, Austin Conklin		

SEDIMENT SAMPLE

Description

NAME (USCS Symbol): color, moisture, % by wt, plasticity, dilatancy, toughness, dry strength,consistency

Brown to dark brown gravelly clay (CL) and sand (SP), wet, non-plastic, soft

Sample Depth (ft):	0 - 0.5	**Sample ID:**	YEAGR-09-SD01-0-0.5
MS/MSD Collected:	No	**Sample Date:**	01/20/18
Duplicate ID:	NA	**Sample Collection Time:**	13:00
Sample Container Type(s):	6oz hdpe	**Sample Collection Methods:**	Hand auger
Preservative(s):	Ice (4 °C)	**Analysis/Method(s):**	UCMR3 List

SURFACE SOIL SAMPLE

Description

NAME (USCS Symbol): color, moisture, % by wt, plasticity, dilatancy, toughness, dry strength,consistency

NA

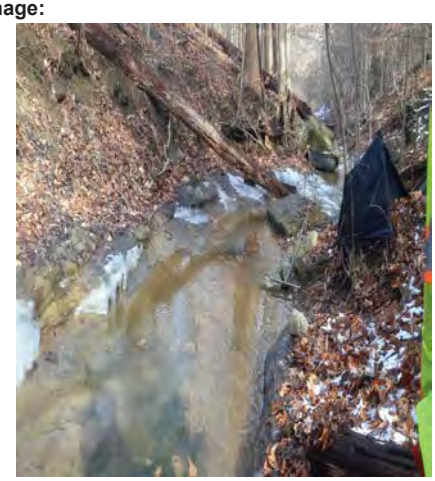
Sample Depth (ft):	NA	**Sample ID:**	NA
MS/MSD Collected:	NA	**Sample Date:**	NA
Duplicate ID:	NA	**Sample Collection Time:**	NA
Sample Container Type(s):	NA	**Sample Collection Methods:**	NA
Preservative(s):	NA	**Analysis/Method(s):**	NA

SURFACE WATER SAMPLE

Time	Intake Depth (in)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments/Observations During Purging (color, sediment, etc.)
13:02	3	4.58	6.68	1.789	1.22	10.6	40.3	None

Sample Depth (ft):	0.25 - 0.25	**Sample Date:**	01/20/18
Sample ID:	YEAGR-09-SW01-012018	**Sample Collection Time:**	13:05
MS/MSD Collected:	No	**Sample Collection Methods:**	Sample container
Duplicate ID:	NA	**Surface Water Depth (ft):**	0.5
Sample Container Type(s):	125ML HDPE	**Water Body and Water Quality Characteristics:**	
Preservative(s):	Ice (4 °C)	Stream, Outfall, Flowing, Clear	
Analysis/Method(s):	UCMR3 List		

Location Image:



Caption: Sample location

Instruments (Manufacturer, Model, and Serial No.):

Equipment Calibrated (Y/N):	Yes
Calibrated Within Criteria (Y/N):	Yes

Turbidity Meter, Water Quality Meter, Manual Hand Tools, Other(s): Sample containers, hand auger
Hach 98703 08513371,
YSI 556 MPS 12L101300

Notes:

None

Signature:

Name (print):

Sarah Levine

QA/QC'd by:	**Tyler Henningsen**	**QA/QC Date:**	**1/26/2018**

APPENDIX F

PHOTOGRAPH LOG

THIS PAGE INTENTIONALLY LEFT BLANK.

Appendix A– Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer:
Sarah Levine

Date: January 9, 2018

Photograph: 1

Direction: South

Description:
Photo of Enviroprobe utilizing Ground Penetrating Radar, at PRL 3, to clear Soil Boring 03SB03 of subsurface utilities.

Photographer:
Sarah Levine

Date: January 10, 2018

Photograph: 2

Direction: North

Description:
Photo of Enviroprobe electromagnetic locator, at PRL 7, and flags used to mark potential subsurface utilities.

Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer:
Sarah Levine

Date: January 17, 2018

Photograph: 3

Direction: South

Description:
Photo of Cascade crew member using Air Knife technology, at BW-02, to clear the top five feet of potential subsurface utilities prior to drilling.

Photographer:
Sarah Levine

Date: January 16, 2018

Photograph: 4

Direction: South

Description:
Photo of the Cascade Geoprobe 7822DT positioned in PRL 1 at TW-01 in preparation to drill a temporary well.

Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer:
Sarah Levine

Date: January 18, 2018

Photograph: 5

Direction: West

Description:
Photo of Cascade crew member utilizing Geoprobe direct push drilling technology to drill TW-02 in PRL 2.

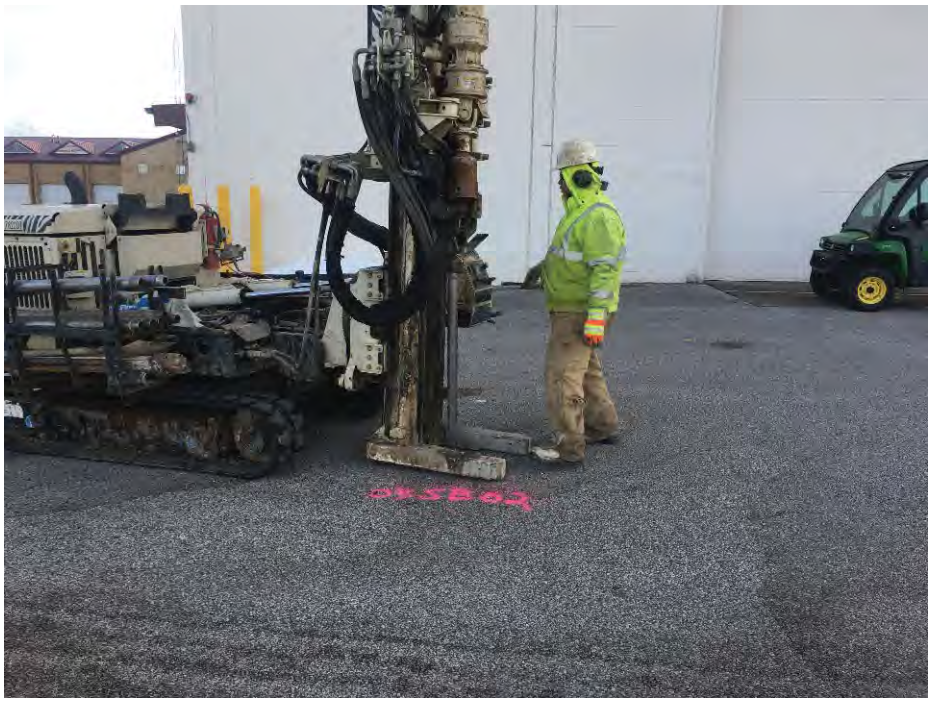
Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 6

Direction: East

Description:
Photo of the Cascade driller advancing 03SB02 in PRL 3.



Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer:
Sarah Levine

Date: January 18, 2018

Photograph: 7

Direction: Northwest

Description:
Photo of TW-04, in PRL 4, being advanced using direct push.

Photographer:
Sarah Levine

Date: January 19, 2018

Photograph: 8

Direction: South

Description:
Photo of the Cascade driller advancing 05SB01 in PRL 5, while TWS records notes.

Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer: Sarah Levine ***Date:*** January 17, 2018 ***Photograph:*** 9 ***Direction:*** West ***Description:*** Photo of the Sediment and Surface Water sample collection location in PRL 6.	
Photographer: Sarah Levine ***Date:*** January 20, 2018 ***Photograph:*** 10 ***Direction:*** East ***Description:*** Photo of the Sediment and Surface Water sample collection location in PRL 9.	

Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer:
Sarah Levine

Date: January 19, 2018

Photograph: 11

Direction: Southwest

Description:
Photo of Cascade utilizing Hollow Stem Augers to remove stuck tooling from 05SB03 in PRL 5.

Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 12

Direction: Northwest

Description:
Photo of Cascade driller removing temporary well PVC casing during abandonment of TW-04 in PRL 4.

Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 13

Direction: Northwest

Description:
Photo of Cascade pouring grout into an abandoned boring as a part of proper abandonment procedures in PRL 4.

Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 14

Direction: North

Description:
Photo of Cascade crew reseeding the grass following abandonment of a soil boring in PRL 5.

Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 15

Direction: North

Description:
Photo of Cascade patching asphalt after abandoning 07SB01 in PRL 7.

Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 16

Direction: North

Description:
Photo exemplifying the result of asphalt patching of the abandoned soil boring 03SB01 in PRL 3.

Appendix A – Photographic Log

Client: National Guard Bureau Operations Division, Restoration Branch ***Project Number:*** 291330006.011

Site Name: McLaughlin Air National Guard at Yeager Airport ***Site Location:*** Charleston, West Virginia

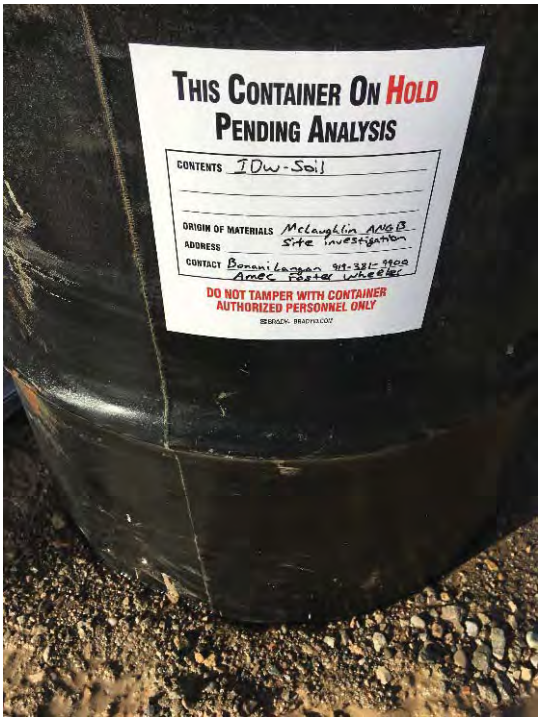
Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 17

Direction: South

Description:
Photo exemplifying a drum label emplaced on each Investigative Derived Waste (IDW) drum staged in PRL 9.



Photographer:
Sarah Levine

Date: January 20, 2018

Photograph: 18

Direction: South

Description:
Photo of all 3 IDW drums staged in PRL 9 following the completion of Site Investigation field efforts.

APPENDIX G

INVESTIGATION DERIVED WASTE

THIS PAGE INTENTIONALLY LEFT BLANK.

VEOLIA
ENVIRONMENTAL SERVICES

SHIPPING DOCUMENT	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Shipping Document Tracking Number
	NONEREQUIRED	1	(877) 818-0087	ZZ 00554015

5. Generator's Name and Mailing Address: RONALD COMER
MCLAUGHLIN AIR NATIONAL GUARD BASE AT YEAGER AIRPORTSAME
1679 COONSKIN DRIVE
CHARLESTON, WV 25311
Generator's Phone: 304 341-6615
Generator's Site Address (if different than mailing address)

6. Transporter 1 Company Name: VEOLIA ES TECHNICAL SOLUTIONS — U.S. EPA ID Number: NJD080631369

7. Transporter 2 Company Name: VEOLIA ES INDUSTRIAL SERVICES — U.S. EPA ID Number: TXR000025791

8. Designated Facility Name and Site Address: VEOLIA ES TECHNICAL SOLUTIONS, L.L.C.
4301 INFIRMARY ROAD
WEST CARROLLTON, OH 45449
Facility's Phone: 937 859-6101
U.S. EPA ID Number: OHD093945293

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Codes
	1. NON RCRA AND DOT NON REGULATED LIQUID	2	DM	800	P	NONE
	2. NON RCRA AND DOT NON REGULATED SOLID	1	DM	400	P	NONE
	3.					
	4.					

14. Special Handling Instructions and Additional Information: ER Service Contracted by VESTS BILL TO VEOLIA WV -|- 1) W:213616 A:SRRLFLIQ-NH 2) W:213611 A:SRRLFSOLID-NH

15. **GENERATOR S/OFFEROR S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: Ronald S Comer — Signature — Month 02 Day 26 Year 18

INT'L

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Shipment

Transporter 1 Printed/Typed Name: Joshua E Brown — Signature — Month 2 Day 26 Year 18

Transporter 2 Printed/Typed Name: Mark Lenoir — Signature — Month 3 Day 1 Year 18

DESIGNATED FACILITY

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Shipping Document Tracking Number:

18b. Alternate Facility (or Generator) — U.S. EPA ID Number
Facility's Phone:

18c. Signature of Alternate Facility (or Generator) — Month Day Year

19. Report Management Method Codes (i.e., codes for treatment, disposal, and recycling systems)

1.	2.	3.	4.
H141	H141		

20. Designated Facility Owner or Operator: Certification of receipt of shipment except as noted in Item 18a

Printed/Typed Name: Bethany Blankenship — Signature — Month 3 Day 2 Year 18

DESIGNATED FACILITY'S COPY

PACKING SUMMARY

Generator Number: 649598
McLaughlin Air National Guard Base at Yeager Airport
1679 Coonskin Drive
Charleston, WV 25311
Attn: Ronald Comer
EPA ID:NONEREQUIRED

Manifest Number: ZZ00554015
Field System ID: OH
Work Order Number: 3005916000
Date Shipped: 02/26/2018

Container#: OH-3005916000-002 Waste Area: Manifest Page/Line: 01 / 1
WP: 213616 DisposalCode: SRRLFLIQ-NH PHY State: L
Date Accumulated: 02/26/2018 Gen Drum ID:
Shipping Name: NON RCRA AND DOT NON REGULATED LIQUID
No. of Commons: 02 Outer Container: 55IA2-DM Inner Container:
Primary Waste Codes: NONE PCB Serial #: OOS Date: / /
Total Cmns Wt: 800 SIC: 4581 Source: G19 Form: W113 System: H141 Cubic Ft.: 7.50
Individual Common Weights: 400, 400 (POUNDS)

Units	Container Size	Net Weight	Chemical Name	EPA/State Codes
1	55 GAL		NON HAZ GROUNDWATER [100%]	NONE

Container#: OH-3005916000-001 Waste Area: Manifest Page/Line: 01 / 2
WP: 213611 DisposalCode: SRRLFSOLID-NH PHY State: S
Date Accumulated: 02/26/2018 Gen Drum ID:
Shipping Name: NON RCRA AND DOT NON REGULATED SOLID
No. of Commons: 01 Outer Container: 55IA2-DM Inner Container:
Primary Waste Codes: NONE PCB Serial #: OOS Date: / /
Total Cmns Wt: 400 SIC: 4581 Source: G19 Form: W319 System: H141 Cubic Ft.: 7.50
Individual Common Weights: 1 @ 400 (POUNDS)

Units	Container Size	Net Weight	Chemical Name	EPA/State Codes
1	55 GAL		NON HAZ SOIL [100%]	NONE

H141 H141

APPENDIX H

DATA VALIDATION REPORTS

THIS PAGE INTENTIONALLY LEFT BLANK.

DATA VALIDATION REPORT

FY16 Phase 1 Regional Site Inspections for Perfluorinated Compounds

Multiple Air National Guard Installations

Samples Collected Between 21 December 2017 and 20 January 2018

McLaughlin Air National Guard Base/Yeager Airport, Charleston, West Virginia

Prepared for:

National Guard Bureau

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
271 Mill Road
Chelmsford, MA 01824
(978) 692-9090

April 2018

Project No. 291330006.011.****

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
%	percent
Amec Foster Wheeler	Amec Foster Wheeler Environment & Infrastructure, Inc.
CCV	Continuing Calibration Verification
COC	Chain of Custody
DL	Detection Limit
DoD	Department of Defense
EPA	United States Environmental Protection Agency
ICAL	Initial Calibration
ICV	Initial Calibration Verification
ID	Identification
LC/MS/MS	Liquid Chromatography/Tandem Mass Spectrometry
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOQ	Limit of Quantification
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PFAS	Per- and Polyfluoroalkyl Substances
PFBS	Perfluorobutanesulfonic Acid
PFHpA	Perfluoroheptanoic Acid
PFHxS	Perfluorohexanesulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual for Environmental Laboratories
RPD	Relative Percent Difference
Vista	Vista Analytical Laboratory

DATA VALIDATION REPORT
FY16 PHASE 1 REGIONAL SITE INSPECTIONS FOR PERFLUORINATED COMPOUNDS

Multiple Air National Guard Installations
Samples Collected Between 21 December 2017 and 20 January 2018
McLaughlin Air National Guard Base/Yeager Airport,
Charleston, West Virginia

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) collected 40 soil samples (including 4 field duplicates), 3 sediment samples (including 1 field duplicate), and 11 water samples (including 2 field duplicates, 1 field blank, and 3 equipment blanks) between 21 December 2017 and 20 January 2018 from the McLaughlin Air National Guard Base/Yeager Airport located in Charleston, West Virginia. Amec Foster Wheeler submitted the samples to Vista Analytical Laboratory (Vista) between 23 December 2017 and 23 January 2018. Vista assigned the samples to sample delivery groups 1702011, 1800177, 1800178, 1800179, and 1800180. Vista analyzed the samples for per- and polyfluoroalkyl substances (PFAS) by modified United States Environmental Protection Agency (EPA) Method 537. A list of these samples by field sample identification (ID), sample collection date, sample matrix, and laboratory sample ID is presented in Table 1.

2.0 DATA VALIDATION METHODOLOGY

Amec Foster Wheeler performed EPA Stage 4 validation on 10 percent (%) of the field samples and EPA Stage 2B validation on the remaining field samples associated with this sampling event, as indicated on Table 1. The Stage 4 validation includes review of the quality control (QC) results in the laboratory's analytical report and reported on QC summary forms as well as recalculation checks and review of the instrument raw data outputs. The Stage 2B validation includes review of the QC results in the laboratory's analytical report and reported on QC summary forms with no review of the associated raw data. Data from equipment and field blanks did not undergo validation because results from these samples are only used to assess data usability for field samples. This data validation has been performed in general accordance with:

- Amec Foster Wheeler, 2017. Final Quality Assurance Project Plan (QAPP), Revision 01. FY16 Phase 1 Regional Site Inspections for Perfluorinated Compounds, Multiple Air National Guard Installations. Contract #: W9133L-14-D-002, Delivery Order 0006, July 2017.

- Department of Defense (DOD), 2017. DoD Quality Systems Manual for Environmental Laboratories (QSM), Version 5.1. January 2017.
- EPA, 2009. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), Version 1.1, September 2009. EPA Document #: EPA/600/R-08/092.

The data were reviewed following Amec Foster Wheeler's general data validation guidelines and using QAPP-specified QC requirements.

The laboratory's certified analytical report and supporting documentation were reviewed to assess the following:

- Data package and electronic data deliverable completeness;
- Laboratory case narrative review;
- Chain of custody (COC) compliance;
- Holding time compliance;
- QC sample frequency;
- Initial calibration (ICAL), initial calibration verification (ICV), and continuing calibration verification (CCV) compliance with method-specified criteria;
- Presence or absence of laboratory contamination as demonstrated by laboratory blanks;
- Accuracy and bias as demonstrated by recovery of surrogate spikes, laboratory control sample (LCS), and matrix spike (MS) samples;
- Internal standard recoveries;
- Analytical precision as relative percent difference (RPD) of analyte concentration between laboratory duplicates or MS/MS duplicate (MSD);
- Sampling and analytical precision as RPD of analyte concentration between field duplicates;
- Assessment of field contamination as demonstrated by field and trip blanks;
- Insofar as possible, the degree of conformance to method requirements and good laboratory practices.

In general, it is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but any reported value may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

LCSs and LCS duplicates (LCSDs) are aliquots of analyte-free matrices that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked matrix is then processed through the same analytical procedures as the samples it accompanies. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

MSs and MSDs are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Equipment blanks are prepared by passing analyte-free water through or over sample collection equipment and collecting the water in sample containers. Equipment blanks are analyzed for the analytical suite required for the project. Equipment blanks are used to monitor for possible sample contamination during the sample collection process and serve as a check on the effectiveness of field decontamination procedures.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

Laboratory and equipment blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in blanks.

When target analytes are detected in blanks, analyte concentrations in the associated samples less than 10 times the concentration detected in the blank will be B qualified.

3.4 LABORATORY AND FIELD DUPLICATES

Laboratory and field duplicate analysis verifies acceptable method precision by the laboratory at the time of preparation and analysis and/or sampling precision at the time of collection.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE USED DURING DATA VALIDATION

B The analyte was detected in the sample and an associated blank and the concentration detected in the sample was less than 10 times the concentration detected in the blank.

U The analyte was analyzed for, but was not detected.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Q The analyte was B qualified because of a detection in an associated blank and additionally J qualified because of an additional QC issue.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 QUALIFICATION REASON CODES

Amec Foster Wheeler applied the following reason code to the data during validation:

FDD Imprecision between field duplicate results.

ISH Internal standard recovery greater than upper control limit.

LCD Imprecision between LCS and LCSD results

MSD Imprecision between MS and MSD results.

MSH Matrix spike recovery greater than upper control limit.

TR Detected concentration is less than the limit of quantification (LOQ).

6.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

The samples were received at the laboratories under proper COC, intact, properly preserved, and at temperatures less than the QAPP-specified maximum of 10 degrees Celsius, with the following exceptions:

- The laboratory noted a number of discrepancies between sample names recorded on container labels and the COC. All labeling discrepancies were resolved with Amec Foster Wheeler and correct information is presented in the final laboratory data deliverables.

7.0 SPECIFIC DATA VALIDATION FINDINGS

Results from these samples may be considered usable with the limitations and exceptions described Sections 7.1 through 8.0.

7.1 PER- AND POLYFLUOROALKYL SUBSTANCES BY MODIFIED EPA METHOD 537

PFAS results generated by Vista are usable with the limitations described in Sections 7.1.1 through 7.1.11.

7.1.1 Holding Times

The aqueous samples were extracted for PFAS within the QAPP-specified maximum holding time of 14 days from sample collection and the extracts were analyzed within the QAPP-specified maximum hold time of 28 days from extraction. The soil samples were extracted for PFAS within the QAPP-specified maximum holding time of 60 days from sample collection and the extracts were analyzed within the QAPP-specified maximum holding time of 30 days from extraction.

7.1.2 Initial Calibrations

The ICALs associated with the analysis of these samples met the QSM 5.1-specified criteria of relative standard deviations of response factors less than 20%, coefficients of determination greater than or equal to 0.99, and all calibration points calculate to 70 to 130% of their true concentrations.

7.1.3 Initial Calibration Verification

ICV recoveries were within the method-specified 70 to 130% limits.

7.1.4 Continuing Calibration Verification

CCV recoveries were within the method-specified 70 to 130% limits.

7.1.5 Laboratory Blanks

PFAS were not detected in the laboratory blanks associated with these samples.

7.1.6 Equipment Blanks

PFAS were not detected in the equipment blanks associated with these samples.

7.1.7 Laboratory Control Sample Accuracy

LCS recoveries were within the QAPP-specified limits of: 60 to 130% for perfluorobutanesulfonic acid (PFBS); 70 to 130% for perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), and perfluorooctanesulfonic acid (PFOS); and 50 to 130% for perfluorononanoic acid (PFNA). The LCS/LCSD RPD QAPP-specified limit of < 30% was met with the exceptions listed below.

- PFNA LCS/LCSD RPD (52.7%) is above QC limit of 30%.
    - Amec Foster Wheeler J qualified the result for PFNA in sample YEAGR-SW-DUP01-011718 due to the potential analytical imprecision. (Qualifier and reason code: J-LCD)
    - Sample YEAGR-GW-BW02-011918 was non-detect for PFNA and not impacted by the imprecision. No qualifications are necessary.

7.1.8 Matrix Spikes/ Matrix Spike Duplicates

Vista performed MS and MSD analyses on samples YEAGR-04-SB01-00-02, YEAGR-06-SD01-0-0.5, YEAGR-06-SW01-011718, YEAGR-GW-ML-FL014-MW004-011918 and YEAGR-02-SB03-00-

02. Recoveries were within the QAPP-specified limits of: 60 to 130% for PFBS; 70 to 130% for PFHpA, PFHxS, PFOA, and PFOS; and 50 to 130% for PFNA, and precision values were less than the QAPP-specified maximum of 30%, with the exceptions listed below.

- Due to a software flaw, Vista is calculating RPDs based on MS and MSD recoveries instead of concentrations detected in the MS and MSD. Amec Foster Wheeler recalculated RPDs between MS and MSD results to confirm that precision values were within limits.
- PFBS (148% MS), PFHxS (315%, 22.3%), PFOA (138% MS), PFOS (402%, -150%) recoveries were outside of specified limits in the MS and/or MSD performed on sample YEAGR-04-SB01-00-02. PFHxS MS/MSD RPD was high at 52.9%. Data limitations are summarized below.
  - Amec Foster Wheeler J qualified the detected PFBS and PFOA results from this sample due to potential high analytical bias. (Qualifier and reason code: J-MSH)
  - The PFHxS and PFOS concentrations in the unspiked native sample were greater than the spike concentration, and data usability cannot be evaluated based on the MS/MSD recovery.
  - Amec Foster Wheeler J qualified the detected PFHxS result from this sample due to the imprecision. (Qualifier and reason code: J-MSD)
- PFOA (MS 135%), PFOS (MS 140%) and PFNA (MSD 132%) recoveries were high in the MS/MSD performed on sample YEAGR-06-SD01-0-0.5. Data limitations are summarized below.
  - Amec Foster Wheeler J qualified the detected PFOS result from this sample due to the potential high analytical bias. (Qualifier and reason code: J-MSH)
  - PFOA and PFNA were not detected in the native sample and not impacted by the potential high analytical bias. No qualification is necessary.

- PFBS (164% MSD), PFHpA (69.6% MSD), PFHxS (147%, -48.4%) and PFOS (-405%, 519%) recoveries were outside of specified limits in the MS and/or MSD performed on sample YEAGR-06-SW01-011718. PFOS MS/MSD RPD was high at 56.2%. Data limitations are summarized below.
  - The PFBS, PFHpA, PFHxS, and PFOS concentrations in the unspiked native sample were greater than the spike concentration, and data usability cannot be evaluated based on the MS/MSD recovery.
  - Amec Foster Wheeler J qualified the detected PFOS result from this sample due to the imprecision. (Qualifier and reason code: J-MSD)
- PFBS (249%, 512%), PFHpA (64.6% MS), PFHxS (376%, 576%), PFOA (228%, 343%), PFOS (237%, -73.5%) recoveries were outside of specified limits in the MS and/or MSD performed on

sample YEAGR-GW-ML-FL014-MW004-011918. The PFBS, PFHpA, PFHxS, PFOA and PFOS concentrations in the unspiked native sample were greater than the spike concentration, and data usability cannot be evaluated based on the MS/MSD recovery.

- PFOS (141% MS) recovery was outside of specified limits in the MS performed on sample YEAGR-02-SB03-00-02. Amec Foster Wheeler J qualified the PFOS result from this sample due to the potential high bias. (Qualifier and reason code: J-MSH)

7.1.9 Surrogate Recoveries

Vista uses labeled internal standards, which are added before extraction, to quantify their analytical results and does not add surrogates to the samples.

7.1.10 Internal Standard Recoveries

Internal standard areas were within the QAPP-specified limits of 50 to 150% of the average area counts measured during the initial calibration, with the following exceptions:

- $^{13}C_8$-PFOS (154%) recovery was high in the analysis of sample YEAGR-06-SW01-011718. Amec Foster Wheeler J qualified the detected PFOS result from this sample due to potential low analytical bias. (Qualifier and reason code: J-ISH)

7.1.11 Data Reporting and Analytical Procedures

Vista J qualified analytes with concentrations between the detection limit (DL) and the LOQ. Amec Foster Wheeler agrees that these results are quantitatively uncertain and has maintained Vista's J qualifiers. (Qualifier and reason code: J-TR)

8.0 FIELD DUPLICATE RESULTS

Amec Foster Wheeler collected field duplicates with samples:

- YEAGR-06-SD01-0-0.5 (YEAGR-SD-DUP01-011718),
- YEAGR-05-SB02-00-02 (YEAGR-SO-DUP01-011818),
- YEAGR-04-SB02-00-02 (YEAGR-SO-DUP02-011818),
- YEAGR-01-SB01-08-10 (YEAGR-SO-DUP03-011818),
- YEAGR-06-SW01-011718 (YEAGR-SW-DUP01-011718),
- YEAGR-GW-ML-FL014-MW004-011918 (YEAGR-GW-DUP01-011918), and
- YEAGR-03-SB03-02-04 (YEAGR-SO-DUP04-012018).

Detected results and RPDs for the field duplicates are summarized in Table 2. Precision values were within the QAPP-specified limits of less than 30% RPD or the difference between analytical results less than the LOQ, with the following exceptions:

- The RPD between PFOS results from sample YEAGR-06-SD01-0-0.5 and its field duplicate YEAGR-SD-DUP01-011718 was high at 31%. Amec Foster Wheeler J qualified the PFOS results from these samples due to potential sampling and/or analytical imprecision. (Qualifier and reason code: J-FDD)
- The RPD between PFOS results from sample YEAGR-05-SB02-00-02 and its field duplicate YEAGR-SO-DUP01-011818 was high at 35%. Amec Foster Wheeler J qualified the PFOS results from these samples due to potential sampling and/or analytical imprecision. (Qualifier and reason code: J-FDD)
- The RPD between PFOS results from sample YEAGR-04-SB02-00-02 and its field duplicate YEAGR-SO-DUP02-011818 was high at 48%. Amec Foster Wheeler J qualified the PFOS results from these samples due to potential sampling and/or analytical imprecision. (Qualifier and reason code: J-FDD)

9.0 SUMMARY AND CONCLUSIONS

Amec Foster Wheeler evaluated a total of 300 data records from field samples during the validation. Amec Foster Wheeler J qualified 68 records (22.6%) as estimated values because of high MS recovery, imprecision between LCS/LCSD results, imprecision between MS/MSD results, imprecision between field duplicate results, high internal standard recoveries, and/or analyte concentrations outside the instrument's calibration range. Qualified data are summarized in Table 3.

REFERENCES

Amec Foster Wheeler, 2017. Final QAPP, Revision 01. FY16 Phase 1 Regional Site Inspections for Perfluorinated Compounds, Multiple Air National Guard Installations. Contract #: W9133L-14-D-002, Delivery Order 0006, July 2017.

DOD, 2017. DoD Quality Systems Manual for Environmental Laboratories, Version 5.1. January 2017.

EPA, 2009. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and LC/MS/MS, Version 1.1, September 2009. EPA Document #: EPA/600/R-08/092.

TABLES

Table 1
Field Samples Submitted to Vista Analytical Laboratory
McLaughlin ANGB/Yeager Airport, Charleston, West Virginia
FY16 Phase 1 Regional Site Inspection for Per-Fluorinated Compounds

Sample Identification	Collection Date	Sample Matrix	Lab Sample ID	Notes
YEAGR-FB-001-122117	21-Dec-17	Water	1702011-01	Field Blank
YEAGR-01-SB01-08-10	18-Jan-18	Soil	1800178-01	
YEAGR-04-SB01-00-02	18-Jan-18	Soil	1800178-02	MS/MSD
YEAGR-04-SB02-00-02	18-Jan-18	Soil	1800178-03	
YEAGR-04-SB03-00-02	18-Jan-18	Soil	1800178-04	
YEAGR-04-SB03-08-10	18-Jan-18	Soil	1800178-05	
YEAGR-05-SB02-00-02	18-Jan-18	Soil	1800178-06	
YEAGR-05-SB03-00-02	18-Jan-18	Soil	1800178-07	
YEAGR-SD-DUP01-011718	17-Jan-18	Sediment	1800178-08	Field duplicate of YEAGR-06-SD01-0-0.5
YEAGR-SO-DUP01-011818	18-Jan-18	Soil	1800178-09	Field duplicate of YEAGR-05-SB02-00-02
YEAGR-SO-DUP02-011818	18-Jan-18	Soil	1800178-10	Field duplicate of YEAGR-04-SB02-00-02
YEAGR-SO-DUP03-011818	18-Jan-18	Soil	1800178-11	Field duplicate of YEAGR-01-SB01-08-10
YEAGR-SW-DUP01-011718	17-Jan-18	Surface Water	1800178-12	Field duplicate of YEAGR-06-SW01-011718
YEAGR-02-SB01-01-03	19-Jan-18	Soil	1800179-01	
YEAGR-02-SB02-02-04	19-Jan-18	Soil	1800179-02	
YEAGR-02-SB02-08-10	19-Jan-18	Soil	1800179-03	
YEAGR-02-SB03-00-02	19-Jan-18	Soil	1800179-04	MS/MSD
YEAGR-02-SB03-08-10	19-Jan-18	Soil	1800179-05	
YEAGR-04-SB01-05-06	19-Jan-18	Soil	1800179-06	
YEAGR-04-SB02-08-10	19-Jan-18	Soil	1800179-07	
YEAGR-05-SB01-00-02	19-Jan-18	Soil	1800179-08	
YEAGR-07-SB01-01-03	19-Jan-18	Soil	1800179-09	
YEAGR-07-SB01-08-10	19-Jan-18	Soil	1800179-10	
YEAGR-07-SB03-01-03	19-Jan-18	Soil	1800179-11	
YEAGR-GW-BW02-011918	19-Jan-18	Ground Water	1800179-12	
YEAGR-03-SB01-01-03	20-Jan-18	Soil	1800180-01	
YEAGR-03-SB02-03-05	20-Jan-18	Soil	1800180-02	
YEAGR-03-SB02-08-10	20-Jan-18	Soil	1800180-03	
YEAGR-03-SB03-02-04	20-Jan-18	Soil	1800180-04	
YEAGR-07-SB03-08-10	19-Jan-18	Soil	1800180-05	
YEAGR-EB-01-012018	20-Jan-18	Water	1800180-06	Equipment Blank
YEAGR-EB-02-012018	20-Jan-18	Water	1800180-07	Equipment Blank
YEAGR-GW-BW01-011918	20-Jan-18	Ground Water	1800180-08	Stage 4 Validation
YEAGR-EB-03-012018	19-Jan-18	Water	1800180-09	Equipment Blank
YEAGR-GW-DUP01-011918	19-Jan-18	Ground Water	1800180-10	Field duplicate of YEAGR-GW-ML-FL014-MW004-011918
YEAGR-GW-ML-FL014-MW004-011918	19-Jan-18	Ground Water	1800180-11	MS/MSD
YEAGR-SO-DUP04-012018	20-Jan-18	Soil	1800180-12	Field duplicate of YEAGR-03-SB03-02-04
YEAGR-03-SB03-08-10	20-Jan-18	Soil	1800180-13	
YEAGR-07-SB02-02-04	20-Jan-18	Soil	1800180-14	
YEAGR-07-SB02-08-10	20-Jan-18	Soil	1800180-15	
YEAGR-09-SD01-0-0.5	20-Jan-18	Sediment	1800180-16	
YEAGR-09-SW01-012018	20-Jan-18	Surface Water	1800180-17	
YEAGR-01-SB01-00-02	17-Jan-18	Soil	1800177-01	Stage 4 Validation
YEAGR-01-SB02-00-02	17-Jan-18	Soil	1800177-02	Stage 4 Validation
YEAGR-01-SB03-00-02	16-Jan-18	Soil	1800177-03	Stage 4 Validation
YEAGR-01-SB03-08-10	16-Jan-18	Soil	1800177-04	Stage 4 Validation
YEAGR-06-SD01-0-0.5	17-Jan-18	Sediment	1800177-05	MS/MSD
YEAGR-06-SW01-011718	17-Jan-18	Surface Water	1800177-06	MS/MSD
YEAGR-09-SB01-00-02	16-Jan-18	Soil	1800177-07	
YEAGR-09-SB01-08-10	16-Jan-18	Soil	1800177-08	
YEAGR-09-SB02-00-02	16-Jan-18	Soil	1800177-09	
YEAGR-09-SB02-08-10	16-Jan-18	Soil	1800177-10	
YEAGR-09-SB03-01-03	16-Jan-18	Soil	1800177-11	
YEAGR-09-SB03-08-10	16-Jan-18	Soil	1800177-12	

ANGB = Air National Guard Bureau
ID = identification
MS/MSD = matrix spike/matrix spike duplicate analyses performed on this sample

Table 2
Field Duplicate Detections
McLaughlin ANGB/Yeager Airport, Charleston, West Virginia
FY16 Phase 1 Regional Site Inspection for Per-Fluorinated Compounds

Analyte	LOQ	Primary Sample	Field Duplicate	Units	RPD	Notes
YEAGR-06-SD01-0-0.5 (YEAGR-SD-DUP01-011718)						
PFHxS	1.84	0.953 J	1.06 J	µg/kg	11%	
PFOS	1.84	7.24	9.90	µg/kg	31%	J-FDD
YEAGR-05-SB02-00-02 (YEAGR-SO-DUP01-011818)						
PFBS	1.82	0.494 J	0.404 J	µg/kg	20%	
PFHpA	1.82	0.373 J	0.303 J	µg/kg	21%	
PFHxS	1.82	7.68	6.88	µg/kg	11%	
PFOA	1.82	1.25 J	1.43 J	µg/kg	13%	
PFOS	1.82	94.3	134	µg/kg	35%	J-FDD
PFNA	1.82	0.905 J	0.834 J	µg/kg	8%	
YEAGR-04-SB02-00-02 (YEAGR-SO-DUP02-011818)						
PFBS	1.90	4.19	3.62	µg/kg	15%	
PFHpA	1.90	0.386 J	0.948 U	µg/kg	NC	± LOQ
PFHxS	1.90	47.4	36	µg/kg	27%	
PFOA	1.90	2.12	1.42 J	µg/kg	40%	± LOQ
PFOS	1.90	670	410	µg/kg	48%	J-FDD
PFNA	1.90	1.51 J	1.14 J	µg/kg	28%	
YEAGR-01-SB01-08-10 (YEAGR-SO-DUP03-011818)						
PFBS	1.79	1.24 J	1.24 J	µg/kg	0%	
PFHpA	1.79	0.678 J	0.751 J	µg/kg	10%	
PFHxS	1.79	55.9	68.3	µg/kg	20%	
PFOA	1.79	20.7	23.4	µg/kg	12%	
PFOS	1.79	9.16	8.66	µg/kg	6%	
YEAGR-06-SW01-011718 (YEAGR-SW-DUP01-011718)						
PFBS	0.00821	0.306	0.287	µg/L	6%	
PFHpA	0.00821	0.155	0.151	µg/L	3%	
PFHxS	0.00821	2.76	2.80	µg/L	1%	
PFOA	0.00821	0.344	0.333	µg/L	3%	
PFOS	0.00821	6.65	5.88	µg/L	12%	
PFNA	0.00821	0.0352	0.047	µg/L	29%	
YEAGR-GW-ML-FL014-MW004-011918 (YEAGR-GW-DUP01-011918)						
PFBS	0.00836	1.81	1.99	µg/L	9%	
PFHpA	0.00836	0.689	0.638	µg/L	8%	
PFHxS	0.00836	9.01	10.1	µg/L	11%	
PFOA	0.00836	0.914	1.17	µg/L	25%	
PFOS	0.00836	6.38	6.93	µg/L	8%	
PFNA	0.00836	0.0611	0.070	µg/L	13%	
YEAGR-03-SB03-02-04 (YEAGR-SO-DUP04-012018)						
PFHxS	2.13	0.459 J	0.557 J	µg/kg	19%	
PFOS	2.13	1.08 U	0.494 J	µg/kg	NC	± LOQ

Notes:

µg/kg = micrograms per kilogram
µg/L = micrograms per liter
ANGB - Air National Guard Bureau
LOQ = limit of quantification
NC = not calculable
RPD = relative percent difference
PFBS = perfluorobutanesulfonic acid
PFHpA = perfluoroheptanoic acid
PFHxS = perfluorohexanesulfonic acid
PFNA = perfluorononanioic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid

Qualifier Definitions:

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected

Reason Codes:

± LOQ = The difference between analyte concentrations is less than the LOQ, indicating acceptable analytical precision.
FDD = Imprecision between field duplicate results

Table 3
Qualifiers Added During Validation
McLaughlin ANGB/Yeager Airport, Charleston, West Virginia
FY16 Phase 1 Regional Site Inspection for Per-Fluorinated Compounds

Sample Identification	SDG	Analyte	Results		Validation Qualifiers and Reason Codes	
YEAGR-01-SB03-08-10	1800177	PFBS	1.51	µg/kg	J	TR
YEAGR-01-SB03-08-10	1800177	PFOA	0.722	µg/kg	J	TR
YEAGR-02-SB02-02-04	1800179	PFHXS	0.516	µg/kg	J	TR
YEAGR-02-SB03-08-10	1800179	PFOS	0.939	µg/kg	J	TR
YEAGR-SO-DUP04-012018	1800180	PFHXS	0.557	µg/kg	J	TR
YEAGR-SO-DUP04-012018	1800180	PFOS	0.494	µg/kg	J	TR
YEAGR-02-SB03-00-02	1800179	PFOS	7.24	µg/kg	J	MSH
YEAGR-03-SB03-02-04	1800180	PFHXS	0.459	µg/kg	J	TR
YEAGR-03-SB03-08-10	1800180	PFOS	0.383	µg/kg	J	TR
YEAGR-04-SB01-00-02	1800178	PFBS	4.5	µg/kg	J	MSH
YEAGR-04-SB01-00-02	1800178	PFHPA	0.737	µg/kg	J	TR
YEAGR-04-SB01-00-02	1800178	PFHXS	37.9	µg/kg	J	MSD
YEAGR-04-SB01-00-02	1800178	PFNA	1.19	µg/kg	J	TR
YEAGR-04-SB01-00-02	1800178	PFOA	3.38	µg/kg	J	MSH
YEAGR-04-SB01-05-06	1800179	PFBS	1.55	µg/kg	J	TR
YEAGR-04-SB01-05-06	1800179	PFHPA	0.505	µg/kg	J	TR
YEAGR-04-SB01-05-06	1800179	PFNA	1.27	µg/kg	J	TR
YEAGR-SO-DUP02-011818	1800178	PFNA	1.14	µg/kg	J	TR
YEAGR-SO-DUP02-011818	1800178	PFOA	1.42	µg/kg	J	TR
YEAGR-SO-DUP02-011818	1800178	PFOS	410	µg/kg	J	FDD
YEAGR-04-SB02-00-02	1800178	PFHPA	0.386	µg/kg	J	TR
YEAGR-04-SB02-00-02	1800178	PFNA	1.51	µg/kg	J	TR
YEAGR-04-SB02-00-02	1800178	PFOS	670	µg/kg	J	FDD
YEAGR-05-SB01-00-02	1800179	PFBS	0.922	µg/kg	J	TR
YEAGR-05-SB01-00-02	1800179	PFHPA	1.16	µg/kg	J	TR
YEAGR-SO-DUP01-011818	1800178	PFBS	0.404	µg/kg	J	TR
YEAGR-SO-DUP01-011818	1800178	PFHPA	0.303	µg/kg	J	TR
YEAGR-SO-DUP01-011818	1800178	PFNA	0.834	µg/kg	J	TR
YEAGR-SO-DUP01-011818	1800178	PFOA	1.43	µg/kg	J	TR
YEAGR-SO-DUP01-011818	1800178	PFOS	134	µg/kg	J	FDD
YEAGR-05-SB02-00-02	1800178	PFBS	0.494	µg/kg	J	TR
YEAGR-05-SB02-00-02	1800178	PFHPA	0.373	µg/kg	J	TR
YEAGR-05-SB02-00-02	1800178	PFNA	0.905	µg/kg	J	TR
YEAGR-05-SB02-00-02	1800178	PFOA	1.25	µg/kg	J	TR
YEAGR-05-SB02-00-02	1800178	PFOS	94.3	µg/kg	J	FDD
YEAGR-05-SB03-00-02	1800178	PFBS	0.62	µg/kg	J	TR
YEAGR-05-SB03-00-02	1800178	PFHPA	0.339	µg/kg	J	TR
YEAGR-05-SB03-00-02	1800178	PFNA	0.351	µg/kg	J	TR
YEAGR-05-SB03-00-02	1800178	PFOA	0.677	µg/kg	J	TR
YEAGR-06-SD01-0-0.5	1800177	PFHXS	0.953	µg/kg	J	TR
YEAGR-06-SD01-0-0.5	1800177	PFOS	7.24	µg/kg	J	MSH,FDD
YEAGR-SD-DUP01-011718	1800178	PFHXS	1.06	µg/kg	J	TR
YEAGR-SD-DUP01-011718	1800178	PFOS	9.9	µg/kg	J	FDD
YEAGR-SW-DUP01-011718	1800178	PFNA	0.047	µg/L	J	LCD
YEAGR-06-SW01-011718	1800177	PFOS	6.65	µg/L	J	MSD,ISH
YEAGR-07-SB01-01-03	1800179	PFOS	0.603	µg/kg	J	TR
YEAGR-07-SB01-08-10	1800179	PFOS	0.815	µg/kg	J	TR

Table 3
Qualifiers Added During Validation
McLaughlin ANGB/Yeager Airport, Charleston, West Virginia
FY16 Phase 1 Regional Site Inspection for Per-Fluorinated Compounds

Sample Identification	SDG	Analyte	Results		Validation Qualifiers and Reason Codes	
YEAGR-07-SB02-08-10	1800180	PFOS	1.94	µg/kg	J	TR
YEAGR-07-SB03-08-10	1800180	PFHXS	0.4	µg/kg	J	TR
YEAGR-09-SB01-00-02	1800177	PFOA	0.46	µg/kg	J	TR
YEAGR-09-SB01-08-10	1800177	PFBS	0.413	µg/kg	J	TR
YEAGR-09-SB01-08-10	1800177	PFOA	1.67	µg/kg	J	TR
YEAGR-09-SB02-08-10	1800177	PFOS	0.56	µg/kg	J	TR
YEAGR-09-SB03-01-03	1800177	PFOA	1.39	µg/kg	J	TR
YEAGR-09-SB03-08-10	1800177	PFHXS	1.49	µg/kg	J	TR
YEAGR-09-SD01-0-0.5	1800180	PFHXS	0.544	µg/kg	J	TR
YEAGR-GW-BW02-011918	1800179	PFHXS	0.00733	µg/L	J	TR
YEAGR-GW-BW02-011918	1800179	PFOS	0.00658	µg/L	J	TR
YEAGR-01-SB01-00-02	1800177	PFBS	0.632	µg/kg	J	TR
YEAGR-01-SB01-00-02	1800177	PFHPA	0.504	µg/kg	J	TR
YEAGR-01-SB01-00-02	1800177	PFNA	0.584	µg/kg	J	TR
YEAGR-SO-DUP03-011818	1800178	PFBS	1.24	µg/kg	J	TR
YEAGR-SO-DUP03-011818	1800178	PFHPA	0.751	µg/kg	J	TR
YEAGR-01-SB01-08-10	1800178	PFBS	1.24	µg/kg	J	TR
YEAGR-01-SB01-08-10	1800178	PFHPA	0.678	µg/kg	J	TR
YEAGR-01-SB02-00-02	1800177	PFBS	1.16	µg/kg	J	TR
YEAGR-01-SB02-00-02	1800177	PFHPA	0.793	µg/kg	J	TR
YEAGR-01-SB02-00-02	1800177	PFNA	0.865	µg/kg	J	TR

Notes:

µg/kg = micrograms per kilogram
µg/L = micrograms per liter
ANGB = Air National Guard Bureau
PFBS = perfluorobutanesulfonic acid
PFHpA = perfluoroheptanoic acid
PFHxS = perfluorohexanesulfonic acid
PFNA = perfluorononanoic acid
PFOA = perfluorooctanoic acid
PFOS = perfluorooctanesulfonic acid

Qualifier Definitions:

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Reason Code Definitions:

FDD = Imprecision between field duplicate results
ISH = internal standard recovery greater than upper control limit
LCD = Imprecision between LCS and LCSD
MSD = Matrix spike recovery greater than upper control limit
MSH = High matrix spike recovery. Result may be biased high.
TR = Detected concentration is less than the limit of quantification.

APPENDIX I

LABORATORY ANALYTICAL REPORTS

THIS PAGE INTENTIONALLY LEFT BLANK.